PARALLEL RUNWAY OPERATION

1. Introduction

In many large airports around the world, an air traffic controller can have several parallel runways.
Air traffic controllers can use simultaneous operations on parallel runways following specific rules and depending of airport layout.

The main objective of operations on parallel runways is to increase runway capacity and aerodrome flexibility. The largest increase in overall capacity includes the use of independent approaches to parallel or near-parallel runways.

The safety of parallel runway operations in controlled airspace is affected by several factors:

- The use and accuracy of the radar monitoring system
- The effectiveness of the controller intervention when an aircraft deviates from the approach course
- The precision with which aircraft fly the approach

2. Definition

2.1. Simultaneous parallel approaches and departure

Independent parallel approaches are simultaneous approaches to parallel instrument runways where radar separation minima are not prescribed between aircraft using adjacent ILS

Dependent parallel approaches are simultaneous approaches to parallel instrument runways where radar separation minima between aircraft using adjacent ILS are prescribed.

Independent parallel departures are simultaneous departures for aircraft departing in the same direction from parallel runways.

Segregated parallel approaches and/or departures are simultaneous operations on parallel or near-parallel instrument runways in which:

- One runway is used exclusively for approaches
- The other runway is used exclusively for departures

It should be noted that when the spacing between two parallel runways is lower than the specified value determined by wake turbulence considerations, the runways are considered as a single runway with regard to vortex wake separation.

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2.2. Mixed and semi-mixed parallel operations

Mixed mode parallel operations are:

- Runways are used for both take offs and landings (mixed operation)

Semi-mixed parallel operations are:

- One runway is used exclusively for departures while other is used for both departures and arrivals.
- One runway is used exclusively for approaches while other is used for both departures and arrivals.

2.3. Near-parallel runways

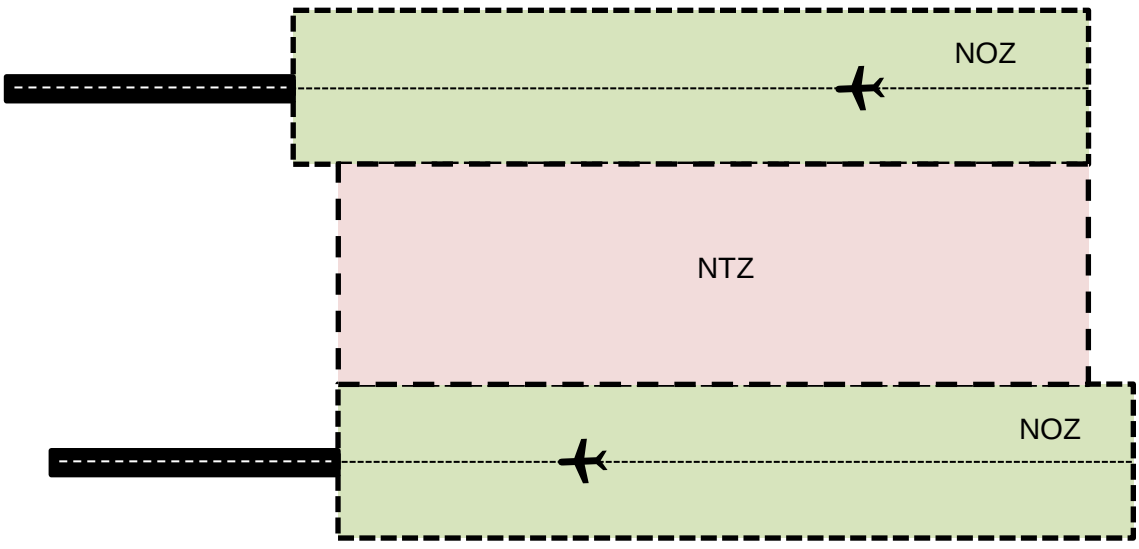
Near parallel runways are non-intersecting runways whose extended centre lines have an angle of convergence or divergence of 15° or less.

Examples:

2.4. No transgression zone and normal operating zone

Normal operating zone is the airspace of defined dimensions extending to either side of an ILS localizer course. Only the inner half of the normal operating zone is taken into account in independent parallel approaches.

No transgression zone is a corridor of airspace of defined dimensions located centrally between the 2 extended runway centre lines, where a penetration by an aircraft requires a controller intervention to manoeuvre any threatened aircraft on the adjacent approach.



3. Minimum Distance for parallel operation

Where parallel non-instrument runways are intended for simultaneous use, the minimum distance between their centre lines should be:

- 210 m

Where parallel instrument runways are intended for simultaneous use, the minimum distance between their centre lines should be:

- 1035 m (3400ft) for independent parallel approaches
- 915 m (3000ft) for dependent parallel approaches
- 760 m (2500ft) for independent parallel departures
- 760 m (2500ft) for segregated parallel operations

For segregated parallel operations, the specified minimum distance may be decreased by 30 m for each 150 m that the arrival runway is staggered toward the arriving aircraft, to a minimum of 300 m; and should be increased by 30 m for each 150 m that the arrival runway is staggered away from the arriving aircraft;

If the minimum distance between each runway centre line is below 760m, the simultaneous operation for take-off and landing is not possible.

