WIZZAIR PREPARATION BOOK

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TAKE-OFF SEGMENTS - VERTICAL PATH

4 SEGMENTS

T/O Distance (from break release to 35’ feet)

- Break release
- Roll-out, “**100 KT”, “V1”, “VR” CALL-OUT**
- **AT VR - ROTATE - Vlof**
- **CLIMB-UP** to 35 feet

1. FIRST segment (from 35 feet to gear-up)

- **CLIMB-UP**
- **“POSITIVE RATE” CALL-OUT**
- **GEAR UP**

2. SECOND segment (from gear-up to acceleration alt.)

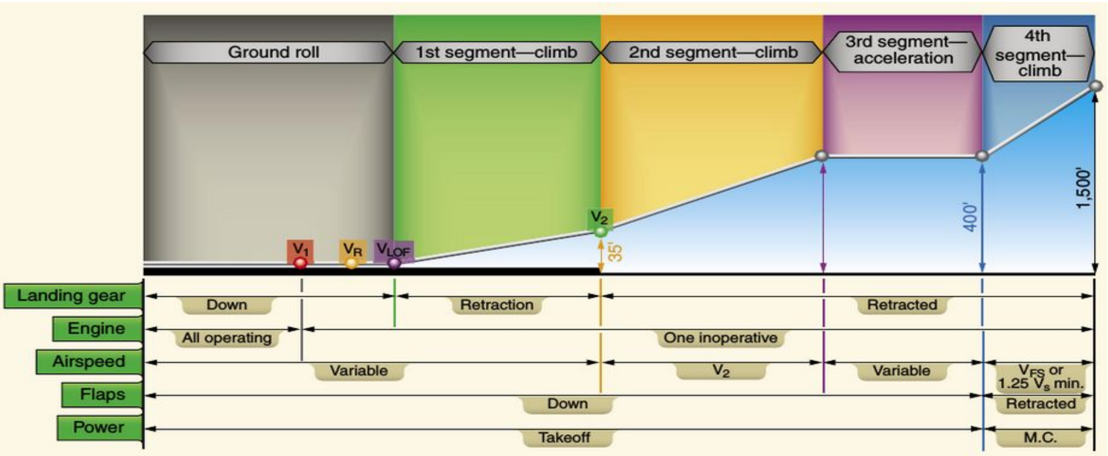
- Climb to specified AAL

3. THIRD segment (acceleration from V2 to engine out acceleration climb speed)

- AAL passed
- **PITCH 10°**
- **Collect speed**
- **LOWER THRUST MCT**
- **FLAPS RETRACTION AT “S” SPEED**
- **SPEED UP TO TARGET SPEED 250 KT**

4. FOURTH segment (climbing to TOC)

- SPEED EN-ROUTE CLIMB SPEED



Items		1st T/O segment	2nd T/O segment	Transition (acceleration)	Final T/O segment
	2 Engine	Positive	2.4%	Positive	1.2%
*	3 Engine	3.0%	2.7%	Positive	1.5%
	4 Engine	5.0%	3.0%	Positive	1.7%
Wing flaps		T.O.	T.O.	T.O.	Up
Landing gear		Down	Up	Up	Up
Engines		1 Out	1 Out	1 Out	1 Out
Power		T.O.	T.O.	T.O.	M.C.
Air speed		$V_{LOF} \rightarrow V_2$	V_2	$V_2 \rightarrow 1.25\ V_S$(Min)	$1.25\ V_S$(Min)

* Required Absolute Minimum Gradient of Flightpath

M.C. = Maximum continuous
V_1 = Critical-engine-failure speed
V_2 = Takeoff safety speed
V_S = Calibrated stalling speed, or minimum steady flight speed at which the aircraft is controllable
V_R = Speed at which aircraft can start safely raising nose wheel off surface (Rotational Speed)
V_{LOF} = Speed at point where airplane lifts off

FUEL POLICIES

FUEL TYPES (4)

1. Taxi fuel
2. Trip fuel
3. Reserve fuel (contingency, alternate, final reserve, Additional fuel)
4. Extra fuel

TAXI fuel:

From startup till T/O.

TRIP fuel:

- Fuel for T/O and climb with expected routing
- TOC - TOD
- TOD - Approach
- Approach to landing

RESERVE fuel:

CONTINGENCY **fuel:**

- Fuel required to compensate unseen factors. (deviation fuel consumption, forecasted met conditions, from planned altitudes, and routings.

  Should be a higher either:

  - 5% of the planned trip fuel in the event of replanning in-flight. OR
  - 5% of the trip fuel for the remainder of the flight
  - 3% of the trip fuel such above if an en-route alternate A/D is available.
    OR
  - 5 minutes flying at holding speed at 1500 feet above destination standard conditions.

ALTERNATE fuel:

- Fuel for missed approach from the applicable MDA/DH, complete missed approach procedure
- For climb with expected departure routing
- TOC to TOD
- TOD to approach
- Approach to landing at destination A/D
- If 2 destination alternate required always count with the one which requires the greatest amount of fuel.

FINAL RESERVE fuel:

- For A/C with turbine engines fuel for 30 minutes of flying at holding speed 1500 feet above A/D elevation in standard conditions. Calculated with the estimated A/C landing mass for alternate or destination if alternate is not required.

ADDITIONAL fuel:

- Provide min. The A/C to descend and proceed to an alternate A/D when there is an engine failure, or pressurization loss, calculated at the most critical point along the route and:
    - 15 minutes holding at 1500 feet
    - Make an approach and landing
    - This additional is only required if the min fuel for trip and final reserve is not enough in a situation like this

  OR
- 15 minutes holding 1500 feet above destination when a flight is planned without destination alternate A/D

EXTRA fuel:

- In the discretion of the commander

INFLIGHT RE-PLANNING

The commander shall ensure during inflight re-planning procedures that the calculated fuel is enough to proceed to the route or to a destination other than originally planned:

- Trip fuel for remaining part of the flight
- Reserve fuel as described before
- Extra fuel

REDUCED CONTINGENCY FUEL PROCEDURES

It's a procedure when the operator's fuel policy includes pre-flight planning to a DESTINATION 1 A/D (commercial destination) with a reduced contingency fuel procedure using a DECISION POINT along the route and a DESTINATION 2 A/D for refuelling. The calculated fuel has to be enough to reach the DESTINATION 2 A/D.

PRE-DETERMINED POINT PROCEDURE

If an operator's fuel policy includes planning to a destination alternate A/D where the distance between the destination A/D and the alternate is longer that a flight can only be routed via a PRE DETERMINED POINT to 1 of these A/Ds the amount of usable fuel has to be enough to proceed.

ISOLATED A/D PROCEDURE

If an operator's fuel policy includes planning to an isolated A/D the last possible point of diversion to any available en-route alternate A/D shall be used as the PRE DETERMINED point above.

PLANNING REQUIREMENTS - ALTERNATES

T/O ALTERNATE

The flight plan shall specify a T/O alternate if meteorological performance considerations might preclude return to the departure A/D.

REQUIREMENTS for T/O alternate

- Must be within 1 HOUR still air flight time with 1 ENGINE INOPERATIVE speed on the actual T/O mass
- MET report /forecasts must indicate that 1 HR BEFORE and 1 HR AFTER ETA the weather will be above landing minima
- For NPA and CIRCLING approaches CEILING must take into account
- ANY 1 engine limitations must take into account
- MIN LDA 1800 (?)

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DESTINATION A/D

- MET reports/forecasts must indicate that 1 HR before and 1 HR AFTER ETA the weather will be above planned landing minima
- For NPA and Circling approaches ceiling must be above MDA.

PLANNING MINIMA for DESTINATION ALTERNATE EN-ROUTE ALTERNATE, 3% ERA and ISOLATED A/D

MET reports/forecasts must indicate that 1 HR before and 1 HR AFTER ETA the weather will be above planned landing minimums:

NON-ETOPS

CAT 2 CAT 3	-	CAT 1 RVR (550m)
CAT 1	-	NPA RVR (750) and CEILING
NPA	-	NPA + 200’ CEILING / RVR (1000m)
CIRCLING	-	CIRCLING

ETOPS

PA	-	DH/DA + 200’ feet and visibility + 800m

NPA - MDH/MDA + 400’ feet and visibility + 1500m

NUMBER of DESTINATION ALTERNATES

1 ALTERNATE REQUIRED

1 must be selected for IFR flights UNLESS:

A.) - Planned duration of flight is less that 6 hours OR
- During in-flight replanning the remaining time to destination is less than 6 hours

AND

- 2 separate RWs are available at destination and the weather report indicate that 1 hour before and 1 hour after ETA the CEILING will be at least 2000’ feet OR CIRCLING + 500’ feet and visibility is at least 5km.

B.) The destination is isolated no alternate exists.

2 ALTERNATE REQUIRED

- If the weather report or forecasts indicate that 1 hour before and 1 hour after ETA the weather will be below the planning minima.
- There is no MET info available.

EN-ROUTE ALTERNATE REQUIREMENTS

- Every moment of flight must be reachable
- Must be within 1 hour flight time at 1 ENGINE INOP speed
- Departure and Arrival must be considered as an intermediate A/D
- If any point on the route exceeds the 380 NM from the departure or arrival A/D an en-route alternate must be selected.

A/C APPROACH CATEGORIES

CLASSIFICATION

Classification based on the speed at threshold = Vat.

Vat = Vso x 1.3

OR

Vat = Vs1g x 1.23 LANDING configuration MLW

Whichever is greater!

A320 is CATEGORY C

Vat	=	120 -140KT
INITIAL APPROACH	=	160 - 240 KT
FINAL APPROACH	=	115 - 140 KT
MAC CIRCLING	=	180 KT
MAX INTERMEDIATE MISSED	=	160 KT
MAX FINAL MISSED	=	240 KT

T/O MINIMUMS - LVTO

- Cannot be less than the landing minima, UNLESS T/O alternate is available.
- If MET visibilit is below the required for T/O and RVR is not reported, the T/O may be commenced if the commander can determine that the RVR/VISIBILITY along the T/O RW is equal or better the minimum. This applies only to the initial part of the T/O run, down to 150m RVR.
- If RVR is reported the reported value has got the priority
- RVR must be achieved for all relevant RVR rep points (up to a distance that covers ASD) except the initial part of T/O. (maybe replaced by pilot assesment)
- Cloud ceiling must be specified

LVTO - LOW VISIBILITY T/O

- When **RVR less than 400m**
- A/D must have LV procedures
- T/O minima cannot be less than the table describe it below:

Take-off RVR/visibility	
Facilities	RVR/visibility *(Note 3)*
Nil (day only)	500 m
Runway edge lighting and/or centreline marking	250/300 m *(Notes 1 and 2)*
Runway edge and centreline lighting	200/250 m *(Note 1)*
Runway edge and centreline lighting and multiple RVR information	150/200 m *(Notes 1 and 4)*

Note 1: The higher values apply to Category D aeroplanes.
Note 2: For night operations at least runway edge and runway end lights are required.
Note 3: The reported RVR/visibility value representative of the initial part of the take-off run can be replaced by pilot assessment.
Note 4: The required RVR value must be achieved for all of the relevant RVR reporting points with the exception given in Note 3 above.

RVR 125m - subject of approval by the authority the operator may reduce T/O minima to 125m provided:

- LVTO procedures in force
- High intensity CENTER LIGHTS max 15M / high intensity edge light are placed max 60m
- Crew authorized for LVTO procedures
- 90m min visual segment is available from the cockpit at the start of T/O run
- The required RVR value is achieved for ALL the relevant RVR rep. points

RVR 75m - subject of approval by the authority the operator may reduce T/O minima to 75m when provided:

- A/C using approved lateral guidance system OR HUD/HUDLS
- RW protection and facilities equivalent to CAT 3 landin operations are available

LANDING MINIMA - NON-NPA

CMV - converted MET visibility

(h) Conversion of reported meteorological visibility to RVR

1. An operator must ensure that a meteorological visibility to RVR conversion is not used for calculating take-off minima, Category II or III minima or when a reported RVR is available.

   Note: If the RVR is reported as being above the maximum value assessed by the aerodrome operator, e.g. "RVR more than 1 500 metres", it is not considered to be a reported RVR in this context and the Conversion Table may be used.

2. When converting meteorological visibility to RVR in all other circumstances than those in subparagraph (h)1. above, an operator must ensure that the following Table is used:

Table 9

Conversion of visibility to RVR

Lighting elements in operation	RVR = Reported Met. Visibility x	
	Day	Night
HI approach and runway lighting	1,5	2,0
Any type of lighting installation other than above	1,0	1,5
No lighting	1,0	Not applicable

NON PRECISION APPROACHES

IT IS AN INSTRUMENT APPROACH with:

- MDH 250 feet minimum
- RVR/CMV 750m minimum
- Gives only lateral directions (no vertical)

NPA shall be flown using CDFA technique (Continuous Descent Final Approach)

MDH CANNOT BE LOWER than:

- OCH for the A/C cat
- System minimum
- MDH specified in the AFM

SYSTEM MINIMA for NPA

System minima for NPA	
VOR/DME	250 ft
LOC	250 ft
SRA term at ½ NM	250 ft
SRA term at 1 NM	300 ft
SRA term at 2 NM	350 ft
VOR	300 ft
NDB	300 ft
NDB/DME	300 ft
RNAV/LNAV	300 ft
VDF	350 ft

VISUAL REFERENCE

AT LEAST 1 ELEMENT must be visible during approach:

- Elements of approach light system
- Threshold
- Threshold markings
- Threshold lights
- Threshold identification lights
- Touchdown zone
- Touchdown zone markings
- Touchdown zone lights
- Visual glide slope indicator
- Runway edge lights
- Other visual references accepted by the authority

REQUIRED RVR/CMV

The minimums depends on:

- MDH
- Type of approach lighting system
- Technique (CDFA)
- Ground facility criteria

NPA with CDFA

- For NPA using CDFA technique, up to and including 3,77 degrees (CAT C A/C) and with a final approach at least 3NM, shall fulfill the following criterias:

  - Final approach offset track max 5 degrees
  - THE FAF or another appropriate fix where the descent is initiated is available or distance information is available. (DME)
  - If the MAPt is defined by timing than the max distance from FAF to threshold distance 8NM

For other approaches a higher RVR/CMV is applicable.

- These RVR values shall be achieved for touchdown zone
- If separate mid-point or stop-end RVR is available, these shall be 250m, or 125m when RCLL are operating.
- Stop-End RVR is only to be considered if relevant
- If the approach is flown with a level flight segment at or above MDA, 400m must be added to the minimum RVR/CMV but max 5000m.

LANDING MINIMA - PA - CAT 1 CAT 2 CAT 3

CAT 1 PRECISION APPROACHES

BASICS

- INSTRUMENTS
    - ILS
    - MLS
    - GLS (GNSS, GBAS)
    - PAR
- RVR MIN 550m
- DH - Decision height MIN 200' FEET
- DH - Decision height min:
    - MIN height specified by the instrument used
    - The OCH category for the A/C
    - 200' feet
    - Lowest DH specified in the AFM

AT LEAST 1 ELEMENT must be visible during approach:

- Elements of approach light system
- Threshold
- Threshold markings
- Threshold lights
- Threshold identification lights
- Touchdown zone
- Touchdown zone markings
- Touchdown zone lights
- Visual glide slope indicator
- Runway edge lights
- Other visual references accepted by the authority

REQUIRED RVR/CMV

- The minimums depends on:
    - DH
    - Type of approach lighting system
    - Technique (CDFA)
    - Ground facility criteria
- These RVR values shall be achieved for touchdown zone
- If separate mid-point or stop-end RVR is available, these shall be 250m, or 125m when RCLL are operating.
- Stop-End RVR is only to be considered if relevant

LOWER THAN STANDARD CAT 1 PRECISION APPROACHES

BASICS

- RVR is less
- DH is the same like CAT 1

VISUAL REFERENCE

The approach below the DH cannot be continued UNLESS visual reference 3 consecutive lights from below:

- Centerline of the approach lights
- Touchdown zone lights
- RW center lights
- Runway edge lights

Combination of these is attained and can be maintained.

Must include at least 1 LATERAL ELEMENT of the ground pattern:

- Approach lighting crossbar
- Landing threshold
- Barrette of touchdown zone lighting

REQUIRED RVR/CMV

- The minimums depends on:
    - DH
    - Type of approach lighting system
- These RVR values shall be achieved for touchdown zone
- If separate mid-point or stop-end RVR is available, these shall be 250m, or 125m when RCLL are operating.
- Stop-End RVR may be disregarded if the length of the first ⅔ of the RW is equal or longer than the required landing field.

OTHER REQUIREMENTS FOR LOWER THAN STANDARD CAT 1

- It shall be flown auto coupled to an autoland
- A/C certification for CAT 2
- The autoland system shall be approached for CAT 3A ops
- Operator must ensure LV procedures established
- Operator shall be approved by the authority
- Crew must be trained and qualified

CAT 2 PRECISION APPROACHES

BASICS

- INSTRUMENTS
    - ILS
    - MLS
- RVR MIN 300m
- DH - Decision height BELOW 200’ FEET and MIN 100’ FEET
- DH - Decision height min:
    - MIN height specified by the instrument used
    - The OCH category for the A/C
    - The DH to which the crew authorized
    - 200’ feet
    - Lowest DH specified in the AFM

VISUAL REFERENCE

The approach below the DH cannot be continued UNLESS visual reference 3 consecutive lights from below:

- Centerline of the approach lights
- Touchdown zone lights
- RW center lights
- Runway edge lights

Combination of these is attained and can be maintained.

Must include at least 1 LATERAL ELEMENT of the ground patter:

- Approach lighting crossbar
- Landing threshold
- Barrette of touchdown zone lighting

REQUIRED RVR/CMV

- These RVR values shall be achieved for touchdown zone
- If separate mid-point or stop-end RVR is available, these shall be 125m, or 75m in case of autoland and CAT 3 DUAL on FMA are operating.
- Stop-End RVR may be disregarded if the length of the first ⅔ of the RW is equal or longer than the required landing field.
- The approach shall be auto coupled below DH - AFCS down to the 80% of applicable DH
- Airworthiness may affect applicable DH due to AFCS

OTHER THAN STANDARD CAT 2 APPROACHES

When some or all of the elements of ICAO ANNEX 14 precision approach lighting system is not available.

BASICS

- INSTRUMENTS
  - ILS
  - MLS
- RVR MIN 350m
- DH - Decision height BELOW 200’ FEET and MIN 100’ FEET
- DH - Decision height min:

  - MIN height specified by the instrument used
  - The OCH category for the A/C
  - The DH to which the crew authorized
  - 200’ feet
  - Lowest DH specified in the AFM

VISUAL REFERENCE

The approach below the DH cannot be continued UNLESS visual reference 3 consecutive lights from below:

- Centerline of the approach lights
- Touchdown zone lights
- RW center lights
- Runway edge lights

Combination of these is attained and can be maintained.

Must include at least 1 LATERAL ELEMENT of the ground pattern:

- Approach lighting crossbar
- Landing threshold
- Barrette of touchdown zone lighting

REQUIRED RVR/CMV

- These RVR values shall be achieved for touchdown zone
- If separate mid-point or stop-end RVR is available, these shall be 250m, or 125m when RCCL operating
- Stop-End RVR may be disregarded if the length of the first ⅔ of the RW is equal or longer than the required landing field.

CAT 3 PRECISION APPROACHES

Category 3 Precision Approaches

Category III minima			
Category	Decision height (ft) *(Note 2)*	Roll-out control/Guidance system	RVR (m)
IIIA	Less than 100 ft	Not required	200 m
IIIB	Less than 100 ft	Fail-passive	150 m *(Note 1)*
IIIB	Less than 50 ft	Fail-passive	125 m
IIIB	Less than 50 ft or No decision height	Fail-operational *(Note 3)*	75 m

Note 1: For aeroplanes certificated in accordance with CS-AWO 321(b)3. or equivalent.
Note 2: Flight control system redundancy is determined under CS-AWO by the minimum certificated decision height.
Note 3: The fail-operational system referred to may consist of a fail-operational hybrid system.

CAT 3A

- ILS or MLS
- DH lower than 100' feet more than 50
- RVR not less 200m

CAT 3 B

- ILS or MLS
- DH lower than 50' feet or no DH
- RVR lower than 200m but min 75m

DH - DECISION HEIGHT MIN:

- MIN height specified by the instrument used
- The DH to which the crew authorized
- Lowest DH specified in the AFM

OPERATIONS WITH NO DH CAN ONLY BE CONDUCTED IF:

- It is authorized in the AFM
- Approach aid and the A/D support the operation
- Operator has an approval for this approach

VISUAL REFERENCE

FAIL-PASSIVE flight-control system:

- CAT 3A and CAT 3B OPS

- The approach below the DH cannot be continued UNLESS visual reference 3 consecutive lights from below:

  - Centerline of the approach lights
  - Touchdown zone lights
  - RW center lights
  - Runway edge lights

- Combination of these is attained and can be maintained.

FAIL-OPERATIONAL flight-control system:

- CAT 3B OPS

- The approach below the DH cannot be continued UNLESS visual reference 1 CENTERLINE LIGHT is attained and can be maintained.
- CAT 3B with no DH - no RW visual contact needed.

Automatic landings are planned for CAT 3 approaches!

- **Fail-Passive flight control system =** In the event of a failure, there is no significant out-of- trim condition or deviation of flight path or attitude but the landing is not completed automatically. For a fail-passive automatic flight control system the pilot assumes control of the aeroplane after a failure.

○

- **Fail-Operational flight control system =** In the event of a failure below alert height, the approach, flare and landing, can be completed automatically. In the event of a failure, the automatic landing system will operate as a fail-passive system.

LANDING MINIMA - CIRCLING, VISUAL, BANS, TAF

CIRCLING APPROACHES

Minimum MDA/H for CIRCLING shall be HIGHER:

- Published circling OCH for A/C category
- DH/MDH of the preceding instrument approach
- Min height for the CAT “C” A/C from EU OPS (600’ feet)

Minimum VISIBILITY for CIRCLING shall be HIGHER:

- Published circling visibility for A/C category
- RVR/CMV for the preceding instrument approach
- Min visibility for the CAT “C” A/C from EU OPS (600’ feet)

VISUAL APPROACHES

It is an approach of an IFR flight when any part of all of an instrument approach is not completed and the approach is executed with visual reference to the terrain

- RVR min 800m
- IFR can be cleared for VISUAL if:
  - Pilot can maintain visual to ground
  - The reported CEILING is not below the approved initial approach level
  - The pilots reports at any time during approach procedure that the visual approach/landing can be completed
- Must be fully stabilized by 1000’ feet

GROUND AID FAILURE

- After passing outer marker or equivalent position, the commander is not expected to consult these instructions
- If failure occur at such a late stage it is the commander discretion to continue approach
- If failure is know before approach, their effect shall be considered as described at EU-OPS and OM.

APPROACH BAN

- The commander may commence an approach regardless of the reported RVR/VISIBILITY BUT the approach CANNOT be continued beyond the OM or equivalent position if the reported RVR/VISIBILITY is still less than the applicable minima
- When RVR is not available MET VISIBILITY has to be converted to RVR. (table before)
- If after passing the OM or equivalent position the reported RVR/VISIBILITY falls below the minimum the approach may be continued to DA/H or MDA/H
- If no OM or equivalent position exist than the commander shall make a decision before descending below 1000' feet above A/D on final approach.
- If the MDA/H is at or higher than 100' feet decision shall be made 500' feet higher
- Always the touchdown zone RVR is controlling (if the mid 125m or stop-end 75m RVR is relevant and reported it is controlling too)
- A/C with rollout guidance mid point RVR is 75m instead of 125m.

TAF

- A/D weather forecast covering a period of 9 or 30 hours
- 9 hours TAF issued every 3 hours
- 12 and 24 hours TAF issued every 6 hours
- RVR is NOT INCLUDED in TAF

ADDITIONAL REQUIREMENTS FOR IFR FLIGHTS

- On an IFR flight a commander shall only commence take-off, or continue beyond the point from which a revised flight plan applies in the event of in-flight re-planning, when information is available indicating that the expected weather conditions, at the time of arrival, at the destination and/or required alternate aerodrome(s) are at or above the planning minima.
- On an IFR flight, a commander shall only continue towards the planned destination aerodrome when the latest information available indicates that, at the ETA, the weather conditions at the destination, or at least one destination alternate aerodrome, are at or above the planning applicable aerodrome operating minima
- On an IFR flight a commander shall only continue beyond the decision point (when using the reduced contingency fuel procedure), or the pre-determined point (when using the pre-determined point procedure), when information is available indicating that the expected weather conditions, at the time of arrival, at the destination and/or required alternate aerodrome(s) are at or above the applicable aerodrome operating minima
- On a VFR flight a commander shall only commence take-off when the appropriate weather reports or forecasts indicate that the meteorological conditions along the route or that part of the route to be flown under VFR will, at the appropriate time, be such as to render compliance with these rules possible
- Special VFR flights are not commenced when the visibility is less than 3 km and not otherwise conducted when the visibility is less than 1,5 km

Minimum visibilities for VFR operations

Airspace class		A B C D E (*Note 1*)	F G	
			Above 900 m (3 000 ft) AMSL or above 300 m (1 000 ft) above terrain, whichever is the higher	At and below 900 m (3 000 ft) AMSL or 300 m (1 000 ft) above terrain, whichever is the higher
Distance from cloud		1 500 m horizontally 300 m (1 000 ft) vertically		Clear of cloud and in sight of the surface
Flight visibility	8 km at and above 3 050 m (10 000 ft) AMSL (*Note 2*) 5 km below 3 050 m (10 000 ft) AMSL			5 km (*Note 3*)

Note 1: VMC minima for Class A airspace are included for guidance but do not imply acceptance of VFR Flights in Class A airspace

Note 2: When the height of the transition altitude is lower than 3 050 m (10 000 ft) AMSL, FL 100 should be used in lieu of 10 000 ft.

Note 3: Cat A and B aeroplanes may be operated in flight visibilities down to 3 000 m, provided the appropriate ATS authority permits use of a flight visibility less than 5 km, and the circumstances are such, that the probability of encounters with other traffic is low, and the IAS is 140 kt or less.

