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Doc 10063

Manual on Monitoring the Application of Performance-based Horizontal Separation Minima

First Edition, 2017



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

The International Civil Aviation Organization (ICAO) noted that some States and regions either had implemented or planned to implement horizontal separation minima in procedurally controlled airspace based on published performance-based operations requirements. It was also noted that these States and regions had developed procedures and practices to support the ongoing safety of these implementations.

The 2011 publication of the first edition of the manual entitled *Operating Procedures and Practices for Regional Monitoring Agencies in Relation to the Use of a 300 m (1 000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive* (Doc 9937) provides guidance on the establishment of such procedures and practices to support the ongoing safe use of the reduced vertical separation minimum (RVSM). It was noted that there was no comparable ICAO-provided guidance for monitoring the application of performance-based horizontal separation minima. Hence, the ICAO Separation and Airspace Safety Panel (SASP) set out to develop a manual analogous to Doc 9937 as a means of assisting States and regions to standardize monitoring activities supporting performance-based horizontal separation minima.

This manual is the result of the SASP work, and should be considered to be supporting material to the *Safety Management Manual* (SMM) (Doc 9859). The proactive safety performance monitoring and measurement guidance provided in this manual can satisfy the safety assurance requirements provided in Annex 19 — *Safety Management* to the Convention on International Civil Aviation. In developing the material contained herein, the SASP relied upon the experience of experts from its Member States that had prior experience in developing relevant procedures and practices. It should be noted that Australia, New Zealand, Singapore and the United States have developed the *Asia/Pacific Region En-Route Monitoring Agency (EMA) Handbook*, and modified portions of that document are reproduced herein. Contributions by other regions, agencies and organizations are anticipated as the document matures and experience is gained.

In order to keep this manual relevant and accurate, suggestions for improving it in terms of format, content or presentation are welcome. Any such recommendation or suggestion will be examined and, if found suitable, will be included in regular updates to the manual. Regular revision will ensure that the manual remains both pertinent and accurate. Comments on this manual should be addressed to:

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GLOSSARY

DEFINITIONS

When the following terms are used in this manual, they have the meanings indicated below.

Note.— Where an asterisk appears beside a term, the term has already been defined as such in Annexes and Procedures for Air Navigation Services (PANS).

ADS C service. A term used to indicate an ATS service that uses ADS-C.

Note.— The Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM) (Doc 4444) does not include ADS-C in its definition for ATS surveillance system. Therefore, an ATS surveillance service does not consider those provided by means of the ADS-C application, unless it can be shown by comparative assessment to have a level of safety and performance equal to or better than monopulse secondary surveillance radar (SSR).

***Aeronautical Information Publication (AIP).** A publication issued by or with the authority of a State and containing aeronautical information of a lasting character essential to air navigation.

Air navigation services provider (ANSP). The organization(s) that operate(s) on behalf of a State to manage air traffic and airspace safely, economically and efficiently through the provision of facilities and seamless services in collaboration with all parties and involving airborne and ground based functions.

***Aircraft address.** A unique combination of 24 bits available for assignment to an aircraft for the purpose of air-ground communications, navigation and surveillance.

***Aircraft identification.** A group of letters, figures or a combination thereof which is either identical to, or the coded equivalent of, the aircraft call sign to be used in air-ground communications, and which is used to identify the aircraft in ground-ground air traffic services communications.

Note 1.— The aircraft identification does not exceed seven characters and is either the aircraft registration or the ICAO designator for the aircraft operating agency followed by the flight identification.

Note 2.— ICAO designators for aircraft operating agencies are contained in the document entitled Designators for Aircraft Operating Agencies, Aeronautical Authorities and Services (Doc 8585).

Aircraft registration. A group of letters, figures or a combination thereof which is assigned by the State of Registry to identify the aircraft.

Note.— Also referred to as registration marking.

***Appropriate authority**

- a) Regarding flight over the high seas: The relevant authority of the State of Registry.
- b) Regarding flight other than over the high seas: The relevant authority of the State having sovereignty over the territory being overflown.

***Area navigation (RNAV) specification.** See navigation specification.

ATM operation. An individual operational component of air traffic services. Examples of ATM operations include the application of separation between aircraft, the re-routing of aircraft, and the provision of flight information.