4. Requirements for independent parallel departures

Independent departure may be conducted if:

- Runway centre lines are spaced by minimum of 760m
- The departure tracks diverge by at least 15° immediately after take-off
- Surveillance radar is capable of identification of aircraft within 2km or 1NM from the end of the runway

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

- Independent departures
- Semi-mixed operation
- Mixed operation

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5. Requirements for independent parallel approach

Independent parallel approaches may be conducted if:

- Runway centre lines are spaced by minimum of 1035m
- Surveillance radar is capable of identification of aircraft (see note*)
- Instrument landing systems (ILS) are being conducted on both runways
- Missed approach track for one approach diverges by at least 30° from the missed approach track of adjacent approach
- Aircraft are advised of the runway identification (or ILS localizer frequency) as early as possible
- Vectoring is used to intercept the ILS localizer course
- A no-transgression zone (NTZ) at least 610m (2000ft) wide is established equidistant between extended runway centre lines and is depicted on the situation display
- Aircraft shall not penetrate the NTZ

Note* of surveillance radar performance specification:
The regulation defines the minimum specification of secondary surveillance radar. But with using IvAc, we have a perfect tool which is not affected by the environment. We simplify this documentation with suppression all non-useful requirements for IVAO.

For independent parallel approaches two aerodrome controllers should be required, one for each runway, with separate aerodrome control frequencies

As early as practicable after an aircraft has established communication with approach control, the aircraft shall be advised that independent parallel approaches are in force.
This information may be provided through the ATIS.

5.1. Radar vectoring requirements

When vectoring to intercept the ILS localizer course, the final vector shall enable the aircraft to intercept the ILS localizer course at an angle not greater than 30° and to provide at least 1.0 NM (2km) straight and level flight prior to the ILS localizer.

The vector shall also enable the aircraft to be established on the ILS localizer course in level flight for at least 2NM (3.7km) prior to intercepting the ILS glide path.

5.2. Minimum separation during parallel approaches

A minimum of 1000ft (300m) vertical separation or a minimum of 3NM (5.6km) radar separation shall be provided until aircraft are established:

- Inbound on the ILS localizer course and
- Within the normal operating zone (NOZ)

Each pair of parallel approaches has a high side and a low side for vectoring to provide vertical separation until aircraft are established inbound on their respective parallel ILS localizer course. The high side altitude should be 1000ft (300m) above the low side at least until 10NM (19km) from the threshold.

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A minimum of 3NM (5.6 km) radar separation shall be provided between aircraft on the same ILS localizer course unless increased longitudinal separation is required due to wake turbulence.

The controllers shall monitor the approach to each runway and ensure that when the 1000ft vertical separation is reduced that:

- Aircraft do not penetrate the no-transgression zone (NTZ)
- The applicable minimum longitudinal separation between aircraft on the same ILS localizer course is maintained.

All approach regardless of meteorological conditions shall be provided with flight path monitoring using radar to ensure aircraft do not enter the NTZ. The controller shall issue control instructions and information to ensure separation between aircraft.

The NTZ is a corridor of airspace established equidistant between 2 extended runway centre lines. The NTZ has a minimum width of 2000ft (610m) and extends from the nearest threshold to the point where the 1000ft (300m) vertical separation is reduced between aircraft on the adjacent extended runway centre lines.

5.3. No-transgression zone (NTZ) penetration

When aircraft is observed to overshoot the turn-on or to continue on a track which will penetrate the no transgression zone (NTZ), the aircraft shall be instructed to return immediately to the correct track.

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

The heading instruction shall not exceed 45° track difference with the ILS localizer course.
No heading instruction shall be given when aircraft altitude is below 400ft.

5.4. Suspension of independent parallel approaches

Independent parallel approaches to parallel runways spaced by less than 1525m between their centre lines shall be suspended under certain meteorological conditions including:

- Wind shear
- Severe turbulence
- Downdrafts
- Significant crosswind
- Significant meteorological conditions such as thunderstorms
- Other conditions prescribed by local ATS authority.
- The aircraft shall be advised that approaches are in use in both runways. This information may be provided through the ATIS.

