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Doc 9643

Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways (SOIR)

Second Edition, 2020



Approved by and published under the authority of the Secretary General

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AMENDMENTS

Amendments are announced in the supplements to the *Products and Services Catalogue*; the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

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FOREWORD

In the 1980s, ICAO invited States and selected international organizations to provide information on current practices and related questions with respect to minimum distances between parallel runways for simultaneous use under instrument flight rules (IFR). The result of this work was the publication of provisions for parallel operations in 1995. The first edition of the Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways (SOIR), which provided guidance material for the implementation of SOIR including minimum distances between parallel instrument runway operations, was published in 2004. While still in use today, those guidelines addressed the operations and technologies of the period to best support the growth air traffic was experiencing.

Today, enabling safe capacity growth remains key, but simultaneously, environmental stewardship has to be managed. Fortunately, new concepts, such as performance-based navigation and new technologies to support air traffic services (ATS) surveillance can be applied to SOIR. These modern capabilities provide more flexible approach procedure design options for SOIR, making SOIR applicable to more runway pairs. Improved navigation, surveillance and automation capability has enabled safe reductions in separation minima during SOIR for many locations. In addition, the flexibility and reduced separations offer improved capacity while also addressing many of the environmental and efficiency challenges at major airports around the globe.

The second edition of the SOIR leverages that work and the experiences of many States in applying both traditional and new practices, and complements the 2018 publication of simultaneous approach separation Standards in the Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444). This manual expands on these guidelines by providing details on the operation and implementation of these Standards.

This manual is intended to be a living document. Periodic amendments or new editions will be published on the basis of experience gained and of comments and suggestions received from users of this manual. Readers are therefore invited to address their comments, views and suggestions to:

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TABLE OF CONTENTS

	<i>Page</i>
Glossary of terms and abbreviations/acronyms	(ix)
Chapter 1. Operational concepts and considerations	1-1
1.1 General	1-1
1.2 Modes of operation	1-1
1.3 Factors affecting simultaneous operations on parallel instrument runways.....	1-2
Chapter 2. Simultaneous approaches to parallel runways (Modes 1 and 2)	2-1
2.1 General	2-1
2.2 Independent parallel instrument approaches (Mode 1)	2-2
2.3 Dependent parallel instrument approaches (Mode 2).....	2-16
2.4 Differences between independent and dependent parallel approaches	2-19
Chapter 3. Independent instrument departures from parallel runways (Mode 3)	3-1
3.1 General	3-1
3.2 Requirements and procedures.....	3-1
Chapter 4. Segregated operations on parallel runways (Mode 4)	4-1
4.1 General	4-1
4.2 Requirements and procedures.....	4-1
4.3 Runway spacings.....	4-2
Chapter 5. Near-parallel runways	5-1
5.1 General	5-1
5.2 Ground equipment	5-2
Chapter 6. Training of ATS personnel.....	6-1
6.1 General	6-1
6.2 Training for approach controllers	6-1
6.3 Training for aerodrome controllers	6-2
Chapter 7. Implementation	7-1
7.1 Trials	7-1
7.2 Implementation	7-1

	Page
Appendix A. Established on RNP AR APCH.....	App A-1
A.1 General	App A-1
A.2 Operations	App A-1
A.3 Designated point	App A-3
A.4 Approach design considerations specific to SOIR	App A-6
A.5 ATC and pilot procedures	App A-7
Appendix B. Examples of Established on RNP AR approaches	App B-1
Appendix C. Working examples of Mode 1 and Mode 2 — Dependent and independent approaches.	App C-1

GLOSSARY OF TERMS AND ABBREVIATIONS/ACRONYMS

Terms that are defined in Standards and Recommended Practices (SARPs) and Procedures for Air Navigation Services (PANS) are used in accordance with the meanings and usages given therein. In this manual, however, there are a number of other terms describing facilities, services, procedures, etc., related to aerodrome operations and air traffic services that are not yet included in Annexes or PANS documents.

TERMS

Airborne collision avoidance system (ACAS). An aircraft system based on secondary surveillance radar (SSR) transponder signals which operates independently of ground-based equipment to provide advice to the pilot on potential conflicting aircraft that are equipped with SSR transponders.