***ATS surveillance service.** A term used to indicate a service provided directly by means of an ATS surveillance system.

***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.

***Automatic dependent surveillance — broadcast (ADS-B).** A means by which aircraft, aerodrome vehicles and other objects can automatically transmit and/or receive data such as identification, position and additional data, as appropriate, in a broadcast mode via a data link.

***Automatic dependent surveillance — contract (ADS-C).** A means by which the terms of an ADS-C agreement will be exchanged between the ground system and the aircraft, via a data link, specifying under what conditions ADS-C reports would be initiated, and what data would be contained in the reports.

Note.— The abbreviated term “ADS contract” is commonly used to refer to ADS event contract, ADS demand contract, ADS periodic contract or an emergency mode.

Call sign. The designator used in air-ground communications to identify the aircraft and is equivalent to the encoded aircraft identification.

Collision risk. The expected number of midair collisions in a prescribed volume of airspace for a specific number of flight hours due to loss of planned separation.

Note.— One collision is considered to produce two accidents.

***Controller-pilot data link communications (CPDLC).** A means of communication between controller and pilot, using data link for ATC communications.

Core lateral navigational performance. That portion of overall lateral navigational performance which accounts for the bulk of observed lateral errors and which can be characterized by a single statistical distribution, usually symmetric about the mean lateral error with the frequency of increasing-magnitude errors decreasing at least exponentially.

***Current flight plan.** See flight plan.

***Data link initiation capability (DLIC).** A data link application that provides the ability to exchange addresses, names and version numbers necessary to initiate data link applications.

***Filed flight plan.** See flight plan.

Flight identification. A group of numbers, which is usually associated with an ICAO designator for an aircraft operating agency, to identify the aircraft in Item 7 of the flight plan.

***Flight information region (FIR).** An airspace of defined dimensions within which flight information service and alerting service are provided.

***Flight plan.** Specified information provided to air traffic services units, relative to an intended flight or portion of a flight of an aircraft.

A flight plan can take several forms, such as:

***Current flight plan (CPL).** The flight plan, including changes, if any, brought about by subsequent clearances.

Note 1.— When the word “message” is used as a suffix to this term, it denotes the content and format of the current flight plan data sent from one unit to another.

***Filed flight plan (FPL).** The flight plan as filed with an ATS unit by the pilot or a designated representative, without any subsequent changes.

Note 2.— When the word “message” is used as a suffix to this term, it denotes the content and format of the filed flight plan data as transmitted.

Aircraft active flight plan. The flight plan used by the flight crew. The sequence of legs and associated constraints that define the expected 3D or 4D trajectory of the aircraft from take-off to landing. (RTCA/EUROCAE)

Horizontal separation. The spacing provided between aircraft in the horizontal (lateral or longitudinal) plane to avoid collision.

Large lateral deviation (LLD). Any lateral deviation from the current flight plan track that is greater than a regionally agreed value pertinent to the applied separation minimum. One possibility for a region is to define an LLD as any lateral deviation with a magnitude at least two times the required navigation performance (RNP) specification associated with the smallest lateral separation minimum possible. In airspace where RNP is not applicable, an LLD should be considered to be a lateral deviation with magnitude greater than or equal to half the lateral separation minimum.

Large longitudinal error (LLE). Any unexpected change in longitudinal separation between an aircraft pair, or for an individual aircraft the difference between an estimate for a given fix and the actual time of arrival over that fix, as applicable.

Note.— See Appendix B, which provides a form for reporting LLEs, and Appendix G for an example of criteria used by the Asia/Pacific (APAC) Region.

Monitoring organization. A body that performs monitoring functions for the application of performance-based horizontal separation minima.

***Navigation specification.** A set of aircraft and flight crew requirements needed to support performance-based navigation operations within a defined airspace. There are two kinds of navigation specification:

RNAV specification. A navigation specification based on area navigation that does not include the requirement for on-board performance monitoring and alerting, designated by the prefix RNAV (e.g. RNAV 5, RNAV 1).

RNP specification. A navigation specification based on area navigation that includes the requirement for on-board performance monitoring and alerting, designated by the prefix RNP (e.g. RNP 4, RNP APCH).