ADDITIONAL EQUIPMENT REQUIREMENTS

CRASH AXES AND CROWBARS

- Above 5,700 kg of MTOW, or having a maximum passenger seating configuration of more than 9 seats, at least one crash axe or crowbar must be located on the flight deck
- If the maximum approved passenger seating configuration is more than 200 and additional crash axe or crowbar must be carried and located in or near the most rearward galley area
- They must not be visible to passengers

MEGAPHONES

For each passenger deck:

Passenger seating configuration	Number of megaphones required
61 to 99	1
100 or more	2

MEANS OF EMERGENCY EVACUATION

- The airplane needs to have an emergency equipment at each exit, if the exit height with landing gear extended is more than 6 feet
- Over wing exits need no devices if the flaps can be lowered below 6 feet from the ground
- Flight crew equipment has the same criterias

LIFE JACKETS AND RAFTS

- The airplane must be equipped with life jackets for each person on board, when:
    - 1Flying over water and at a distance of more than 50 NM from the shore, or
    - When taking off or landing at an aerodrome where the take-off or approach path is so disposed over water that in the event of a mishap there would be a likelihood of a ditching

- The airplane must be equipped with sufficient life-rafts, when it is operating at a distance away from land (which is suitable for an emergency landing), greater than that corresponding to:

    - 120 minutes at cruising speed or 400 NM, whichever is the lesser, for airplanes capable of continuing the flight to an aerodrome with the critical engine failed at any point along the route or planned diversions, or
    - 30 minutes at cursing speed or 100NM,whichever is lesser for all other airplanes

- The raft capacity must be enough to accommodate all people on board, even if the greatest capacity raft is lost
- The raft must be equipped with at least 2 ELTs, emergency locator lights, life saving equipment including means of sustaining life (food and medicines)

DOORS

- With a maximum passenger seating configuration of more than 19 passengers, a door between the passenger compartment and the cockpit with a placard "crew only" shall be installed, and a locking means to prevent passengers from opening it without the permission of the crew
- There must be means for opening each door that separates a passenger compartment from another compartment that has emergency exit provisions

HAND FIRE EXTINGUISHER

- An operator shall not operate an aeroplane unless hand fire extinguishers are provided for use in crew, passenger and, as applicable, cargo compartments and galleys
- At least one hand fire extinguisher, containing Halon 1211, or equivalent as the extinguishing agent, must be conveniently located on the flight deck for use by the flight crew
- At least one hand fire extinguisher must be located in each galley not located on the main passenger deck
- At least one readily accessible hand fire extinguisher must be available for use in each Class A or Class B cargo or baggage compartment and in each Class E cargo compartment that is accessible to crew members in flight
- The following number of hand fire extinguishers must be evenly distributed in the passenger compartment(s)

At least one of the fire extinguishers located in the passenger compartment of an aeroplane with a maximum approved passenger seating configuration of at least 31, and not more than 60, and at least two of the fire extinguishers located in the passenger compartment of an aeroplane with a maximum approved passenger seating configuration of 61 or more must contain Halon 1211, or equivalent as the extinguishing agent.

Maximum approved passenger seating configuration	Number of Extinguishers
7 to 30	1
31 to 60	2
61 to 200	3
201 to 300	4
301 to 400	5
401 to 500	6
501 to 600	7
601 or more	8

COCKPIT VOICE RECORDERS (CVRs)

- In order to assist accident and incident investigations CVRs are required to be carried and operated at all times in aircraft involved in commercial air transport
- Eu-Ops requires the carriage of CVRs in specific aeroplanes
- There are 3 cases:
  - Aeroplanes with Certificate of Airworthiness issued after 1st of April 1998; multi engine turbine; max pax more than 9; MTOM greater than 5,700 kg
    CVR has to be capable of retaining the information recorded during at least the last 2 hours of operation
  - Aircraft with C of A issued after 1st of January 1990 up to and including 31st of March 1998; multi engine turbine; max pax more than 9; MTOM of 5,700 kg or less
    CVR has to be capable of retaining the information recorded during the last 30 minutes of operation
  - Any aeroplane with C of A issued before 1st of April 1998 and MTOM over 5,700 kg
- CVR has to be capable of retaining the information recorded during the last 30 minutes of operation

FLIGHT DATA RECORDERS (FDR)

- FDRs are required to be capable of recording data pertaining to the operation of the aeroplane systems, control positions and performance parameters
- They are required to assist in the investigation of accidents and incidents
- 3 Classifications are existing:
  - 1. C of A issued after 1st of April 1998; multi engine turbine powered with max pax seating configuration of more than 9 OR has a max certificated takeoff mass over 5,700 kg = The FDR is required to be capable of retaining the data recorded during the last 25 hours (or 10 hours if the max certificated takeoff mass is less than 5,700 kg)
  - 2. C of A issued between 1st of June 1990 and 31st of March 1998 with a max certificated takeoff mass over 5,700 kg = The FDR is required to be capable of retaining the data recorded during the last 25 hours
  - 3. C of A issued before 1st of June 1990; turbine powered and with a max certificated takeoff mass over 5,700 kg = The FDR is required to be capable of retaining the data recorded during the last 25 hours

REQUIRED EQUIPMENT FOR IFR FLIGHT

- All aeroplanes operated under IFR, or when the aeroplane cannot maintain the desired attitude without reference to one or more flight instruments, must be equipped with:
  - A magnetic compass
  - An accurate timepiece indicating the time in hours, minutes and seconds
  - 2 sensitive pressure altimeters with counter drum-pointer, or equivalent presentation
  - An ASI with means of preventing malfunctioning due to either condensation or icing
  - A turn and slip indicator
  - An attitude indicator (artificial horizon)
  - A heading indicator (directional gyro)
  - A means of indicating whether the power supply to the gyro instrument is adequate
  - A means of indicating in the flight crew compartment the OAT
  - A rate-of-climb and descent indicator
  - Such additional instruments or equipment as may be prescribed by the authority

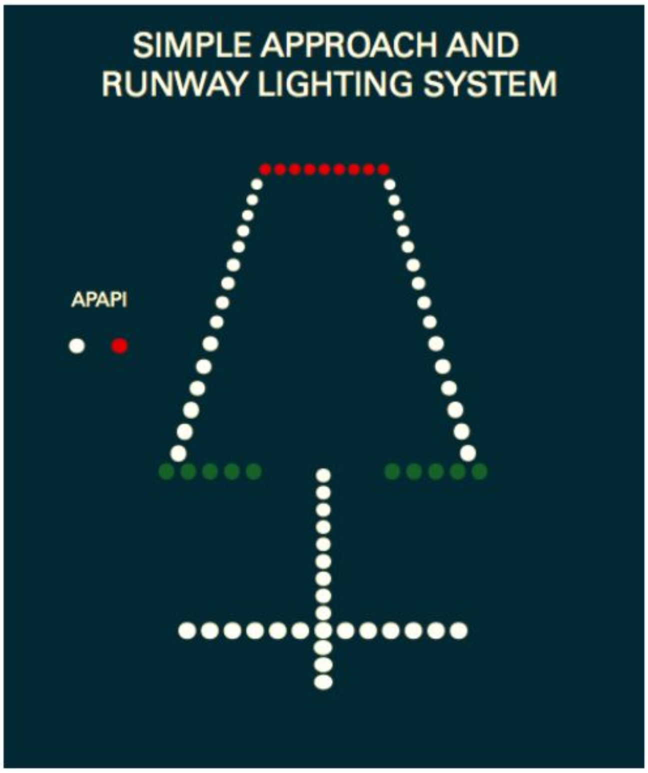
APPROACH - RW - TAXIWAY LIGHTS AND MARKS

APPROACH LIGHTS

Patterns of fixed lights with variable intensity, designed to give the pilot guidance to the threshold, or aiming point of the RW in poor weather conditions or at night.

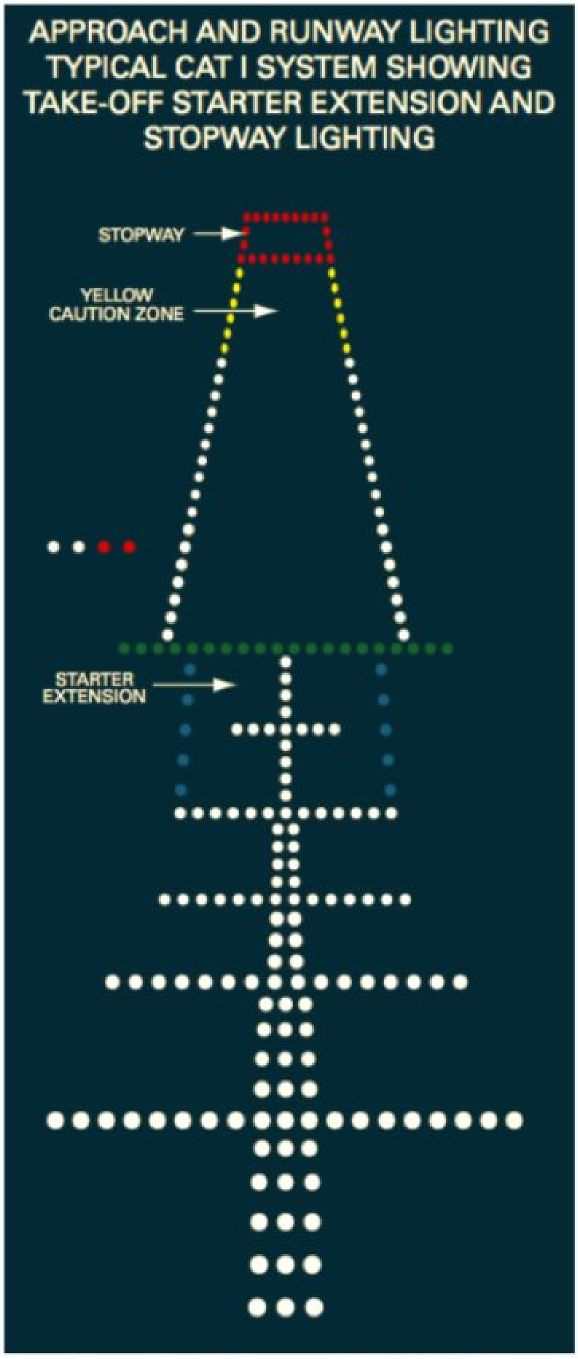
SIMPLE APPROACH LIGHTING SYSTEM

- Lights extended the centerline of the RW, whenever possible over a distance at least 420m from the threshold with a crossbar (18-30m wide) at a distance of 300m from the threshold.
- Used at non instrument RW
- May be used on NPA instrument RW



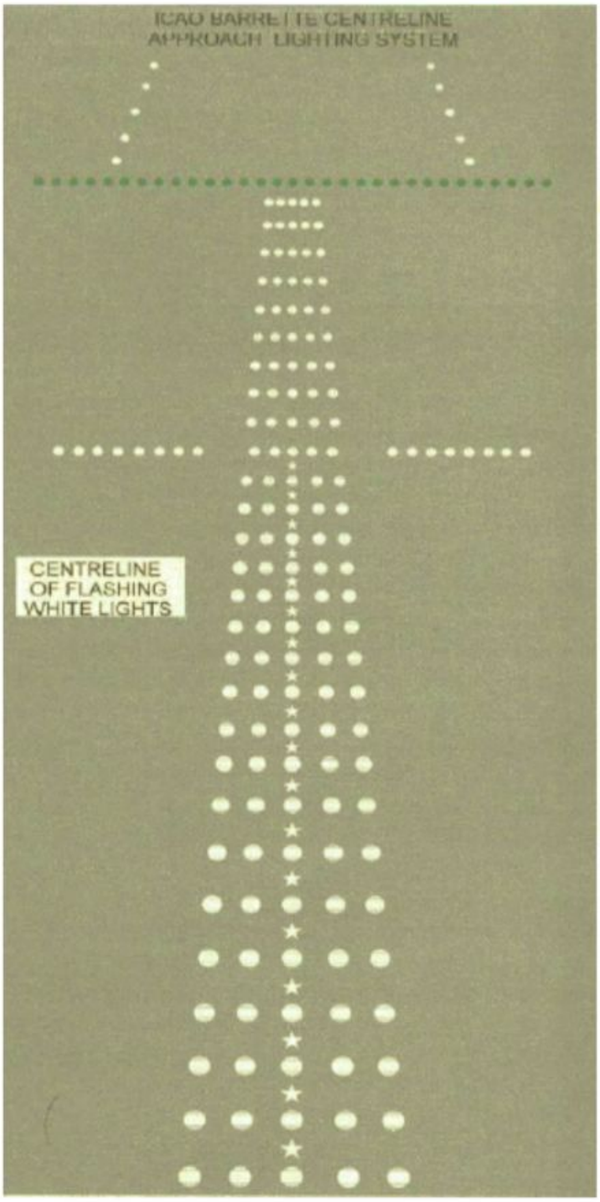
PRECISION APPROACH CAT 1 LIGHTING SYSTEM (CALVERT)

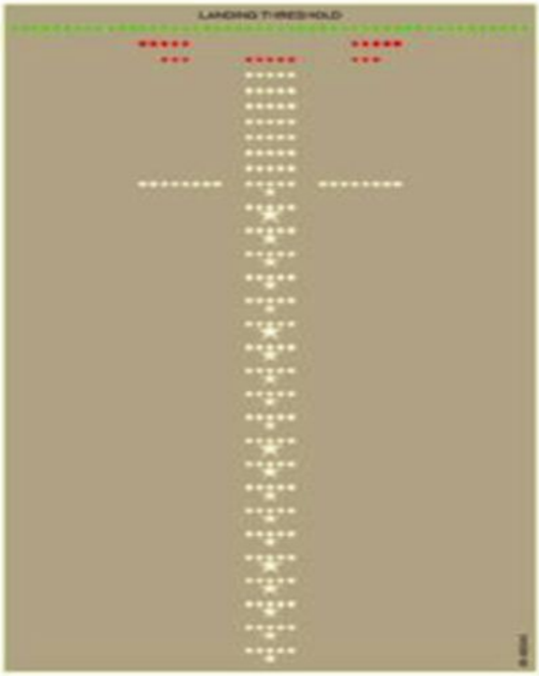
- Row of lights extended of RW centerline at least 900m from RW threshold.
- If it's length is less than 900m (which coincides CAT 1 200' feet minima with 3 degree glide path, so DH over the first lamps)
- Consist 5 crossbars each 150m away with 3 segments:
  - Inner segment 0-300m
  - Middle segment 400-600m
  - Outer segment 600-900m
- Any ILS or MLS antenna will be treated as an obstacle and will be lighted.



ICAO PRECISION APPROACH CAT 1 LIGHTING SYSTEM

- At least 900m row of lights in form of BARRETTES extended of RW centerline with only 1 crossbar at 300m from RW threshold
- Centerline may be flashing toward the threshold
- Threshold may be enhanced by using wing strobes. (rotating)

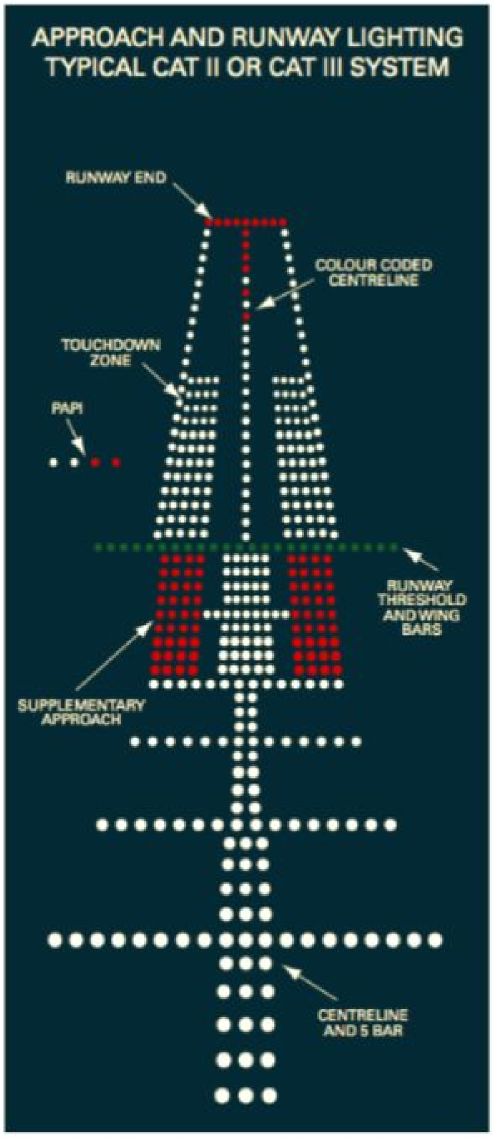




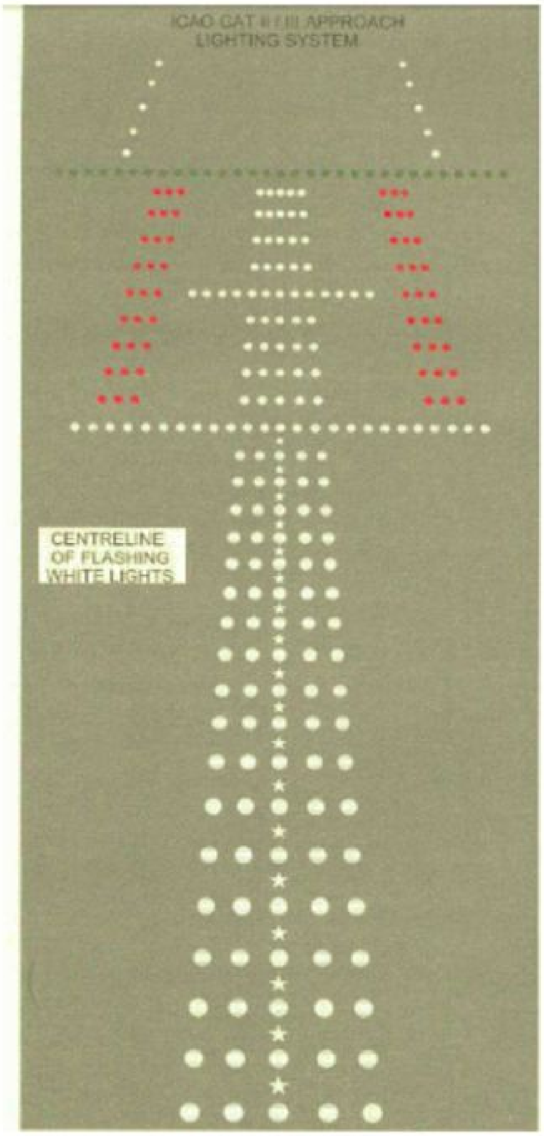
ALSF-1 Layout

PRECISION APPROACH CAT 2-3 LIGHTING SYSTEM

- More complex to help the pilot get the visual criteria at DH
- Based either on CALVERT 5 bar and centerline system or ICAO barrettes system
- Both 900m long and give some altitude information
- Both augmented at the inner segment (0-300m from threshold) by the supplementary approach lighting system. Calvert replaced centerline with barrettes and both system get some red wing barrettes to enhance the inner segment.
- DH for CAT 2 is not lower than 100’ feet which is above 300m from the threshold. (assuming 50‘ feet above threshold)



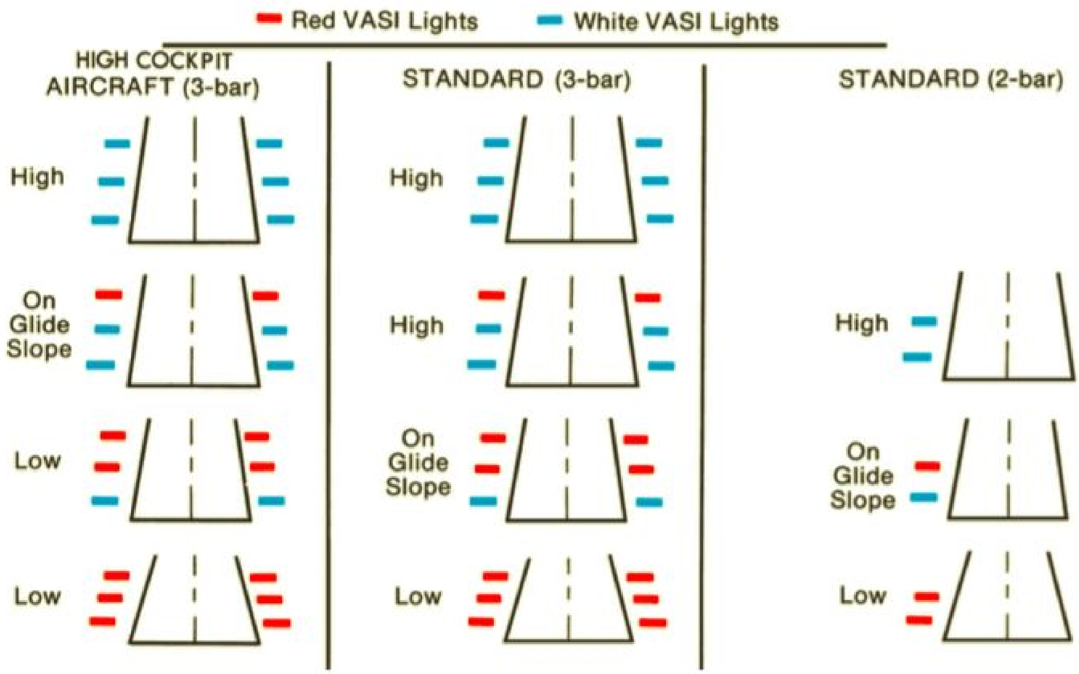
Calvert 5 bar and centerline system



ICAO system (ALSF-2)

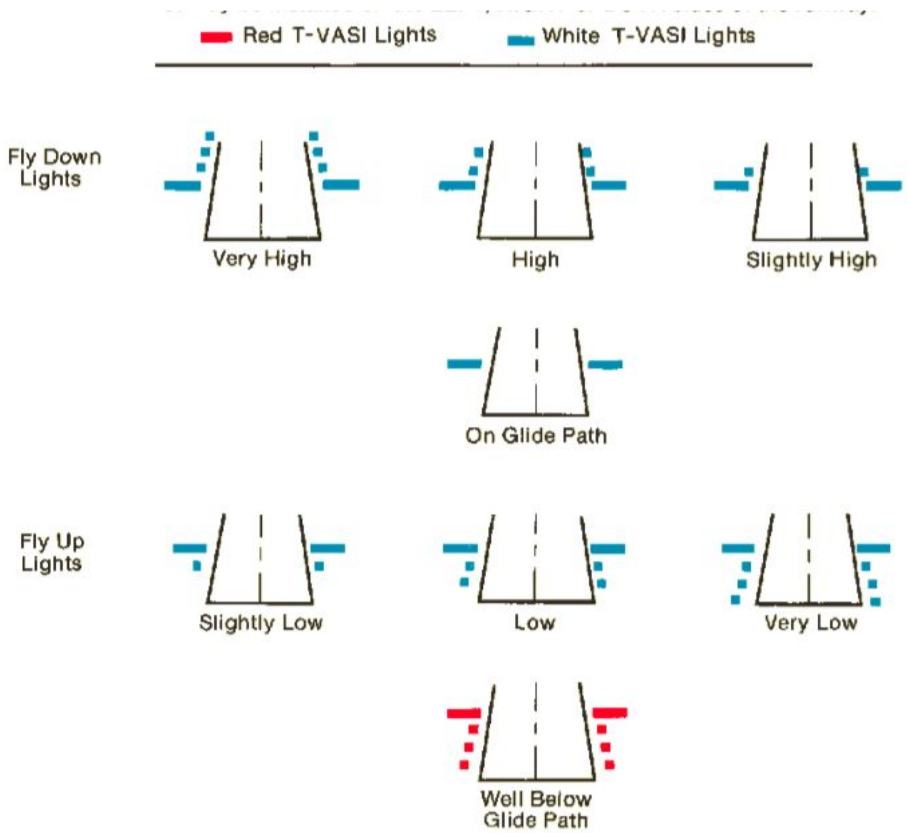
VASI - VISUAL APPROACH SLOPE INDICATOR

VASI is normally installed on the left side of the RW.



T-VASI - VISUAL APPROACH SLOPE INDICATOR

VASI is normally installed on the left side of the RW.



RUNWAY MARKINGS

THRESHOLD MARKINGS

- Provided at the threshold for instrument and non-instrument rws
- Longitudinal lines symmetrically with centerline
- Number of stripes depends on the RW width as below
- They are at least 30m
- If there is a RW designator there must be 3-3 stripes on each sides of centerline

RUNWAY WIDTH	NUMBER OF STRIPES
18m	4
23m	6
30m	8
45m	12
60m	16

DESIGNATION MARKINGS

- Located at the threshold.
- Consists 2 digit number
- On parallel RWs, each RW designation number is supplemented by a letter in order from left to right, (from approach view)

CENTERLINE MARKINGS

- Consist of a line of uniformly spaced stripes and gaps.
- Stripes 30m long
- Gaps 20m long

TOUCHDOWN ZONE MARKINGS

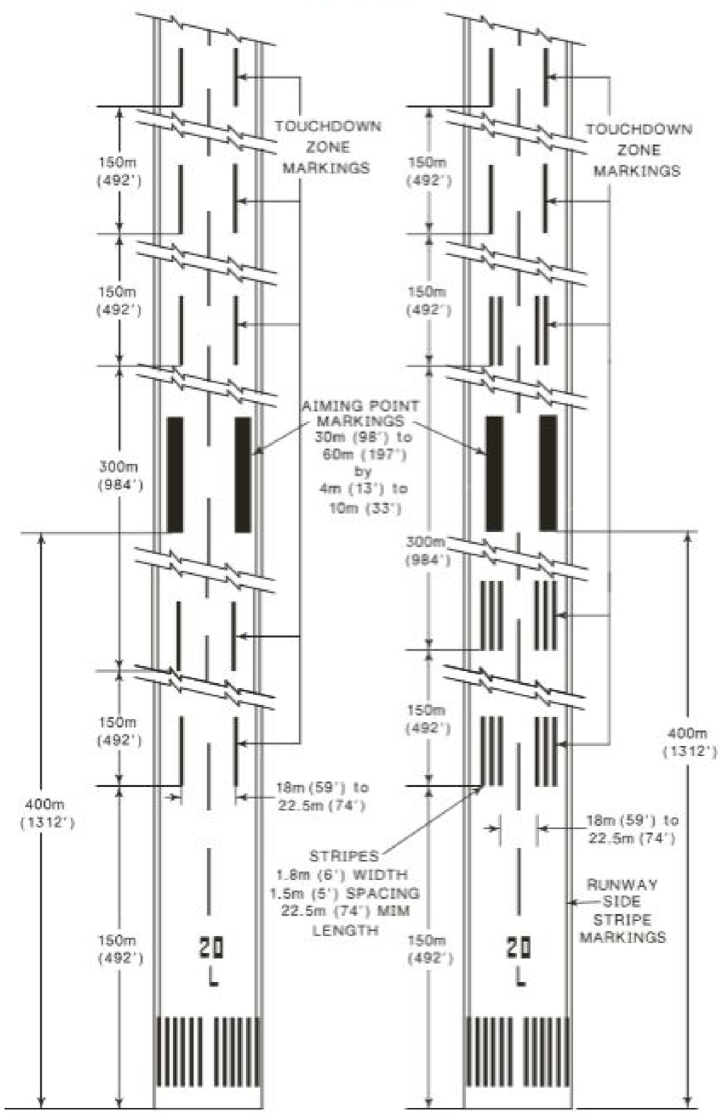
- Provided in the touchdown zone, for PA RWs, NPA RWs, Non-Instrument RWs where additional identification of touchdown zone required.
- Shall consists of pairs of rectangular markings symmetrically disposed the RW centerline with the number of pairs related to the landing distance available (LDA).