Approach procedure with vertical guidance (APV). A performance-based navigation (PBN) instrument approach procedure designed for 3D instrument approach operations Type A

Area navigation (RNAV). A method of navigation which permits aircraft operation on any desired flight path within the coverage of ground- or space-based navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

ATS surveillance system. A generic term meaning variously, ADS-B, PSR, SSR or any comparable ground-based system that enables the identification of aircraft.

Note.— A comparable ground-based system is one that has been demonstrated, by comparative assessment or other methodology, to have a level of safety and performance equal to or better than monopulse SSR.

Break-out procedure(s). Immediate evasive manoeuvres, which are performed on instruction by air traffic control.

Closely spaced runways. Runways that are parallel or near parallel and spaced less than 1 525 m (5 000 ft) but not less than 1 035 m (3 400 ft) apart

Correction zone. Additional airspace provided for the purpose of resolving conflicts.

Delay time. The time allowed for an air traffic controller to react, coordinate and communicate the appropriate command to the pilot, for the pilot to understand and react, and for the aircraft to respond.

Dependent parallel approaches. Simultaneous approaches to parallel or near-parallel instrument runways where ATS surveillance system separation minima between aircraft on adjacent extended runway centre lines are prescribed.

Deviation alert. An aural and visual alarm indicating situations where an aircraft deviates into the no transgression zone (NTZ) established between parallel runway approaches.

Glide path. A descent profile determined for vertical guidance during a final approach.

Independent parallel approaches. Simultaneous approaches to parallel or near-parallel instrument runways where ATS surveillance system separation minima between aircraft on adjacent extended runway centre lines are not prescribed.

Independent parallel departures. Simultaneous departures from parallel or near-parallel instrument runways.

Miss distance. The minimum lateral spacing achieved when the tracks of both aircraft are parallel after the threatened aircraft has executed the evading manoeuvre in the deviation analysis.

Mixed parallel operations. Simultaneous approaches and departures on parallel or near-parallel instrument runways.

Near-parallel runways. Non-intersecting runways whose extended centre lines have an angle of convergence/divergence of 15 degrees or less.

Normal operating zone (NOZ). Airspace of defined dimensions extending to either side of a published instrument approach procedure final approach course or track. Only that half of the normal operating zone adjacent to a no transgression zone (NTZ) is taken into account in independent parallel approaches.

No transgression zone (NTZ). In the context of independent parallel approaches, a corridor of airspace of defined dimensions located centrally between the two extended runway centre lines, where a penetration by an aircraft requires a controller intervention to manoeuvre any threatened aircraft on the adjacent approach.

Precision approach (PA) procedure. An instrument approach procedure based on navigation systems (ILS, MLS, GLS and SBAS CAT I) designed for 3D instrument approach operations Type A or B.

Segregated parallel operations. Simultaneous operations on parallel or near-parallel instrument runways in which one runway is used exclusively for approaches and the other runway is used exclusively for departures.

Semi-mixed parallel operations. Simultaneous operations on parallel or near-parallel instrument runways in which one runway is used exclusively for departures while the other runway is used for a mixture of approaches and departures, or one runway is used exclusively for approaches while the other runway is used for a mixture of approaches and departures.

Standard instrument departure (SID). A designated instrument flight rule (IFR) departure route linking the aerodrome or a specified runway of the aerodrome with a specified significant point, normally on a designated ATS route, at which the en-route phase of a flight commences.

Standard instrument arrival (STAR). A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an ATS route, with a point from which a published instrument approach procedure can be commenced.

ABBREVIATIONS/ACRONYMS

ADS-B	automatic dependent surveillance – broadcast
AIP	Aeronautical Information Publication
APCH	approach
APV	approach procedure with vertical guidance
ATC	air traffic control
ATIS	automatic terminal information service
ATS	air traffic service
CNS	communications, navigation, and surveillance

FAF	final approach fix
FAP	final approach point
GBAS	ground-based augmentation system
GLS	GBAS landing system
GNSS	global navigation satellite system
IAF	initial approach fix
IF	intermediate fix
IFR	instrument flight rules
ILS	instrument landing system
MLAT	multilateration
MLS	microwave landing system
NAVAID	navigation aid
NOZ	normal operating zone
NTZ	no transgression zone
PA	precision approach
PAOAS	parallel approach obstacle assessment surface
PBN	performance-based navigation
PRM	precision runway monitor
RA	resolution advisory
RF	radius to fix
RNP	required navigation performance
RNP AR	required navigation performance authorization required
RTF	radiotelephone
SBAS	satellite-based augmentation system
SOIR	simultaneous operations on parallel or near-parallel instrument runways
SSR	secondary surveillance radar
TA	traffic advisory
TCAS	traffic alert and collision avoidance system
VMC	visual meteorological conditions
VHF	very high frequency

.....

