Separation

- ATS Surveillance Services
- Separation Methods and Minima
- Separation in the Vicinity of Aerodromes
- Radar Separation
- Wake Turbulence Separation
- Runway Separation
- Visual Separation
- Procedural Control

ATS Surveillance Services

General Procedures

Aircraft identification

For aircraft to be provided ATS surveillance services, aircraft identification must be established, and the pilot informed. Identification should then be maintained until the termination of ATS surveillance.

Identification on a secondary surveillance radar system (SSR) is established by one of the following methods:

- Recognition of the setting of a discrete transponder code (i.e., not ending in 00)
- Observation of the IDENT feature of an aircraft transponder where a discrete transponder code has already been assigned.

Once radar identification has been established the pilot shall be informed. If at any time identification is lost or ATS surveillance service terminated, this pilot shall also be informed.

Position information

Where identification has been performed the aircraft should be informed of its position except in the following cases:

- Transfer of identification from one controller to another; or
- Assigned discrete SSR code identification and the aircraft’s position is consistent with its expected position based on its flight plan; or
- Based on the pilot’s report of position or within 1 NM of the departure runway and consistent with the planned departure time of the aircraft.

Position information shall be passed in the following forms:

- As a well-known geographical location; or
- As a magnetic track and distance from a significant point, enroute navigational aid or approach aid; or
- Direction (using points of a compass) from a known position; or
- Distance to touchdown if the aircraft is on final approach; or
- Distance and direction from the centerline of an ATS route.

Wherever practical, position information shall be made with reference to positions or routes relevant to the aircraft concerned.

Radar vectoring

Vectoring is achieved by assigning aircraft specific headings which will enable the aircraft to maintain the desired track.

When vectoring an aircraft, controllers should comply with the following:

- When an aircraft is given its initial vector diverting it from a previously assigned route, the pilot shall be informed of what the vector is to accomplish, and the limit of the vector should be specified (e.g., to position for approach).
- Controlled flights shall not be vectored into uncontrolled airspace except in case of emergency or to avoid adverse meteorological conditions, or on the specific request of the pilot.

When vectoring an IFR flight and when giving an IFR flight a direct routing which takes the aircraft off an ATS route, the controller should ensure that the minimum obstacle clearance exists at all times until the aircraft reaches a point where it is able to resume its own navigation.

When radar vectors are terminated, the controller shall issue an appropriate instruction to the aircraft to return it to its pre-planned route, and the aircraft should be instructed to resume own navigation.

Application of separation

Separation shall only be applied with reference to ATS surveillance systems if there is reasonable assurance that identification of aircraft will be obtained and maintained.

When the control of an identified aircraft will be transferred to a sector that applies procedural separation, or a higher separation minima, this separation must be applied before the aircraft enters the next sector, or the sector of airspace where the higher separation minima applies.

Under no circumstances should the symbols on the radar screen touch or overlap unless vertical separation is assured.

Separation minima based on ATS surveillance

SSR/ADS-B/MLAT based separation minima

When aircraft are under ATS surveillance either from SSR, ADS-B or MLAT, the minimum horizontal separation is 5.0 NM.

This may be reduced to 3.0 NM when radar and/or ADS-B and MLAT systems capabilities at a given location permit.

Separation minima on final approach

A minimum separation of 2.5 NM may be applied between aircraft under ATS surveillance when established on the final approach course within 10 NM of the runway threshold provided:

- The average runway occupancy of aircraft is not more than 50 seconds; and
- Braking action is reported as good and runway occupancy times are not adversely affected by contaminants such as slush, ice, and snow; and
- The aerodrome controller is able to observe visually or by means of surface movement radar or surface movement guidance and control (SMGCS), the runway in use and exit and entry taxiways; and
- Distance based wake turbulence minima do not apply; and
- Aircraft approach speeds are closely monitored by the controller and adjusted where necessary to ensure minimum separation; and
- Aircraft operators and pilots have been made fully aware of the need to exit the runway in an expeditious manner at the assigned exit taxiway

Separation from adjacent airspace

Except where transfer of control to be made, aircraft shall not be vectored closer than 2.5 NM to the boundary of the airspace that a controller is responsible for unless there has been prior coordination with the controller of the adjacent sector. This ensures that minimum horizontal separation will always exist between aircraft in different sectors.

Distance-based wake turbulence separation minima

The following distance-based wake turbulence separation minima shall by applied when aircraft are under ATS surveillance during the approach and departure phases of flight.

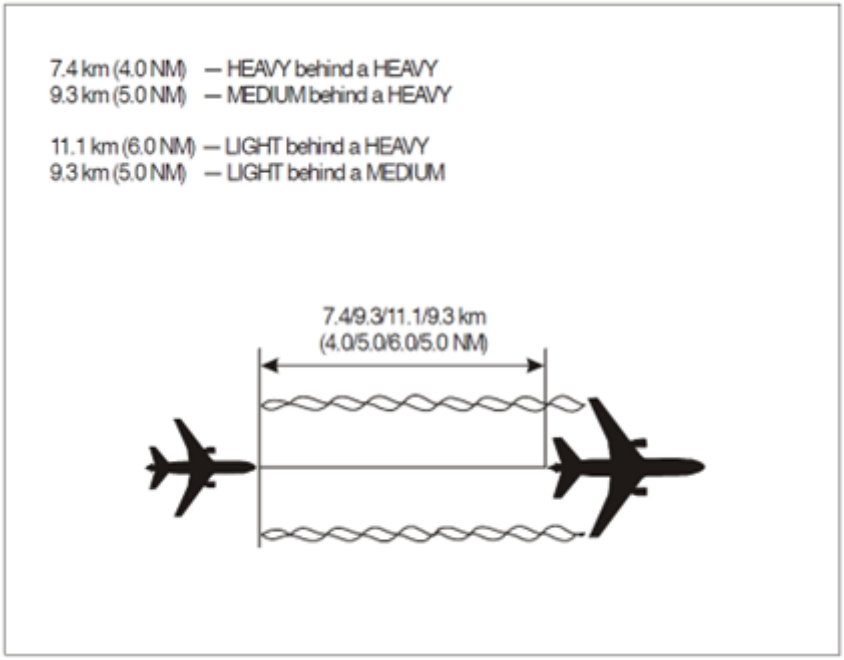
These minima shall be applied under the following circumstances:

- An aircraft is operating directly behind another at the same altitude or less than 1000 ft below; or
- Both aircraft are using the same runway, or a parallel runway separated by less than 760 meters; or
- An aircraft is crossing behind another aircraft at the same altitude or less than 1000 ft below

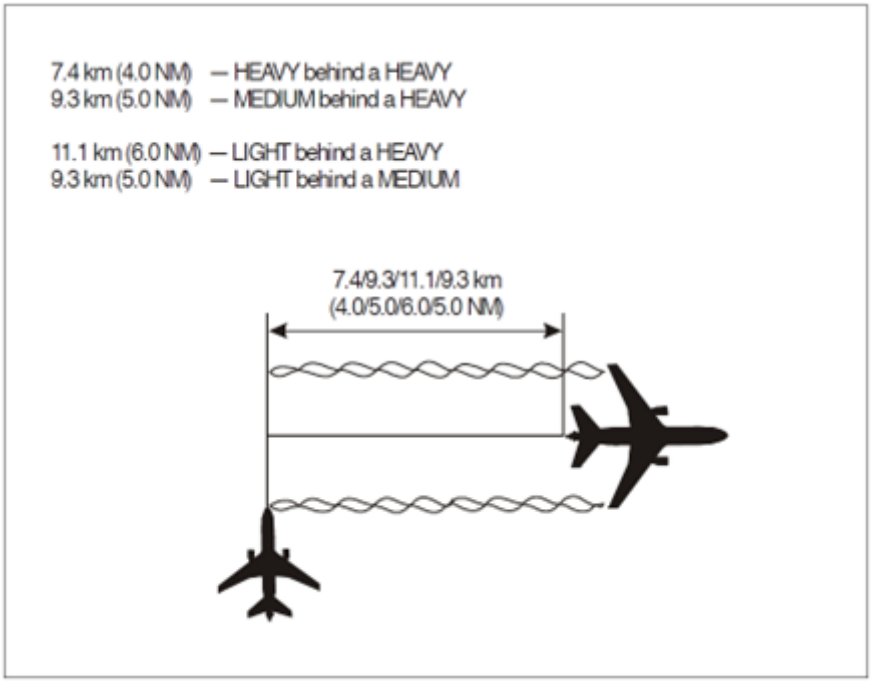
Preceding Aircraft Category Succeeding Aircraft Category Separation Minima	**Succeeding Aircraft Category**	**Separation Minima**
SUPER		
	HEAVY	*6 NM*
	MEDIUM	*7 NM*
	LIGHT	*8 NM*
HEAVY		
	HEAVY	*4 NM*

Preceding Aircraft Category Succeeding Aircraft Category Separation Minima	Succeeding Aircraft Category	Separation Minima
MEDIUM	*5 NM*	
LIGHT	*6 NM*	
MEDIUM	*LIGHT*	*5 NM*

Aircraft operating directly behind:



Aircraft crossing behind:



Separation from aircraft that are holding

Where vertical separation does not exist between aircraft established in a holding pattern and aircraft not holding, a minimum of 5.0 NM of horizontal separation must exist.

Separation of aircraft on reciprocal tracks

Where confirmation has been obtained from radar derived that aircraft on reciprocal tracks have passed, there is no requirement to ensure that minimum radar separation exists before reducing the minimum vertical separation provided:

- Both aircraft are properly identified; and
- Radar label leader lines for both tracks are not crossed; and
- The distance between the position symbols is increasing; and
- The position symbols are not touching or overlapping

Verification of Mode C altitude readout

Verification of pressure-altitude-derived level information Mode C displayed to the controller shall be affected by simultaneous comparison (reported and observed at least once on initial contact by the first controller providing a surveillance service), when an aircraft enters civil controlled airspace after departure from an aerodrome.

Following successful verification, the Mode C information may be considered to remain verified provided it is associated with a Mode A SSR Code that has been previously validated by another controller and that the observed Mode C information has an error of 200ft or less at all levels.

Determination of level occupancy

Maintaining a level

An aircraft may be considered to be maintaining a level when the observed altitude readout is within the tolerances, of the assigned level.

Vacating a level

An aircraft can be considered to have vacated a level during a climb or descent when the observed altitude readout is more than 200ft from the previously occupied level, in the anticipated direction.

Passing a level

An aircraft may be considered to have crossed a level during a climb or descent when the observed altitude readout has passed the level by more than 200ft in the required direction.

Reaching a level

An aircraft may be considered to have reached a level to which it had been cleared when whichever is the greater of 3 sensor or display updates, or 15 seconds has passed since the level information has indicated that it is within the appropriate tolerance.

Departing a runway

Aircraft may be considered to have departed a runway when the surveillance display indicates a positive rate of climb from the aerodrome elevation. However, Mode C information shall not be used when the display varies by more than 200ft from the aerodrome elevation during the take-off roll.

Separation Methods and Minima

Separation is required to ensure there is always a minimum distance between aircraft to minimize the risk of collision. This is provided by means of position reports, or by identification on radar.

There are two main types of separation employed by ATC: vertical and horizontal separation. If at any time one type of separation between aircraft is below the prescribed minimum, the other type of separation must exist. For example, if the horizontal separation between aircraft is below minimum, vertical separation must exist.

Vertical and horizontal separation must be provided:

- Between all flights in Class A and B airspace
- Between all IFR flights in Class C, D, and E airspace
- Between IFR and VFR flights in Class C airspace
- Between IFR and special VFR flights

When issuing clearances, the controller must ensure that it would not reduce the separation between aircraft to below the required minima. In addition, if one type of separation minima cannot be maintained, then another type of separation must be applied between aircraft before any separation minima is infringed.

Vertical separation

Vertical separation minima

Vertical separation is assured by assigning aircraft specific altitudes or flight levels in accordance with the altimeter setting procedures described in section 2.1.