LDA or DISTANCE BETWEEN THRESHOLDS	PAIR(S) of MARKINGS
Less than 900m	1
Less than 1200m but not less than 900m	2
Less than 1500m but not less than 1200m	3
Less than 2400m but not less than 1500m	4
2400m or more	6

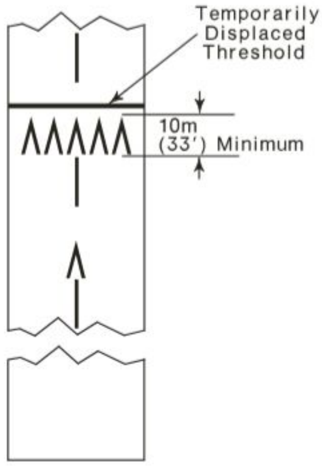
AIMING POINT MARKINGS

- Provided at each approach end of instrument os non-instrument RWs
- Consists of 2 stripes 30-60m long, 4-10m wide

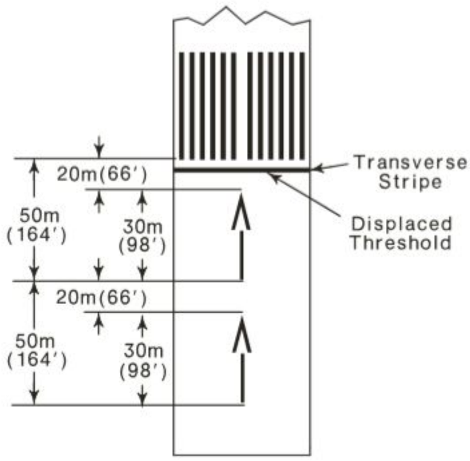
RUNWAY TOUCHDOWN ZONE AND AIMING POINT MARKINGS
(continued)



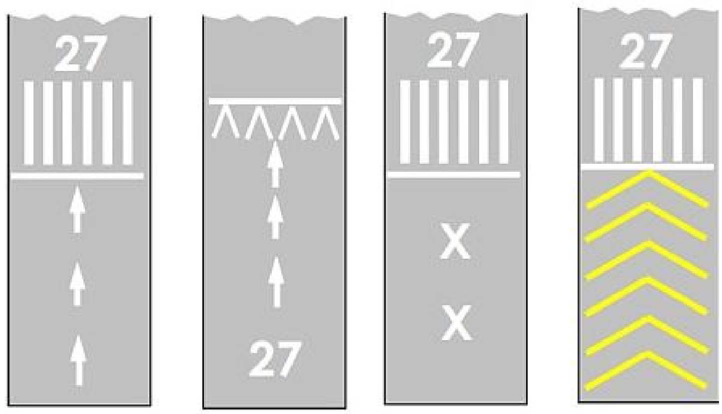
DISPLACED THRESHOLD MARKINGS



TEMPORARILY DISPLACED THRESHOLD



TEMPORARILY OR PERMANENTLY DISPLACED THRESHOLD



Permanently displaced (pre threshold area fit for aircraft movement)

Temporarily displaced for 6 months or less (runway designator is not moved)

Pre threshold area not fit for aircraft movement

Pre threshold area fit for use by aircraft as a stopway only

CLOSED RW TAXIWAY MARKINGS (PERMANENT, TEMPORARY)

- Shall be displayed at each end of RW, or portion declared permanently closed from all A/C
- Closed marking shaped as a cross
- White on RW, and yellow on T
- taxiway

NON-LOAD BEARING SURFACE MARKINGS

- Shoulders for taxiway, holding bays, aprons etc.
- This mark consists of a pair solid lines the same color as the taxiway centerline marking

TAXIWAY

TAXIWAY LIGHTS

- Edge of taxiway: BLUE
- Center of taxiway: GREEN

High speed taxiway turn-off indicator lights

- On RW intended for use in RVR conditions less than 350m AND/OR where heavy traffic is expected.
- Located on the same side on the RW where the taxiway out is placed
- Fixed unidirectional yellow lights

RW STRUCTURE

DEFINITIONS OF DISTANCES

CLEARWAY

Clearway is the area beyond the runway not less than 152m wide centrally located about the extended centerline of the runway and under the control of airport authorities. Clearway is expressed as a plane extending from the end of runway with up slop not exceeding 1.25% above which no object or terrain protrudes with exception of threshold lights.

STOPWAY

Stopway is the area at the end of take-off runway no less wide than the runway and centered upon extended centerline of runway and able to support the aeroplane during an aborted take-off without causing structural damage to the aeroplane.

TORA (Take off Run Available)

TORA is defined as length of runway suitable for normal operations. It need not always equal to LDA (landing distance available). TORA doesn't include Stopway or Clearway.

TODA (Take off Distance Available)

TODA is the length of runway plus any clearway if available. In case no clearway exists, TODA is same as TORA. TODA includes ground as well as air segments.

ASDA (Accelerate-Stop Distance Available)

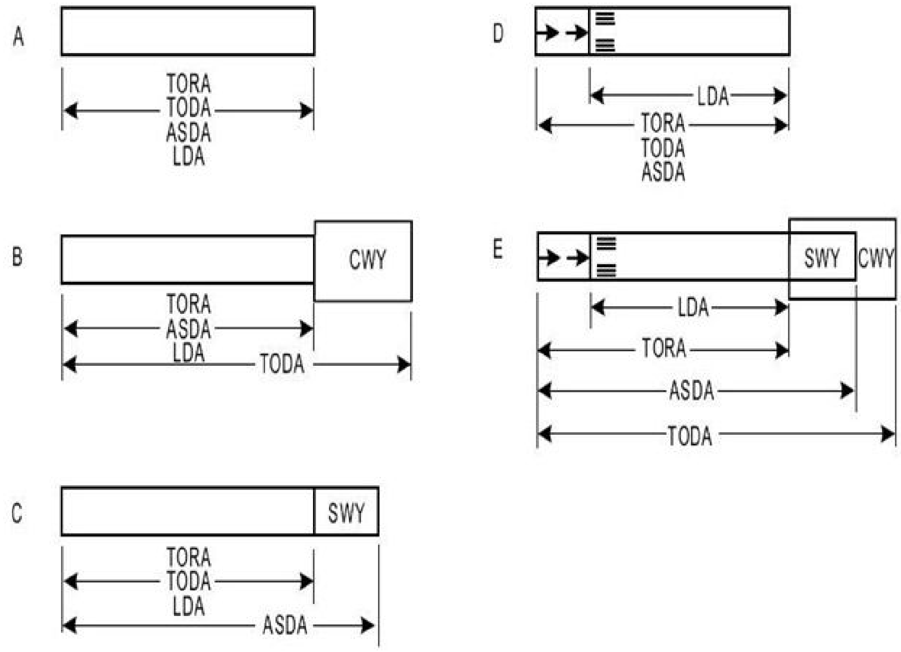
ASDA is used for calculation of V1. It is defined as sum of LDA/TORA (as applicable) and Stopway. In case take-off is aborted the aircraft can be brought to a stop either on the runway or on Stopway. ASDA must not be used as TORA.

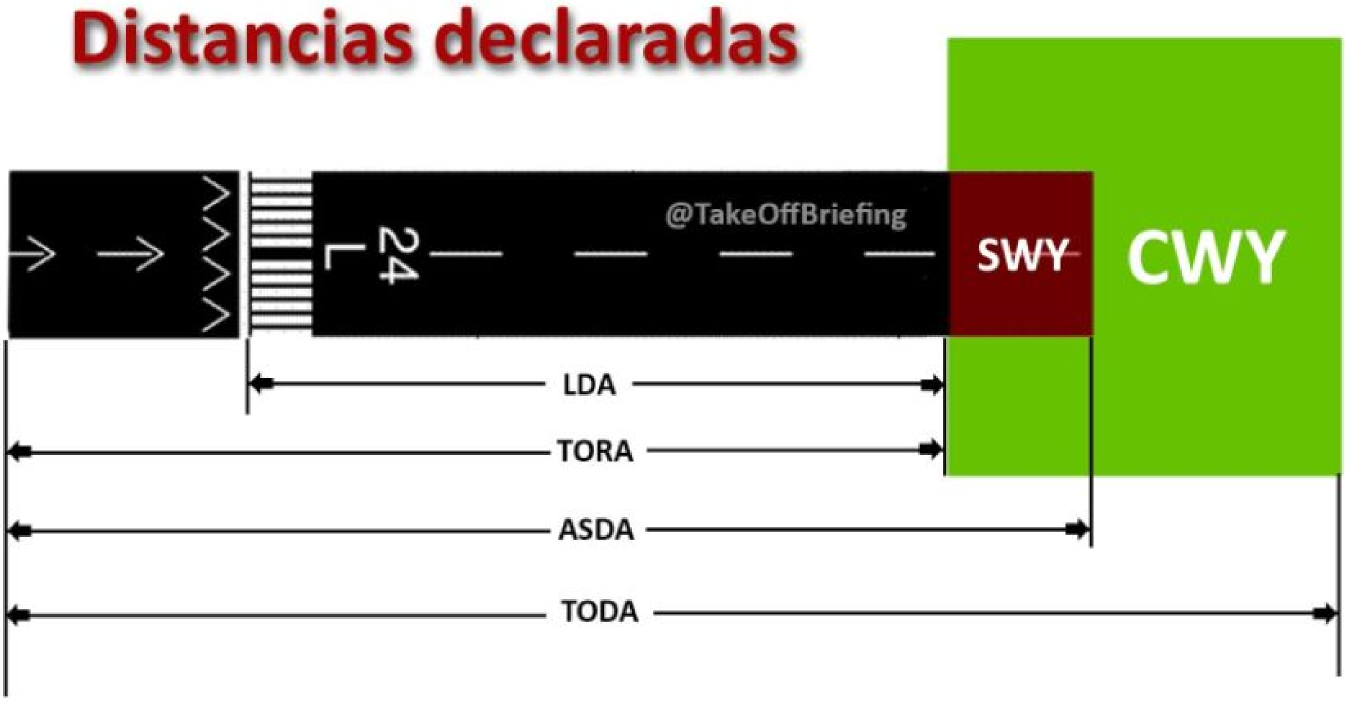
LDA (Landing Distance Available)

LDA is the runway length declared available and suitable for landing an airplane.
Information on Clearway, Stopway, TORA, TODA, ASDA & LDA for different runways can be obtained from Aerodrome Information Publications, Jepessen Charts and RTOW charts.

SCREEN HEIGHT

- An imaginary screen that is just cleared by the lowest part of the aircraft with undercarriage extended and in an unbanked attitude when taking off and landing.
- Contaminated RW 30' feet
- Dry RW 15' feet


A
TORA
TODA
ASDA
LDA
B
CWY
TORA
ASDA
LDA
TODA
C
SWY
TORA
TODA
LDA
ASDA
D
LDA
TORA
TODA
ASDA
E
SWY
CWY
LDA
TORA
ASDA
TODA


Distancias declaradas
@TakeOffBriefing
24
L
SWY
CWY
LDA
TORA
ASDA
TODA

RUNWAY reports in EUROPE

BASICS

- Information of RW conditions are expressed by one or more 8 figure groups attached to the METAR
- It's format: AABCDDEE

RW DESIGNATOR

AABCDDEE

AA BCDDEE

RUNWAY DESIGNATOR (1st and 2nd figure)

PARALLEL RWYs	The right RWY is identified by adding 50 to the Designator, e.g 77=27R, while the left RWY only the RWY figures appears e.g 27=27L
88	**The figure 88** instead of a RWY designator indicates that conditions reported apply to all RWY at the Aerodrome.
99	**The figure 99** instead of a RWY designator indicates that a previous RWY report is repeated.

TYPE OF DEPOSIT

AA**B**CDDEE

AA **B** CDDEE

TYPE OF DEPOSIT (3rd figure)

0 = CLEAR and DRY
1 = DAMP
2 = WET or Water Patches
3 = RIME or FROST (<1mm)
4 = DRY SNOW
5 = WET SNOW
6 = SLUSH
7 = ICE
8 = COMPACTED or ROLLED SNOW
9 = FROZEN RUTS or RIDGES

/ = TYPE of DEPOSIT NOT REPORTED, e.g due to RWY clearance/de-icing i progress.

EXTENT OF CONTAMINATION

AAB**C**DDEE

AAB **C** DDEE

EXTENT OF CONTAMINATION (4th figure)

1 = 10% or less of RWY covered
2 = 11% to 25% of RWY covered
5 = 26% to 50% of RWY covered
9 = 51% to 100% of RWY covered

/= NOT REPORTED e.g due to RWY clearance or de-icing in progress.

DEPTH OF DEPOSIT

AABC**DD**EE

AABC **DD** EE

DEPTH OF DEPOSIT (5th and 6th figure)

00 = less than 1mm
01 to 90 = depth in mm (e.g. 23 = 23mm)

92 = 10cm	96 = 30cm
93 = 15cm	97 = 35cm
94 = 20cm	98 = 40cm
95 = 25cm	

99 = RWY not operational due to snow, slush, ice, large drifts or RWY clearance. Depth not reported.

// = Depth operationally not significant e.g with ice or rolled snow, or not measurable e.g RWY wet.

FRICTION COEFFICIENT OR BRAKING ACTIONS

AABCDD**EE**

AABCDD **EE**

FRICTION CO-EFFICIENT OR BRAKING CONDITIONS (7th and 8th figure)

Either the measured Friction Coefficient or an estimated Braking Action is reported as follows:

- FRICTION COEFFICENT

01 to 90	Reported figures from 01 to 90 represent FC (Example: 05 = FC 0.05 or 28 = FC 0.28)

OR

- BRAKING ACTION

Reported by following code figures:

91 =	POOR
92 =	MEDIUM/POOR
93 =	MEDIUM
94 =	MEDIUM/GOOD
95 =	GOOD
99 =	UNRELIABLE, BA and FC not possible to assess, misleading, e.g in case of aquaplaning.
// =	BA and FC not reported; RWY not operational; Aerodrome closed; etc.

RW - SNOWTAM reports

BASICS

- ICAO specifies SNOWTAM as a special series of NOTAM, notifying the presence or removal of hazardous conditions due to SNOW, ICE, SLUSH or STANDING WATER associated with snow, slush and ice on the movement area.
- Max validity is 24 hours
- New SNOWTAM will be issued whenever significant change occurs
- Typical SNOWTAM will consists:
  - Header block (adressees, date and time, serial number)
  - Body (related A/D information)

A/D SNOWTAM format:

A. - A/D identifier
B. - DATE/TIME of observation (UTC)
C. - RW designator
D. - Cleared RW length in meter (if less than published length)
E. - Cleared RW width in meter (if less than published width)
F.) - Deposits over total RW length (observed on each third RW) :

1. DAMP
2. WET or WATER PATCHES
3. RIME (normally less than 1mm deep)
4. DRY SNOW
5. WET SNOW
6. SLUSH
7. ICE
8. COMPACT or ROLLED SNOW
9. FROZEN RUTS or RIDGES

G. - Mean depth of deposits (mm) (for each third RW segment)
H. - Friction measurements or estimates (for each third RW segment) and friction measuring Device.

Measure friction values:

› 40	=	GOOD
36 - 39	=	MEDIUM - GOOD
30 - 35	=	MEDIUM
26 - 30	=	MEDIUM - POOR
‹ 25	=	POOR

Estimated friction:

5	=	GOOD
4	=	MEDIUM - GOOD
3	=	MEDIUM
2	=	MEDIUM - POOR
1	=	POOR
9	=	UNRELIABLE

Friction Measuring Device

BRD	=	Brakemeter-Dynometer
GRT	=	Grip tester
MUM	=	Mu-meter
RFT	=	Runway friction tester
SFH	=	Surface friction tester (high-pressure tire) SFL = Surface friction tester (low-pressure tire) SKH = Skiddometer (high-pressure tire)
SKL	=	Skiddometer (low-pressure tire)

TAP = Tapley meter

I. - Not used
J. - CRITICAL SNOWBANKS (if present)
K. - RUNWAY LIGHTS (if obscured)
L. - FURTHER CLEARING OPERATIONS (if planned)
M. - FURTHER CLEARANCE EXPECTED TO BE COMPLETED BY (UTC)
N. - TAXIWAY
O. - Not used
P. - TAXIWAY SNOWBANKS
Q. - Not used
R. - APRON
S. - NEXT PLANNED OBSERVATION/MEASUREMENT
T. - PLAIN LANGUAGE REMARKS

- For aerodromes with more than one runway, items C) through P) will be repeated in ascending order of runway identifier.

METAR WIZZAIR

HORIZONTAL VISIBILITY

- When there is no marked variation in the visibility by direction, the minimum is given in meters. When there is a marked directional variation, however, the reported minimum will be followed by one of the eight points of the compass to indicate its direction, e.g. "4000NE". If the minimum visibility is less than 1500 meters, and the visibility in another direction is more than 5000 meters, both the minimum and maximum values, and their directions will be given, e.g. "1400SW 6000N". A code figure of "9999" indicates a visibility of 10 km or more, while "0000" indicates that the visibility is less than 50 meters.

RUNWAY VISUAL RANGE (RVR)

- An RVR group has the prefix "R" followed by the runway designator, then a slash followed by the touchdown zone RVR in meters. If the RVR is assessed simultaneously on two or more runways, the RVR group will be repeated; parallel runways will be distinguished by the addition of "L", "C" or "R" after the runway designator to indicate the left, central or right parallel runway respectively, e.g. "R31L/1100, R31R/1150". When the RVR is greater than the maximum value which can be assessed, or more than 1500 meters, the group will be preceded by the letter "P", followed by the lesser of these two values, e.g. "R31L/P1500". When the RVR is less than the minimum value which can be assessed, the RVR will be reported as "M" followed by the minimum value that can be assessed, e.g. "R31L/M0050".

CLOUD

- Up to four cloud groups may be included, in ascending order of their bases. Each group consists of three letters to indicate the amount (FEW = 1 to 2 octal, SCT/Scattered = 3 to 4 octas; BKN/Broken = 5 to 7 octas and OVC/Overcast = 8 octas) and three figures indicating the height of the base of the cloud layer in hundreds of feet above aerodrome level. Apart from significant convective clouds (CB = cumulonimbus; TCU = towering cumulus) cloud types are not indicated. Cloud layers or masses are reported such that the first group represents the lowest individual layer of any amount; the second group is the next individual layer of more than 2 octas; the third group is the next higher-layer of more than 4 octas, and the additional group, if any, represents significant convective cloud, if not already reported, e.g. "SCT010 SCT015 SCT018CB BKN025".

CAVOK AND SKC

- "CAVOK" will replace the visibility, RVR, weather and cloud groups when the visibility is 10 km or more; there is no cloud below 5000 feet or below the highest MSA, whichever is the greater, and no cumulonimbus; and there is no precipitation, thunderstorm, shallow fog or low drifting snow.
- If any of these conditions are not met, but there is no cloud to report, then the cloud group is replaced by "SKC" (sky clear).

AIR TEMPERATURE AND DEW POINT

- The air temperature and dew point are shown in degrees Celsius, separated by a slash. A negative value is indicated by "M" in front of the appropriate digits, e.g. 10/03 or "01/M01".

PRESSURE SETTING

The QNH is rounded down to the next whole Hectopascal and reported as a four-figure group preceded by the letter "Q". If the QNH value is less than 1000 hPa, the first digit will be "0", e.g. "Q0993".

RECENT WEATHER

Operationally significant weather which has been observed since the previous observation, but which was not current at the time of the present observation, will be reported using the standard present weather code preceded by the indicator "RE", e.g. "RETS".

WINDSHEAR

A windshear group may be included if windshear is reported along the take-off or approach paths in the lowest 1600 feet with reference to the runway in use. "WS" is used to begin the group as in the examples: "WS TKOF RWY20", "WS LDG RWY20".

RUNWAY STATE

- When snow or other runway contamination is present, an eight-figure group may be added at the end of the METAR. (also known as MOTNE code).

TREND (TREND-TYPE LANDING FORECAST)

- A trend group is added when significant changes in conditions are forecast to occur during the two hours following the time of observation. The codes "BECMG" (becoming) or "TEMPO" (temporarily) are used, and may be followed by a time group (in hours and minutes UTC) preceded by one of the indicators "FM" (from), "TL" (until) or "AT" (at). These are followed by the expected change using the standard codes, e.g. "BECMG FM1100 250/35G50KT" or "TEMPO FM0630 TL0830 3000 SHRA". Where no such significant changes are expected, the trend group will be replaced by the word "NOSIG".

Significant Present and Forecast Weather Codes				
Qualifier		Weather Phenomena		
Intensity or Proximity	Descriptor	Precipitation	Obscuration	Other
- Light Moderate (no Qualifier) + Heavy (well developed in the case of FC and PO) VC - In the vicinity	MI - Shallow BC - Patches BL - Blowing SH - Shower(s) TS - Thunderstorms FZ - Freezing (Super - Cooled) PR - Partial (covering part of aerodrome)	DZ - Drizzle RA - Rain SN - Snow IC - Ice Crystals (Diamond Dust) PL - Ice Pellets GR - Hail GS - Small hail - (<5 mm in diameter and/or snow pellets) UP - Unknown Precipitation PY - Spray	BR - Mist FG - Fog FU - Smoke VA - Volcanic Ash DU - Widespread Dust SA - Sand HZ - Haze	PO - Dust/Sand Whirls (Dust Devils) SQ - Squall FC - Funnel Cloud(s) (tornado or water spout) SS - Sandstorm/ Duststorm

METAR ICAO

INTRODUCTION

The letters METAR stand for METeorological Aerodrome Report. METARs contain coded messages pertaining to the actual weather conditions at a given aerodrome, at a stated time. Typical METARs for United Kingdom aerodromes, extracted from the United Kingdom Met Office website, are shown below.

```
ZCZC ZKA498 031428
GG EGTKZGZX
031428 EGGYYBYA
SAUK34 EGYY 031420
METAR EGDG NIL=
METAR EGHD 031420Z 00000KT 9999 SCT025 13/08 Q1032=

METAR EGHE NIL=
METAR EGHK 031420Z 34005KT 9999 SCT020 BKN040 15/08 Q1031 NOSIG=
METAR EGJA 031420Z 05008KT 020V100 9999 FEW030 SCT050 15/09 Q1031=
METAR EGJB 031420Z 04008KT 9999 FEW028 BKN250 15/08 Q1031
METAR EGJJ 031420Z 04010KT 010V100 9999 FEW030 16/08 Q1030 NOSIG=
METAR EGTE 031420Z 02005KT 040V050 9999 FEW024 BKN045 15/07 Q1031=
METAR EGTG 031420Z 00000KT 9999 BKN036 14/06 Q1032=
```

METARs are usually issued every half hour during aerodrome operating hours. The aim of this chapter is to explain the METAR coding, group by group.

DECODING THE METAR

This example reproduces the first eight code groups normally found in a METAR.

METAR EGTK 231020Z 26012G25KT 220V300

For clarity the METAR has been split into its significant parts (a) to (h):

METAR EGTK 231020Z 260 12G25KT 220 V300
(a) (b) (c) (d) (e) (f) (g) (h)

Report Type

The first code, (a), is the identification of the type of report; in this case a METAR.

Aerodrome

The four letter ICAO designator of the issuing aerodrome is shown next, (b); this example is for Oxford/Kidlington, EGTK.

Date-Time Groups

The third group, (c), is the date/time group, which simply gives the date of the actual weather observation. The first two digits represent the day of the month, followed by the time in hours and minutes. Time is always given as Coordinated Universal Time (UTC), which is, for all practical purposes, the same as Greenwich Mean Time (GMT): the local time at Greenwich, London. In the METAR, itself, UTC is indicated by the code Z, pronounced “Zulu”.

WIND INFORMATION

The next items in the METAR (d, e ,f and g) are the observed wind information. Firstly, the direction of the wind given in degrees true, rounded up or down to the nearest 10 degrees, (d), and then the wind speed in knots, (e), which is a mean speed taken over a 10 minute period. However, if a gust is observed which is at least 10 knots more than the mean wind speed, then a gust figure, (g), comes after the mean wind; this gust figure is preceded by the le er G, (f).

The next code-group, (h), may or may not appear depending on the directional variability of the wind. Variability is shown after the main wind group and signifies the extremes in the direction of the wind during the previous 10 minutes. The le er V will appear between these two extremes. If there is no wind, the coding, 00000KT, will be used.

VISIBILITY

Visibility in the METAR is represented by the next group, depicted in red in the example. In the METAR, the reported visibility is the prevailing visibility and, may, under certain conditions, include the minimum visibility. Here, the prevailing visibility is reported as 1,400 metres.

Prevailing visibility is the visibility value which is either reached, or exceeded, around at least half the horizon circle, or within at least half of the surface of the aerodrome. If the visibility in one direction, which is not the prevailing visibility, is less than 1,500 m, or less than 50% of the prevailing visibility, the lowest visibility observed, and its general direction, should also be reported.

Up to 10 km, the visibility is measured in metres. For example, 6000 means that the prevailing visibility is 6,000 metres. Once the visibility reaches 10 km or more, the code figure used is 9999.

Visibility of less than 50 metres is indicated by the code 0000. In this example the prevailing visibility is 1,400 metres.

METAR EGTK 231020Z 26012G25KT 220V300 1400

In some instances, runway visibility information is given in a METAR; this is known as Runway Visual Range (RVR.) RVR is given only when either the horizontal visibility or the RVR, itself, is less than 1,500 metres. The RVR group starts with the le er R, and then goes on to give the runway in use, followed by the threshold visibility in metres.

In the following example, for Oxford Kidlington, we have a prevailing visibility of 1,400 metres, with an RVR, on Runway 30, of 1,100 metres.

METAR EGTK 211020Z 26012G25KT 1400 R30/1100
If the RVR is more than the maximum reportable value of 1,500 metres, the code P is used in front of the visibility value, R30/P1500.

A letter can sometimes come after the RVR to indicate any trends that the RVR has shown. A U means that the visibility has increased by 100 m or more in the last 10 minutes, e.g. R30/1100U. A D shows that visibility has decreased in that same time period, R30/1100D. An N added to the visibility group shows that there is no distinct trend observed, R30/1100N.

THE WEATHER GROUP

The next section of the METAR is the weather group. The weather group gives information on the present weather at, or near, the aerodrome at the time of the observation. The weather group +SHRA added to our example METAR means “heavy showers of rain”.

METAR EGTK 211020Z 26012G25KT 1400 R30/1100 +SHRA
The following table lists the various codes which may be used in the METAR weather group to describe different weather phenomena.