Chapter 1

OPERATIONAL CONCEPTS AND CONSIDERATIONS

1.1 GENERAL

1.1.1 The use of parallel or near-parallel runways to maximize aerodrome capacity is not a new concept. In Annex 14, Volume I, Chapter 3, 3.1.11, it is recommended that where parallel runways are intended for simultaneous use, by medium or heavy aeroplanes, under visual meteorological conditions (VMC) only, the minimum distance between their centre lines should be 210 m (690 ft). Under instrument flight rules (IFR), however, the safety of parallel runway operations is affected by several factors such as the precision with which aircraft can navigate to the runway, the accuracy of the air traffic service (ATS) surveillance monitoring system, the ability of controllers to intervene when an aircraft deviates from the final approach course or track, and the controller, pilot and aircraft reaction times.

1.1.2 The continued impetus for considering simultaneous operations on parallel or near parallel instrument runways under IFR is provided by the need to increase capacity at busy aerodromes. This increase in capacity can be accomplished either by using existing parallel runways more efficiently or by building additional runways; the cost of the latter can be very high and politically and/or environmentally challenging. On the other hand, an aerodrome already having parallel runways could increase its capacity if these runways could be safely operated simultaneously under IFR with appropriate published instrument approach procedures. However, other factors, such as surface movement guidance and control, environmental considerations, and landside/airside infrastructure, may negate the advantages to be gained from simultaneous operations.

1.1.3 Near-parallel runways are defined as non-intersecting runways whose extended centre lines have an angle of convergence/divergence of 15 degrees or less. Simultaneous approach and departure operations may be viable on near-parallel runways on a case-by-case basis. See chapter 5 for details.

1.2 MODES OF OPERATION

1.2.1 Airports that have parallel runways can operate with some of the runways dedicated solely to arrivals and departures or choose to allow both types of operation from a single runway. Depending on this “mode”, four different simultaneous operations on parallel or near-parallel instrument runways (SOIR) apply, two for approach, one for departure, and one for a mix of both approach and departure.

1.2.1.1 *Mode 1, independent parallel approaches*

- Simultaneous approaches to parallel or near-parallel instrument runways where separation minima based on ATS surveillance systems between aircraft on adjacent extended runway centre lines **are not** prescribed.

1.2.1.2 *Mode 2, dependent parallel approaches*

- Simultaneous approaches to parallel or near-parallel instrument runways where separation minima based on ATS surveillance systems between aircraft on adjacent extended runway centre lines **are** prescribed.

1.2.1.3 *Mode 3, independent parallel departures*

- Simultaneous departures from parallel or near-parallel instrument runways. Not all runway pairs are eligible. When the spacing between two parallel runways is less than the specified value dictated by wake turbulence considerations, the runways are considered as a single runway with regard to separation between departing aircraft.

1.2.1.4 *Mode 4, segregated parallel operations*

- 1.2.1.4.1 Simultaneous operations on parallel or near-parallel instrument runways in which one runway is used exclusively for approaches and the other runway is used exclusively for departures.

- 1.2.1.4.2 In the case of segregated parallel approaches and departures, there may be semi-mixed operations, i.e. one runway is used exclusively for departures, while the other runway is used for a mixture of approaches and departures, or one runway is used exclusively for approaches while the other is used for a mixture of approaches and departures. There may also be mixed operations, i.e. simultaneous parallel approaches with departures interspersed on both runways. In all cases, however, semi-mixed or mixed operations may be related to the other three basic modes listed in 1.2.1.1, 1.2.1.2, 1.2.1.3 as follows:

	<i>Mode</i>
a) <i>Semi-mixed parallel operations</i>	
1) One runway is used exclusively for approaches while:	
— approaches are being made to the other runway, or	1 or 2
— departures are in progress on the other runway.	4
2) One runway is used exclusively for departures while:	
— approaches are being made to the other runway, or	4
— departures are in progress on the other runway.	3
b) <i>Mixed parallel operations</i>	
All modes of operation are possible.	1, 2, 3, 4

1.3 FACTORS AFFECTING SIMULTANEOUS OPERATIONS ON PARALLEL INSTRUMENT RUNWAYS

1.3.1 In the case of simultaneous parallel approaches to two parallel or near-parallel instrument runways, each with an associated instrument approach procedure, the approach minima for each runway are not affected. The operating minima used are identical to those applied for single runway operations.