Unless subject to the conditions described below, aircraft flying below FL 290 must be separated by a minimum of 1000 ft. Above this level, aircraft must be separated by at least 2000 ft vertically.

Reduced vertical separation minima (RVSM)

Special instrument and equipment installation is required for an aircraft to be able to operate in RVSM airspace. Between FL 290 and FL 410, RVSM may be applied. Most modern turbine aircraft are equipped to operate in RVSM airspace.

Under RVSM, for aircraft flying below FL 410, the minimum vertical separation is 1000 ft. Above this level, a separation minima of 2000 ft is applied.

Assignment of cruising levels

Aircraft will typically be assigned only one cruising level for an aircraft travelling beyond a controller’s control area. It is the responsibility of the next controller to issue further climb as appropriate.

ATC must also ensure that the cruising level is not below the published minimum enroute cruising level for a specified route or airway.

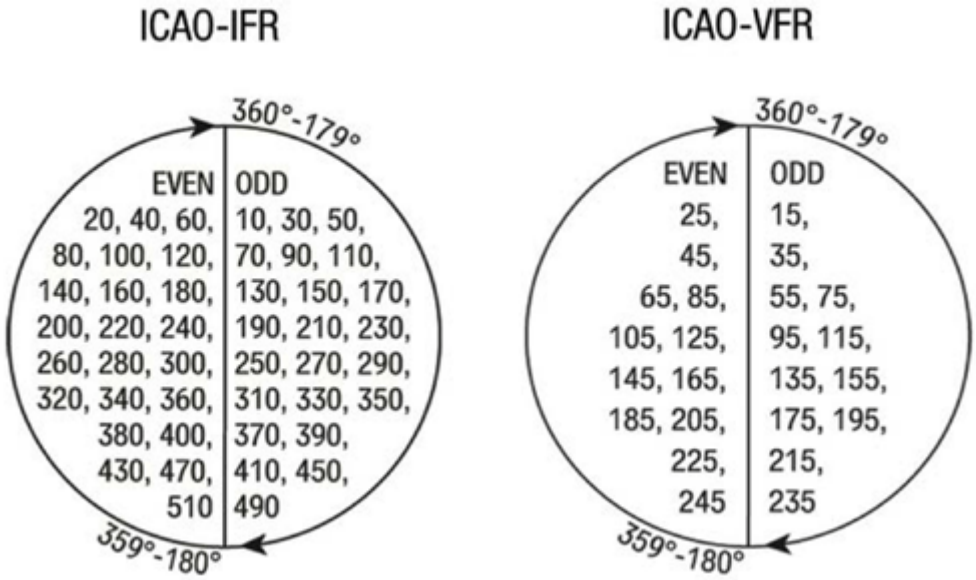
In general, aircraft already occupying a specified cruising level will have priority for that cruising level. For example, when two or more aircraft have requested the same cruising level, the preceding aircraft will normally have priority.

RVSM cruising levels

Cruising levels in RVSM airspace are assigned according to the semi-circular rule *(Table 3-1)*. The semi-circular specifies cruising levels based on an aircraft’s planned magnetic track.

Additionally, any regional level restrictions must also be complied with in conjunction with the semi-circular rule.

Semi-circular rule for aircraft cruising levels



Vertical separation during climb or descent

During a climb or descent, aircraft may only be permitted to initiate a climb or descent to a level previously occupied by another aircraft after the latter has reported vacating that level.

The only exceptions to this rule apply when aircraft are encountering severe turbulence, or their performance is markedly different, such as a lightly loaded 777 following an A320. For these cases, the second aircraft may only be cleared to the level of the fist after it has passed a level separated by the specified minimum.

Consideration must also be given to the vertical speed of aircraft descending in a holding pattern, to ensure that the separation minima is not infringed at any point. If required, ATC should specify minimum or maximum descent rates.

Horizontal separation

Lateral separation

Lateral separation is applied so that the spanwise distance between two aircraft never reduces to below a specified minimum. This is ensured by operating aircraft on different routes at different locations, by visual observation, by, the use of navigational aids or by area navigation (RNAV).

Lateral separation criteria and minima

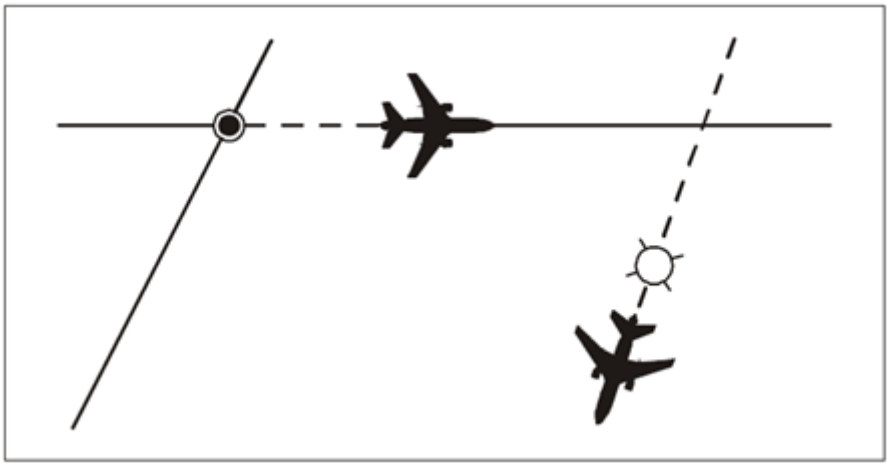
Lateral separation can be applied through the following methods:

- By reference to position reports which positively indicate aircraft geographical location, visually or by reference to a navigational aid
- By reference to VOR, NDB, or GNSS on intersecting tracks or ATS routes separated by a minimum appropriate to the navigational aid used (Table 3-2)

Lateral separation between two aircraft flying VOR or GNSS on crossing tracks:

Angular difference between tracks measured at the common point (degrees)	**1000 ft to FL 190 Distance from common point**	**FL 200 to FL 600 Distance from common point**
15 to 135	*15 NM*	*23 NM*
The distances given here are ground distances between aircraft		

Visual representation of lateral separation based on geographical position:



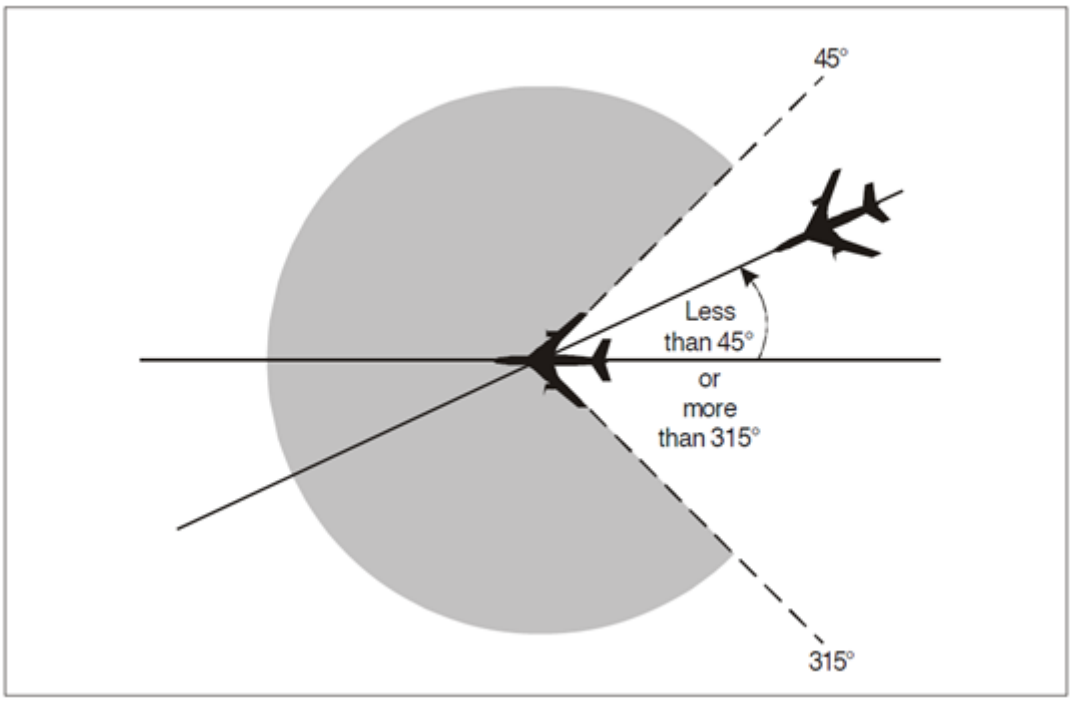
Longitudinal separation

Longitudinal separation is applied so that the distance between two aircraft never reduces below a prescribed minimum on their longitudinal axis (nose to tail). Longitudinal separation will be applied for aircraft on the same or diverging tracks using speed control.

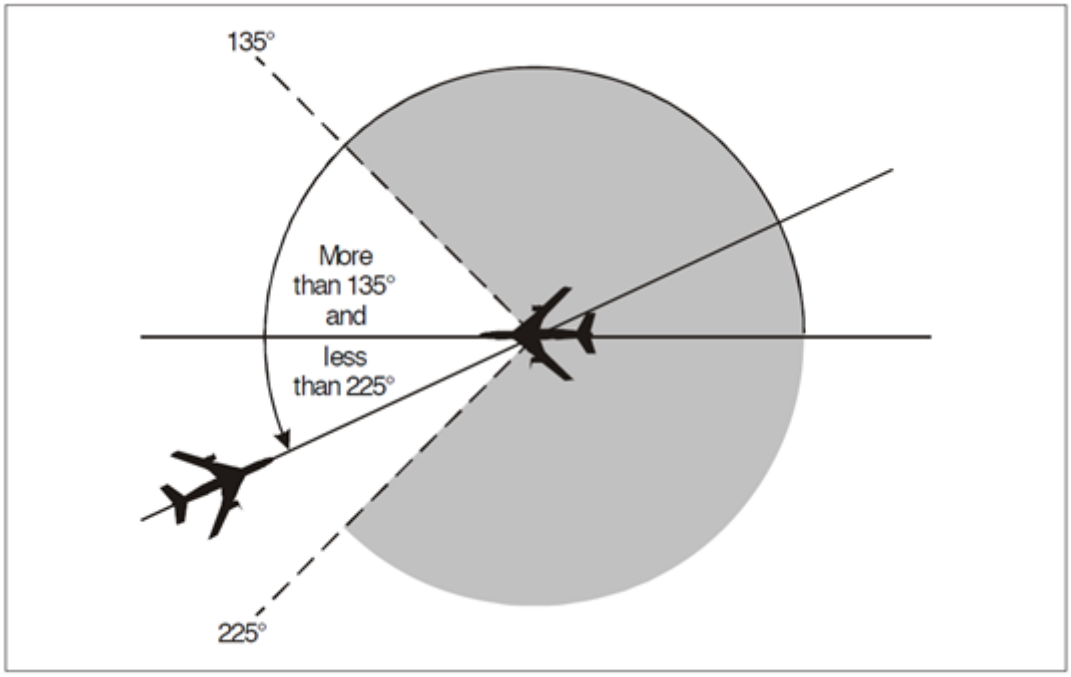
When applying time or distanced based longitudinal separation, controllers must exercise caution for aircraft with different speed characteristics. If a following aircraft maintains a higher speed than the preceding aircraft, speed control must be applied before aircraft are expected to reach minimum separation.