Significant Present and Forecast Weather Codes				
Qualifier		Weather Phenomena		
Intensity or Proximity	Descriptor	Precipitation	Obscuration	Other
- Light Moderate (no Qualifier) + Heavy (well developed in the case of FC and PO) VC - In the vicinity	MI - Shallow BC - Patches BL - Blowing SH - Shower(s) TS - Thunderstorms FZ - Freezing (Super - Cooled) PR - Partial (covering part of aerodrome)	DZ - Drizzle RA - Rain SN - Snow IC - Ice Crystals (Diamond Dust) PL - Ice Pellets GR - Hail GS - Small hail - (<5 mm in diameter and/or snow pellets) UP - Unknown Precipitation PY - Spray	BR - Mist FG - Fog FU - Smoke VA - Volcanic Ash DU - Widespread Dust SA - Sand HZ - Haze	PO - Dust/Sand Whirls (Dust Devils) SQ - Squall FC - Funnel Cloud(s) (tornado or water spout) SS - Sandstorm/ Duststorm

The first column represents the intensity or proximity of a weather phenomenon. These have the following meaning:

-     meaning light
+   meaning heavy
VC   meaning in the vicinity of, but not at, the observation point

If there is no qualifier (no + or -) in front of precipitation, then the precipitation is moderate

The second column in the table, bearing the title Descriptor, contains le ers which add detail to each weather phenomenon; for example, BC means patches, and is frequently used to describe fog, SH means showers, and TS means thunderstorm.
The last three columns in the table contain codes which describe the weather phenomena themselves.
The column headed Precipitation contains codes for drizzle, rain, snow, hail etc. The next column covers those weather phenomena which are classified as Obscurations; these include mist, fog, smoke, and ash.

The last column in the table contains those weather phenomena which have not already been mentioned in the table. This group mainly consists of the more unusual weather events that are rarely reported in the United Kingdom.

Referring to the weather group of the partially complete METAR which indicated heavy showers of rain, +SHRA, we see that + means heavy, SH indicates showers and RA stands for rain.

THUNDERSTORMS

A Thunderstorm report will appear in a METAR if thunder has been heard within the last 10 minutes.

A thunderstorm is represented by the le ers TS. If there is no precipitation, the le ers TS will appear on their own. However, if there is precipitation, a further two le ers, which signify the type of precipitation, are inserted after the TS. For example, if there is rain observed from the thunderstorm, TSRA will appear in the METAR. If hail were to be observed, the code would read TSGR, or TSGS, with GS meaning small hail.

CLOUD COVERAGE

The next code-group to appear in the METAR gives detail of cloud coverage, as highlighted in red below. In this case the highlighted code means: overcast sky, base 2,000 feet, with cumulonimbus.

METAR EGTK 211020Z 26012G25KT 1400 R30/1100 +SHRA OVC020CB
There are several prefixes which are used to describe cloud amount, at any given level. Cloud coverage is reported in the METAR using the following three le er codes:

FEW (FEW 1-2) meaning one to two eighths of cloud coverage.

SCATTERED (SCT 3-4) meaning three to four eighths of cloud coverage.

BROKEN (BKN 5-7) meaning five to seven eighths of cloud coverage.

OVERCAST (OVC 8) meaning complete cloud coverage, or eight eighths.

Cloud base is given as a three digit figure showing hundreds of feet. Cloud base in a METAR is always measured as height above aerodrome level, using the current aerodrome QFE.

For example, 6 eighths of cloud (6 oktas) at 1 900 feet above aerodrome level would appear in the METAR as BKN019. 8 oktas at five hundred feet would be abbreviated to OVC005.

The only cloud types that are specified in the METAR are the significant convective clouds. These are cumulonimbus (CB) and towering cumulus (TCU).

Looking back to the cloud group we see the code OVC020CB. This refers to an overcast sky covered by convective cumulonimbus cloud whose base is 2,000 ft above aerodrome level. The previous weather group, +SHRA, indicates that the cloud detailed in the cloud group is producing a heavy shower of rain. If there is no cloud observed at the airfield, the code SKC, meaning sky clear, is used.

OBSCURATION

If the sky at an aerodrome is obscured for reasons other than cloud cover, and cloud coverage cannot easily be determined, the code VV is used in place of the cloud information. VV is followed by the vertical visibility in hundreds of feet.

METAR EGTK 231020Z 26005KT 300FG OVC VV002 (a) (b) (c)

The highlighted codes in this METAR indicate that:
Visibility is 300m in fog (a), the sky is overcast (b), and the vertical visibility is 200ft (c).

This METAR decodes as follows:

METAR for Oxford/Kidlington, observed at 1020 UTC on 23rd of the month; the surface wind is 260o True, at 5 knots; the visibility is 300 m in fog (a); the sky is overcast (b), and a vertical visibility of 200 ft has been reported (c).

If the vertical visibility cannot be assessed, three forward slashes will replace the cloud height figures, e.g. VV///.

The code CAVOK is frequently used in the METAR code, being the abbreviation for “cloud, ceiling and visibility are OK.” If CAVOK is used, it will replace the visibility, RVR, weather and cloud groups. There are four criteria which must be met in order for CAVOK to appear in the METAR. These are:

- the visibility must be 10 kilometres or more.
- the height of the lowest cloud must be no less than 5 000 feet, or the level of highest minimum sector altitude, whichever is the greater.
- there must be no cumulonimbus present.
- there must be no significant weather.

METAR EGTK 231020Z 26012G25KT 220V300 CAVOK

TEMPERATURE AND DEW POINT

The temperature and dew point constitute the next group in the METAR code. The temperature and dew point code is simply a two-digit number giving the air temperature, with a forward slash, followed by another two-digit number which indicates the dew point. Both temperatures are measured in degrees Celsius. For example, the code 10/02 indicates that the air temperature is plus 10° C, and the dew point is plus 2° C. If either figure is negative, the prefix M will be used, as in 10/M02. The dew point in the example just given is minus 2° C.

METAR EGTK 231020Z 26012G25KT 220V300 CAVOK 10/M02 This METAR decodes as follows:

METAR for Oxford/Kidlington, observed at 1020 UTC on 23rd of the month; the surface wind is 260° (True) at 12 knots, gusting to 25 knots and varying in direction from 220° (T) to 300° (T); the visibility is 10 km or more, with no cloud below 5,000 ft; there are no cumulonimbus and there is no significant weather at, or in the vicinity of, the aerodrome; the air temperature is +10° C and the dew point is -2° C.

QNH

The next METAR code is the QNH. The QNH will be represented by the le er Q, followed by a four digit number representing the actual pressure value. If the QNH is less than 1000 millibars, the value will be preceded by a zero. For example, a QNH of 991 millibars would appear as Q0991.

METAR EGTK 231020Z 26012G25KT 220V300 9999 -RA FEW060 SCT120 10/M02 Q0991

It is important to note that the only pressure value given in a METAR is the QNH. The QNH is always rounded down for safety reasons, if there are digits after the decimal point; for instance, if the QNH were 991.7 millibars, the QNH would be reported as Q0991.

The above METAR decodes as follows:

METAR for Oxford/Kidlington observed at 1020 UTC on 23rd of the month; the surface wind is 260° (T) at 12 knots, gusting to 25 knots, and variable in direction from 220° (T) to 300° (T); the prevailing visibility is 10 km or more with light rain; there are 1 to 2 oktas of cloud at 6,000 ft and 3 to 4 oktas at 12,000 ft; the air temperature is +10° C and the dew point is -2° C; the QNH is 991 millibars.

RECENT WEATHER

If there has been recent significant weather, either in the past hour, or since the last METAR was issued, and if the significant weather has ceased, or reduced in intensity, a METAR code group beginning with RE will appear. RE stands for recent. If there has been a thunderstorm during the hour, but which has now abated, giving only light rain, the present weather is reported as light rain, –RA; the fact that there have been thunderstorms in the past hour is reported by the three le er code RETS:

METAR EGTK 231020Z 26012G25KT 220V300 9999 –RA FEW060 SCT120 10/M02 Q0991

WINDSHEAR

Although not currently issued at United Kingdom airfields, windshear information may be reported in the METAR. This will simply be denoted by the le ers WS, followed by the necessary details, such as WS ALL RWY, meaning windshear on all runways, or WS 30, meaning windshear present on Runway 30.

METAR EGTK 231020Z 26012G25KT 220V300 9999 –RA FEW060 SCT120 10/M02 Q0991 RETS WS ALL RWY

TREND, BECMG, TEMPO

A TREND forecast is valid for 2 hours after the time of the observation of the METAR, and constitutes the final section of the METAR. The change in weather conditions indicated by the code, TREND, can be further qualified by the codes, BECMG, meaning becoming, or TEMPO meaning temporarily.

BECMG indicates that the change in the present weather will be long-lasting. TEMPO, on the other hand, means that the change is temporary, and that the different conditions will prevail for periods of less than one hour, only, and no more than half the time period, in aggregate. The codes may be followed by a time period in hours and minutes. The time periods given may be preceded by FM meaning from, TL meaning until, or AT meaning at.

For example, TEMPO FM1020 TL 1220 1000 +SHRA translates as: temporarily, from 1020Z to 1220Z, the visibility will reduce to 1,000 metres, in heavy showers of rain.

If there is no expected change in the meteorological conditions being forecast by the METAR, the code NOSIG is used to indicate that no significant change is expected in the next two hours.

METAR EGTK 231020Z 26012G25KT 220V300 9999 –RA FEW060 SCT120 10/M02 Q0991 RETS WS ALL RWY NOSIG

SNOWTAM

An additional eight figure runway state code will be added after any TREND information, when there is snow or other runway contamination. This code is sometimes referred to as a SNOWTAM.

The SNOWTAM takes the form:

- runway designator.
- runway deposits.
- extent of runway contamination.
- depth of deposit.
- the braking action.

In order to decode a SNOWTAM, a pilot should consult the UK AIP, GEN 3.5.10, Meteorological Codes.

SPECIAL REPORTS

A variation on the METAR is the Special Report. A Special Report, which is denoted by the abbreviation, SPECI, has the same format as a METAR except that the code SPECI will replace METAR at the beginning of the report. A SPECI will be issued when the weather conditions significantly change in the period between routine observations. A SPECI can be issued to indicate either an improvement or a deterioration in the weather.

SPECI EGTK 231025Z 26012G25KT 220V300 2000 +RA OVC010 5/M02 Q0991 RETS WS ALL RWY NOSIG

END OF MESSAGE
An equals sign (=) appears at the end of the METAR to denote that the message is complete.

METAR EGTK 231020Z 26012G25KT 220V300 9999 –RA FEW060 SCT120 10/M02 Q0991 RETS WS ALL RWY NOSIG =

SUMMARY

Although METARs may appear confusing to the uninitiated, with practice, it is quite a simple task to decode a METAR accurately and speedily. Pilots should consult METARs for departure and destination aerodromes and also for other aerodromes along the planned route, and, in particular, for aerodromes upwind of a destination aerodrome, in order to get a picture of the weather which is approaching the destination.

If the aerodrome of destination does not issue a METAR, consult a METAR from an aerodrome in the vicinity of your destination.

TAF - TERMINAL AERODROME FORECAST

Aerodrome weather forecast (TAF) is usually issued to describe the forecast conditions at an aerodrome covering a period of 9 to 24 hours. The validity periods of many of the longer forecasts may not start for up to 8 hours after the time of origin and the forecast details only cover the last 18 hours.

The 9-hour TAF is updated and re-issued every 3 hours, and those valid for 12 and 24 hours, every 6 hours. Amendments are issued as and when necessary.

A TAF may be subdivided into two or more self-contained parts by the use of the abbreviation

"FM" (from) followed by the time UTC to the nearest hour, expressed as two figures. Many of the groups used for a METAR are also used in the TAF but differences are noted below:

VALIDITY PERIOD

- Whereas a METAR is a report of conditions at a specific time, the TAF contains the date and time of origin, followed by the start and finish times of the validity period in whole hours UTC, e.g. LHBP 130600Z (date and time of issue) 0716 (period of validity 0700 to 1600 hours UTC).

HORIZONTAL VISIBILITY

- Only the minimum visibility is forecasted, RVR is not included.

WEATHER

- If no significant weather is expected, the group is omitted. After a change group, however, if the weather ceases to be significant, the abbreviation "NSW" (no significant weather) will be inserted.

CLOUD

- When clear sky is forecasted, the cloud group will be replaced by "SKC" (sky clear). When no cumulonimbus, or clouds below 5000 feet or below the highest minimum sector altitude, whichever is the greater, are forecasted but "CAVOK" or "SKC" are not appropriate, the abbreviation "NSC" (no significant cloud) will be used.

SIGNIFICANT CHANGES

- In addition to "FM" and the time significant changes may be indicated by the abbreviation "BECMG" (becoming) or "TEMPO" (temporarily). A four-figure group indicating the beginning and ending of the period in which the change is expected to occur follows "BECMG". The change in the forecast conditions is expected to be permanent and to occur at an unspecified time within this period. A four-figure time group will similarly follow "TEMPO"; it indicates a period of temporary fluctuations in the forecasted conditions that may occur at any time during the stated period. The "TEMPO" conditions are expected to last less than one hour in each instance and, in total, less than half the period indicated

PROBABILITY

- The probability of a significant change occurring will be given as a percentage, but only 30% and 40% will be used. The abbreviation "PROB" will precede the percentage, which will be followed by a time group, or a change and time group, e.g. "PROB30 0507 0800FG BKN004", or "PROB40 TEMPO 1416 TSRA BKN010CB".

AMENDMENTS

- When a TAF requires amendment, the amended forecast will have "AMD" inserted ahead of the aerodrome identifier, and will cover the remainder of the validity period of the original forecast.

NOISE ABATEMENT DEPARTURE CLIMB PROCEDURE

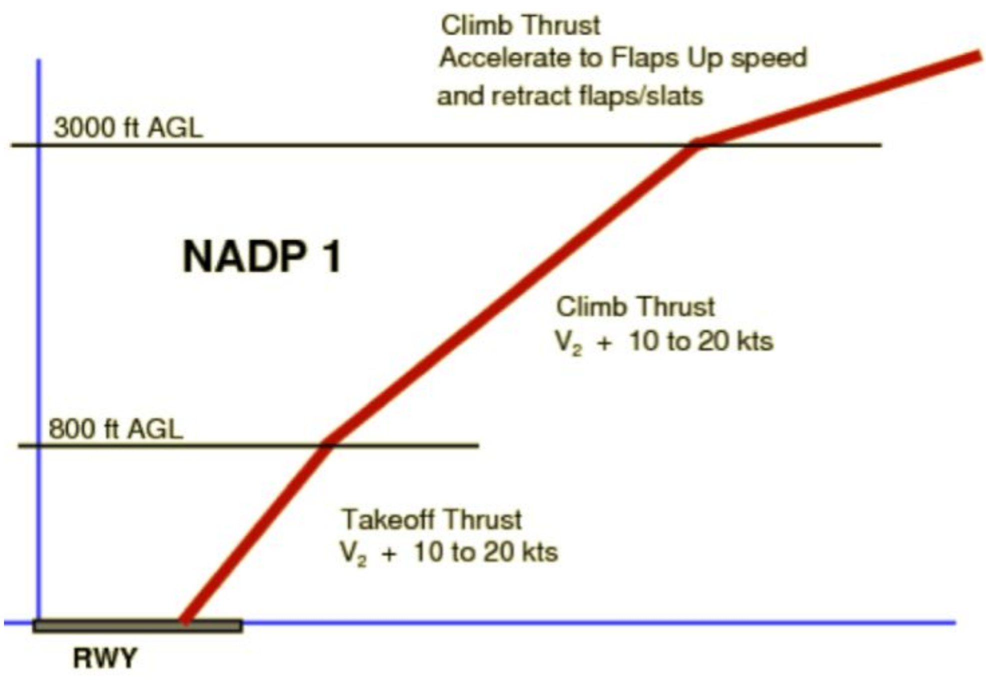
BASICS OF NADP

- Operating procedures for T/C and CLIMB must ensure that the safety has priority over noise abatement.
- These procedure must be designed to keep it simple without significant increase in workload during critical phases of flight
- The 2 main NADP procedure differ in the ACCELERATION segment for FLAP/SLAT retraction is either initiate prior to reaching the maximum predescribed height or only at the predescribed height
- To ensure optimum acceleration performance, thrust reduction may be initiated at an intermediate flap setting

NADP-1

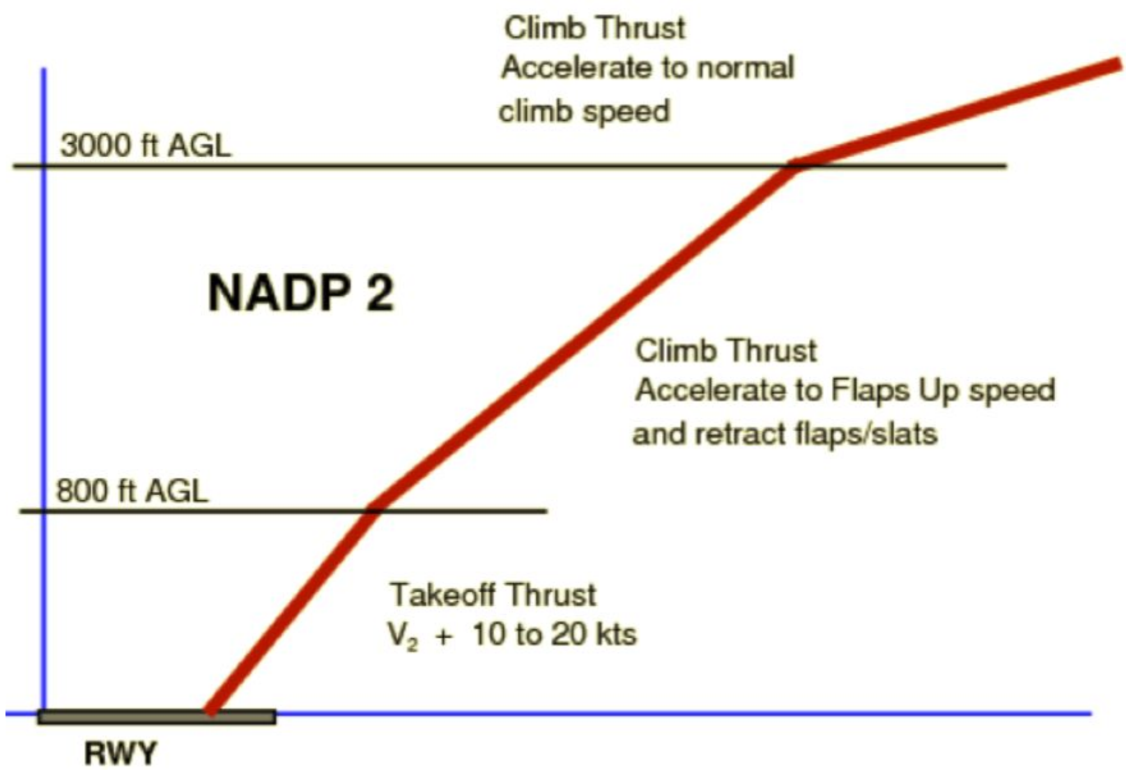
At the predescribed maximum altitude, accelerate and retract flaps/slats on schedule while maintaining a positive rate of climb, and complete the transition to normal en-route climb speed

- The NADP is not to be initiated below 800' feet above A/D elevation
- Initial climb speed to the NOISE ABATEMENT INITIATION POINT shall NOT be LESS than V2 + 10 KT
- On reaching an altitude at or above 800' feet A/D elevation, adjust and maintain engine thrust in accordance with the noise abatement schedule provided in the AOM. Configuration remain the same speed is V2 + 10-20KT
- At no more than 3000' feet while maintaining a positive rate of climb, accelerate and retract flaps/slats on schedule
- At or above 3000' feet A/D elevation, accelerate to en-route climb speed



NADP-2

- This procedure differs from NADP-1 that it involves of FLAP/SLAT retraction on reaching the minimum prescribed altitude
- The power reduction is to be performed at the first FLAP/SLAT retraction or when the zero FLAP/SLAT configuration is attained
- At the prescribed altitude, complete the transition to normal en-route climb procedures
- The noise abatement procedures is not to be initiated at less than 800 feet above aerodrome elevation
- The initial climbing speed to the noise abatement initiation point is V2+10-20 kts
- On reaching an altitude equivalent to at least 800 feet above aerodrome elevation, decrease aircraft pitch angle whilst maintaining a positive rate of climb and accelerate towards Vzf and either reduce power with the initiation of the first flap/slat retraction, or reduce power after flap/slat retraction
- Maintain a positive rate of climb, and accelerate to and maintain a climb speed of Vzf+10-20 kts to 3,000 feet above aerodrome elevation
- On reaching 3,000 feet above aerodrome elevation, transition to normal en-route climb speed



FLIGHT PROCEDURE

MINIMUM FLIGHT ALTITUDES

- Except IFR approach or Departure when on track the published minimum altitude on A/D charts, the minimum altitude must not be lower than the MSA
- If a subsequent route segment has a higher MOCA or MORA, this new altitude must be obtained before passing the checkpoint

MINIMUM OBSTACLE CLEARANCE ALTITUDES (MOCA)

Lower published altitude in effect between radio fixes on VOR airways, or route segments which meets obstacle clearance requirements for the entire route segment
The MOC value to be applied in the primary area for the en-route phase of an IFR flight is 1000’ feet
In mountainous areas it will be increased as:

Variation in terrain elevation	*MOC*
Between 900 m (3 000 ft) and 1 500 m (5 000 ft)	450 m (1 476 ft)
Greater than 1 500 m (5 000 ft)	600 m (1 969 ft)

MINIMUM OFF-ROUTE ALTITUDE (MORA)

MORA clears all terrain or man-made obstacle by 1000’ feet where highest elevation or obstacles are 5000’ feet MSL or less
A clearance of 2000’ feet is provided above 5000’ feet MSL.
The lowest MORA is 2000’ feet

ROUTE MORA

An area extended 10 NM either side of route centerline, including 10NM radius beyond radio fix or reporting point or mileage break

GRID MORA

It is an altitude computed by values are shown each grid formed by charted lines of latitude and longitude. Shown as thousands and hundreds.

ALLOWANCE OF WIND SPEEDS

When operating 20NM miles within terrain elevation more than 2000’ feet MSL MORA and MOCA values has to be increased like below.

Terrain Elevation	Wind speed in Knots			
	0 – 30	31 – 50	51 – 70	More than 70
2,000 –8,000 feet	+500 ft	+1000 ft	+1500 ft	+2000 ft
More than 8,000 feet	+1000 ft	+1500 ft	+2000 ft	+2500 ft

TEMPERATURE CORRECTION

Surface Temperature	Correction to MOCA/MORA
ISA – 16ºC to ISA – 30ºC	MOCA/MORA plus 10%
ISA – 31ºC to ISA – 50ºC	MOCA/MORA plus 20%
ISA – 51ºC or below	MOCA/MORA plus 25%

MINIMUM EN-ROUTE IFR ALTITUDE (MEA)

- Lower published altitude between radio fixes that meets obstacle clearance requirements between those fixes.
- The MEA applies the entire width of the airway.

MINIMUM SECTOR ALTITUDE (MSA)

- Depicted on the instrument approach charts that provides an 1000' feet obstacle clearance within 25NM radius from the NAV facility.
- If its radius is differ it is stated on the chart
- If divided to sectors each sectors can have different values
- Authority provide MSA values

MAXIMUM AUTHORIZED ALTITUDE

A published altitude representing the maximum usable altitude or FL for an airspace structure or route segments.

MINIMUM VECTORING ALTITUDE (MVA)

- The lowest MSL altitudes at which radar controller will provide vectors for an IFR flight except it has authorized because of radar approaches, departures, missed approaches
- Altitude meets IFR obstacle clearance requirements
- It may be lower than published MEA
- Charts depict MVA normally only for controllers

MINIMUM HOLDING ALTITUDE (MHA)

Lowest altitude predescribed for holding patterns.

MINIMUM CROSSING ALTITUDE (MCA)

Lowest altitude at certain fixes at which an A/C must cross the fix.

Navigational procedures

RNP - Required Navigational Performance

BASICS OF RNP

- RNP is a statement of navigational performance accuracy essential operations in a defined airspace
- RNP is based on a 95% factor = A/C will be within the required RNP for a period of not less than 95% of the flight time
- RNAV is the primary means of meeting RNP requirements
- RNP airspace = Airspace, ROUTE, PROCEDURE where the minimum navigational performance requirements (RNP) established
- Critical component of RNP is the ability of the navigational system to monitor its navigation performance, and to alert pilot if the operational requirement is or is not being met during the operation

FORMAT

RNP - X X = the RNP factor/designator relates to navigational accuracy of the A/C in NM

TYPICAL RNP VALUES

BASIC RNAV	=	RNP-5
TYPICAL RNP values enroute/terminal	=	RNP-5, RNP-4
RNP SID/STAR	=	RNP-1
OCEANIC, REMOTE	=	RNP-10
GNSS RNAV	=	RNP-0,3 RNP-1, RNP-5

A/C without GPS primary

- NAV perfomance depends on NAVAID updating and on the time of the last update
- Outside the NAVAID coverage, performance is determined by the IRS drift rate, it means a time limitation of RNP value

A/C with GPS primary

- If GPS primary is available = navigation exceeds all the requirements known, including RNAV approaches
- With GPS primary RAIM is required - horizontal integrity limit calculation and alert

RNAV - AREA NAVIGATION

RNAV area navigation allows A/C operates on any desired flight path within station-referenced navigational aids or within capability limits of self.contained aids, or a combination of both

LNAV	-	horizontal plane
VNAV	-	vertical plane

RNAV INPUTS

1. VOR/DME
2. ILS/MLS
3. LORAN
4. GNSS
5. INS/IRS
6. ADC
7. TIME

OCEANIC/REMOTE RNAV

- Over north atlantic - RNP-12
- Over north, central and east-pacific RNP-10

B-RNAV - BASIC RNAV

- RNP-5
- All A/C carrying 30pax or more required to have B-RNAV

P-RNAV - PRECISION RNAV

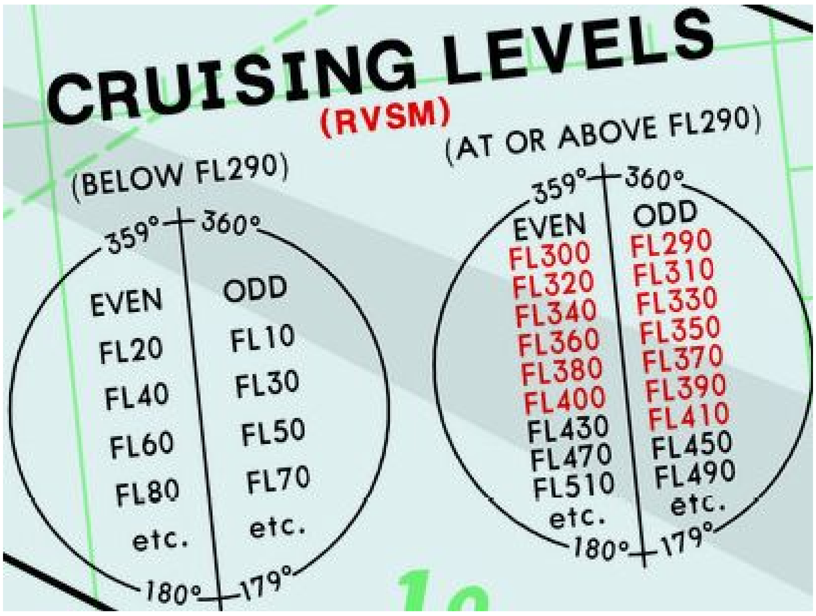
- RNP-1
- Provides operation such as departures, arrivals, approaches up to FAWP
- Specific operator approval is required for use P-RNAV
- RAIM required where GNSS is used as primary source

RAIM - RECEIVER AUTONOMOUS INTEGRITY MONITORING

- RAIM is Receiver Autonomous Integrity Monitoring for aviation GPS applications.
- In order for a GPS receiver to perform a RAIM or Fault Detection function, a minimum of 5 satellites with satisfactory geometry must be visible to the GPS receiver.
- Some equipment may have an enhanced RAIM capability called Fault Detection and Exclusion (FDE). This uses a minimum of 6 satellites to detect a faulty satellite and exclude it from the navigational calculations, thereby enabling the continuation of accurate navigational calculations, and consequently aircraft navigation to continue without interruption.
- Preflight predictions ensure that sufficient satellites will be in view during the approach to enable GPS receiver equipment to perform RAIM and FDE.