Note.— The Performance-based Navigation (PBN) Manual, Volume II (Doc 9613) contains detailed guidance on navigation specifications.

(Refer to Doc 9613, Volume 1 — *Concept and Implementation Guidance*, Explanation of Terms).

Occupancy. A parameter of the collision risk model which is twice the count of aircraft proximate pairs in a single dimension divided by the total number of aircraft flying the candidate paths in the same time interval.

Operational approval. An approval granted to the operator by a State authority after being satisfied that the operator meets specific aircraft and operational requirements.

Operational risk. The risk of collision due to operational errors and in-flight contingencies.

Overall risk. The risk of collision due to all causes, which includes the technical risk and the operational risk.

Passing frequency. The frequency of events in which the centres of mass of two aircraft are at least as close together as the metallic length of a typical aircraft when traveling in the same or opposite directions on adjacent routes separated by the lateral separation standard at the same flight level.

Performance-based communication (PBC). Communication based on performance specifications applied to the provision of air traffic services.

Note.— An RCP specification includes communication performance requirements that are allocated to system components in terms of communication transaction time, continuity, availability, integrity, safety and functionality needed for the proposed operation in the context of a particular airspace concept.

***Performance-based navigation (PBN).** Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace.

Note.— Performance requirements are expressed in navigation specifications (RNAV specification, RNP specification) in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept.

Performance-based surveillance (PBS). Surveillance based on performance applied to the provision of air traffic services.

Note.— An RSP specification includes surveillance performance requirements that are allocated to system components in terms of surveillance data delivery time, continuity, availability, integrity, accuracy of the surveillance data, safety and functionality needed for the proposed operation in the context of a particular airspace concept.

***Procedural control.** Term used to indicate that information derived from an ATS surveillance system is not required for the provision of air traffic control service.

***Procedural separation.** The separation used when providing procedural control.

Required communication monitored performance (RCMP). The maximum time against which ACP is assessed.

Required communication performance (RCP) specification. A set of requirements for air traffic service provision, aircraft capability, and operations needed to support performance-based communication.

Note.— The term RCP, currently defined as “a statement of performance requirements for operational communication in support of specific ATM functions”, has been revised to align the concept of PBC with the concept of

PBN. The term RCP is now used in the context of a specification that is applicable to the prescription of airspace requirements, qualification of ATS provision, aircraft capability, and operational use, including post-implementation monitoring (e.g. RCP 240 refers to the criteria for various components of the operational system to ensure an acceptable intervention capability for the controller is maintained).

***Required navigation performance (RNP) specification.** See navigation specification.

Required surveillance monitored performance (RSMP). The maximum time against which ASP is assessed.

Required surveillance performance (RSP) specification. A set of requirements for air traffic service provision, aircraft capability, and operations needed to support performance-based surveillance.

Note.— The term RSP is used in the context of a specification that is applicable to the prescription of airspace requirements, qualification of ATS provision, aircraft capability, and operational use, including post-implementation monitoring (e.g. RSP 180 refers to the criteria for various components of the operational system to ensure an acceptable surveillance capability for the controller is maintained).

***State of Design.** The State having jurisdiction over the organization responsible for the type design.

***State of Manufacture.** The State having jurisdiction over the organization responsible for the final assembly of the aircraft.

***State of Registry.** The State on whose register the aircraft is entered.

Note.— In the case of the registration of aircraft of an international operating agency on other than a national basis, the States constituting the agency are jointly and severally bound to assume the obligations which, under the Chicago Convention, attach to a State of Registry. See, in this regard, the Council Resolution of 14 December 1967 on Nationality and Registration of Aircraft Operated by International Operating Agencies which can be found in the document entitled Policy and Guidance Material on the Economic Regulation of International Air Transport (Doc 9587).

***State of the Operator.** The State in which the operator's principal place of business is located or, if there is no such place of business, the operator's permanent residence.

***Target level of safety (TLS).** A generic term representing the level of risk which is considered acceptable in particular circumstances.

Technical risk. The risk of collision associated with aircraft navigational performance.

ACRONYMS

When the following abbreviations are used in this manual, they have the meanings indicated below.