For separation purposes the terms “same track”, “reciprocal track”, and “crossing track” have the following meanings:

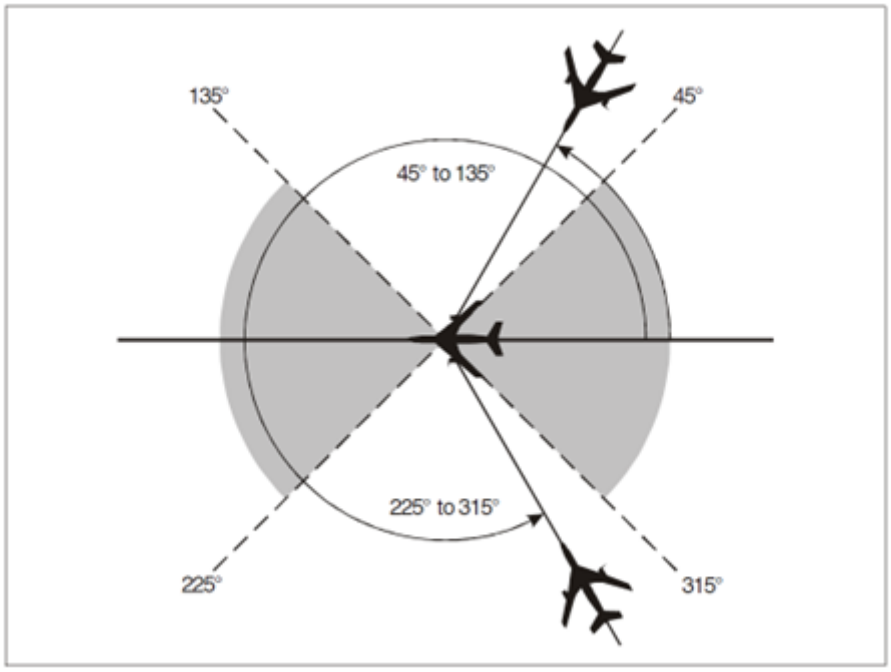
Aircraft on the same track:



Aircraft on reciprocal tracks:



Aircraft on crossing tracks:



Longitudinal separation minima based on distance using GNSS or DME

Aircraft maintaining separation with reference to any combination of DME or on board GNSS systems (RNAV) must be in direct contact with ATC though VHF radio.

The following minima applies for this type of separation.

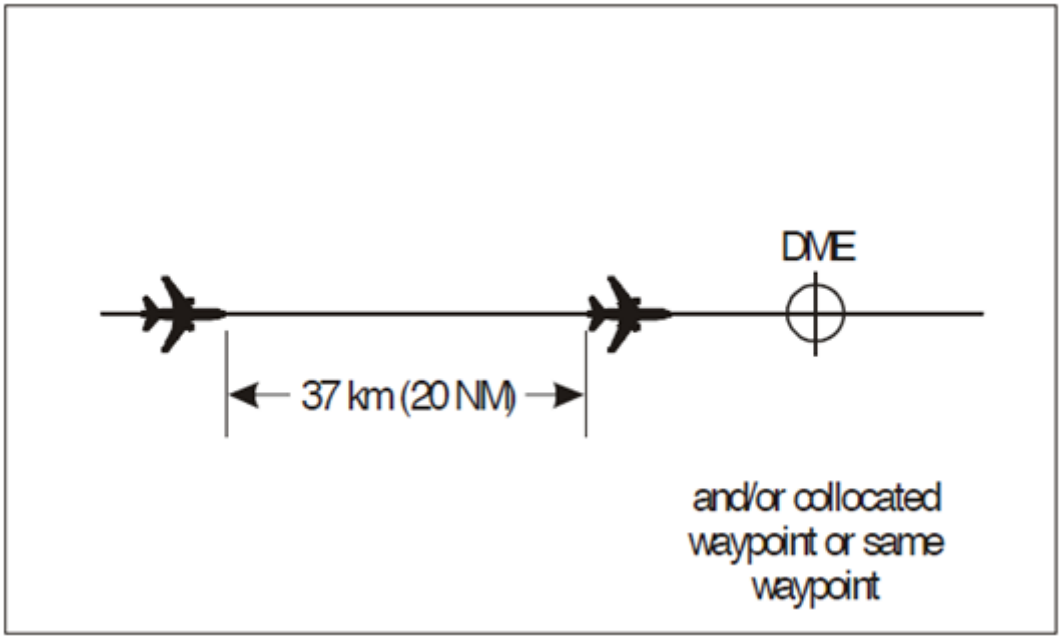
Aircraft at the same level

For aircraft at the same level, and following the same track *(Figure 3-5)* the longitudinal separation minima is 20 NM, provided each aircraft uses the following:

- The same “on track” DME
- An “on track” DME and a collocated waypoint where one aircraft is using DME and the other
- GNSS
- The same waypoint where both aircraft are using GNSS

Separation must be checked by obtaining constant GNSS based or DME based position data at frequent intervals. Aircraft that are ADS-B out capable will satisfy this requirement.

Longitudinal separation for aircraft at the same level on the same track using DME and/or collocated GNSS waypoint:

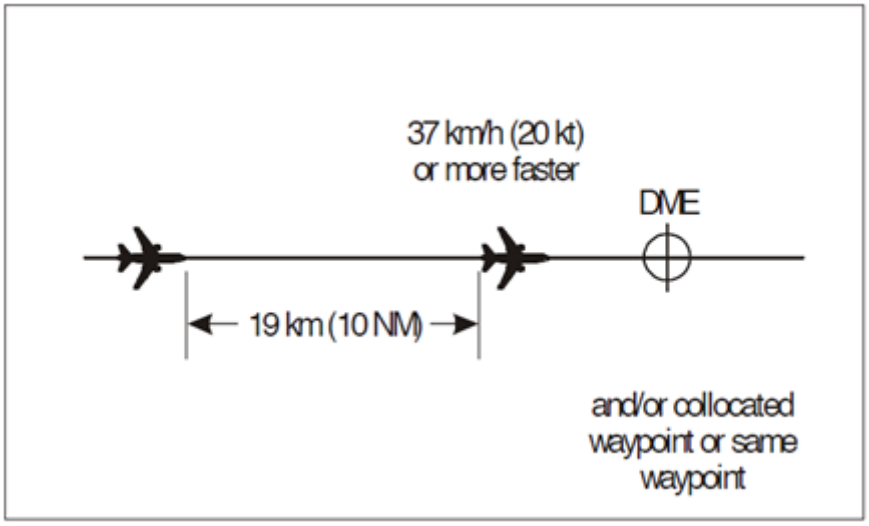


Reduced longitudinal separation

For aircraft at the same level following the same track, the longitudinal separation minima may be reduced to 10 NM, provided the leading aircraft is travelling 20 knots faster or more *(Figure 3-6)*.

The same conditions as 3.2.4.1 will also apply in order to use this reduced separation.

Reduced DME/GNSS based longitudinal separation for aircraft on the same track and at the same level:



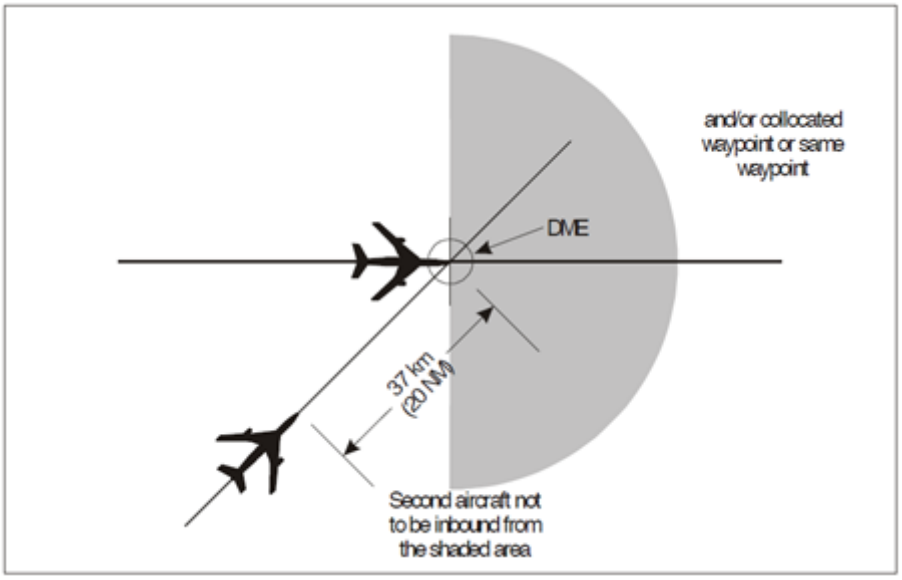
Aircraft on crossing tracks

For aircraft on crossing tracks where the relative angle between the tracks is less than 90 degrees, the aircraft shall be separated by a minimum of 20 NM provided each aircraft reports a distance based on DME/collocated GNSS waypoint *(Figure 3-7)*.

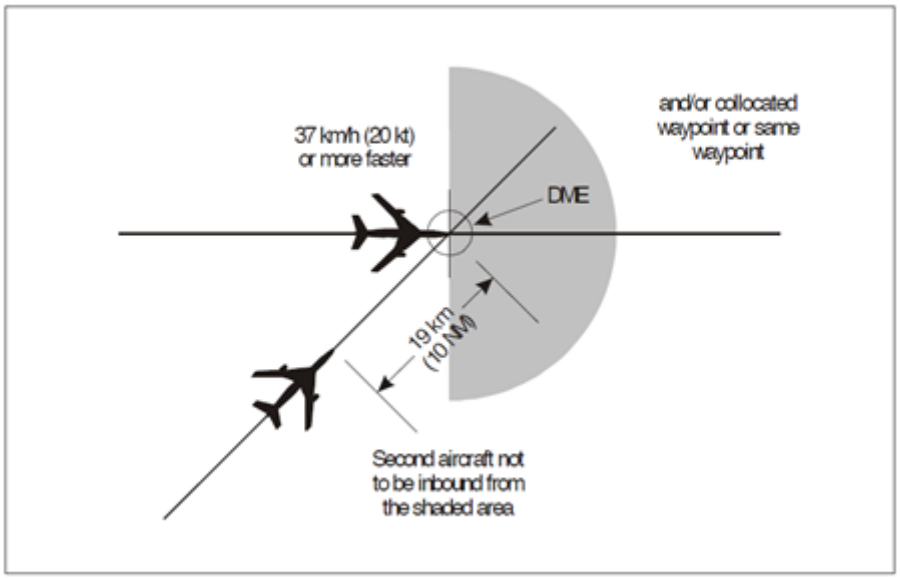
A reduced separation minimum of 10 NM may also be applied if the leading aircraft is travelling 20 knots or faster or more *(Figure 3-8)*.

The same conditions as 4 .2.4.1 shall apply for both these cases.

DME/GNSS based separation for crossing traffic at the same level:



DME/GNSS based reduced separation for crossing traffic at the same level:



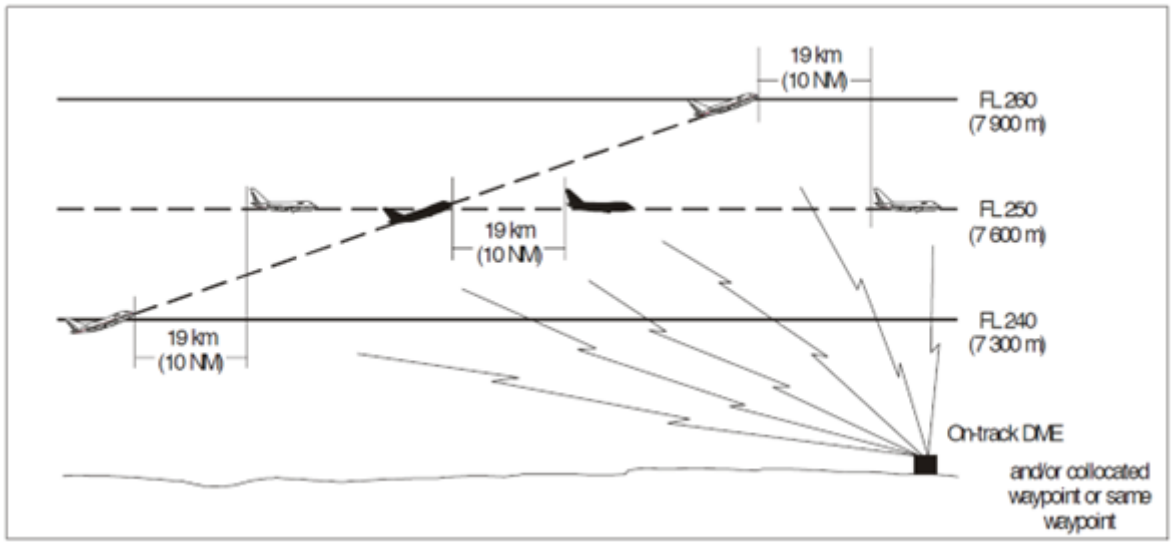
Aircraft climbing or descending

The separation minima for aircraft climbing or descending through the level of another following the same track is 10 NM.