RVSM - REDUCED VERTICAL SEPARATION MINIMA

- In order to make more FLIGHT LEVELS in the cruise available, a system has been adopted wich prohibits VFR flights at a certain altitudes.
- The separation for IFR levels between FL290 - FL410 (inclusive) is reduced from 2000’ feet to 1000’ feet.
- Above FL410 the altimeters errors are considered too great to continue the 1000’ feet separation
- RVSM airspace needs a special qualification
- For flying in RVSM airspace **significant weather charts** must be on board
- Changing flight levels shall always be done with AFCS
- During climb or descent overshoot or undershoot maximum 150’ feet



REQUIRED EQUIPMENT BEFORE ENTERING RVSM

- 2 primary altimeter systems agree within 200' feet
- 1 automatic altitude controlling system
- 1 altitude alerting system
- SSR transponder with altitude reporting capability that can be connected to the altitude measurement system in use for maintaining altitude

CONTINGENCY PROCEDURE WHEN UNABLE TO MAINTAIN RVSM

- Notify ATC of any equipment failure and weather hazards, which may affect the capability to maintain the cleared level or the RVSM requirements. In this case ATC is required to establish either an appropriate horizontal separation minimum, or an increased vertical separation min. Of 200' feet
- ATS can suspend RVSM due to MET conditions (turbulence)
- When ATC notify a deviation from assigned altitude by more than 300' feet, immediate action is required by the pilot to establish the original assigned altitude

GPWS - GROUND PROXIMITY WARNING SYSTEM

- GPWS is intended to provide warning of unintentional closure with the ground where the crew must take an immediate action
- It can generate ALERT (caution) and WARNING (command)
- When warning is received immediate action is to disconnect A/P, level wings, and initiate a max gradient climb to MSA

TYPES OF ALERT AND WARNINGS

1. Genuine: Warning IN ACCORDANCE its technical specification
2. Nuissance: Same as genuine however pilot is flying an accepted safe procedure
3. False: Warning that is NOT IN ACCORDANCE its technical specification

MODES

Mode 1	-	Excessive barometric descent rate
Mode 2	-	Excessive terrain closure rate
Mode 3	-	Altitude loss after T/O or G/A
Mode 4A	-	Unsafe terrain clearance with landing gear not down
Mode 4B	-	Unsafe terrain clearance with flaps not in landing configuration
Mode 5	-	Below glide slope deviation alert
Mode 6A	-	Below selected minimum radio altitude
Mode 6A	-	Altitude call-outs and bank angle alert
Mode 7	-	Windshear alerting

EGPWS - ENHANCED GROUND PROXIMITY WARNING SYSTEM

- GPWS suffers from limitations because the radar cannot see front of the A/C
- EGPWS is a more enhanced system with a terrain threat display
- Combines accurate location of A/C, its course and height (ADC/GPS) with a 3D electronic map of the world with terrain elevation information
- Terrain threat warning will be initiated in sufficient time to comfortably avoid any threat, (color codes and audible warning as well - whoop whoop pull-up)

TCAS

- TCAS or in ICAO ACAS is to provide A/C proximity alert for crew
- ACAS II. is required by EUROCONTROL
- It provides collision avoidance maneuver advice in vertical plane
- Based on SSR transponder signals, interrogating MODE C and MODE S transponders of nearby A/Cs. (intruders)
- Non-transponding A/C will be invisible
- ACAS II works independently from A/C navigation system
- ACAS/TCAS version now is 7.0 and 7.1

TYPE OF WARNINGS

TA	- TRAFFIC ADVISORY	-	approximate position of intruder which may become a threat
RA	- RESOLUTION ADVISORY	-	recommends a maneuver or a restriction of a maneuver in vertical plane to resolve conflict with a SSR MODE C A/C

OPERATING POLICY

- TCAS shall be operated in TA/RA mode
- RA alerts are inhibited below certain radio altitudes to avoid nuisance warnings
- TCAS advisory shall be immediately be responded
- PF must ensure immediate action has been made
- Corrective action must:
    - Not be opposite as indicated by the RA
    - Follow RA even if it is in conflict with ATC
- For TA immediate maneuver is not required
- After solving the conflict as required by the RA and A/C deviates from ATC, pilot must return back to the cleared/assigned level and notify ATC asap

ACAS/TCAS TYPES

1. ACAS I ONLY TA
2. ACAS II TA/RA (only vertical)
3. ACAS III TA/RA (vertical and horizontal)

WEATHER HAZARDS

THUNDERSTORMS

- The following procedures are recommended by Wizzair OM when the pilots find themselves committed to fly through an area of thunderstorm activity

APPROACHING TO THE THUNDERSTORM AREA

- Ensure that all persons on board have their safety belts fastened and loose items are secured
- One pilot should control the airplane and the other one monitor the instruments
- Select an altitude for penetration whilst maintaining terrain clearance
- Consider the operation of all de icing equipment
- Disregard any radio navigation indications subject to static interference
- Turn the cockpit lighting gully on and lower the crew seats and sun visors to minimize the blinding effect of lightning flashes
- All pressurized airplanes must be equipped with weather radar
- Monitor the weather radar to select the safest track

WITHIN THE THUNDERSTORM AREA

- The autopilot should be engaged
- Autothrust should be used unless thrust variations are excessive
- If auto flight is not possible, control the plane maintaining a constant pitch attitude appropriate for the current phase of flight, by reference to the attitude indicators
- Avoid harsh or excessive control movements
- Attempt to maintain the original heading
- Do not correct for altitude gained or lost through up and down draughts unless absolutely necessary
- Never climb in an attempt to get over the top of the storm
- Do not take off if a thunderstorm is overhead or approaching
- At destination, hold if a thunderstorm is overhead or approaching, divert if necessary
- Avoid severe thunderstorms even at the cost of diversion
- If storm clouds have to be over flown, always maintain at least 5000 feet vertical separation from cloud tops
- If the weather radar is inoperative, avoid by 10 miles any storm that by visual inspection is tall, growing rapidly or has an anvil top
- Monitor long ranges on radar to avoid getting into a blind alley of TS
- Avoid flying under a CB

ICING CONDITIONS

- Means an atmospheric environment that may cause ice to form on the aircraft or in the engines
- Expected when the OAT (on ground and for takeoff), or when the TAT (in flight) is at or below 10°C, and there is visible moisture in the air or standing water, slush, ice or snow is present on the taxiways or runways
- Effects of icing include: Aerodynamic effects, weight alteration, instrument errors, windscreen obscuration, aerial icing and built up ice breaking away damaging engines

ICAO CLEAN A/C CONCEPT

- During icing conditions the commander shall not takeoff unless the external surfaces are clear of ice that would affect the performance
- The commander shall not fly the plane if icing is expected and the airplane is not certified for flight where icing is expected

TYPES OF ICE

CLEAR ICE

- Crystal clear and solid layer on the top of critical surfaces, can be only checked by hands-on, tactile check
- Formed by slow freezing of large supercooled droplets
- As a result of rain or high humidity on cold soaked wings may even occur at ambient temperatures of 15°C
- Clear ice may be hidden under a layer of snow or slush

BLADE ICE

- Can form on the back side of fan blades when the engine rotates overnight in a humid air, at temperatures close to or below 0°C
- It can be detected only by tactile check

RIME ICE

- It is a rough deposit of ice formed by instantaneous freezing of small supercooled water droplets

FROST

- Forms by the process of sublimation when the temperature of a collecting surface and the dew point are both below freezing
- The water vapor changes directly to ice in the form of frost
- White, crystalline coating

DE-ICING

- It is a method by which ice, slush or snow is physically removed from the airplane by means of spraying the airplane with de-icing fluid

ANTI ICING

- It is a precautionary method to produce protection against the formation of ice, slush and snow for a limited period by applying a layer of anti-icing fluid on the airplane critical surfaces, which is assumed to flow off during takeoff

De-icing and anti-icing can be either a one-step or a two-step procedure:

1. One-step procedure:

- De-icing and anti-icing are carried out at the same time using a combined de-icing and anti-icing fluid to both remove frozen deposits and to protect the de-iced surfaces for a limited period of time

2. Two-step procedure

- Involves a process of ice removal followed by a process of anti-icing.
- The first step is carried out with just hot water or a hot mixture of water and anti-icing fluid.
- Anti icing is carried out in the second step with a hot or cold anti-icing fluid, undiluted or diluted with water, to give protection against freezing or refreezing.
- This second step must be performed within 3 minutes after the start of the first step, and if needed area by area.
- Concentration of the anti icing fluid mixture for the second step is based upon OAT and weather conditions to provide the desired holdover time

The fluids used in both processes have holdover times quoted against the nature of the ice to be removed and protected against and the range of ambient temperatures. After the expiry of the holdover time, the process is to be repeated if required.

PREVENTIVE ANTI ICING

- It can be carried out as a precautionary measure well in advance of a flight (during overnight stop) to prevent frost, ice, snow or slush to form on the protected surfaces

FLUID TYPES

- The ISO anti-icing code has been developed to represent the quality of the treatment the aircraft has received
- The commander can use this code in correlation with the holdover time tables to evaluate the amount of protecting he has got against re- freezing

- Only the following three fluid types are approved for Wizzair operations, also these are the main ones currently available and in use:

  ISO type 1

  These fluids provide a very limited protection against re-freezing during precipitation conditions. The concentration of this fluid is not related to the holdover time. Due to their properties Type 1 fluids form a thin liquid wetting film that provides a limited holdover times especially in conditions of freezing precipitation. With this type of fluid increasing the concentration of the fluid in the fluid/water mix would not provide additional holdover time

  ISO type 2 & 4:

  These fluids provide an extensive protection against re-freezing during precipitation conditions. They contain a pseudo-plastic thickening agent that enables the fluid to form a thicker liquid wetting film on external aircraft surfaces. This film provides a longer holdover times especially in conditions of freezing precipitation. With this type of fluid additional holdover time will be provided by increasing the concentration of the fluid in the fluid/water mix, with maximum holdover time available from undiluted fluid.

HOLDOVER TIME

- The holdover time is the estimated time an anti-icing fluid will prevent frost, ice snow or slush to form on the protected surfaces under average weather conditions mentioned in the holdover time tables
- The time of protection will be shortened in heavy weather conditions
- High wind velocities or jet blast may reduce holdover time below the lower time stated in the range
- Holdover times may also be reduced when the airplane`s skin temperature is lower than OAT
- Anti-icing fluids remaining on the surfaces ensure ice protection
- With a one-step operation the holdover time begins at the start of the operation and with a 2 step operation at the start of the final (anti-icing) step
- Just before takeoff the Commander shall make sure that the holdover time has not run out. If so, the aircraft has to be de-iced/anti-iced again.
- Under no circumstances can an airplane, that has been anti-iced, receive another coat of Type 2 or 4 fluid on top of the existing film. If the holdover time is exceeded, surfaces must first be de-iced with a mixture of hot water and de-icing fluid, before another application of Type 3 or 4 fluid is made.

Wizzair specific information on icing conditions:

- Wizz Air aircraft are certified for known-icing conditions
- However it is not certified for takeoff or flight when carrying ice deposits resulting from ground operations or storage
- Thin hoarfrost is acceptable on the upper surface of the fuselage (Wizz OM)
- On the underside of the wing tank area, a maximum layer of 3 mm of frost will not penalize takeoff performance (Wizz OM)

Turbulence

- If the weather conditions, cloud structure and route forecast indicate that turbulence is likely, the cabin crew should be pre-warned, and the pax advised to return to their seats and to ensure that their seatbelts are securely fastened
- Avoid areas with known or forecasted severe turbulence
- If it is not avoidable, aim to keep the speed in the region of the target speed given in the AFM (protection against gust effects on structural limits). Also, consider requesting a lower flight level to increase margin to buffet onset. Sufficient buffet margin exists at optimum altitude
- There are 3 levels of turbulence: light, moderate and severe

WINDSHEAR

- Pilots must remain alert to the possibility of windshear and be prepared to react
- IF windshear is suspected before takeoff, delay until conditions improve
- Select the most favorable runway for takeoff, considering location of the likely windshear
- Use the weather radar or the predictive windshear system before takeoff
- Monitor closely airspeed and its trend during takeoff run for early signs of windshear
- If windshear is likely during approach, delay the landing or divert
- Use the weather radar for approach and select the most favorable runway
- Whenever windshear is encountered, it shall be reported to ATC as soon as possible

JET STREAMS

- Avoid flying along the edge of jet streams due to the possibility of associate turbulence
- Pilots shall be aware of the effect of increased fuel consumption due to unexpected significant head wind components that can be experienced
- It may be possible to avoid jet streams by changing route and altitude

RAIN SNOW AND OTHER PRECIPITATION

- Slower taxi speeds are required to allow for the reduction in braking performance in snow, slush or standing water
- At the same time higher thrust may be required to overcome the drag caused by such contaminants, and great care shall be taken to avoid jet blast from blowing unsecured ground equipment or contaminants into nearby aircraft
- Take care of banks of cleared snow, and delay flap selection to avoid damage to flap surfaces or the accumulation of slush on their mechanisms
- On the runway, directional control may be adversely affected by surface contamination
- Takeoff distance is increased due to slower acceleration
- ASD is increased for the same reason
- Landing distance will be increased because of poor braking action and aquaplaning
- Observe crosswind limitations when landing on a contaminated runway
- Use anti-skid braking systems to the maximum degree
- Heavy precipitation can be associated with windshear
- Takeoff is prohibited in the following conditions: Heavy snow (+SN),
- Heavy snow pellets (+GS), Heavy snow grains (+SG), Heavy ice pellets (+PL), Moderate/heavy freezing rain (FZRA, +FZRA), Moderate/heavy hail (GR, +GR)

DUST STORMS AND SAND STORMS

- Avoid flying in active dust storms or sandstorms whenever possible
- When on the ground, airplanes should be kept under cover if dust or sand storms are forecasted or in progress

VOLCANIC ASH

- Volcanic activity can be hazardous to airplanes (extreme abrasion, visibility, airfoil and control surface damage, pitot-static system impaired and engine failures)
- The NOTAM system details known areas of volcanic activity where ash may be present in the atmosphere
- Always avoid, especially at night or at daytime IMC when ash clouds may not be seen
- Weather radar will not pick up any ash return

MOUNTAIN WAVES

- These form on the lee of a range of mountains when a strong wind is blowing broadside on to the range
- They are usually in the form of standing waves, with several miles between peaks and troughs
- They can extend to 10,000 to 20,000 feet above the mountain range and for up to 200-300 miles downwind
- IT can be recognized by long term variations in speed and pitch attitude in level cruise, variations may be large
- Keep in mind that at cruise heights the margin between low and high speed limits can be very small
- The effect of mountain waves reduces with increased height
- However, near the ground in a mountain wave area severe turbulence and windshear may be encountered, this region is known as a lee wave rotor and is caused by flow separation behind the mountain range -> Takeoff or landing is not advisable in this rotor.
- If severe turbulence is encountered at low level in the lee of a mountain range, the quickest way out is UP. If unable to climb, the next best option is directly away from the range

SIGNIFICANT TEMPERATURE INVERSIONS

- All ambient temperature variations have an effect on airplane performance
- Inversions will affect performance adversely
- Large temperature inversions encountered shortly after takeoff can seriously degrade an airplanes climb performance, particularly at high operating mass. Also, if the airplane is operating to a maximum landing mass limited by go-around climb performance considerations, the required gradient may not be achieved
- The maximum cruising altitude capability of the plane can be significantly reduced if a temperature inversion of even a small magnitude exists at upper levels. This may prevent an airplane reaching its preferred cruising altitude. In this situation, the plane`s buffer margins may be so eroded that a descent is necessary
- Temperature inversions at lower level in the atmosphere are associated with deteriorating visibility and prevent the clearing of fog for long periods

WAKE TURBULENCE CATEGORIES (MASS CAT, SEPARATION)

MASS CATEGORIES FOR WAKE SEPARATION

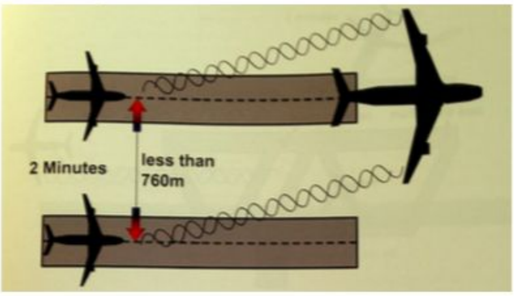
Mass categories for wake vortex separations		
Category	**ICAO and Flight Plan**	**UK**
Heavy	MTOM ≥ 136000 kg	MTOM ≥ 136000 kg
Medium	7000 kg < MTOM < 136000 kg	40000 kg < MTOM < 136000 kg
Small	NA	7000 kg < MTOM ≤ 40000 kg
Light	MTOM ≤ 7000 kg	MTOM ≤ 7000 kg

SEPARATION ON ARRIVAL

Leading Aircraft	Minimum Distance (NM)
A380	7
Heavy	5
Medium (see Note)	3

Note: *Where the leading medium aircraft is a B757 the minimum distance shall be increased to 4 NM.*

SEPARATION ON DEPARTURE



Departing from an intermediate point on the same runway or from an intermediate point of a parallel runway separated by less than 760m	
Leading Aircraft	**Minimum time**
A380	4 minutes
Heavy	3 minutes
Medium	Note below

Note: *Separation for wake turbulence reasons alone is not necessary.*

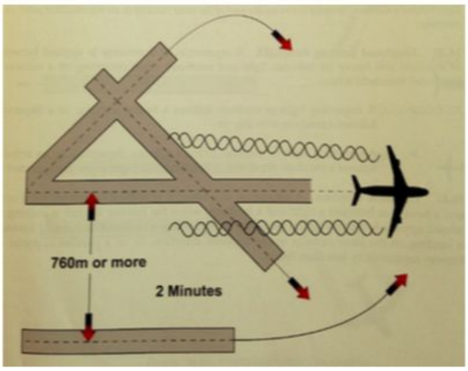
Minimum wake separation at the time aeroplanes are airborne:

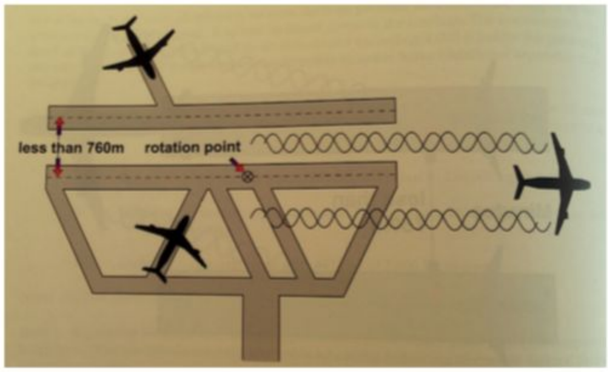
Departing from same position or from parallel runway separated by less than 760m	
Leading Aircraft	**Minimum time**
A380	3 minutes
Heavy	2 minutes
Medium	Note below

OPERATING ON RW WITHH DISPLACED RW THRESHOLD

Operating on a runway with a displaced landing threshold if the projected flight paths are expected to cross				
Leading Aircraft		**Following Aircraft**		**Minimum spacing at time aircraft are airborne or have touched down**
Heavy	Arrival	Medium	Departure	2 minutes
Heavy	Departure	Medium	Arrival	2 minutes

OPERATING ON CROSSING OR DIVERGING RWs GREATER THAN 760M APART





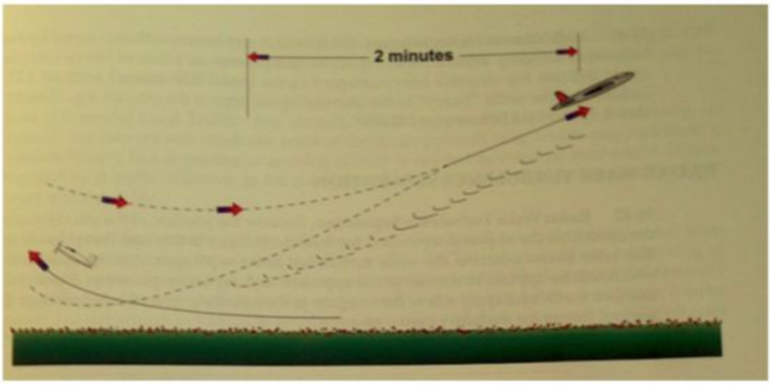
Operating on crossing and diverging runways or on parallel runways greater than 760 metres apart			
Leading Aircraft	**Aircraft crossing behind**	**Minimum distance**	**Time equivalent**
Heavy	Heavy	4 NM	2 minutes
	Medium	5 NM	3 minutes
	Small	6 NM	3 minutes
	Light	8 NM	4 minutes
Medium	Medium	3 NM	2 minutes
	Small	4 NM	2 minutes
	Light	6 NM	3 minutes
Small	Medium or small	3 NM	2 minutes
	Light	4 NM	2 minutes

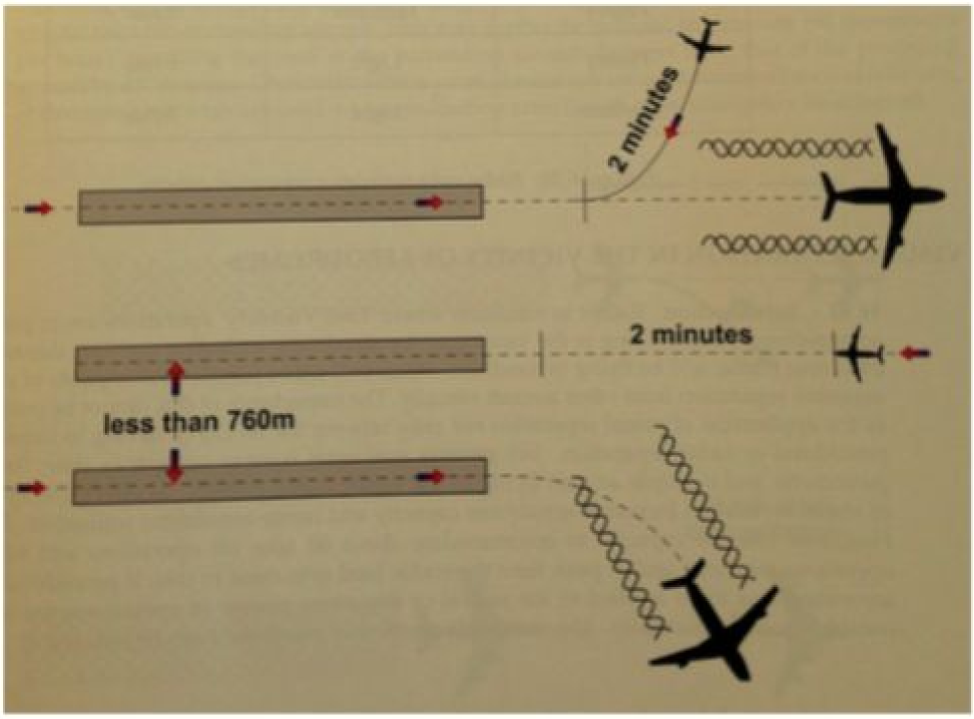
Note: *The spacing above shall be applied whenever the projected flight paths of the aircraft cross.*

OPPOSITE DIRECTIONS RWS OPERATION

A minimum of two minutes shall be applied between a light, small or medium aircraft and a heavy aircraft, and between a light aircraft and a small or medium aircraft when the heavier aircraft is making a low or missed approach and the lighter aircraft is:

- Utilizing an opposite direction runway for take-off, or
- Landing on the same runway in the opposite direction, or
- Landing on a parallel opposite direction runway separated by less than 760 meters.





MINIMUM EQUIPMENT LIST - MEL

MEL MEANS MINIMUM EQUIPMENT LIST

- Based on the original Aviation Regulations, all the equipment installed in the aircraft must be operative at all times, or the aircraft looses its airworthiness until the item is repaired. This rule often created hard situation to operators, because all the aircrafts instruments and equipment, regardless of whether they were essential or not to the flight operation, had to be operative. This is why FAA modified the rules, and as a major improvement, created the MEL concept, a solution for operators to continue aircraft operation with certain inoperative instruments and equipment under some specific conditions. The MEL is a precise listing of instruments and equipment that can be inoperative under specific conditions and procedures, and the aircraft can continue safe operation, and remain airworthy.

- It does NOT contain items that are obviously required, such as wings, flaps, propeller, etc. Also, it never includes the following instruments and equipment:

    - Instruments and equipment that are either specifically or otherwise required by the airworthiness requirements under which the aircraft is type certificated and which are essential for safe operations under all operating conditions
    - Instruments and equipment required by an airworthiness directive (AD) to be in operable condition unless the airworthiness directive provides otherwise
    - Instruments and equipment required for specific operations by the applicable part (91, 135, 121)

- ANY instrument and equipment that is NOT included in the MEL, MUST be operative at all times, regardless of the actual operation conducted. (Unless that specific equipment or instrument is NEWLY installed and not required by any airworthiness rule, AD or FAR such as extra navigational equipment, passenger convenience system, etc. However in this situation, the inoperative instrument or equipment still must be disabled and placarded!)

- When an operator adds a new instrument or equipment to an aircraft, the operator must notify the FSDO (Flight Standard District Office, FAA office, it can be any equivalent office in other countries) having oversight within 10 calendar-days following the change. The FSDO forwards the request to the FOEB (Flight Operations Evaluation Board), and they decide whether the new item could be added to the MMEL or not. If they approve, then the operator will receive an updated MMEL and LOA containing the new information.

TIME LIMITATIONS

CATEGORY A

- Items in this category shall be repaired within the time interval specified in column 6 (Remarks and Exceptions). Whenever the proviso in column 6 of the MEL states cycles or flight time, the time interval begins with the next flight after the discovery. When the interval is listed as flight days, the time interval starts on the flight day after the day of discovery.