1.3.2 There are some special procedures that have been promulgated in States using independent parallel approaches. To make flight crews aware of the importance of executing precise manoeuvres to intercept and closely follow published procedures, they are notified prior to commencing approach that simultaneous parallel instrument approaches are in progress. This procedure also alerts flight crews to the possibility of an immediate evasive manoeuvre (break-out procedure) in case of a deviation by an aircraft on the adjacent extended centre line.

1.3.3 Theoretical studies indicate that the maximum arrival capacity may be achieved by operating independent parallel approaches, followed by dependent parallel approaches. These theoretical gains can, however, often be significantly lower in practice due to practical difficulties associated with implementation.

1.3.4 Further reductions in the theoretical capacity may arise through a lack of pilot familiarity with the procedures at aerodromes where there is a high proportion of unscheduled flights. Lack of familiarity can also result in the selection of incorrect instrument landing system (ILS) or microwave landing system (MLS) frequencies, ground-based augmentation system (GBAS) landing system (GLS) or satellite-based augmentation system (SBAS) channel numbers, or selection of an incorrect procedure from the database. Language difficulties, in particular lack of proficiency in the English language, may present communication problems between controllers and pilots.

1.3.5 When there are aircraft departing during mixed or semi-mixed operations, gaps have to be created in the landing stream. The effect of this is a reduction in the arrival capacity in order to accommodate departures; hence, it is a critical factor in determining the maximum runway capacity. Also, when operating departures on the landing runway, the probability of missed approaches increases with a corresponding reduction in capacity.

1.3.6 Factors that can affect the maximum capacity or the desirability of operating parallel runways simultaneously are not limited to runway considerations. Taxiway layout and the position of passenger terminals relative to the runways can make it necessary for traffic to cross active runways, a situation which may lead not only to delays but also to a reduction in the level of safety due to the possibility of runway incursions. The total surface movement environment must be carefully assessed when determining how particular parallel runways are to be used. In addition, when initiating parallel approach operations in visual meteorological conditions (VMC), consideration should be given to protecting the ILS signal from interference from ground movements.

1.3.7 The decision to implement simultaneous operations at a particular location must take into consideration all of the foregoing factors as well as any other constraints such as environmental considerations.

Chapter 2

SIMULTANEOUS APPROACHES TO PARALLEL RUNWAYS (MODES 1 AND 2)

2.1 GENERAL

2.1.1 This chapter presents the requirements for reduced spacing for independent and dependent approach operations to parallel runways under instrument flight rules (IFR).

2.1.2 The concepts, procedures, and dimensions applicable to independent and dependent parallel approaches are based on published procedures approved for simultaneous parallel approach operations. The use of other approach technology not covered in this manual may necessitate changes to the separation and spacing requirements of parallel runway operations.

2.1.3 The primary purpose for permitting simultaneous operations on parallel or near-parallel instrument runways is to increase arrival capacity. The largest increase in arrival capacity is achieved through the use of independent approaches (Mode 1) to parallel or near-parallel instrument runways.

2.1.4 A potential problem associated with simultaneous parallel approaches is the possibility that an aircraft will make the approach to the wrong runway. There are a number of possible causes, including:

- a) a controller may give an incorrect clearance to the wrong runway;
- b) the pilot may misinterpret the approach clearance;
- c) the pilot may select the incorrect approach procedure; and
- d) the pilot on an instrument approach may, after reaching visual conditions, visually acquire and line up for the wrong runway. Such an event might occur too quickly and too close to the threshold to be reliably detected or resolved by the controller. If this situation is determined to be a problem, some means of improving visual runway identification may be required.