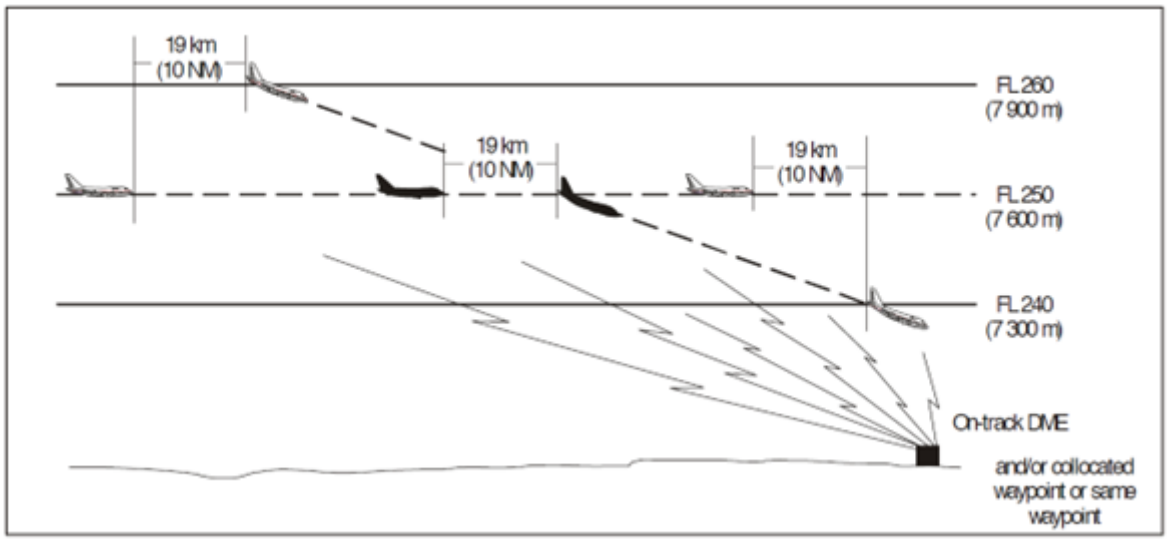
In this case, one aircraft must maintain the same level when vertical separation does not exist *(Figure 3-9, 3-10)*.

The same conditions as 4 .2.4.1 also apply.

DME/GNSS based longitudinal separation for aircraft climbing through the level of another on the same track:



DME/GNSS based longitudinal separation for aircraft descending through the level of another on the same track:


19 km
(10 NM)
19 km
(10 NM)
19 km
(10 NM)
FL 260
(7 900 m)
FL 250
(7 600 m)
FL 240
(7 300 m)
On-track DME
and/or collocated
waypoint or same
waypoint

Separation in the Vicinity of Aerodromes

Procedures for departing aircraft

General

At aerodromes where standard instrument departures (SIDs) are established, departing aircraft should normally be cleared to follow an appropriate SID

If no specific procedures are established or aircraft are unable to comply with a SID, the direction of flight after take-off, the initially cleared level and any other necessary information should be passed to the aircraft.

Standard clearances for departing aircraft

Standard clearances for departing aircraft shall contain the following items:

- Aircraft identification;
- Clearance limit, normally the destination aerodrome;
- Designator of the assigned SID, if applicable;
- Cleared level;
- Allocated SSR code;
- Any other necessary instructions or information not contained in the SID description

Clearances on a SID

Where departing aircraft are expected to comply with all speed and altitude restrictions on the SID, the phrase “CLIMB VIA SID TO ” shall be used by the controller.

When departing aircraft is cleared to proceed directly to a published waypoint on the SID, the speed and altitude restrictions associated with the bypassed waypoints are cancelled. All remaining speed and altitude restrictions remain applicable.

When a departing aircraft is vectored or cleared to a point that is not on the SID, all published speed and altitude restrictions on the SID are cancelled. If necessary, the controller shall:

- Reiterate the cleared level
- Provide speed and altitude restrictions as necessary
- Notify the pilot if is expected that the aircraft will be subsequently instructed to re-join the SID and the expected point where this will occur.

Procedures for arriving aircraft

General

At aerodromes where standard instrument arrivals (STARs) have been established, aircraft will normally be cleared to follow the appropriate STAR. The aircraft shall be advised of the type of approach and runway-in-use as early as possible. After coordination with the approach controller, the first aircraft may be cleared for the approach by the area control center controller.

An IFR flight shall not be cleared for an initial approach below the appropriate minimum altitude specified for the procedure unless.

- The pilot has reported passing an appropriate point as define by a navigation aid or as a waypoint; or
- The pilot reports the aerodrome is and can be maintained in sight; or
- The aircraft is conducting a visual approach; or
- The controller has determined the aircraft’s position by the use of an ATS surveillance system and a lower minimum altitude has been established for that sector.

Standard clearances for arriving aircraft

Where standard clearances are in use for arriving aircraft, provided no terminal delay is expected, the area control center may clear an aircraft to follow a STAR without prior coordination with the approach controller.

Provision shall always be made to inform the approach controller of the sequence of aircraft following the same STAR.

Standard clearances for arriving aircraft shall contain the following items:

- Aircraft identification;
- Designator of the assigned STAR if applicable;
- Runway-in-use except where part of the STAR description;
- Cleared level;
- Any other necessary instruction or information not contained in the STAR description

Clearances on a STAR

Where arriving aircraft are expected to comply with all published altitude and speed restrictions on a STAR, the phrase “DESCEND VIA STAR TO ” should be used.

When arriving aircraft are cleared to proceed directly to a published waypoint on the STAR, the speed and altitude restrictions associated with the bypassed waypoints are cancelled. All remaining speed and altitude restrictions remain applicable.

When arriving aircraft are vectored or cleared to a point that is not on the STAR, all published speed and altitude restrictions on the STAR are cancelled. If necessary, the controller shall:

- Reiterate the cleared level; and
- Provide speed and altitude restrictions as necessary; and
- Notify the pilot if is expected that the aircraft will be subsequently instructed to re-join the STAR and the expected point where this will occur.

Visual approach

An IFR aircraft may be cleared to execute a visual approach provided the pilot can maintain visual reference to the terrain and:

- The reported ceiling is at or above the level of the beginning of the relevant initial approach segment; and
- The pilot reports at the level of the beginning of the initial approach segment or at any time during the instrument approach procedure that with the prevailing meteorological conditions there is reasonable assurance that a visual approach and landing can be completed.

Subject to these conditions, clearance for an IFR aircraft to execute a visual approach may be requested by the pilot or initiated by the controller. In the latter case, the flight crew must agree to continue visually.

For successive visual approaches, separation shall be maintained between aircraft by the controller until the pilot of the second aircraft reports having the first aircraft in sight and is able to maintain own separation. Where both aircraft are HEAVY category aircraft or the preceding aircraft is of a heavier category, a caution of possible wake turbulence shall be provided if the distance between them islower than the appropriate wake turbulence minimum.

Instrument approach

The approach controller shall specify the instrument approach procedure to be used by the arriving aircraft. A flight crew may request an alternative approach procedure and, if circumstances permit, should be cleared accordingly.

If visual reference is established before completion of the approach procedure, the entire procedure must be executed unless the aircraft requests and is cleared for a visual approach.

Holding

In the event of extended delays, aircraft should be advised of such delay, and be permitted to reduce speed in order to absorb some of the arrival delay.

When delay is expected the area control center shall normally be responsible for clearing aircraft to the holding fix and for including holding instructions, expected approach time or onward clearance time as applicable.

Operations on parallel runways

Departing aircraft

Types of operation

Parallel runways may be used for independent instrument departures in the following modes:

- Both runways used exclusively for departures (independent departures); or
- One runway is used exclusively for departures while the other is used for a mixture of departures and arrivals (semi-mixed operations); or
- Both runways are used for mixed arrivals and departures (mixed operations)

Requirements and procedures for independent parallel departures

Independent parallel IFR departures may be conducted on parallel runways provided:

- The minimum distance between runway centerlines is at least 760 m; and
- Departure tracks diverge by at least 15 degrees immediately after take-off; and
- A suitable surveillance system capable of identifying aircraft within 1 NM of the runway is available; and
- ATS operational procedures ensure that track separation is achieved.

Arriving aircraft

Types of operation

Parallel runways may be used for simultaneous instrument operations for:

- Independent parallel approaches; or
- Dependent parallel approaches; or
- Segregated parallel approaches

Requirements and procedures for independent parallel approaches

Independent parallel approaches may be conducted provided that:

- The minimum distance between runway centerlines is 1035 meters and suitable ATS surveillance equipment is available such as SSR, MLAT or ADS-B; and
- Instrument landing system (ILS) approaches are being conducted on both runways; and
- The missed approach track for one approach diverges by at least 30 degrees from the missed approach track of the adjacent approach; and
- Aircraft are advised of the runway identification as early as possible; and
- Vectoring is used to intercept the final approach course; and
- A no transgression zone (NTZ) at least 610 meters wide equidistant between runway centerlines must exist and be clearly marked on the radar display; and

- Separate controllers monitor the approaches to each runway and ensure that where 1000 ft vertical separation is reduced, aircraft do not enter the NTZ and applicable longitudinal separation between aircraft on the same localizer course is maintained; and
- Transfer of control is initiated before the higher of the two aircraft has intercepted the glide slope.
- The approach controller has frequency override capability over aerodrome control

As early as possible when aircraft have established communications with the approach controller, aircraft must be informed that independent parallel approaches are in use. This may be done through an ATIS broadcast.

When vectoring to intercept the ILS localizer course, the final vector should allow the aircraft to intercept at an angle of not greater than 30 degrees and allow for at least 1.0 NM of straight and level flight before the localizer intercept. The vector should also enable the aircraft to fly straight and level for at least 2.0 NM after establishing on the localizer before establishing on the glide path.

A minimum of 1000 ft vertical separation or a minimum radar separation of 3.0 NM must be applied between aircraft on parallel approaches until they are established on the final approach course.

For aircraft on the same localizer course, a minimum separation of 3.0 NM shall be applied unless greater longitudinal separation is required for wake turbulence or other reasons.

When assigning the final heading to intercept the ILS localizer course, the runway shall be confirmed and the aircraft shall be advised of:

- Its position relative to a fix on the ILS localizer course; and
- The altitude to be maintained when established on the ILS localizer course until the glide slope intercept point is reached; and
- If required, clearance for the appropriate ILS approach.

When aircraft are observed to overshoot the turn-on or continue on a track that will penetrate the NTZ, aircraft shall be instructed to return immediately to the correct track.

When an aircraft is observed entering the NTZ, the aircraft on the adjacent ILS localizer course shall be immediately instructed to climb and turn to the assigned heading/altitude to avoid the deviating aircraft.

Flight path monitoring shall not be terminated until:

- Visual separation is applied, provided both controllers are advised wherever visual separation is applied;
- The aircraft has landed, or in the case of a missed approach, 1.0 NM from the departure end of the threshold.

Suspension of independent parallel approaches

Independent parallel approaches shall be suspended to runways with centerlines that are spaced less than 1525 meters from each other under certain meteorological conditions such as wind shear, turbulence, crosswind, and thunderstorms, which may increase the instances of localizer deviations.