CATEGORY B

- Items in this category shall be repaired within three (3) consecutive calendar days (72 hours), excluding the day the malfunction was recorded in the Aircraft Operations Record/Logbook. For example, if it were recorded at 10 a.m. on January 26th, the three-day interval would begin at midnight the 26th and end at midnight the 29th.

CATEGORY C

- Items in this category shall be repaired within ten (10) consecutive calendar days (240 hours), excluding the day the malfunction was recorded in the Aircraft Operations Record/Logbook. For example, if it were recorded at 10 a.m. on January 26th, the 10-day interval would begin at midnight the 26th and end at midnight February 5th.

CATEGORY D

- Items in this category shall be repaired within one hundred and twenty (120) consecutive calendar days (2880 hours), excluding the day the malfunction was recorded in the Aircraft Operations Record/Logbook.

CONFIGURATION DEVIATION LIST (CDL)

- Similarly to the MEL, the CDL lists the airplane panels and doors that may be missing for a particular operation and graphically indicates areas of damage to the airplane skin/structure that is considered acceptable for flight

FAILURE MANAGEMENT

RADIO COMMUNICATION FAILURE

As soon as it possible ATC shall maintain separation between the A/C having com failure end other A/C on the assumption that the A/C operate under IMC or VFR.

VRF COM FAILURE ON A CONTROLLED A/C

1. Set transponder code 7600
2. Continue fly in VMC
3. Land at the nearest suitable A/D
4. Report its arrival time by the most expeditious means to the appropriate ATS unit

IFR COM FAILURE ON A CONTROLLED A/C

- Set transponder code 7600
- Maintain for a period of 7 minutes the last assigned speed and level OR the minimum flight altitude, if the minimum flight altitude is higher than the assigned flight level
    - The period of 7 minutes starts:
        - If operating on route without compulsory reporting points or instructions have been received to omit position report:
            - At the time when reaching the previously assign level or
            - When the 7600 transponder code has been set
            - …. whichever is later
        - If operating on a route with compulsory reporting points and NO instructions have been received to omit position report:
            - At the time when reaching the previously assign level, OR
            - At the previously reported pilot estimate for the compulsory reporting point, OR
            - At the time of the failed position report
            - Whichever is later
- After adjust level and speed in accordance with the filed flight plan
- If being radar vectored or proceeding offset according to RNAV without specified limit rejoin the current flight plan route asap, but no later than the next significant point
- Proceed according to the flight plan route to the appropriate navigation aid serving the destination A/D and HOLD OVER before start descent
- Commence descent from the navigational aid above at or as close the expected approach time last received, OR at or as close as possible to, the estimated arrival time used in the current flight plan

- Complete a normal instrument approach procedure as specified for the navigational aid
- Land if possible within 30 minutes after the estimated time of arrival specified above or at the last acknowledged expected approach time whichever is later

EMERGENCY DESCENT PROCEDURE

ACTION BY PILOT-IN-COMMAND

When an aircraft experience sudden decompression or similar malfunction requiring an emergency descent, the A/C shall if able:

- Initiate a turn away from the assigned route back or track before commencing the emergency descent
- Advise ATC ASAP
- SET 7700 and SET EMR mode ADS/CPDLC
- Turn on exterior lights
- Watch for conflicting traffic both visually and by reference of TCAS/ACAS
- Coordinate its further intention with ATC

The A/C shall not descend below the lowest published minimum altitude which will provide a minimum of vertical clearance of 1000' feet or in mountainous area 2000' feet above.

ABANDONING T/O

- To V1 we can abandon take off
- After V1 we take the problem into the air
- Climb above MSA and take the appropriate actions

ONE ENGINE INOPERATIVE PROCEDURE

DETECTING DEAD ENGINE DA 42

- One engine inoperative means an asymmetric loss of thrust, resulting in uncommanded yaw and roll in direction of the so- called "dead" engine (with coordinated controls). To handle this situation it is vital to maintain directional control by mainly rudder and additional aileron input. The following mnemonic can help to identify the failed engine:
- "Dead foot - dead engine"
- This means that, once directional control is re-established, the pilot can feel the control force on the foot pushing the rudder-pedal on the side of the operative engine, while the foot on the side of the failed engine feels no force. Further, the engine instruments can help to analyze the situation.
- Control over the flight attitude has priority over attempts to solve the current problem ("first fly the aircraft").

- With respect to handling and performance, the left-hand engine (pilots view) is considered the "critical" engine for DA 42
- Depending on the situation the following attempts can be made to restore engine power prior to securing the engine:
-
- Once the engine has been shut down for longer than 30 seconds, it can only be restarted below 8000 ft (TAE 125-02-99 engine) or 6000 ft (TAE 125-01 engine) pressure altitude.
- In case of low fuel quantity in the affected engine*s fuel tank you may feed it from the other engine*s fuel tank by setting the affected engine*s fuel selector to CROSSFEED.

CHECKLIST for ENGINE FAILURE:

1. POWER lever	IDLE
2. If in icing conditions	alternate air ON
3. Fuel quantity	check
4. Fuel selector	check ON / CROSSFEED if required
5. ECU SWAP	ECU B
6. Circuit breakers	check / reset if necessary

GEAR FAILURE DIAMOND DA 42

CHECKLIST for GEAR DOWN FAILURE:

1. After setting GREEN DOWN no 3 green indication for 1-2 times
2. Check gear indicator lights
3. Check ELECT.MASTER ON
4. Check Bus voltage in normal range
5. Check Circuit breaker in / reset if necessary
6. SELECT DOWN the Gear selector
7. PULL OUT the Manual gear extension handle
8. Check Gear indicator lights for 3 green lights

- The landing gear should now extend by gravity and relief of hydraulic pressure from the system. If one or more landing gear indicator lights do not indicate the gear down & locked after completion of the manual extension procedure steps 1 - 6 reduce airspeed below 110 KIAS and apply moderate yawing and pitching to bring the landing gear into the locked position.
- If the landing gear is correctly extended and locked, as indicated by the 3 green lights, the red light is illuminated additionally if the GEAR circuit breaker is pulled.

PIPER SENECA 220T OEI PROCEDURE

3.3 EMERGENCY PROCEDURES CHECKLIST

AIRSPEEDS FOR SAFE OPERATIONS

One engine inoperative air minimum control ....66 KIAS
One engine inoperative best rate of climb ....92 KIAS
One engine inoperative best angle of climb..78 KIAS
Maneuvering ....136 KIAS
Never exceed...205 KIAS

ENGINE INOPERATIVE PROCEDURES

NOTE

The power on the operating engine should be reduced when safe to do so.

DETECTING DEAD ENGINE

Loss of thrust.
Nose of aircraft will yaw in direction of dead engine (with coordinated controls).

ENGINE SECURING PROCEDURE (FEATHERING PROCEDURE)

Minimum control speed ....66 KIAS
One engine inoperative best rate of climb ....92 KIAS
Maintain direction and airspeed above 85 KIAS.
Mixture controls ....forward
Propeller controls...forward
Throttle controls ....(40 in. Hg. Max.) forward
Flaps...retract
Gear..retract
Identify inoperative engine.
Throttle of inop. engine..retard to verify

To attempt to restore power prior to feathering:

Mixtures ....as required
Fuel selector ....ON
Magnetos ....left or right only
Aux. fuel pump ....unlatch, ON HI, if power is not immediately restored - OFF
Alternate air...ON

If power cannot be restored continue with feathering procedure.
Prop control of inop. engine ....feather before RPM drops below 800
Mixture of inop. engine ....idle cut-off
Trim ....as required (3° to 5° of bank toward operative engine - ball 1/2 to 1 out)
Aux. fuel pump of inop. engine ....OFF
Magnetos of inop. engine ....OFF
Cowl flaps ....close on inop. engine, as required on operative engine
Alternator of inop. engine..OFF
Electrical load..reduce
Fuel selector ....OFF inop. engine, consider crossfeed
Aux. fuel pump operative engine...OFF
Power of operative engine ....as required

OXYGEN SUPPLY

- Oxygen requirements for A/C which are intended to fly overs 25.000' feet and which are designed to maintain cabin pressure altitudes below 10.000' feet.
- PAX shall be provided automatically deployable oxygen equipment
- Total number of dispensing unit must exceed with 10% extra of SEATS
- There could be on board a portable undiluted O2 for PAX to handle physiological reasons.

Supply for	Duration and cabin altitude
All occupants of flight deck seats on flight deck duty	Entire flight time when the cabin pressure altitude exceeds 13,000 ft and entire flight time when the cabin pressure altitude exceeds 10,000 ft but does not exceed 13,000 ft after the first 30 minutes at those altitudes, but in no case less than: *- 30 minutes for airplanes certificated to fly at altitudes not exceeding 25,000 ft (Note 2)* *- 2 hours for airplanes certificated to fly at altitudes more than 25,000 ft (Note 3)*
All required cabin crew members	Entire flight time when cabin pressure altitude exceeds 13 000 ft but not less than 30 minutes *(Note 2)*, and entire flight time when cabin pressure altitude is greater than 10 000 ft but does not exceed 13 000 ft after the first 30 minutes at these altitudes
100 % of passengers (Note 5)	Entire flight time when the cabin pressure altitude exceeds 15 000 ft but in no case less then 10 minutes *(Note 4)*
30 % of passengers (Note 5)	Entire flight time when the cabin pressure altitude exceeds 14 000 ft but does not exceed 15 000 ft
10 % of passengers (Note 5)	Entire flight time when the cabin pressure altitude exceeds 10 000 ft but does not exceed 14 000 ft after the first 30 minutes at these altitudes

Quick donning mask

- Pressurized A/C operating above 25.000' feet oxygen masks for fight crew members shall be QUICK DONNING type of mask.

Protective breathing Equipment - PBE

- Each member of flight crew and cabin crew shall have a PROTECTIVE BREATHING EQUIPMENT (PBE) to protect eyes, nose and mouth. It has to provide O2 for 15 minutes.
- In certain circumstances for cabin crew PBE must be portable.

DECISION MAKING - ASPECT OF CRM

BASICS of CRM

- Crewmembers are to remember that good CRM may be impaired when deliberately using a language unknown to one or more crewmembers.
- A non-punitive working culture and encourages individual crew members to forward details of any safety, security, behavioral (CRM) and flight irregularities to Flight Operations in order to keep flight standards high.
- However, in the interests of good CRM, it is important that all crewmembers feel able to communicate freely where necessary. It is particularly important that those cabin crew members working at the rear of the aircraft feel free to call the flight deck directly using the interphone system when necessary.
- Abnormal and emergency procedures frequently require a high degree of CRM. It is recognized that it may not always be possible to follow the task sharing philosophies used during normal operations. However, the crew should adhere as closely as possible to normal procedures.
- The workload on the PM can be demanding and a high degree of CRM is required. Work as a team.

DODAR CONCEPT:

D (DIAGNOSIS),
O (OPTIONS),
D (DECISION),
A (ASSIGN or ALLOCATE [DUTIES]),
R (REVIEW).

• Include all relevant crewmembers in the process.
• Follow a structured scheme as suggested below which will assist the process and should result in logical decisions:

▪ DIAGNOSIS

Keep the process as simple as possible (using the KISS principle). TIME – FUEL. Always begin the decision process with a careful review of the fuel status. The exception is if an immediate landing is required due to smoke, fire or any other high level emergency. The fuel review should consider **quantity, balance and consumption**. Remember that a wing tank that is leaking fuel should normally be considered as unusable. If the emergency or abnormal situation is not time critical (such as smoke or fire) time will be dictated by usable fuel. Obviously a fuel leak may quickly lead to a time critical situation.

▪ OPTIONS

Look for obvious and simple solutions. Assess the time and fuel available. Collect information on suitable airport/runway combinations according to time and fuel and ensure a safe landing can be made (including the 15% company margin) when time or fuel is not limiting. Evaluate the time required for landing (for the subsequent NITS briefing to the SCA and for the ATC update).

▪ DECISION

Keep the process as simple as possible. Use good CRM and arrive at a logical decision. Do not procrastinate. While crew inputs are important (according to good CRM practice) in order to arrive at a timely and suitable outcome, the final decision always remains with the Commander.

▪ ASSIGN TASKS/COMMUNICATE

Once the decision is made by the Commander, he should allocate tasks according to the situation. Task allocation in the cockpit should be done according to:

- The workload with regard to the experience of the co-pilot.

Once, the allocation of tasks is made the Commander should immediately give the NITS briefing to the SCA. This allows both the cabin and cockpit to be prepared simultaneously. A passenger PA should be made at an appropriate time, generally during a lower workload period.

NEXT STEPS:

- Monitor the situation. If new factors appear, make sure the plan is still able to reach the objective. Stay organized.
- Remember there may the deferred checklist items requested by the procedures.
- Ask for updates from ATC so as to not be surprised by unexpected elements during the final stages of the flight.
- Keep a high situational awareness of time, weather and fuel.

▪ REVIEW

• A brief review should include the following:
- Fuel status/weather update?
- Is the cabin prepared, has cabin crew and ATC been updated and have the passengers been informed?
- Has the briefing been completed?
- Has anything been overlooked?

KISS PRINCIPLE

KISS is an acronym for "Keep it simple, stupid" as a design principle noted by the US NAVY in 1960. The KISS principle states that most systems work best if they are kept simple rather than made complicated; therefore simplicity should be a key goal in design and unnecessary complexity should be avoided.

NITS BRIEFING

N	NATURE
I	INTENTION
T	TIME
S	SPECIALS

The captain then calls the Senior CA (The one in charge of cabin crew onboard) and gives a NITS briefing. NITS is for Nature of emergence, Intentions of the captain, Time available, and finally S is for specific instructions.

BRIEFING LOGICS

Departure briefing method

- A/C STATUS:
    - Documents
    - MEL
    - CDL
- NOTAMs
- WEATHER
    - Departure
    - Destination
    - Alternates (T/O, En-route, Dest.)
    - Planning minimums
- BRIEFING
    - Parking stand
    - Taxiway
    - T/O config (flaps, pwr, climb req.)
    - SID
    - SE-routing
    - MSA
    - Transition altitude
    - NAV/FMS/GPS setup
- T/O EMERGENCY BRIEFING
- QUESTIONS AND SUGGESTION

Approach briefing method

- A/C status (failures)
- NOTAMs
- WEATHER
    - Destination
    - Alternate
- BRIEFING
    - LD
    - STAR
    - MEA
    - HOLDING (entry)
    - FUEL TO ALTERNATE - minimum diversion fuel
    - NAV/FMS/GPS setup
    - CHART BRIEFING including MISSED APPROACH
    - RW course, length, slope, contamination
    - Landing weight, speed reference
    - Use of reverse and breaking
    - Exit RW / TAXIWAY
- QUESTIONS AND SUGGESTION

AIRLINE OM STRUCTURE

PARTS A - GENERAL/BASICS

- All non type-related operational policies, instructions and procedures needed for a sage operation

PARTS B - A/C OPERATING MATTERS

- All type related instructions and procedures needed for operation
- It shall take account of any differences between types, variant or individual A/C used by the operator

PARTS C - ROUTE AND A/D INSTRUCTIONS AND INFORMATION

- All instructions and information needed for area operations

PARTS D - TRAINING

- All training instructions and information for personnel required for safe operation

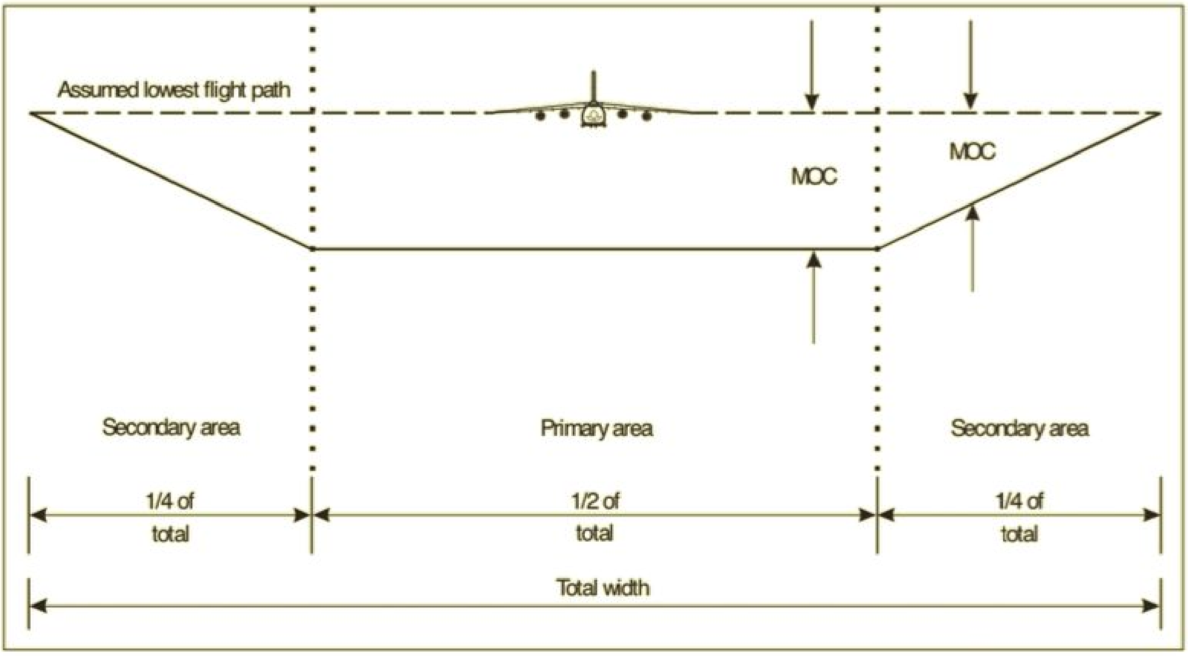
PAN-OPS - GENERAL CRITERIAS

BASICS

PAN OPS - Procedures for Air Navigation Services / Aircraft Operations

OBSTACLE CLEARANCE

- It is a primary safety consideration in the development of instrument flight procedures
- The vertical cross section of each segment is divided to primary and secondary areas.
- Over primary there is a full obstacle clearance, reducing to zero at the outer edge of secondary areas
- On straight segments the primary area width is the half of the whole segment
- MOC - minimum Obstacle Clearance is only provided at primary area and the inner side of secondary area



ACCURACY of FIXES

	VOR[1]	*ILS*	*NDB*
System use accuracy of facility providing track	±5.2°	±2.4°	±6.9°
System use accuracy of facility NOT providing track	±4.5°	±1.4°	±6.2°

PROTECTION AREAS FOR TURNS

- At any turning manoeuvre speed is the controlling factor
- Outer boundary of turn based on the highest speed A/C category
- Inner boundary of turn based on the lowest speed A/C category

GENERAL CRITERIA FOR DEPARTURE PROCEDURES

TURNING PROCEDURES

- The point for start the turn must be readily identifiable by the pilot when flying under IMC

REDUCED POWER T/O

- Reduced power T/O should not be required in adverse operating conditions such as:
    - RW surface conditions are adversely affected
    - Horizontal visibility is less than 1NM
    - When the crosswind component including gusts, exceeds 15KT
    - When the tailwind component including gusts, exceeds 5KT
    - When windshear reported, or thunderstorm expected the approach or departure segments

INSTRUMENT DEPARTURE PROCEDURES

- Design is usually dictated by the environment of the A/D
- It may also be required to provide ATC requirements in the case of SID routes
- If the departure route requires a turn more than 15 degree, a turning departure is constructed

WIND EFFECT

- The procedures assume that pilots not going to compensate wind effect when being radar vectored
- But it is assumed that pilots will compensate for known or estimated wind effects when flying departure routes, which are expressed as tracks

OBSTACLE CLEARANCE

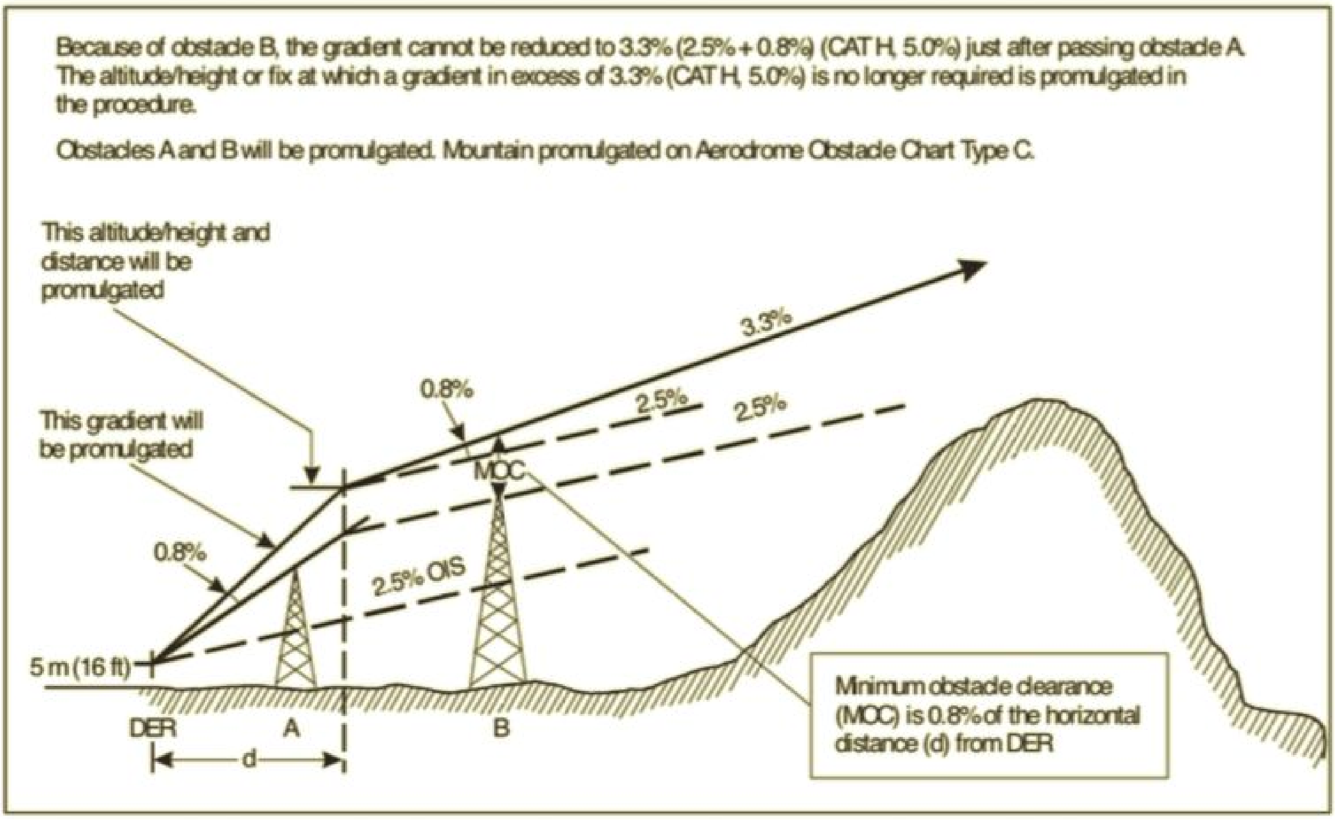
- The minimum obstacle clearance equals zero at the DER
- From that point it increases 0.8% / distance in the direction of flight assuming maximum turn 15 degree
- At the turn initiation area and turning area minimum 295’ feet OC provided

PDG - PROCEDURE DESIGN GRADIENT

- Normally it is 3.3%
- PDG based on an obstacle identification surface (OIS) having 2.5% nt gradient or a gradient determined by the most critical obstacle penetrating the surface, whichever is higher and add an additional margin of 0.8%

RADAR VECTORS DURING DEPARTURE

- Pilots should not accept radar vectoring during departures unless:
  - They are above the minimum altitudes/heights required to maintain OC in the event of engine failure. This relates to the engine failure between V1 and MSA or at the end of a contingency procedure as appropriate OR
  - The departure route is non-critical with respect to OC



PAN-OPS - STANDARD INSTRUMENT DEPARTURES

TYPES OF SID

1. Straight departures
2. Turning departures

SIDs are based on track guidance acquired:

- 20km (10.8NM) within from the DER for STRAIGHT departures
- 10km (5.4NM) within from the DER for TURNING departures

STRAIGHT DEPARTURES

- Initial departure track is 15 degree of alignment to RW centerline
- When OBSTACLE exists and affecting the departure route higher than 3.3% PDG may be specified

TURNING DEPARTURES

- Initial departure track requires a TURN MORE THAN 15 degree of alignment to RW centerline
- Straight flight is assumed until reaching an altitude/height of at least 400' feet (120m)
- Procedures normally not contains turns at a point 600m from the DER

INITIATING TURNS

- Defined by ALTITUDE/HEIGHT
- Defined by a FIX or FACILITY

TURN SPEEDS

- The speeds are those of the final misses approach speed but increased by 10% to account for higher A/C mass on departure

TURN PARAMETERS

ALTITUDE

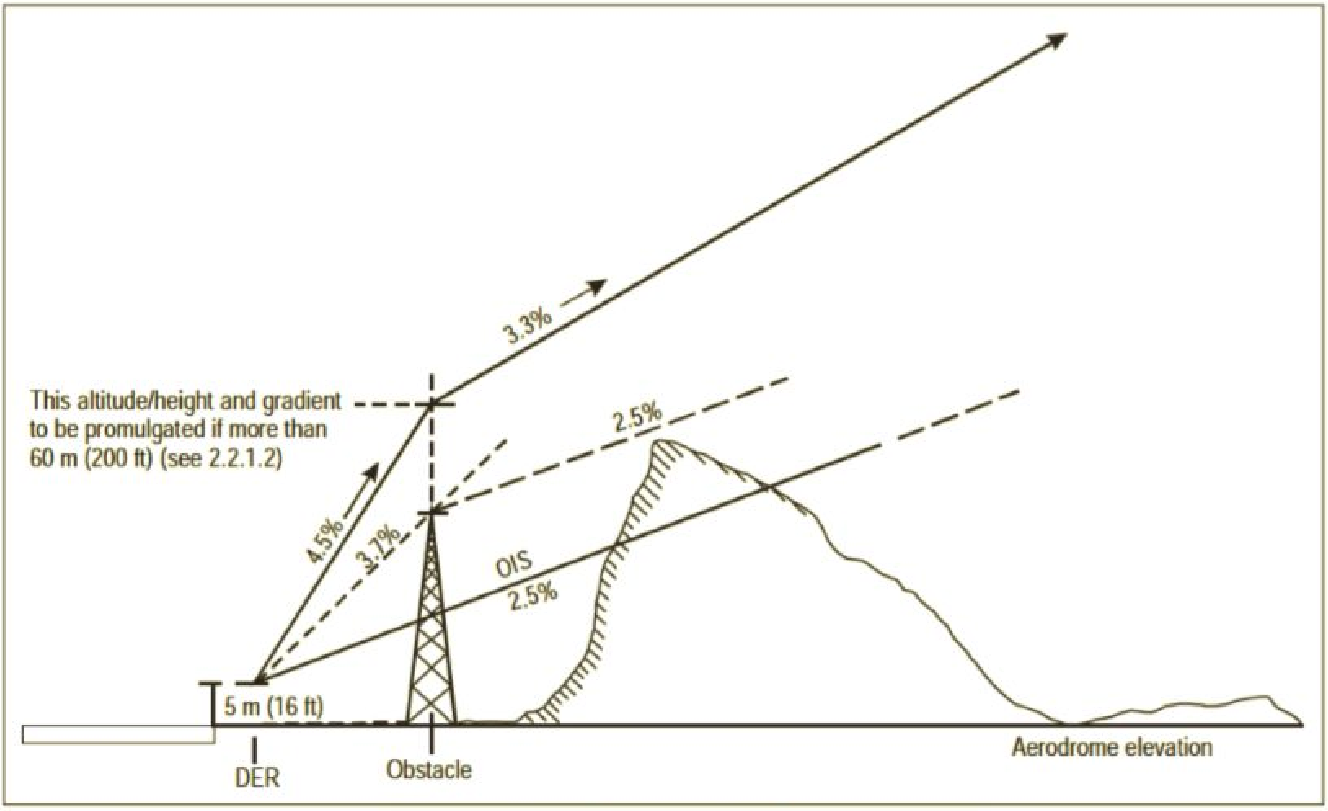
- Defined by ALTITUDE/HEIGHT
- Defined by a FIX or FACILITY

WIND

- Max. 95% of probability wing on omnidirectional basis, where statistical wind data is available
- Where no wind data is available an omnidirectional 30KT is used

TECHNICAL TOLERANCES

- Pilot reaction time 3 sec
- Bank establishment type 3 sec



Procedure Design Gradient

PAN-OPS - ARRIVAL AND APPROACH PROCEDURES

The design of an instrument approach procedure is in general, dictated by the terrain surrounding the A/D, the type of operations and the A/C

SEGMENTS OF APPROACH PROCEDURES

May have 5 segments:

- ARRIVAL
- INITIAL
- INTERMEDIATE
- FINAL
- MISSED APPROACH

TYPES OF APPROACHES

- STRAIGHT-IN
- CIRCLING

STRAIGHT-IN APPROACH

- Whenever is possible a straight-in procedure is designed alignment with the RW centerline
- In case of NPA a straight in approach is considered acceptable if the angle between the final approach track and the RW centerline is not more than 30 degree

CIRCLING APPROACH

- Where terrain or other constraints cause the final approach track alignment or descent gradient to fall outside of the criteria for straight-in approach
- The final approach track of a circling approach procedure is generally aligned to pass over some portion of the usable landing surface of the a/D

A/C CATEGORIES

Most significant performance factor is the A/C speed

CLASSIFICATION

Classification based on the speed at threshold = Vat.