6. Requirements for dependent parallel approach

Independent parallel approaches may be conducted if:

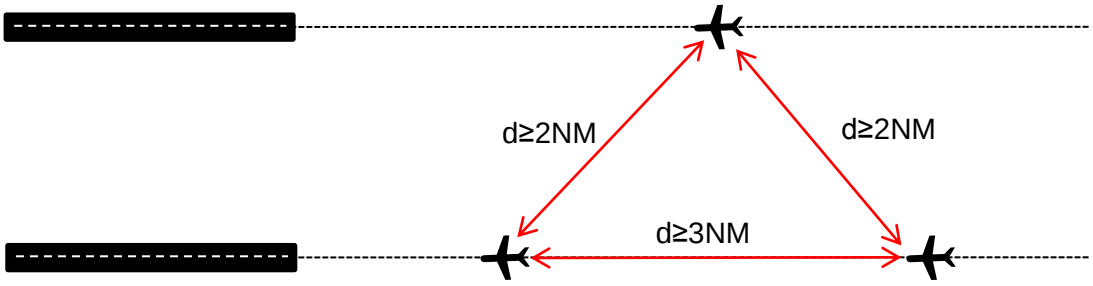
- Runway center lines are spaced by minimum of 915m
- Surveillance radar is capable of identification of aircraft
- Instrument landing systems (ILS) are being conducted on both runways
- Missed approach track for one approach diverges by at least 30° from the missed approach track of adjacent approach
- Vectoring is used to intercept the ILS localizer course

6.1. Minimum separation during parallel approaches

A minimum of 1000ft (300m) vertical separation or a minimum of 3NM (5.6km) radar separation shall be provided between aircraft during turn-on to parallel ILS localizer courses.

A minimum of 3NM (5.6 km) radar separation shall be provided between successive aircraft on the same ILS localizer course unless increased longitudinal separation is required due to wake turbulence

A minimum of 2NM (3.7 km) radar separation shall be provided between successive aircraft on adjacent ILS localizer courses.



Each pair of parallel approaches has a high side and a low side for vectoring to provide vertical separation until aircraft are established inbound on their respective parallel ILS localizer course. The high side altitude should be 1000ft (300m) above the low side at least until 10NM (19km) from the threshold.

7. Requirements for segregated operations on parallel runways

Theoretical studies and practical examples indicate that maximum aerodrome capacities (take-off + landing) can be achieved by using parallel runways in a mixed mode of operation.

However, other factors result in a lower achievable capacity like:

- The mix of aircraft types
- Environmental considerations
- Landside infrastructure
- Non-availability of landing aids

Because of these constraints, maximum runway capacity may, in some cases, only be achieved by adopting a fully segregated mode of operation:

- One runway is used exclusively for landings
- The other runway is used exclusively for departures

7.1. Advantages

The advantages to be gained from segregated parallel operation as compared with mixed parallel operation are:

- Separate monitoring controllers are not required
- No interaction between arriving and departing aircraft on the same runway
- Reduction in the number of potential missed approach
- Less complex ATC environment for approach and tower controllers
- Reduced possibility of pilot error due to selection of wrong ILS frequency

7.2. Requirements

Segregated parallel operation may be conducted if:

- Runway centre lines are spaced by minimum of 760m
- The departure tracks diverge by at least 30° immediately after take-off from the missed approach track of the adjacent approach

The following types of approaches may be conducted in segregated parallel operations for the specific type of approach:

- ILS approach
- Surveillance radar or precision radar approach
- Visual approach

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8. Simultaneous operations on parallel instrument runways

The primary purpose for permitting simultaneous operations on parallel or near-parallel instrument runways is to increase runway capacity.

The maximum capacity when operating parallel runways simultaneously cannot be defined only with runway considerations.
Taxiway layout (presence/absence of high speed taxiway), the position of passenger terminals (close or not to a runway), traffic to cross active runways can:

- Lead to delays
- Decrease the safety level due to the possibility of runway incursions

8.1. Approach minima

In the case of simultaneous parallel approaches, the approach minima of each runway are not affected. The operating minima used are identical to those applied for single runway operations.

8.2. Determining the mode of operations

Theoretical studies and practical examples indicate that maximum aerodrome capacities (take-off + landing) can be achieved by using parallel runways in a mixed mode of operation.

Theoretical studies indicate that the maximum arrival capacity (landing only) may be achieved by:

1. Operating independent parallel approach, then
2. Operating dependant parallel approach

Other factors such as the infrastructure, the mix of aircraft types, and environmental considerations result in a lower achievable capacity. Because of these constraints, maximum runway capacity may, in some cases, only be achieved by adopting a fully segregated mode.

The advantages to be gained from segregated parallel operations as compared to mixed parallel operations are as follows:

- no interaction between arriving and departing aircraft on the same runway
- a possible reduction in the number of missed approaches;
- a less complex ATC environment
- a reduced possibility of pilot error

8.3. Safety on parallel approaches

Parallel runway operations need to be carefully managed in such a manner as to minimise the risk of runway incursion or wrong runway use.
Closely-spaced parallel runways may affect the pilots' situational awareness or lead to their distraction or confusion.