Requirements and procedures for dependent parallel approaches

Dependent parallel approaches may be conducted provided:

- The runway centerlines are spaced by 915 meters; and
- Aircraft are vectored to intercept the final approach track; and
- Suitable SSR equipment is available; and
- ILS approaches are conducted on both runways; and
- Aircraft are advised that approaches are in use for both runways (this may be provided in the ATIS); and
- The missed approach track for one approach diverges by 30 degrees from the missed approach track of the adjacent approach; and
- Approach control has frequency override capability over aerodrome control.

A minimum vertical separation of 1000 ft or a minimum radar separation of 3.0 NM is is provided to aircraft during the turn-on to intercept the localizer course.

The minimum radar separation between aircraft established on the final approach course shall be:

- 3.0 NM for aircraft on the same localizer course unless increased longitudinal separation is required for wake turbulence; or
- 2.0 NM between aircraft established on adjacent localizer courses

Requirements and procedures for segregated parallel operations

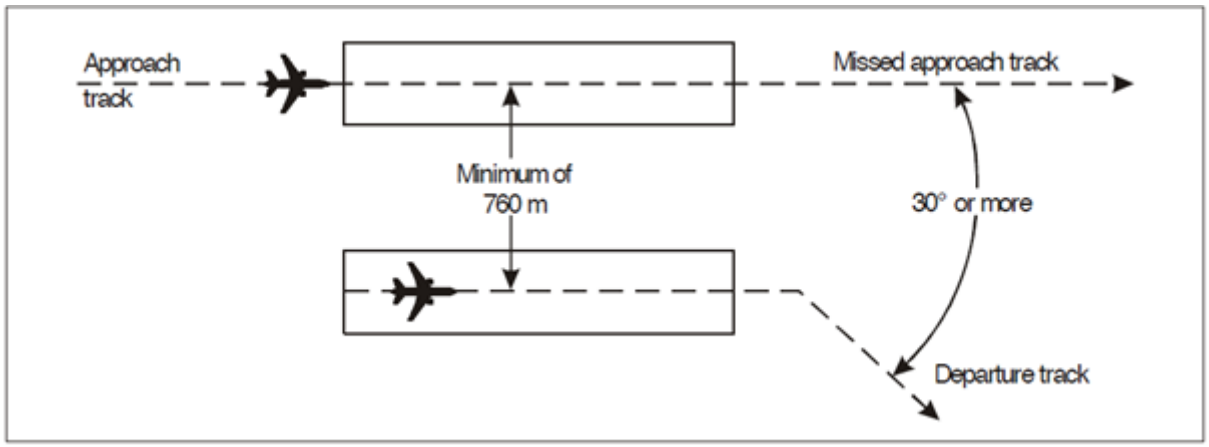
Segregated parallel operations *(Figure 4-1)* may be conducted on parallel runways:

- The runway centerlines are spaced by 760 meters
- The nominal departure track diverges by at least 30 degrees from the missed approach track of the parallel approach.

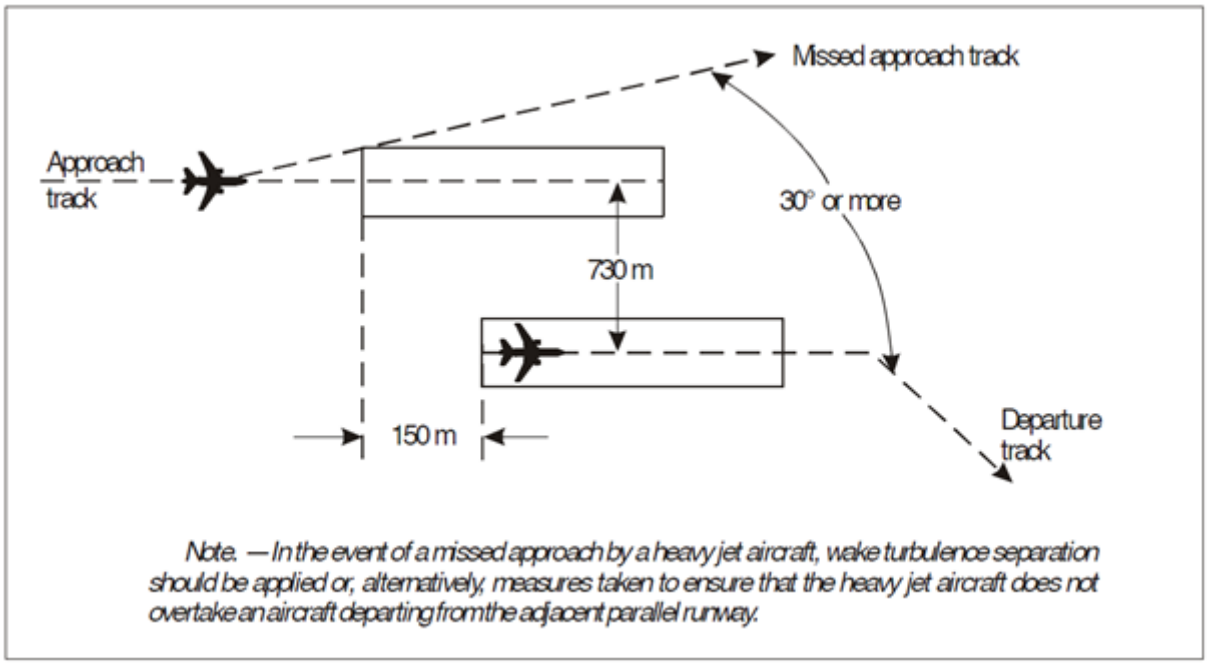
The minimum distance between parallel runway center lines for segregated parallel operations may be decreased by 30 meters for each 150 meters the arrival runway is staggered toward the arriving aircraft, to a minimum of 300 meters *(Figure 4-2)*.

The following types of approaches may be conducted in segregated parallel operations provided suitable surveillance radar and suitable ground services are available such as an ILS.

Segregated parallel operations:



Segregated parallel operations where runways are staggered:



Note. — In the event of a missed approach by a heavy jet aircraft, wake turbulence separation should be applied or, alternatively, measures taken to ensure that the heavy jet aircraft does not overtake an aircraft departing from the adjacent parallel runway.

Radar Separation

Radar separation defines the **minimum horizontal and vertical distance** that must be maintained between two aircraft in flight.

Since **safety is the top priority in aviation**, controllers must ensure separation is maintained at all times. **Radar separation is considered maintained when either horizontal or vertical separation (or both) exist between aircraft.**

When aircraft **lose both horizontal and vertical separation**, it is classified as a **Loss of Separation (LoS)**. If a controller is responsible for a **LoS**, it will result in an automatic failure during an exam.

Radar separation applies wherever **air traffic control (ATC) has radar equipment** available. In **Approach and Center sectors**, radar is always used to verify separation. **Tower controllers at international airports also use radar screens**, so radar separation must be ensured in the **tower environment** for **departures and approaches**.

A separate guide is available detailing **radar separation procedures for tower controllers**.

When is Separation Required?

The requirement for **radar separation** depends on the **airspace** and the applicable **flight rules**.

Radar Separation Requirements

Radar separation is **mandatory** between:

- **All flights in airspace A and B** (not applicable in some countries).
- **IFR to IFR** in airspace **C, D, and E**.
- **IFR to VFR** in airspace **C**.
- **Special VFR to IFR** within a **Control Zone (CTR)**.

Vertical Separation

The following **minimum vertical separation** applies between aircraft requiring separation:

Flight Level Range	Vertical Separation	Remarks
FL410 - UNL	2000 FT	
FL290 - FL410	2000 FT	**CVSM** (Conventional Vertical Separation Minimum, exception)

1000 FT	**RVSM** (Reduced Vertical Separation Minimum, standard)	
GND - FL245	1000 FT	

> Vertical separation applies at both **altitudes (AMSL)** and **flight levels (FLs)**.
> Vertical separation **is not used on final approach**, where **only horizontal separation** is applied.

Horizontal Separation

The following **minimum horizontal separation** applies between aircraft requiring separation:

Flight Level Range	Horizontal Separation
FL245 - UNL	5 NM
GND - FL245	3 NM
Final approach (within 10 NM)	2.5 NM

> Horizontal separation is **always measured as a direct line** between the **centers of aircraft radar targets**.

Formation Flight Considerations

- **Formation flights must be separated from other traffic by 1 NM more than the required minimum distance.**
- **Two formation flights must be separated from each other by 2 NM more than the required minimum distance.**

Wake Turbulence Considerations

If **wake turbulence separation** requirements **exceed** the above values, the **higher separation value always applies** to ensure safety.

Wake Turbulence Separation

Wake turbulence refers to **vortex turbulence** generated by aircraft, particularly during **takeoff and landing**. Controllers must ensure **minimum separation distances** to prevent accidents caused by wake turbulence.

When is Wake Turbulence Separation Required?

Wake turbulence separation applies in situations where **wake turbulence is expected**, including:

Enroute Separation (Radar-Separated Aircraft)

Separation is required if:

- An aircraft is directly **behind another aircraft** at the **same altitude** or **less than 1000ft below**.
- An aircraft **crosses behind another aircraft** at its **6 o'clock position**, at the **same altitude** or **less than 1000ft below**.

Approach and Departure Phases

Separation is required when:

- An aircraft is directly **behind another aircraft** at the **same altitude** or **less than 1000ft below**.
- An aircraft **crosses behind another aircraft** at its **6 o'clock position**, at the **same altitude** or **less than 1000ft below**.
- Both aircraft use the **same runway** or **parallel runways** less than **760m apart**.
- Aircraft use **crossing or parallel runways** (**760m or more apart**) and one aircraft flies **through the flight path** of the preceding aircraft at the **same altitude** or **less than 1000ft below**.

Exceptions: When Wake Turbulence Separation is NOT Required

Wake turbulence separation **does not apply to**:

- **VFR approach flights**.
- **IFR approach flights performing a visual approach**, where the pilot:
  - Has **reported the preceding aircraft in sight**.
  - Has been **instructed to follow it** and **maintain their own separation**.

> **In these cases, a wake turbulence warning must be issued: "CAUTION WAKE TURBULENCE"**.

Phases of Flight for Wake Turbulence Application

Departure Phase

A **VFR flight** remains in the **departure phase** until:

- Reaching **1000ft above aerodrome level**.
- Reaching **level flight**.
- Entering **right downwind**.

Approach Phase

A **VFR flight** is in the **approach phase** when:

- It is at or below **1000ft above aerodrome level**.
- It has entered the **traffic pattern**.
- It has begun its **final descent** within a **control zone**.

Special Cases:

> A **touch-and-go** is considered an **approaching aircraft until touchdown**, after which it is handled as a **departing aircraft**. A **low approach** is considered **approaching until it crosses the runway threshold**, after which it is considered **departing**.

Wake Turbulence Categories (WTC)

Aircraft are categorized based on **Maximum Takeoff Mass (MTOM)**:

WTC	MTOM
Light (L)	≤ 7t
Medium (M)	7t < MTOM < 136t
Heavy (H)	≥ 136t
Super (J)	A388; A225

> Aircraft in the **Super (J) category** are treated as **Heavy (H) above FL100**. WTC information is always available in the **flight plan**.

Minimum Wake Turbulence Separation Values

Wake turbulence separation can be **distance-based** or **time-based**.

- **Distance-based** separation is the **default standard**.
- **Time-based** separation applies **when distance-based separation is not feasible**.

Distance-Based Wake Turbulence Separation

Preceding Aircraft	Following Aircraft	Minimum Separation
Super	Heavy	5.0 NM
	Medium	7.0 NM
	Light	8.0 NM
Heavy	Heavy	4.0 NM
	Medium	5.0 NM
	Light	6.0 NM
Medium	Light	5.0 NM

Time-Based Wake Turbulence Separation

Time-based separation is used for **departing and approaching aircraft**.

If an aircraft departs from an **intersection** or **crossing runway**, **1 minute is added** to the separation value.