Vat = Vso x 1.3 OR **Vat = Vs1g x 1.23 LANDING configuration MLW**

Whichever is greater!

Aircraft category	*V_{at}*	*Range of speeds for initial approach*	*Range of final approach speeds*	*Maximum speeds for visual manoeuvring (circling)*	*Maximum speeds for missed approach*	
					Intermediate	*Final*
A	<91	90/150(110*)	70/100	100	100	110
B	91/120	120/180(140*)	85/130	135	130	150
C	121/140	160/240	115/160	180	160	240
D	141/165	185/250	130/185	205	185	265
E	166/210	185/250	155/230	240	230	275
H	N/A	70/120**	60/90***	N/A	90	90
CAT H (PinS)***	N/A	70/120	60/90	N/A	70 or 90	70 or 90

V_{at} — Speed at threshold based on 1.3 times stall speed V_{so} or 1.23 times stall speed V_{s1g} in the landing configuration at maximum certificated landing mass. (Not applicable to helicopters.)

* Maximum speed for reversal and racetrack procedures.

** Maximum speed for reversal and racetrack procedures up to and including 6 000 ft is 100 kt, and maximum speed for reversal and racetrack procedures above 6 000 ft is 110 kt.

*** Helicopter point-in-space procedures based on basic GNSS may be designed using maximum speeds of 120 KIAS for initial and intermediate segments and 90 KIAS on final and missed approach segments, or 90 KIAS for initial and intermediate segments and 70 KIAS on final and missed approach segments based on operational need. Refer to PANS-OPS, Volume II, Part IV, Chapter 1, "Area navigation (RNAV) point-in-space (PinS) approach procedures for helicopters using basic GNSS receivers".

Note.— The V_{at} speeds given in column 2 of Table I-4-1-1 are converted exactly from those in this table, since they determine the category of aircraft. The speeds given in the remaining columns are converted and rounded to the nearest multiple of five for operational reasons and from the standpoint of operational safety are considered to be equivalent.

OBSTACLE CLEARANCE (OC)

- It is the primary safety consideration while developing instrument approach procedures

OBSTACLE CLEARANCE ALTITUDE / HEIGHT (OCA / OCH)

- For each individual approach procedure an obstacle clearance altitude/height is calculated.

PA - PRECISION APPROACH PROCEDURES

- The **LOWEST ALTITUDE** (OCA) or alternatively the **LOWEST HEIGHT** (OCH) above the elevation of the relevant RW threshold (OCH) **AT** which the missed approach must be initiated, cannot continue descent or even level flight!

NPA - NON-PRECISION APPROACH PROCEDURES

- The **LOWEST ALTITUDE** (OCA) or alternatively the **LOWEST HEIGHT** (OCH)
  - above the A/D elevation **OR**
  - above elevation of the relevant RW threshold (OCH) (if the threshold elevation is more than 7' feet (2m) below the RW elevation)
- **BELOW** that an A/C cannot descend

CIRCLING

- The **LOWEST altitude** (OCA) or alternatively the **LOWEST HEIGHT** above the A/D elevation (OCH) below that an A/C cannot descend

Aircraft categories	*Rate of descent*	
	Minimum	*Maximum*
A, B	120 m/min (394 ft/min)	200 m/min (655 ft/min)
C, D, E	180 m/min (590 ft/min)	305 m/min (1 000 ft/min)

Rate of Descent in the final approach segment of a procedure with no FAF

VERTICAL PATH CONTROL PROCEDURES

- CFIT = Controlled Flight Into Terrain
- Risk of CFIT is high at NPA
- The use of traditional step down procedure is not recommended
- The CDFA, Continuous Descent Final Approach technique is preferred whenever it is possible to reduce pilot workload and make less chance for errors during flying the approach

CDFA - CONTINUOUS DESCENT FINAL APPROACH

It simplifies the final segment of NPA approaches. Improves pilots situational awareness with stabilized approach criteria.

- It requires a continuous descent, flown:
    - With VNAV guidance
    - Calculated by onboard equipment
    - Based on manual calculations of the required ROD, without level-offs

- The ROD is selected and adjusted to descent a point to 50' feet (15m) above the RW threshold
- The descent shall be calculated and flown to pass at or above the minimum altitude at any stepdown fix
- If the visual references required to land not have been required when the A/C reaching the MDA(H) than the vertical portion of the missed approach is initiated at an altitude at or above the relevant MDA(H)
- At NO TIME LEVEL flown at or near the MDA(H)
- At NO TIME shall turn begins before reaching MAPt
- If the A/C reaches MAPt before descending to MDA(H) the missed approach procedure shall be initiated
- IMPORTANT: upon approaching the MDA(H) the crew has to decide:
    - Land - if the required visual criterias achieved
    - INITIATE MISSED APPROACH

- THERE IS NO LEVEL FLIGHT SEGMENT AFTER MDA(H)

APPROACH OPERATIONS UTILIZING BARO-VNAV EQUIPMENT

BARO-VAN can be utilized in 2 different approach and landing operations:

Approach and land with VERTICAL GUIDANCE

- BARO-VNAV is required
- Lateral navigation by RNP approach

NPA and landing operations

- BARO-VNAV is NOT required
- Suggest using CDFA technique

DESCENT GRADIENT

- The minimum/optimum descent gradient/angle in the final approach of procedure with FAF is 5.2% / 3 degree
- Where a steeper descent gradient is necessary the maximum permissible is 6.1% / 3.5 degree for CAT "C" A/C
- Pilots should consider the required descent gradient rate for NPA final approach segments before starting the approach.

PAN-OPS - ARRIVAL SEGMENT

STAR

- A standard instrument arrival (STAR) route permits transition from en-route phase to the approach phase.

PROTECTION OF THE ARRIVAL SEGMENT

- The width of the protection area decreases from the en-route value until the initial approach value with a maximum convergence angle of 30 degree each side of the axis.
- This convergence starts at (25NM) before the INITIAL APPROACH FIX (IAF).
- The arrival phase normally ends at the IAF
- Provides 1.000' feet obstacle clearance

PAN-OPS - INITIAL APPROACH SEGMENT

DESCRIPTION

- Initial approach segment starts at the **IAF - Initial Approach Fix** and ends at the **IF - Intermediate Fix.**
- A/C speed and configuration will depend on the distance from the A/D and also depends on the descent required
- Normally track guidance is provided along the initial approach segment to the IAF with the maximum angle of interception of

    - 90 degree for a PA - precision approach
    - 120 degree for NPA - non-precision approach

MINIMUM OBSTACLE CLEARANCE

- The initial approach segment provides at least 1.000' feet (300m) of OC in the primary area, reducing laterally to zero at the outer edges of the secondary area

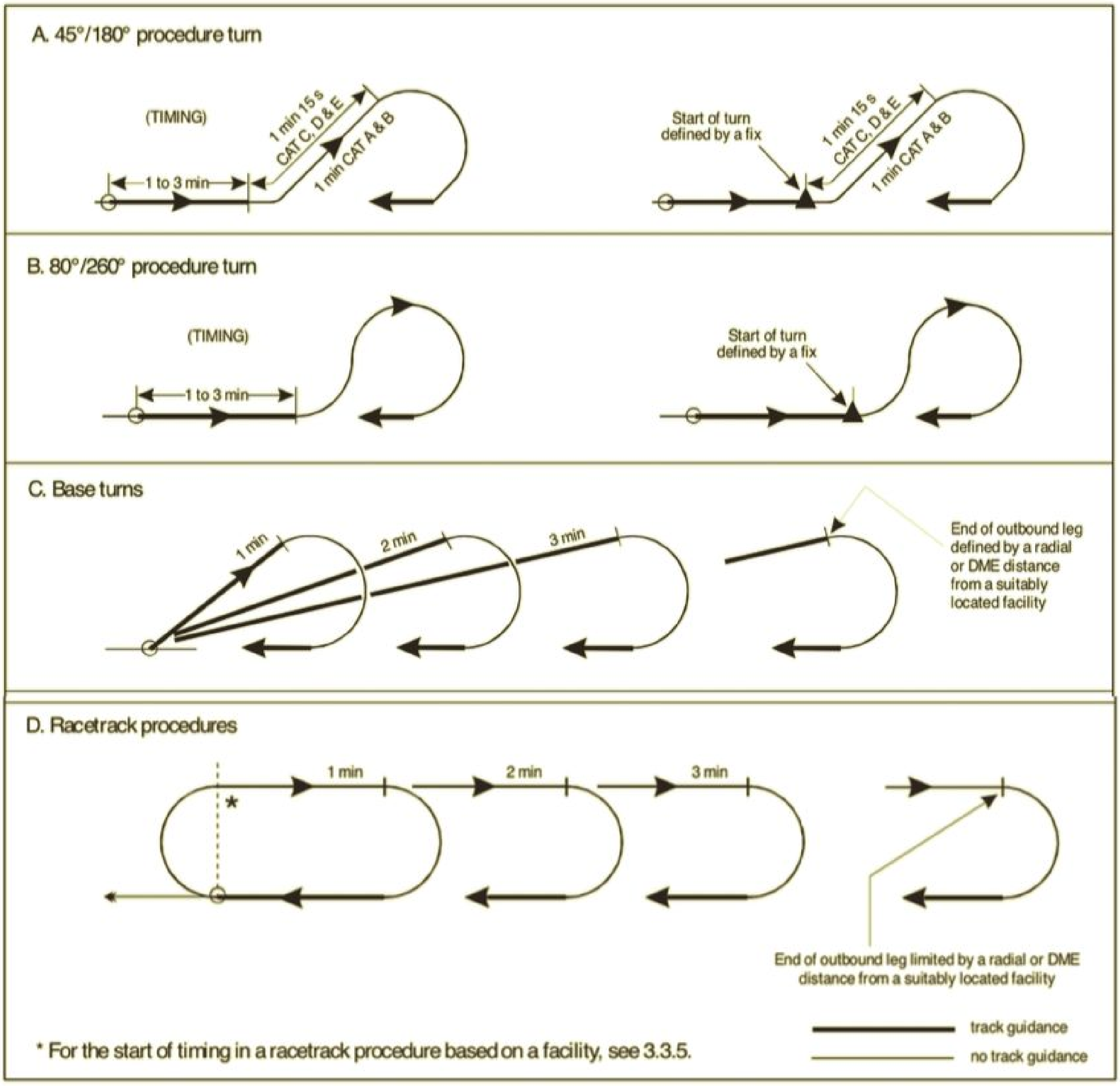
TYPES OF MANOEUVRES

- Where no suitable IAF (Initial Approach Fix) or IF (intermediate Fix) available to construct an instrument approach procedure, there a REVERSAL procedure, RACETRACK procedure or HOLDING pattern is required.
- This can be when only 1 single facility is provided for the A/D, and in this case this facility will provide both IAF and IF

REVERSAL PROCEDURE

- May be started with a PROCEDURE or BASE TURN
- The directions and timing specified procedure should be strictly followed to stay inside the airspace provided, do not apply them unless specified for the current airspace
- There are 3 generally recognized manoeuvre related to reversal procedures:

    - 45/180 turn
    - 80/260 turn
    - Base turn



45/180 TURN

- It starts at a facility or fix and consist of 4 parts:
  - Straight leg (track guidance, may be timed or radial/DME limited)
  - 45 degree turn
  - Straight leg (without track guidance - 1min for CAT A,B - 1:15min for CAT C,D,E)
  - 180 degree turn back to intercept inbound track

80/260 TURN

- It starts at a facility or fix and consist of 3 parts:
- Straight leg (track guidance, may be timed or radial/DME limited)
- 80 degree turn
- 260 degree turn back to intercept inbound track

BASE TURN PROCEDURE

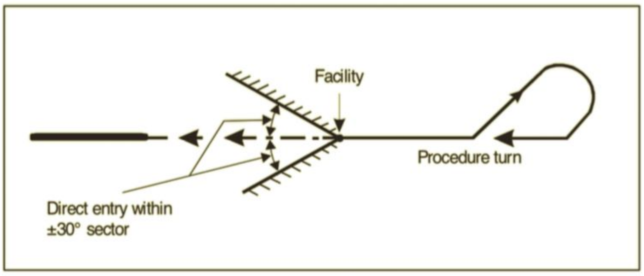
- It consist of 2 parts:
  - A specified outbound track and timing or DME distance from a facility.
  - A turn to intercept the inbound track
- Outbound track and/or timing may be different for A/C.

RACETRACK PROCEDURE

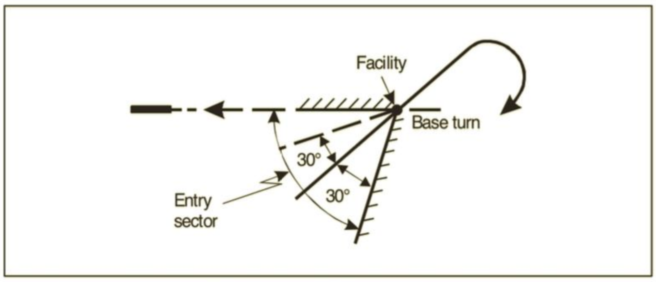
- A RACETRACK procedure consists of a turn from the inbound track through 180 degree from overhead the facility or fix on the outbound track, for 1,2 or 3 minutes, followed by a 180 degree turn in the same direction to return to the inbound track
- As an alternate timing the outbound track may be limited by a DME distance or intersecting radial/bearing.

ENTRY INTO RACETRACK PROCEDURE

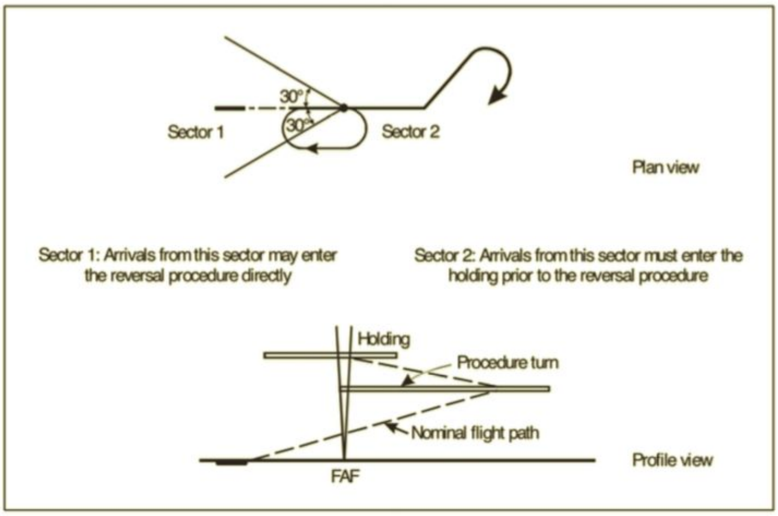
- Normally a racetrack procedure is used when A/C arrive overhead the fix from various directions
- In these cases pilots should enter the procedure similar to holding entry procedures.



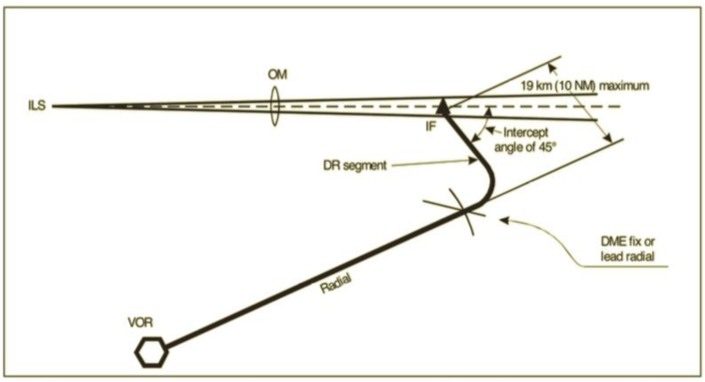
Direct entry to procedure turn



Direct entry to base turn



Example of "omnidirectional" arrival using a holding procedure in association with a reversal procedure



Dead reckoning segment

FLIGHT FOR RACETRACK AND REVERSAL PROCEDURE

ENTRY

- Unless the procedure specifies particularly entry restrictions, reversal procedures shall be entered from a track within +- 30 degree of the outbound track of the reversal procedure

SPEED RESTRICTION

- Speed may be specified. Must not be exceeded to stay inside the protected area.

BANK ANGLE

- Procedures are based on 25 degree bank angle, or the bank angle giving a rate of turn 3 degree / sec whichever is less

DESCENT

- The A/C shall cross the fix or facility and fly outbound on the specified track, descending as necessary, but no lower than the minimum crossing altitude/height associated with that segment
- If further descent is specified after inbound turn this descent shall not be started until the A/C established the inbound track
- An A/C is considered to be established when:
    - Within half full scale deflection for the ILS and VOR
    - Within +- 5 degree of the required bearing for NDB

OUTBOUND TIMING RACETRACK PROCEDURE

- When the procedure is based on a facility, the outbound timing starts:
    - From a beam the facility; or
    - On attaining the outbound heading, whichever comes later
- When the procedure is based on a fix, the outbound timing starts from attaining the outbound heading.
- The turn on to the inbound track should be started:
    - 1. Within the specified time (adjusted for wind); or
    - 2. When encountering any DME distance; or
    - 3. When the radial/bearing specifying a limiting distance has been reached, whichever occurs first.

WIND EFFECT

- To achieve a stabilized approach, due allowance should be made in both heading and timing to compensate for the effects of wind so that the aircraft regains the inbound track as accurately and expeditiously as possible.
- In making these corrections, full use should be made of the indications available from the aid and from estimated or known winds.
- This is particularly important for slow aircraft in high wind conditions, when failure to compensate may render the procedure unflyable (i.e. the aircraft may pass the fix before establishing on the inbound track) and it could depart outside the protected area).

PAN-OPS - INTERMEDIATE APPROACH SEGMENT

- This is the segment during which the A/C speed and configuration should be adjusted to prepare the A/C for FINAL APPROACH.
- For this reason the descent gradient is kept as shallow as possible

MINIMUM OC - OBSTACLE CLEARANCE

- During the intermediate approach the OC requirement reduces from 300m (984' feet) to 150m (492' feet) in the primary area, reducing laterally zero at the outer edge of the secondary area

BEGINNING AND THE END OF THE SEGMENT

WITH FAF / FAP

The intermediate segment begins when after a turn it is on the inbound track
It ends at the FAF or FAP as applicable

WITHOUT FAF / FAP

Where no FAF specified there the inbound track is the final approach segment

PAN-OPS - FINAL APPROACH SEGMENT

- This segment where the alignment and descent for landing is made
- Final approach may be a straight-in approach and landing, or a directing to an A/D for visual manoeuvre

FINAL APPROACH TYPES

- NPA with FAF
- NPA without FAF
- Approach with VERTICAL GUIDANCE (APV)
- PA - PRECISION APPROACH

NPA WITH FAF

- This segment starts with the FAF - Final Approach Fix and ends at the MAPt - Missed Approach Point
- FAF is sited on the final approach track in a distance which permits to the selection of final approach configuration, and descent from the intermediate approach altitude/height to the appropriate MDA(H) either for a start-in or for a visual approach
- The optimum distance is 5 NM from threshold
- The maximum length should not be greater than 10NM. Minimum length is 3NM

OPTIMUM DESCENT GRADIENT / MAXIMUM DESCENT GRADIENT

- NPA provides the optimum final approach descent gradient of 5.2% / 3 degree.

NPA WITHOUT FAF

- When an A/D is served by a single facility a procedure may be designed where the facility is both the IAF and MAPt
- These procedure indicate:
    - Minimum altitude/height for a reversal procedure or racetrack
    - An OCA(H) for final approach
- In the absence of the FAF descent to MDA(H) is made once the A/C established inbound on the final approach track
- Procedure altitudes/heights not provided for NPA without FAF

PA PRECISION APPROACH WITH FAP

FINAL APPROACH POINT FAP

- Begins with the final approach point = FAP
- This is the point in the space where the intermediate approach track altitude/height intercepts the nominal glide path (ILS) / microwave landing system (MLS) elevation angle

FINAL APPROACH LENGTH

- The intermediate approach altitude/height generally intercepts the nominal glide path (ILS) / microwave landing system (MLS) elevation angle at heights from 3.000’ feet above the RW elevation
- Counting with the 3 degree glide path interception occurs between 1000’ - 3000’ feet at a distance of 3NM to 10NM

OUTER MARKER / DME FIX

- The final approach area contains a fix or a facility that provides verification of the glide path/MLS elevation angle and altimeter relationship
- The outer marker or equivalent DME fix is normally used for this purpose
- Altitude error and altitude tolerance is accepted while crossing the fix

DETERMINATION OF THE DA or DH

ILS

CAT 1	-	BARO ALTIMETER
CAT 2	-	RADIO ALTIMETER and FLIGHT DIRECTOR
Missed approach climb gradient:	-	2.5%

Glide path angle:

Minimum	-	2.5 degree
Optimum	-	3.0 degree
Maximum	-	3.5 degree

MLS

CAT 1	-	BARO ALTIMETER
CAT 2	-	RADIO ALTIMETER and AUTO COUPLED FLIGHT DIRECTOR
Missed approach climb gradient:	-	2.5%

Elevation angle:

Minimum	-	2.5 degree
Optimum	-	3.0 degree

Maximum: 3.5 degree

PAN-OPS - MISSED APPROACH SEGMENT

DESCRIPTION

- During the missed approach phase the pilot is facing with a demanding task of changing A6C configuration, altitude and attitude. For this reason this procedure should kept as simple as possible and consists of 3 phases:

    - Initial
    - Intermediate
    - Final

- Only 1 missed approach procedure is established for each instrument approach procedure
- It provides OC
- It specifies a point where the missed approach begins, and a point or an altitude/height where it ends
- The MAPt in a procedure may be defined by:

    - The point of intersection of an electronic glide path with the applicable DA(H) in APV or PA, or
    - A navigation facility or fix, or a specified distance from the FAF in NPA

MISSED APPROACH GRADIENT

- Calculated by 2.5% minimum missed approach gradient
- It must be indicated on the chart

PHASES

INITIAL PHASE

- It begins at the MAPt and ends at the start of climb. (SoC)
- This phase requires attention to establish climb and change A/C configuration
- No turns expected in this phase (usually no track guidance and higher workload)

INTERMEDIATE PHASE

- It begins with the start of climb (SoC)
- The climb is continued, normally straight ahead and the end of this phase is the first point where 50m (164' feet) OC is obtained and can be maintained
- MOC shall be 30m at this phase
- The track in this phase can be changed by max 15 degree from the initial phase track
- During this phase A/C starts track correction

FINAL PHASE

- It begins at the first point where 50m (164' feet) OC is obtained
- It ends where a new approach, holding or a return to en-route flight is initiated
- Turns may be described in this phase and can be maintained

PARAMETERS

TURNING MISSED APPROACH

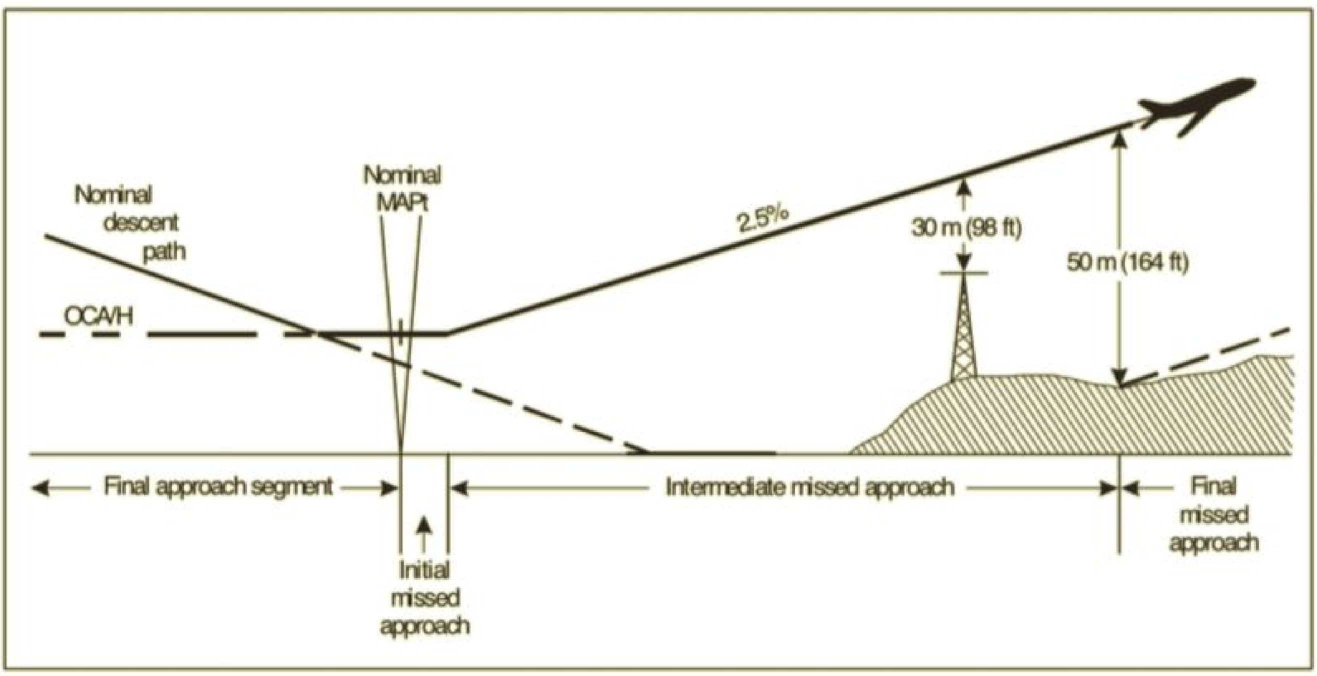
- Turns in missed approach procedures defined only where terrain and OC factors make it necessary