2.1.5 Errors in both surveillance and navigation contribute to the uncertainty regarding an aircraft's flight path. Improvements in both surveillance and navigation performance may therefore be necessary to ensure that the number of false alarms is kept low and that true errors are identified in a timely manner. As the spacing between parallel runways decreases, it may become more difficult for the approach controller to determine whether an aircraft is correctly aligned as the controller intended. There are a number of ways to reduce the probability of an aircraft approaching the wrong runway, which include:

- a) employing high resolution displays as per the description in section 2.2.1;
- b) instituting procedures that require confirmation of the runway assignment, i.e. verbal verification of the frequency, channel number, or procedure;
- c) designing each procedure to have its own unique track to align with the different runways; and

- d) designing adjacent procedures that have clearly separate tracks, enabling early detection by air traffic control (ATC).

2.1.6 In addition, to reduce the possibility of runway misidentification, an improved surveillance system may provide early detection of an aircraft deviating off its expected flight path. Any reduction below the required separation may be detected sooner, allowing more time for the controller to act. Early detection of an unexpected deviation may have an effect on the resulting miss distance between aircraft on parallel approaches.

2.1.7 Automated alerting may also help identify potential and actual deviations.

2.2 INDEPENDENT PARALLEL INSTRUMENT APPROACHES (MODE 1)

2.2.1 Requirements and procedures

2.2.1.1 Surveillance requirements are dependent on runway centre line spacing. Annex 14 identifies recommended minimum distance between runway centre lines for parallel operations. The Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444), Chapter 6, Table 6-1 specifies what surveillance performance is required to conduct independent parallel approaches at various runway centre line spacings, repeated here as Table 2-1:

Table 2-1. Air traffic service (ATS) surveillance system criteria for different runway centerline spacings (PANS ATM, Table 6-1)

Runway centre line spacing	ATS surveillance system criteria
Less than 1 310 m (4 300 ft) but not less than 1 035 m (3 400 ft)	• a minimum accuracy for an ATS surveillance system as follows: – for secondary surveillance radar (SSR), an azimuth accuracy of 0.06 degrees (one sigma); or – for multilateration system (MLAT) or automatic dependent surveillance - broadcast (ADS-B), an accuracy of 30 m (100 ft); • an update period of 2.5 seconds or less; and • a high-resolution display providing position prediction and deviation alert is available.
Less than 1 525 m (5 000 ft) but not less than 1 310 m (4 300 ft)	• an ATS surveillance system with performance specifications other than those above, but equal to or better than: – for SSR, a minimum azimuth accuracy of 0.3 degrees (one sigma); or – for MLAT or ADS-B, a performance capability equivalent to, or better than, the SSR requirement can be demonstrated;

Runway centre line spacing	ATS surveillance system criteria
	• an update period of 5 seconds or less; and • when it is determined that the safety of aircraft operations would not be adversely affected.
1 525 m (5 000 ft) or more	• a minimum SSR azimuth accuracy of 0.3 degrees (one sigma) or, for MLAT or ADS-B, a performance capability equivalent to, or better than, the SSR requirement can be demonstrated, and • an update period of 5 seconds or less.

Note 1.— Information pertaining to use of ADS-B and MLAT and their system performance is contained in the Assessment of ADS-B and Multilateration Surveillance to Support Air Traffic Services and Guidelines for Implementation (Circ 326).

Note 2.— Refer to Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444) Chapter 2 Section 2.6.2.f) where ADS-B implementation envisages reliance upon a common source for surveillance and/or navigation.

2.2.1.2 As early as practicable after an aircraft has established communication with approach control, the aircraft is to be advised that independent parallel approaches are in use. The use of the automatic terminal information service (ATIS) is an accepted method to provide the flight crew with this information.

2.2.1.3 During simultaneous independent approach operations:

- a) controllers are required to advise aircraft as early as possible of the assigned runway or instrument approach procedure and any additional information considered necessary to confirm correct selection;
- b) the final approach course or track is to be intercepted by use of:
 - 1) vectoring; or
 - 2) a published approach procedure transition from an initial approach fix (IAF) or intermediate fix (IF);
- c) a no transgression zone (NTZ) of at least 610 m (2 000 ft) wide needs to be established equidistant between extended runway centre lines (Figure 2-1) and is depicted on an ATS surveillance system situation display (see 2.2.2 for more information on NTZ);
- d) the approaches are monitored by:
 - 1) a separate monitoring controller for each runway; or
 - 2) a single monitoring controller for no more than two runways, if determined by a safety assessment and approved by the appropriate ATS authority (2.2.1.7 and 2.2.4 refer);