Departing aircraft

Preceeding	Suceeding	Separation value	Separation value (intersection)
M	L	2 min	3 min
H	L	2 min	3 min
	M	2 min	3 min
J	L	3 min	4 min
	M	3 min	4 min
	H	2 min	3 min

Approaching aircraft

Preceeding	Suceeding	Separation value
M	L	3min

H	L	3min
	M	2min
J	L	4min
	M	3min
	H	2min

Minimum Time Separation: Mixed Arrival/Departure Use with Displaced Threshold

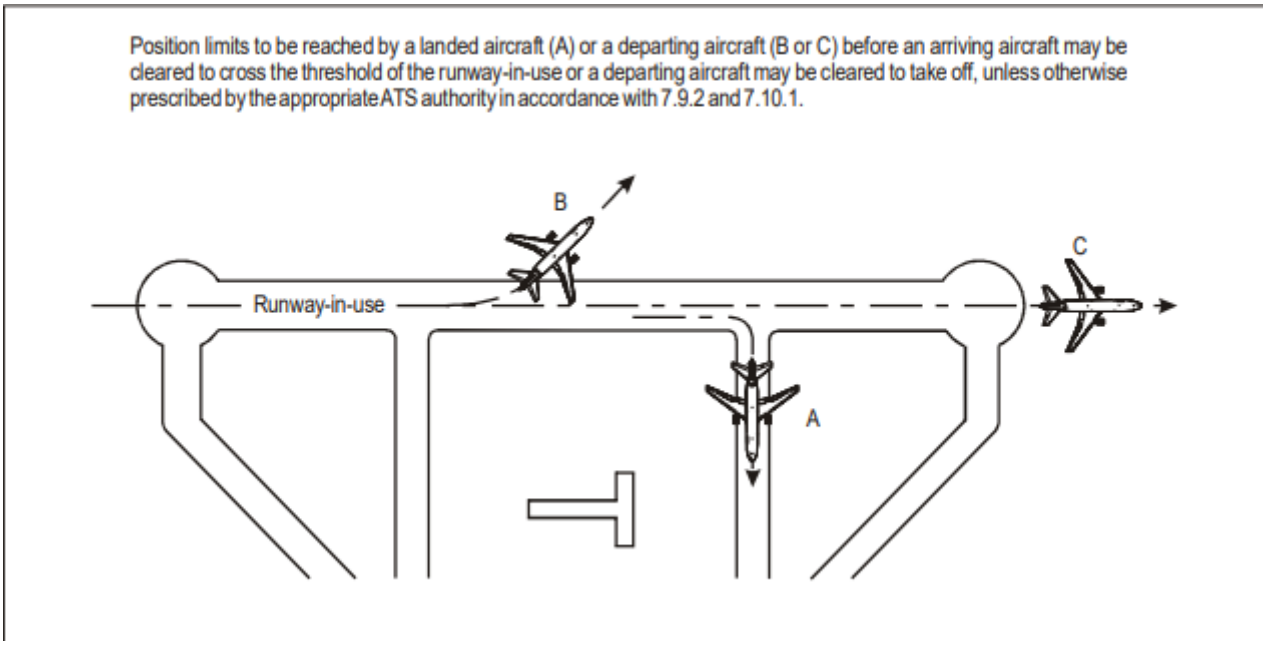
Suceeding Aircraft	Preceding Aircraft	Time Separation
Departing Heavy	Super arrival	2 minutes
Departing Light/Medium	Heavy arrival	2 minutes
Departing Light	Medium arrival	2 minutes
Heavy arrival	Super departure	2 minutes
Light/Medium arrival	Heavy departure	2 minutes
Light arrival	Medium departure	2 minutes
Departing Light/Medium	Super arrival	3 minutes
Light/Medium arrival	Super departure	3 minutes

Runway Separation

Only one aircraft may occupy a runway at a time. Takeoff or landing clearance must not be issued if another aircraft is occupying the runway unless specific conditions allow otherwise.

A departing aircraft will not normally be cleared for takeoff until:

- The preceding departing aircraft has **crossed the end of the runway-in-use** or has **started a turn**.
- All preceding landing aircraft are **clear of the runway-in-use**.



- **Takeoff clearance** may be issued when there is reasonable assurance that prescribed separation will exist at the time of departure.
- If an ATC clearance is required before takeoff, it must be **transmitted and acknowledged** before issuing the takeoff clearance.
- The takeoff clearance must be issued **when the aircraft is ready for departure** and at or approaching the departure runway. The **runway designator must be included** to avoid misinterpretation.
- An **immediate takeoff clearance** may be issued before the aircraft enters the runway, requiring the aircraft to taxi onto the runway and depart in one continuous movement.

A landing aircraft will not normally be permitted to cross the runway threshold unless:

- The preceding departing aircraft has **crossed the end of the runway-in-use** or **started a turn**.
- All preceding landing aircraft are **clear of the runway-in-use**.

To expedite traffic, a landing aircraft may be instructed to:

- **Hold short** of an intersecting runway after landing.
- **Land beyond** the touchdown zone. *(Not applicable to HEAVY aircraft.)*
- **Vacate the runway** at a specified exit taxiway.
- **Expedite vacating** the runway.

Controllers must consider aircraft type, runway length, exit locations, braking action reports, and weather conditions when issuing such instructions. If a pilot is unable to comply, they must inform ATC immediately.

When necessary, such as in low visibility, an aircraft may be instructed to report when it has vacated the runway. The report must be made **after the entire aircraft is beyond the relevant runway-holding position**.

Reduced runway separation

Reduced Runway Separation (RRS) can only be applied if the following conditions are met:

- **Tailwind component does not exceed 5 knots**
- **Visibility is at least 5 km** and the ceiling is **1,000 ft (300 m) or higher**
- **Wake turbulence separation is maintained** at all times
- **Braking action is not significantly impaired** by precipitation
  - On VATSIM, braking is considered impaired by **snow (SN), snow grains (SG), ice grains (PL), hail (GR), and rime (GS)**
  - **Rain (RA) and drizzle (DZ) do not affect RRS**
- The following aircraft in the RRS sequence **must receive traffic information** about the preceding aircraft

RRS can **only be applied during daylight hours**, from **30 minutes after sunrise to 30 minutes before sunset**.

Aircraft Categories

For RRS, aircraft are divided into three categories based on size and type:

Category	Aircraft Type	Examples
Category 1	Single-engine propeller aircraft, max takeoff weight **≤ 2,000 kg**	C152, C172, P28A, A210, DA40, DR40, DV20, SR22
Category 2	Single-engine propeller aircraft (2,000 – 7,000 kg) and twin-engine propeller aircraft (≤ 7,000 kg)	DA62, PA34, TBM9, BE58, B350
Category 3	All other aircraft	AT75, DH8D, C25C, CRJ9, B738, A359

Departure Behind Departure

The following departure must receive **traffic information** about the leading departure. If all conditions are met, the second departure may be cleared for takeoff **as soon as the first departure has taken off and is a defined distance ahead**.

Preceding Aircraft	Succeeding Aircraft	Minimum Distance After Takeoff
Category 1 or 2	**Category 1**	**600 m**
Category 1 or 2	**Category 2**	**1,500 m**
Category 3	**Any Aircraft**	**2,400 m**

Example:

A **DV20 (Cat 1) IFR** departs first, followed by a **BE58 (Cat 2) VFR**. Normally, the second aircraft would have to wait until the DV20 passes the end of the runway. Under **RRS**, the BE58 can be cleared for takeoff **as soon as the DV20 is airborne and at least 1,500 m ahead**. This improves runway efficiency.

Arrival Behind Arrival

The second approach must receive **traffic information** about the first approach. If all conditions are met, the second approach may be cleared for landing **before the preceding aircraft has vacated**, provided the first aircraft keeps moving and does not backtrack.

Preceding Aircraft	Succeeding Aircraft	Minimum Distance After Landing
Category 1 or 2	**Category 1**	**600 m** and moving toward an exit without backtracking
Category 1 or 2	**Category 2**	**1,500 m** and moving toward an exit without backtracking
Category 3	**Any Aircraft**	**2,400 m** and moving toward an exit without backtracking

Example:

A **C172 (Cat 1) IFR** lands first, followed by a **TBM9 (Cat 2) IFR**. Normally, the TBM9 would have to wait until the C172 clears the runway. Under **RRS**, the TBM9 can be cleared to land **as soon as the C172 has passed 1,500 m beyond the threshold and is still moving toward an exit**.

Arrival Behind Departure

The arriving aircraft receives **traffic information** about the departure. If all conditions are met, the landing clearance may be issued **once the departing aircraft is airborne and past the defined distance**.

Preceding Departure	Succeeding Arrival	Minimum Distance Past Threshold
Category 1 or 2	**Category 1**	**600 m**

Preceding Departure	Succeeding Arrival	Minimum Distance Past Threshold
Category 1 or 2	**Category 2**	**1,500 m**
Category 3	**Any Aircraft**	**2,400 m**

Example:

A **DA40 (Cat 1) departs**, followed by a **B350 (Cat 2) arriving**. Normally, the B350 would wait until the DA40 passes the end of the runway. Under **RRS**, the B350 can receive landing clearance **as soon as the DA40 is airborne and at least 1,500 m past the threshold**.

Departure Behind Arrival

RRS does not apply in this case. A departure must wait until a landing aircraft has completely vacated the runway.

Scenario	Minimum Requirement for the Second Aircraft
Departure behind departure	First aircraft is airborne and has passed **600m (Cat 1), 1,500m (Cat 2), or 2,400m (Cat 3)** ahead
Arrival behind arrival	First aircraft has landed and is still moving toward an exit, at least **600m (Cat 1), 1,500m (Cat 2), or 2,400m (Cat 3)** past the threshold
Arrival behind departure	Departing aircraft is airborne and has passed **600m (Cat 1), 1,500m (Cat 2), or 2,400m (Cat 3)** past the threshold
Departure behind arrival	**RRS not applicable** – standard separation required

Intersecting runways

Many airports use intersecting runways to accommodate varying wind conditions or maximize efficiency in limited space. Proper separation procedures must be followed to ensure safe operations.

Departure Following a Departure

When two aircraft are departing from intersecting runways, the second aircraft may only begin its takeoff roll if one of the following conditions is met:

- The first aircraft has taken off and initiated a turn that ensures safe separation, or
- The first aircraft has completely crossed the intersection.

Departure Following an Arrival

If a landing aircraft is on the intersecting runway, the departing aircraft may only begin its takeoff roll when:

- The landing aircraft has **fully vacated the runway**, or
- The landing aircraft has **stopped before the intersection** as instructed and completed its landing roll, or
- The landing aircraft has **crossed the intersection**.

Arrival Following a Departure

If an arriving aircraft is following a departing aircraft on an intersecting runway, the arriving aircraft may only cross the runway threshold when:

- The departing aircraft has taken off and initiated a turn that maintains separation, or
- The departing aircraft has completely crossed the intersection.

Arrival Following an Arrival

For two landing aircraft on intersecting runways, the second aircraft may only cross the runway threshold if:

- The first aircraft has **vacated the runway**, or
- The first aircraft has **stopped before the intersection** as instructed and completed its landing roll, or
- The first aircraft has **crossed the intersection**.

Simultaneous landings on intersecting runways are only permitted under the following conditions:

- One of the intersecting runways must have at least **2200 meters** of available distance between the threshold and the intersection.
- Additional conditions must be met:
  - **Visual Meteorological Conditions (VMC)** must exist.
  - Braking action must not be negatively affected.
  - Both aircraft must be informed of the simultaneous landings.
  - The aircraft landing on the **2200m runway must stop before the intersection** as instructed.

Scenario	Condition for Second Aircraft to Proceed
Departure following a departure	First aircraft has either **crossed the intersection** or **initiated a turn**.
Departure following an arrival	Landing aircraft has **vacated the runway**, **stopped before the intersection**, or **crossed the intersection**.
Arrival following a departure	Departing aircraft has **crossed the intersection** or **initiated a turn**.
Arrival following an arrival	First arriving aircraft has **vacated the runway**, **stopped before the intersection**, or **crossed the intersection**.