A potential problem with close parallel runway spacing is the possibility that an aircraft may make an approach to the wrong runway; it is possible in the absence of the right level of crew discipline and interaction for alignment with the wrong runway to follow.

8.4. Safety of independent approaches

Independent operations on closely-spaced parallel runways are significantly safety critical and should be used only after a proper risk assessment has been undertaken.

In this process, the following parameters should be considered:

- Weather limitations: For parallel runways spaced by less than 1,525 m but not less than 1,035 m between centre lines, parallel operation should be suspended under certain adverse weather conditions including windshear, turbulence, downdrafts, crosswind and severe weather such as thunderstorms, which might increase approach path deviations.
- ILS flight error: The track of aircraft using the ILS localiser course is subject to errors like the accuracy of the signal or the airborne equipment (not applicable for IVAO network as the ILS signals are perfect in our simulators)
- Navigation guidance: The ability of the pilot or autopilot to follow or not the navigational guidance.
- Obstacle evaluation: An obstacle survey and evaluation must be completed for the area opposite the other parallel runway
- Pilot training: All pilots conducting simultaneous independent approaches should be familiar with the issues that arise. (This is not the case for all IVAO pilots. Their knowledge may differ from beginner to advanced commercial flight).
- Controller training: Air traffic controllers should require some training about the use of independent approach procedures including radar techniques.
- Risk analysis: This analysis is not applicable for the IVAO network. IVAO do not make statistical safety analysis due to the fact pilots are not professional and make more mistakes than real ATPL pilots.
- Airborne collision avoidance system (ACAS/TCAS): Some unnecessary missed approaches occurred as a result of “ignorance” of resolution advisories (RAs). The use of “traffic advisory (TA) only” mode during parallel approach operations should be recommended and indicated on the published approach charts.
- Transponder failure: If an aircraft transponder fails during an instrument approach, the radar controller will instruct any adjacent aircraft to cancel their approach. In IVAO, the transponder failure is not simulated except if a pilot is facing a network disconnection. The radar controller will decide to cancel adjacent aircraft approach or not, in function of the analysis of the situation.
- Fast/slow aircraft: ATC must create a gap in the arrival flow to prevent the conflicting situation when a fast aircraft deviates towards a slower aircraft on the adjacent approach. Slower aircraft may not be able to move away quickly enough to assure safe spacing.
- Approach charts: The charts showing instrument approach procedures to runways used for simultaneous parallel instrument operations should indicate such operations

8.5. Safety of dependent Approaches

For dependant parallel approach, two factors apply:

- less distance between runways means a greater distance between the aircraft on final approach track
- less distance between runways also means that the deviating aircraft crosses the adjacent approach track more quickly.

9. Near-Parallel Runways

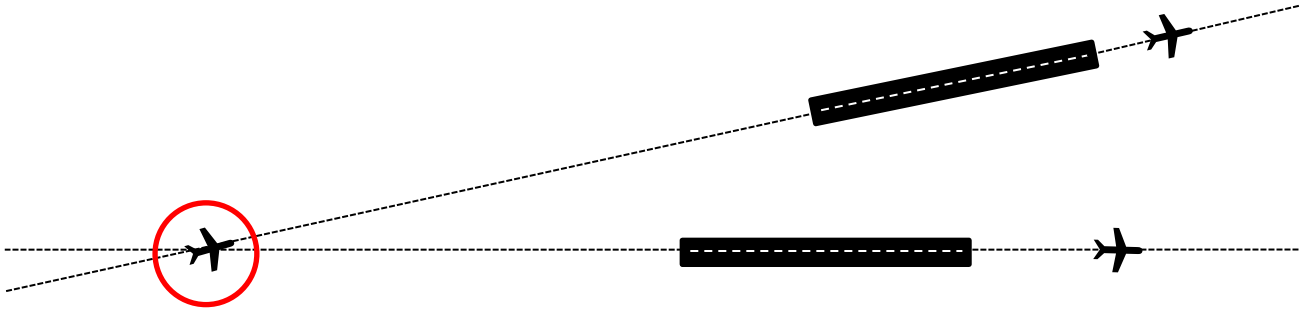
No special procedures have been developed as yet for simultaneous operations to near-parallel runways. Each situation is considered on a case-by-case basis and is dependent on a number of variable conditions.

The most important factor to be considered is the point at which the runway centre lines converge. This point depends on the relative position of the two runways.

It is also important to consider whether the two runways are used simultaneously in the converging or diverging direction.

In the diverging direction of two near-parallel runways:

- independent approaches are not permitted where there are intersecting approach paths
- independent departure or segregated operation is acceptable



The various modes of operation described in the preceding chapter should also be considered for near parallel runway operations.

A study must be made for each mode of operation for each specific aerodrome before such procedures can be implemented and used.

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