AIRSPEED

- The protected airspace for turns is based on the speeds for final missed approach
- Where operationally required to avoid obstacles, the IAS as slow as at the intermediate missed approach phase

TURN PARAMETERS

Bank angle	-	15 degree average
Speed		
Wind	-	Where statistical data are available 95% probability on omnidirectional basis is used. Where no data is available, omnidirectional wind of 30KT is used.
Flight technical tolerances	-	Pilot reaction time 0-3 sec
	-	Bank establishment time 0-3 sec



Missed Approach Phases

VISUAL MANOEUVRING AREA (CIRCLING AREA)

- VISUAL MANEUVERING (circling) is a term used to describe the phase of flight after an instrument approach has been completed
- It brings the A/C in position for landing on a RW, which is not suitably located for a straight in approach or where the descending criteria or alignment criteria can not met

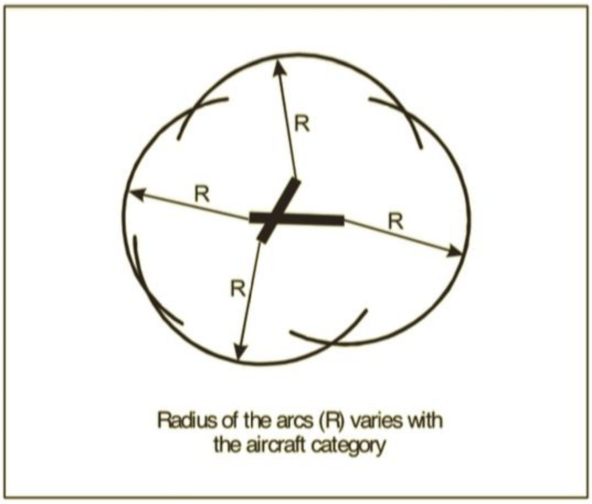
VISUAL FLIGHT MANOEUVRE

- CIRCLING is a visual flight manoeuvre
- After initial visual contact the basic assumption that the RW environment (threshold, approach lighting or other marking) should be kept in sight while at minimum altitude/height MDA(H) for circling
- The length of the final segment is based on an allowance of 30 sec of flight before the RW threshold

PROTECTION

- The visual maneuvering area for a circling approach is determined by drawing arsc centered on each RW threshold and joining those arcs with tangent lines.
- The radius of these arcs related to:
    - A/C category
    - Speed
    - Wind speed
    - Bank angle

- Descent below MDA(H) should not be made until:
    - Visual reference has been established and can be maintained
    - The pilot has the RW threshold in sight
    - The required OC can be maintained and the A/C is in position to carry out a landing



Circling approach area

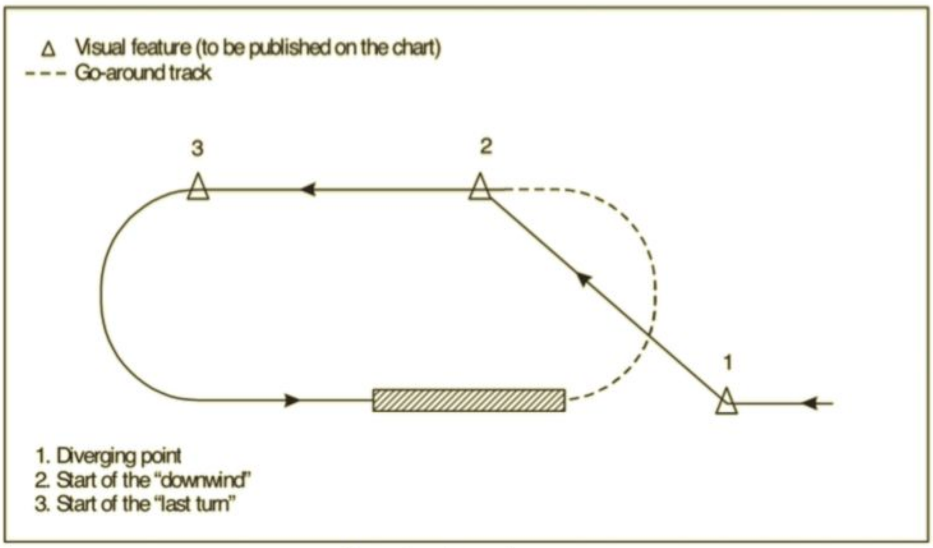
MISSED APPROACH PROCEDURE WHILE CIRCLING

- If visual reference is lost while circling to land from an instrument approach, the missed approach specified for that particular procedure shall be followed
- It starts with initiating a climbing turn, within the circling area towards the landing RW, to return to the circling altitude or higher immediately followed by interception and execution of the missed approach procedure
- IAS shall not exceeding the IAS assigned to circling
- Circling manoeuvre may be carried out more than 1 direction, for this reason different pattern has to be established during missed approach procedure

Category of aircraft/IAS (kt)	*A/100*	*B/135*	*C/180*	*D/205*	*E/240*
TAS at 2 000 ft MSL + 25 kt wind factor (kt)	131	168	215	242	279
Radius (r) of turn (NM)	0.69	1.13	1.85	2.34	3.12
Straight segment (NM) (this is a constant value)	0.30	0.40	0.50	0.60	0.70
Radius (R) from threshold (NM)	1.68	2.66	4.20	5.28	6.94

Note.— Radius from threshold (R) = 2r + straight segment.

Example of determining radii for circling area for aerodromes at 1000 ft MSL



Standard track

PAN-OPS - EN-ROUTE PROCEDURES

2 methods to determine en-route OC areas:

- SIMPLIFIED method (standard)
- REFINED method

OBSTACLE CLEARANCE AREAS

SIMPLIFIED METHOD	-	OC area is defined as a central primary area and 2 lateral buffera areas
REFINED METHOD	-	OC is divided into a central primary area and 2 lateral secondary areas

The width of the primary area corresponds to a 95% probability of containment (2SD)
The total width of the area corresponds to a 99.7% probability of containment (3SD)

REDUCTIONS TO SECONDARY WIDTHS

- Secondary areas for en-route operations may be reduced when justified by factors such as:
    - Relevant information on flight operational experience
    - Regular flight inspection of facilities to ensure better than standard signals
    - Radar surveillance

AREA WITHOUT TRACK GUIDANCE

- When a track guidance is not provided, outside of coverage of navigation facilities along the route, the primary area splays/getting wider at an angle of 15 degree from its width at the last point where track guidance was available
- The same time the width of the buffer area is progressively reducing to zero ending in an area without track guidance where the full minimum MOC is applied

AREA MINIMUM ALTITUDES

- Within each quadrant formed by parallels and meridians the area minimum altitude shall be shown

EN-ROUTE AREA OC - OBSTACLE CLEARANCE

- MOC value for IFR flight in the primary area is 1.000' feet
- Mountainous area shall be higher as described below:

Variation in terrain elevation	*MOC*
Between 900 m (3 000 ft) and 1 500 m (5 000 ft)	450 m (1 476 ft)
Greater than 1 500 m (5 000 ft)	600 m (1 969 ft)

The MOC to be applied outside of primary area:

Simplified method	-	buffer area MOC is half of the primary area
Refined method	-	in the secondary area, the OC is reduced from the full clearance at the inner edge to zero at the outer edge

TURN PROTECTIONS

Turns can be executed overhead a facility or at a fix
En-route turns specific parameters:

Altitude	-	At or above which the area is designed
IAS	-	315 KT
Wind		
Flight technical tolerances	-	Max. pilot reaction time 10sec
	-	Bank establishment time 5 sec

PAN-OPS - HOLDINGS

DESCRIPTION

- To ensure that A/C remains in the protected areas the pilot should use established error check procedures to reduce the effect of operating errors, data errors or equipment malfunction

PARAMETERS

SPEEDS

Levels[1]	*Normal conditions*	*Turbulence conditions*
Up to 4 250 m (14 000 ft) inclusive	425 km/h (230 kt)[2] 315 km/h (170 kt)[4]	520 km/h (280 kt)[3] 315 km/h (170 kt)[4]
Above 4 250 m (14 000 ft) to 6 100 m (20 000 ft) inclusive	445 km/h (240 kt)[5]	520 km/h (280 kt) or 0.8 Mach, whichever is less[3]
Above 6 100 m (20 000 ft) to 10 350 m (34 000 ft) inclusive	490 km/h (265 kt)[5]	
Above 10 350 m (34 000 ft)	0.83 Mach	0.83 Mach

1. The levels shown represent *altitudes* or corresponding *flight levels* depending upon the altimeter setting in use.
2. When the holding procedure is followed by the initial segment of an instrument approach procedure promulgated at a speed higher than 425 km/h (230 kt), the holding should also be promulgated at this higher speed wherever possible.
3. The speed of 520 km/h (280 kt) (0.8 Mach) reserved for turbulence conditions shall be used for holding only after prior clearance with ATC, unless the relevant publications indicate that the holding area can accommodate aircraft flight at these high holding speeds.
4. For holdings limited to CAT A and B aircraft only.
5. Wherever possible, 520 km/h (280 kt) should be used for holding procedures associated with airway route structures.

BANK ANGLE / RATE OF TURN

- All turns are to be made at a bank angle of 25 degree or at a rate which provides 3 degree tirn / sec, whichever requires lesser bank

ALLOWANCE FOR KNOWN WIND

- All procedures depict track
- Pilots should attempt to maintain the track, corrections for wind applying in both heading and timing. Corrections shall be made during entry and while flying the holding pattern

START OF OUTBOUND TIMING

- Begins over or abeam the fix, whichever occurs later
- If there is no abeam information start timing when turn to outbound is completed

OUTBOUND LEG BASED ON DME DISTANCE

- If the outbound leg length is based on DME distance, then the outbound leg terminates as soon as the limiting DME distance is reached

LIMITING RADIALS

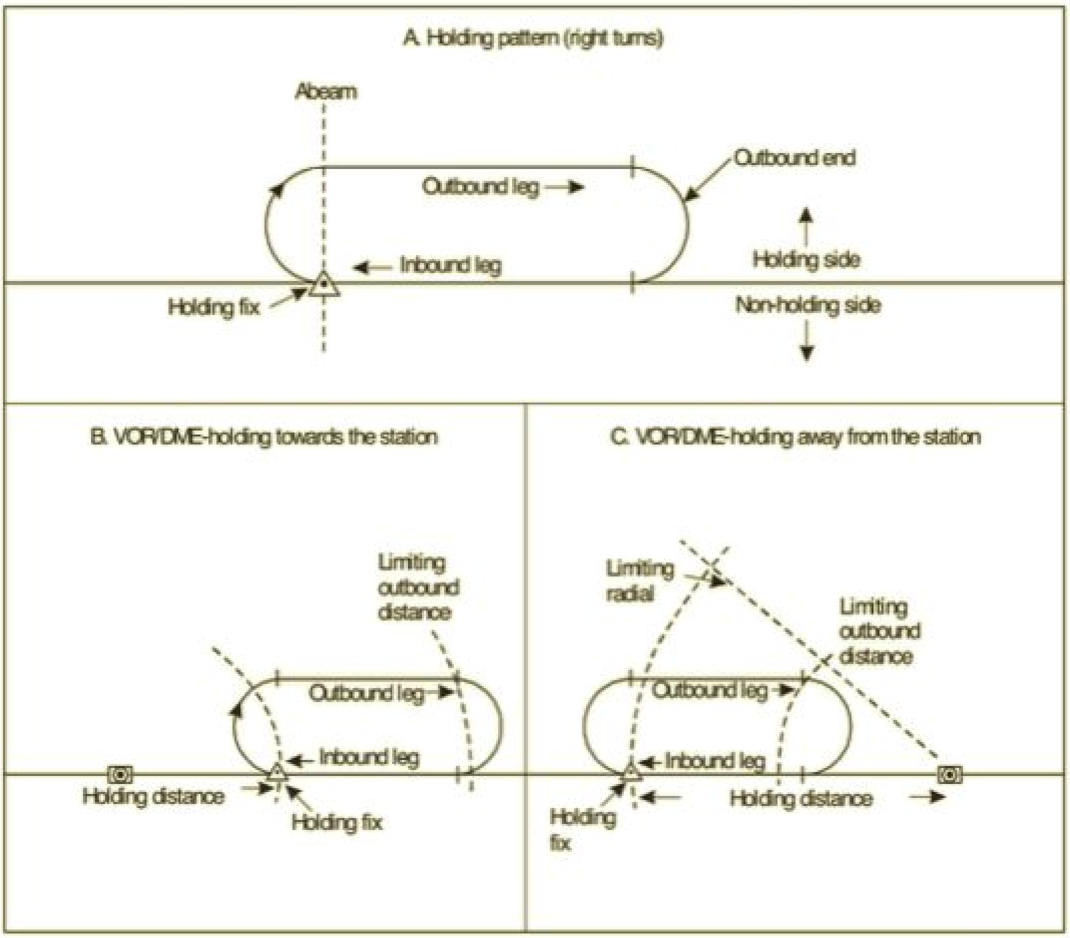
- In the case when holding away from the station a limiting radial may be specified
- If the limiting radial is reached before the limiting DME distance, this radial should followed until the turn to inbound is initiated (latest where the limiting DME distance reached)

Entries

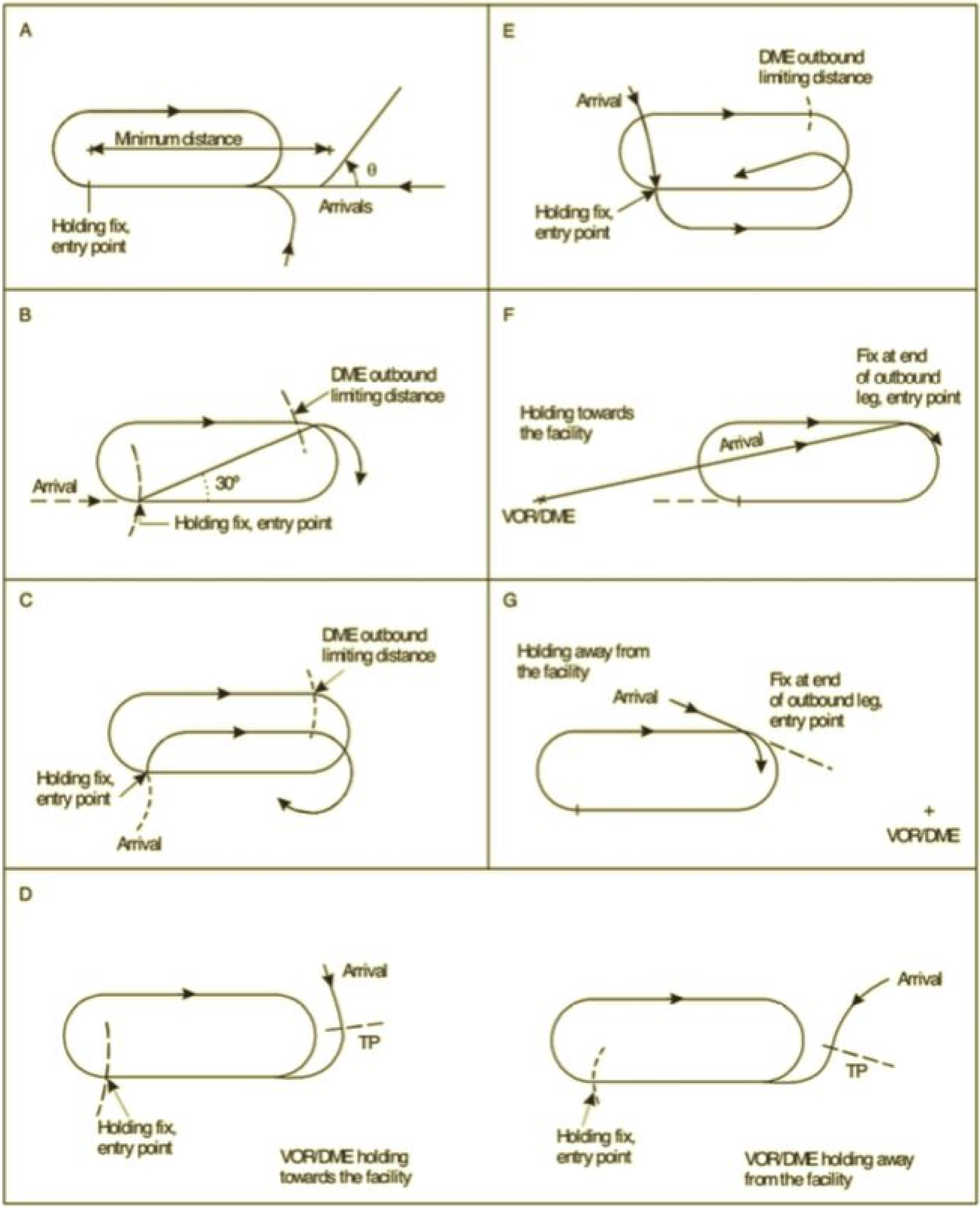
Entry into the holding is according to the heading in relations to the 3 sectors, with a flexible zone 5 degree either side of sectors

VOR INTERSECTION - Entry limited to the radials forming the intersection
VOR/DME fix - Entry track is limited to:

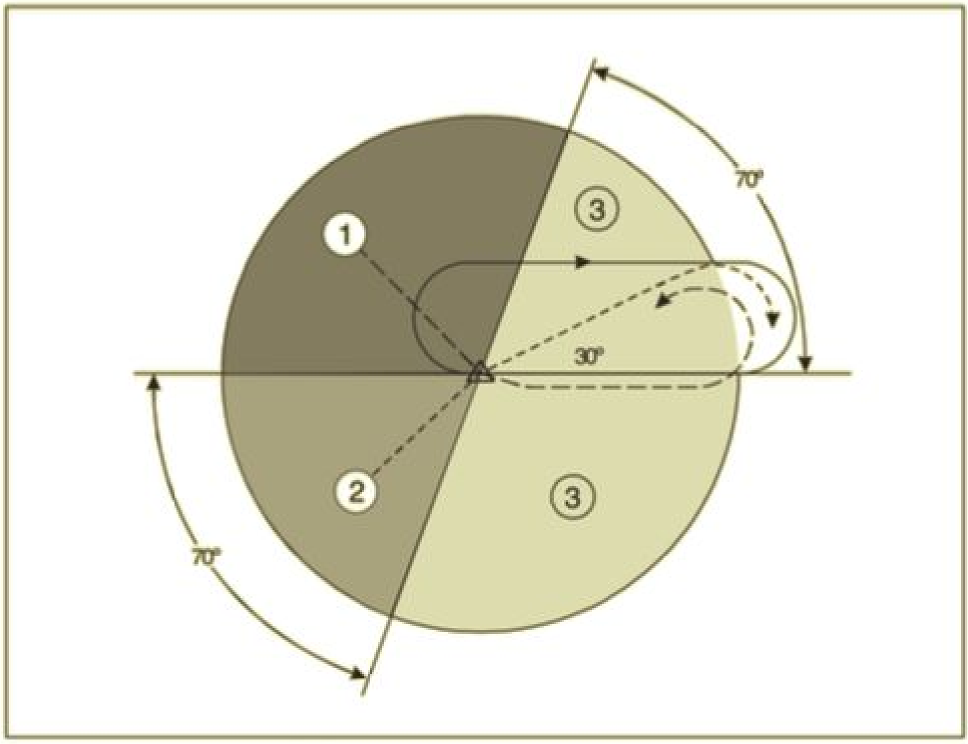
- VOR radial
- DME arc
- Entry radial to the VOR/DME fix at the end of outbound leg as published



Shape and terminology associated with right turn holding pattern



VOR/DME holding entry procedures



Holding entry sectors

SECTOR 1 ENTRY - PARALLEL

SECTOR 2 ENTRY - OFFSET

SECTOR 3 ENTRY - DIRECT

DME ARC ENTRY PROCEDURE

- At the fix the A/C shall enter the holding pattern in accordance with either the SECTOR 1 (PARALLEL) or SECTOR 3 (DIRECT) procedure.

IN THE HOLDING

STILL AIR CONDITIONS HOLDING OUTBOUND LEG

A.) TIMING:

AT OR BELOW 14.000’ feet	-	1 minute
ABOVE 14.000’ feet	-	1:30 minute

B.) WHEN USING DME and the limiting distance is reached

WIND CORRECTION

- Correction should be made on both heading and timing to compensate wind effects and ensure to get back on inbound track before passing the fix

DEPARTING PATTERN

When clearance is received specifying the exact time for departure from the holding point, pilot should establish adjusted pattern within the allowed limits to be ready when that time come

HOLDING OC - OBSTACLE CLEARANCE

HOLDING AREA

- Basic holding area
- Entry area

Basic holding area

It is the airspace required for a holding pattern at a specific level, based on the allowances for A/C speed, wind effect, timing errors and holding fix characteristics

Entry area

It is an airspace required for the entry procedure

BUFFER AREA

- An additional buffer area extends 5 NM beyond the boundary of the holding area.
- Significant obstacles in the buffer area are taking into account when determining the minimum holding level

MINIMUM HOLDING LEVEL

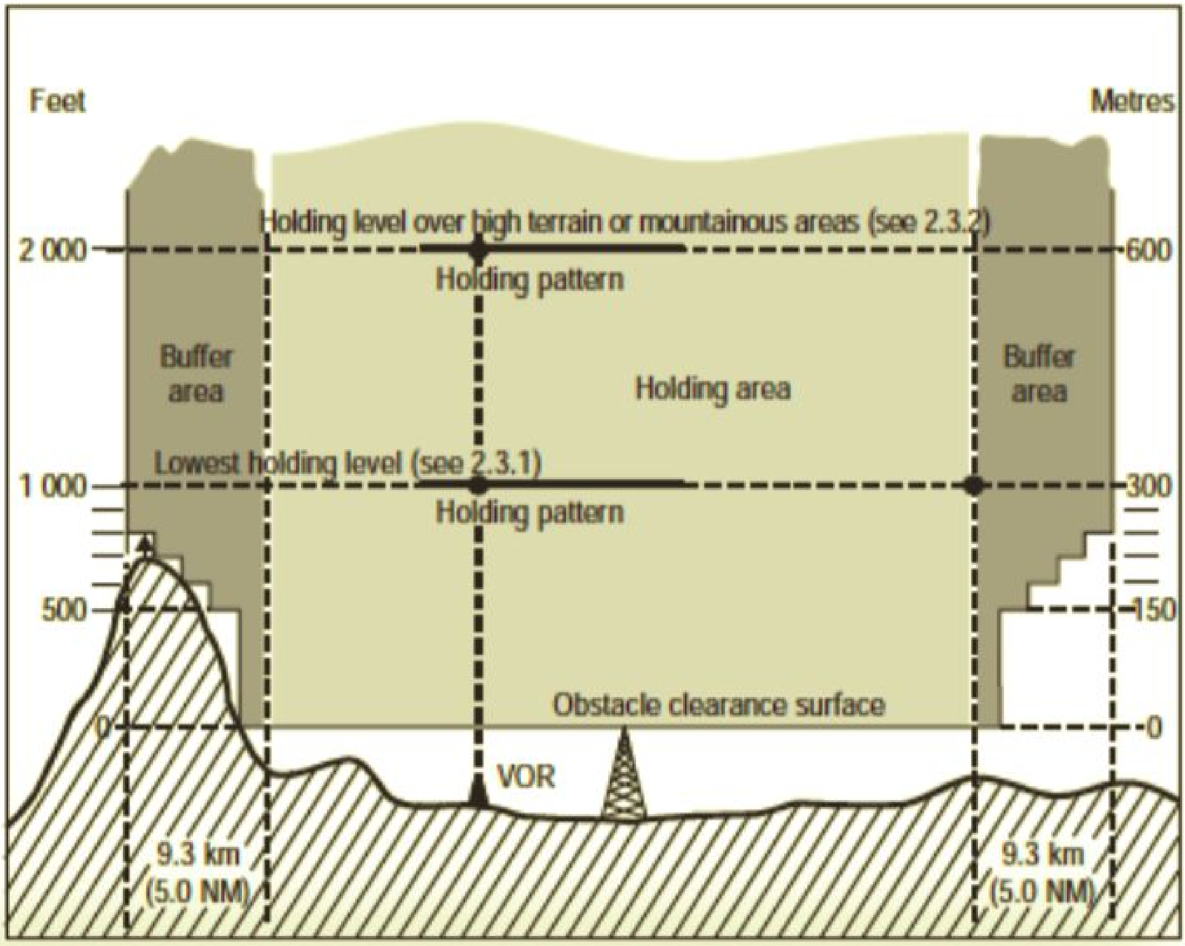
A.) 300m (984’ feet) above obstacles in the holding area
B.) As specified in the table below

The minimum holding altitude must be rounded up to the nearest 50m or 100’ feet as appropriate.

Distance beyond the boundary of the holding area	*Minimum obstacle clearance over low flat terrain*	
	Metres	*Feet*
0 to 1.9 km (0 to 1.0 NM)	300	984
1.9 to 3.7 km (1.0 to 2.0 NM)	150	492
3.7 to 5.6 km (2.0 to 3.0 NM)	120	394
5.6 to 7.4 km (3.0 to 4.0 NM)	90	295
7.4 to 9.3 km (4.0 to 5.0 NM)	60	197
Category H		
0 to 3.7 km (0 to 2.0 NM)	Linear 300 to 0	Linear 984 to 0

OC OVER MOUNTAINOUS AREA

- Over high terrain additional OC up to a total of 600m (1969' feet) is provided to accommodate of possible effects of turbulence, drown drafts or other meteorological phenomena which can effects altimeters.



Minimum holding level as determined by the obstacle clearance surface related to the holding area and the buffer area