Opposite direction

When an aircraft departs in the **opposite direction**, the following aircraft may only commence takeoff when:

- The **preceding aircraft has crossed the point** where the following aircraft will start its takeoff roll.

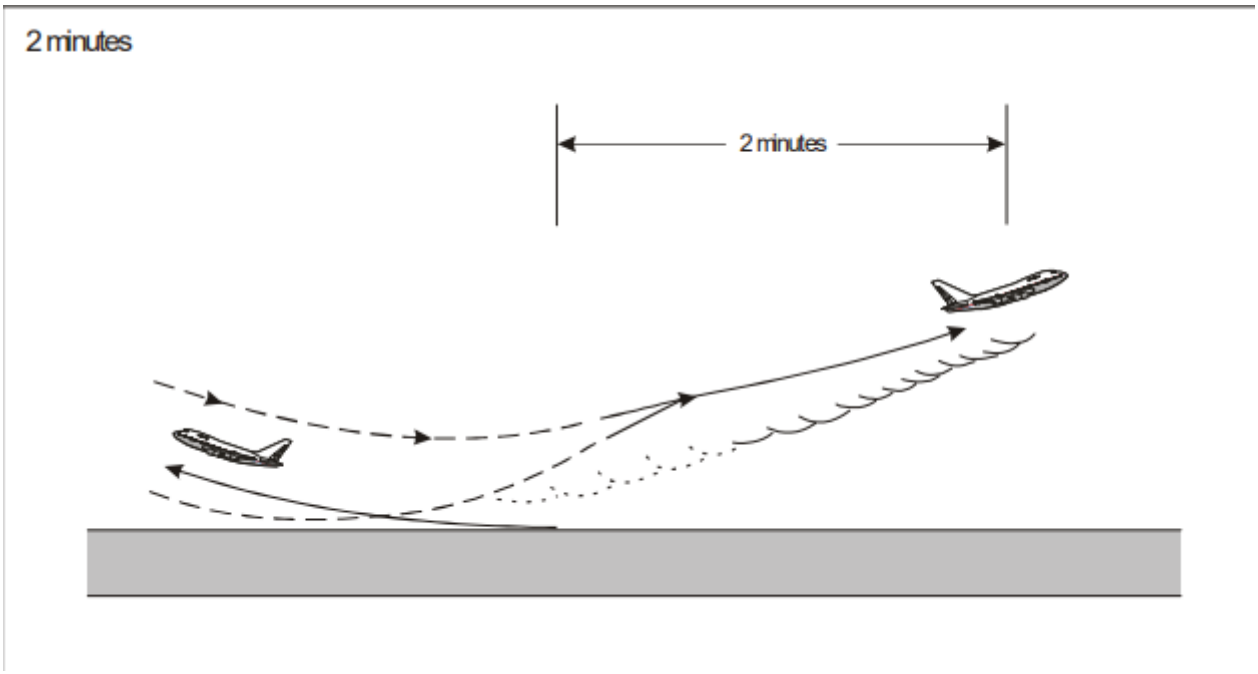
Additionally, a **minimum separation of 2 minutes** must be applied when:

- A **LIGHT or MEDIUM aircraft follows a HEAVY aircraft**.
- A **LIGHT aircraft follows a MEDIUM aircraft** that is making a **low or missed approach**.

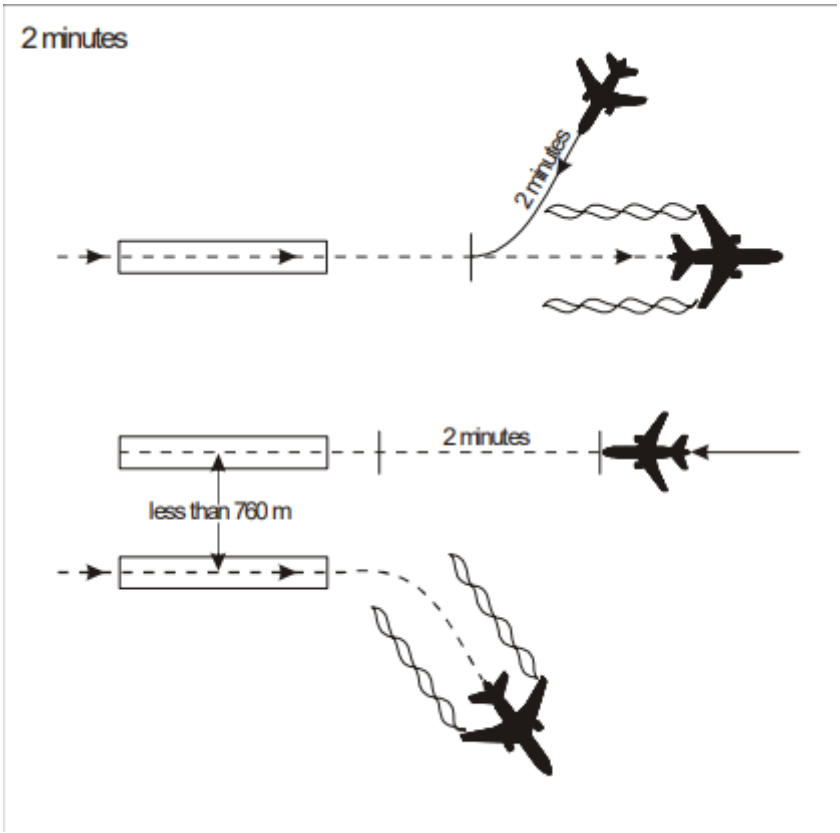
These rules apply to:

- **Takeoffs from opposite-direction runways**.
- **Landings on the same runway in the opposite direction** or on a **parallel opposite-direction runway** separated by less than **760m (2,500 ft)**.

Two-minute wake turbulence separation for opposite-direction take-off:



Two-minute wake turbulence separation for opposite-direction landing:


2 minutes
2 minutes
2 minutes
less than 760 m

Visual Separation

Visual separation refers to two types of separation procedures used in different scenarios:

1. **Visual separation in the vicinity of aerodromes** – Relevant primarily for **tower controllers** and, in some cases, **approach controllers**.
2. **Delegation of separation to pilots during climb or descent** – Relevant for **approach controllers**.

Visual Separation in the Vicinity of Aerodromes

Radar separation (excluding **wake turbulence separation** and **runway separation**) may be **reduced** near an aerodrome if **one** of the following conditions is met:

- The **tower controller** has continuous **visual contact** with both aircraft and provides **traffic information** to at least one of them.
- Both **pilots** have the **other aircraft in sight** and confirm they can maintain adequate separation.
- If **one aircraft is following another**, the **following pilot** reports they **have the leading aircraft in sight** and can maintain separation.

> The terms **“vicinity of the aerodrome”** and **“adequate separation”** are not explicitly defined, so **controllers must use discretion**, such as when **avoiding a missed approach** where minimum separation could be compromised.

Delegation of Separation During Climb or Descent

Under specific conditions, **responsibility for separation** between two aircraft may be **delegated to the pilots**.

- Own separation is applied:
  - upon crew request;
  - in airspace classes D and E only;
  - at or below 10,000 ft;
  - during climb or descent;
- All flights must be in VMC (they may fly under IFR though);
- All pilots must agree to the use of own separation;

- Alternative instructions should be given to IFR flights if it is considered that VMC may not be maintained for the whole duration of the clearance.

Phraseology Example: Own Separation - Final

Station	Phraseology
ATC	"RAM123, traffic, traffic two o’clock, five miles, A320, report in sight."
Pilot	"Traffic in sight, RAM123."
ATC	"RAM123, number three, cleared visual approach runway 35R, in the event of missed approach, climb runway heading to 4'000ft, maintain visual separation from A320 to runway 35L."

Own separation is **NOT** to be used:

- On controller's initiative;
- In airspace classes A, B and C;
- At night;
- In IMC;
- Above 10,000 ft;
- If all aircraft are maintaining their level;
- If the use of own separation is not agreed by all pilots concerned.

Procedural Control

General

The general principles of air traffic control are the same regardless of whether procedural or surveillance methods are used (i.e. the controller monitors the traffic situations, detects and solves conflicts by providing separation, and ensures orderly flow of the air traffic). The difference lies in the way situational awareness is built and updated (by pilot reports, estimates and visual observation), the separation minima themselves (as described in ICAO Doc 4444, Chapter 5) and the support tools (flight strips instead of a situation display).

Where procedural control is employed, separation is ensured by dividing the airspace either vertically or laterally. In a Control Zone where reliable surveillance is not available, it may be classified as procedural, meaning separation is maintained using specified time or distance criteria. There are four types of procedural separation: lateral, longitudinal, vertical, and visual.

Typical Applications

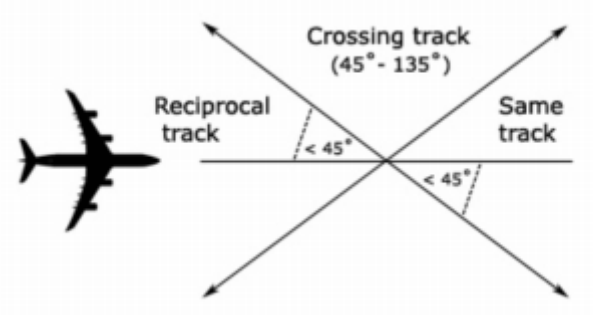
Typical applications of procedural control include:

- In airspace where surveillance cover is not available (e.g. oceanic airspace or sparsely populated areas)
- In terminal movement areas (TMAs) if the traffic levels are such that they do not warrant the installation and maintenance of a surveillance system
- In aerodrome control zones (CTRs), especially if the traffic density is relatively low and the aerodrome layout is not complex (e.g. only one runway, one apron and a few taxiways)
- Backup solution in case of complete failure of all surveillance-based systems

Separation

Longitudinal Separation

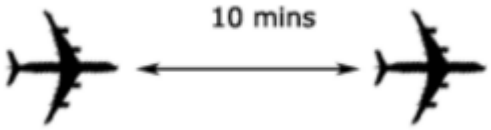
Longitudinal separation is only applied between aircraft flying on identical or reciprocal tracks.



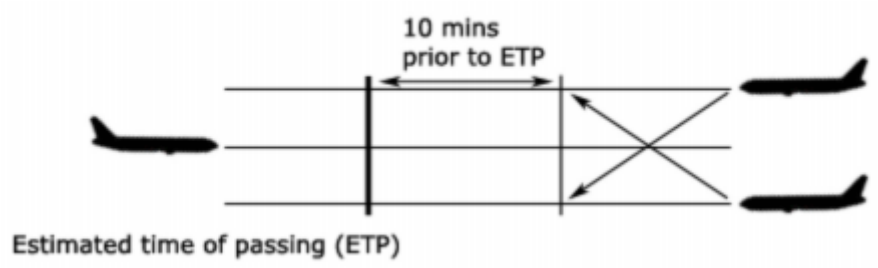
To maintain longitudinal time separation, pilot-provided estimates must be used to ensure that the time interval between two aircraft meets or exceeds the required minimum.

Time

Same Track:
Aircraft following the same track, including situations where one is climbing or descending through another's level, must maintain a separation of at least 10 minutes.



Reciprocal Track:
Aircraft on reciprocal tracks must be separated using vertical separation. A vertical separation minimum of 10 minutes must be in place before the estimated passing time.



After the estimated time of passing, no aircraft may climb or descend through the other's level until at least 10 minutes have passed. If positive identification of passing is confirmed, this requirement may be reduced, which will be discussed later in this section.

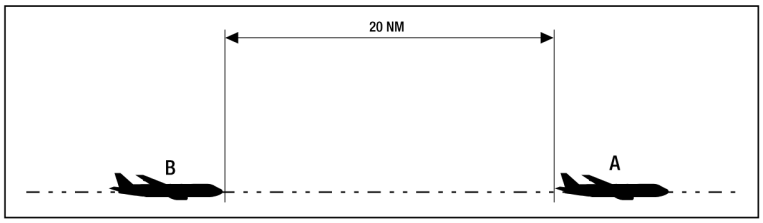
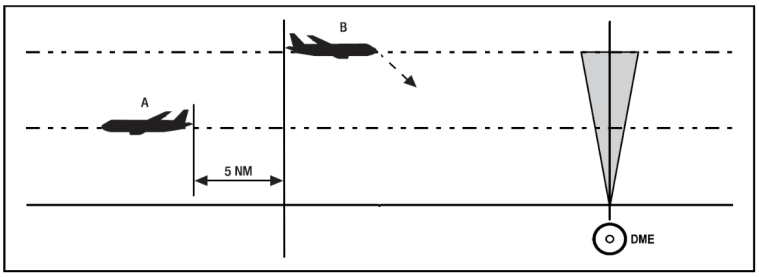
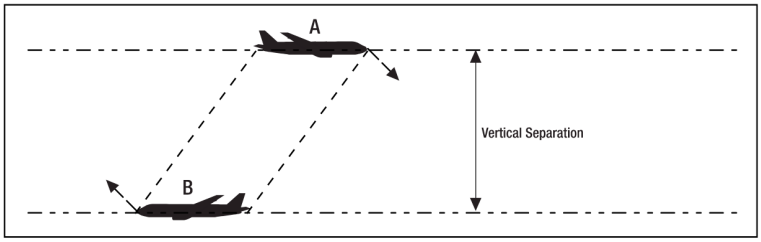
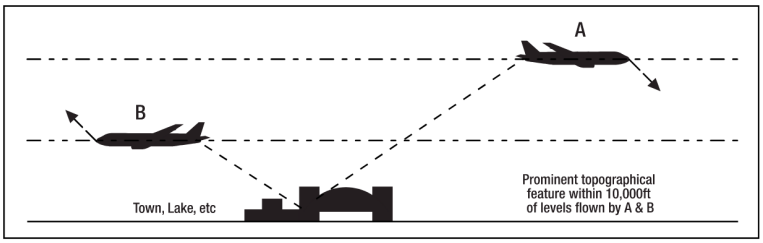
Distance

Distance Reports:
The lead aircraft must be navigating directly to or from the designated navigational aid. The distance report from the lead aircraft must always be obtained before requesting it from the following aircraft.

Distance checks must be performed as outlined in the table below:

Condition	Minimum Interval for Distance Checks
No speed control applied	15 minutes
Speed control applied to limit closure to ≤ 35 knots or Mach 0.06	15 minutes
Closure rate exceeds 35 knots or Mach 0.06	Standard is not valid
Speed control applied to maintain a stable or increasing separation	30 minutes

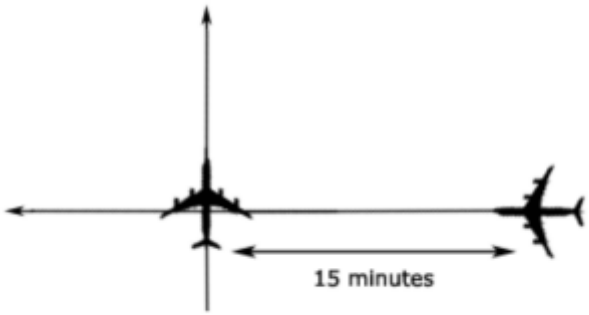
Methods of Ensuring Distance-based Separation:

Method	Conditions	
20nm Exists Between	• Aircraft are on the same track.	
5nm Definite Passing	• Reports indicate that the aircraft have passed and the distance is opening.	
Sight and Pass	• Both aircraft report sighting and passing the other by day, and in Oceanic by night. • Both aircraft are above A100. • There is no possibility of incorrect identification by other aircraft.	
Opposite Side of Visual Fix	• Both aircraft report passing the same visual fix. • The visual fix must be a prominent topographical feature within 10,000 FT of the levels of each aircraft.	

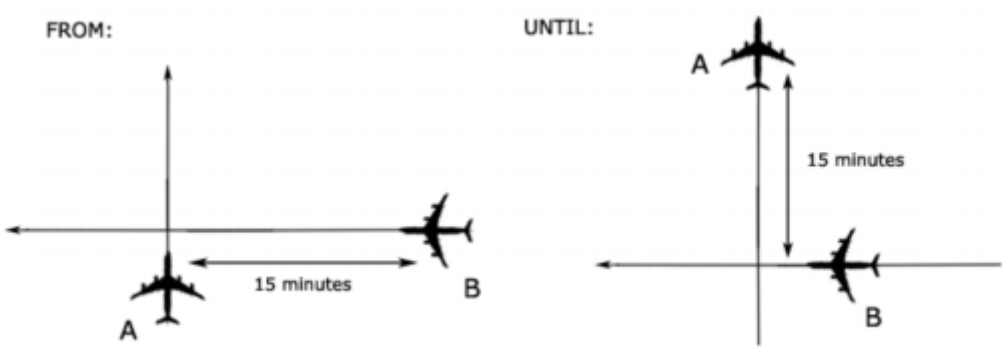
Lateral Separation

Time-based Crossing Track

Aircraft on crossing tracks, including cases where one is climbing or descending through another's level, must maintain a separation of 15 minutes at the intersection point.



If a 15-minute separation cannot be ensured at the crossing point, vertical separation must be applied. This vertical separation remains in effect from the time the second aircraft is 15 minutes from the intersection until the first aircraft has passed it by 15 minutes.



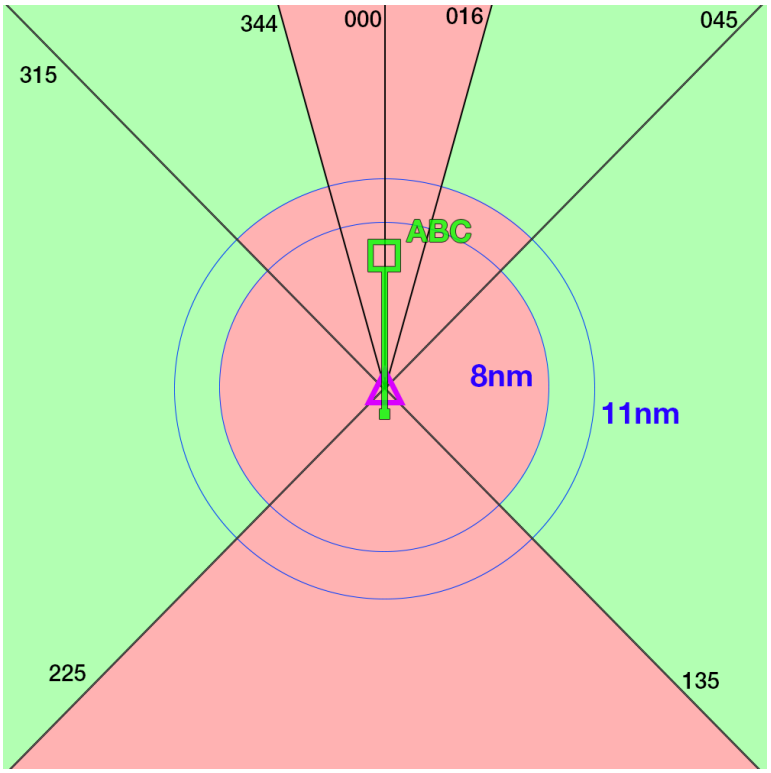
Lat Sep Table

Lateral separation is determined based on the concept of a **Lateral Separation Point (Lat Sep point)**—the distance at which procedural lateral separation is considered to exist, depending on the angle of intersection between two tracks. The required separation distances are outlined in the table below:

Intersection Angle	Required Separation
0° - 15°	No lateral separation
16° - 44°	11nm
45° - 135°	8nm
136° - 180°	No lateral separation

Visually, an aircraft at point **ABC** is considered laterally separated from aircraft in the **green zones** , whereas it is **not** laterally separated from aircraft in the **red zones**. These criteria only apply when both aircraft are tracking directly to or from the crossing point.

This method is particularly useful for planning restrictions when surveillance coverage is not guaranteed.



Vertical Separation

Vertical separation is the most commonly used method in non-radar environments, allowing controllers to maintain aircraft at different flight levels without the risk of loss of separation—unless one aircraft needs to climb or descend.

The primary reference for aircraft altitudes and assigned levels is pilot-reported data.

Altitude / Flight Level	Separation Standard
SFC - FL290	1000ft
FL290 - FL410	RVSM: 1000ft, Non-RVSM: 2000ft
FL410 - FL600	2000ft
Any Supersonic Aircraft, regardless of FL	3000ft

> RVSM airspace is only applicable between **FL290 and FL410**.
> An aircraft **cannot** be cleared to climb or descend into a level that was previously occupied by another aircraft until that aircraft has confirmed it is clear of the relevant levels.

Procedures

Timed Approaches

Timed approaches, utilizing either nonradar procedures or radar vectors to align aircraft with the final approach course, may be conducted at airports with an active tower or approach controller, provided the following conditions are met:

- The procedure relies on appropriate NAVAIDs and either standard or special instrument approach procedures, or sufficient radar coverage to facilitate:
  - Aircraft holding at a designated fix on the approach course or receiving radar vectors for a straight-in approach while adhering to specified minima, including wake turbulence requirements.
  - Aircraft proceeding toward the airport along the approach course while crossing the holding or approach fix at an assigned altitude, if required.
  - Aircraft continuing descent to execute an approach at the destination airport.
- Continuous communication must be maintained with the aircraft until the pilot is instructed to switch to the tower frequency.
- If multiple missed approach procedures exist, none should require a course reversal.
- If only one missed approach procedure is available, the following conditions must be met:
  - A course reversal is not necessary.
  - The reported ceiling and visibility meet or exceed the highest prescribed circling minimums for the approach in use.

> Ceiling minima are determined by comparing the Minimum Descent Altitude (MSL) with the reported ceiling (AGL) plus the airport elevation.

Approach Sequence

Once an aircraft passes the final approach fix inbound (for a nonprecision approach) or the outer marker or equivalent fix inbound (for a precision approach), clearances for subsequent timed approaches should be issued as follows:

- Clear the following aircraft for approach, instructing it to descend to the altitude vacated by the preceding aircraft.
- Assign a specified time for the following aircraft to cross the final approach fix or outer marker inbound.
- When using radar to manage sequencing, vector aircraft to cross the final approach fix or outer marker at the assigned time.

If an alternative missed approach procedure is unavailable and weather conditions are below the required minima, the next aircraft should only be cleared for approach once the preceding aircraft has landed or canceled its IFR flight plan.

All aircraft must be transferred to the tower frequency before reaching the final approach fix.

Sequence Interruption

If necessary, the established approach sequence may be interrupted to accommodate aircraft executing a different type of approach.

Level Flight Restriction

When weather conditions indicate that an aircraft will be in IFR conditions at the final approach fix (for nonprecision approaches) or the outer marker or equivalent fix (for precision approaches), the second aircraft must be cleared for approach early enough to ensure at least **one minute of level flight** before crossing the final approach fix or outer marker.

Additional spacing should be applied when needed, considering:

- The relative speeds of the aircraft involved.
- Current weather conditions.
- The distance between the approach fix and the airport.
- The type of approach being conducted.

Time Check

Prior to issuing a specific time for an aircraft to depart the approach fix inbound, a time check should be provided—unless the aircraft is being vectored to the final approach course.

Missed Approaches

- If weather conditions suggest a missed approach is likely, an alternative missed approach procedure should be assigned to the next aircraft.
- If an aircraft executes a missed approach, the next aircraft may continue the approach only if it has been assigned an alternative missed approach procedure.
- Radar control must be maintained, or remaining aircraft must be held at their assigned altitudes until conditions permit issuing further approach clearances.

In cases where a timed approach sequence is in place and an aircraft misses an approach:

- Retain radar control of subsequent aircraft or instruct them to maintain their last assigned altitude (at or above the minimum holding altitude).
- The aircraft should return to the holding or approach fix and remain there until approach clearance can be issued under safe traffic conditions.