ACARS	Aircraft communication addressing and reporting system
ACP	Actual communication performance
ACTP	Actual communication technical performance
ADS	Automatic dependent surveillance
ADS-B	Automatic dependent surveillance – broadcast
ADS-C	Automatic dependent surveillance – contract
ANSP	Air navigation services provider
APANPIRG	Asia/Pacific Air Navigation Planning and Implementation Regional Group
APAC	Asia/Pacific
ARTCC	Air Route Traffic Control Center
ASP	Actual surveillance performance
ATC	Air traffic control
ATM	Air traffic management
ATS	Air traffic services
BRG	Bearing
CAA	Civil Aviation Authority
CMA	Central Monitoring Agency
CNS	Communication, navigation and surveillance
CPDLC	Controller-pilot data link communication
CRA	Central Reporting Agencies
CRM	Collision risk model
CSP	Communication service provider
DCPC	Direct controller-pilot communication
DDE	Double-double exponential
DE	Double exponential
DLMA	Data Link Monitoring Agency
EMA	En-Route Monitoring Agency
FAA	Federal Aviation Administration
FANS	Future air navigation system
Fapfh	Fatal accidents per flight hour
FIR	Flight information region
FIT	FANS Interoperability Team
FL	Flight level
FMC	Flight management computer
FMS	Flight management system
GNSS	Global navigation satellite system
GOLD	Global Operational Data Link Document
HF	High frequency
HOP	Horizontal overlap probability
ICAO	International Civil Aviation Organization
IGA	International general aviation
INS	Inertial navigation system
KYA	Know Your Airspace
LDC	Lateral deviation contract
LLD	Large lateral deviation
LLE	Large longitudinal error
LOA	Letter of Agreement

MNPS	Minimum navigation performance specification
MNT	Mach number technique
NAT	North Atlantic
NM	Nautical miles
NP	Number of aircraft pairs per hour
ONP	Observed navigation performance
PARMO	Pacific Approvals Registry and Monitoring Organization
PBC	Performance-based communication
PBCS	Performance-based communication and surveillance
PBN	Performance-based navigation
PBS	Performance-based surveillance
PDC	Pre-departure clearance
PIRG	Planning and Implementation Regional Group
PORT	Pilot operational response time
PSR	Primary surveillance radar
RASG	Regional Airspace Safety Group
RASMAG	Regional Airspace Safety Monitoring Advisory Group
RCP	Required communication performance
RMA	Regional Monitoring Agency
RNAV	Area navigation
RNP	Required navigation performance
RSMP	Required surveillance monitored performance
RSP	Required surveillance performance
RVSM	Reduced vertical separation minimum
SARPs	Standards and Recommended Practices
SARSIG	Safety Analysis and Reduced Separation Implementation Group
SASP	Separation and Airspace Safety Panel
SAT	Satellite
SATCOM	Satellite communication
SATVOICE	Satellite voice
SEASMA	South East Asia Safety Monitoring Agency
SMS	Safety management system
SPG	Systems Planning Group
SSR	Secondary surveillance radar
TLS	Target level of safety
TSD	Traffic sample data
UTC	Coordinated Universal Time
VHF	Very high frequency
WATRS	Western Atlantic Route System
WPR	waypoint position report
ZNY	New York oceanic airspace

PUBLICATIONS

(referred to in this manual)

The following documents are referred to in this manual or may provide additional guidance material.

ICAO DOCUMENTS

Annexes to the Convention on International Civil Aviation

Annex 6 — Operation of Aircraft
Part I — *International Commercial Air Transport — Aeroplanes*
Part II — *International General Aviation — Aeroplanes*
Part III — *International Operations — Helicopters*

Annex 8 — Airworthiness of Aircraft

Annex 11 — Air Traffic Services

Annex 15 — Aeronautical Information Services

Annex 19 — Safety Management

Procedures for Air Navigation Services

ATM — Air Traffic Management (PANS-ATM) (Doc 4444)

Manuals

Aircraft Type Designators (Doc 8643)

Designators for Aircraft Operating Agencies, Aeronautical Authorities and Services (Doc 8585)

Location Indicators (Doc 7910)

Manual on Airspace Planning Methodology for the Determination of Separation Minima (Doc 9689)

Manual on a 300 m (1 000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive (Doc 9574)

Operating Procedures and Practices for Regional Monitoring Agencies in Relation to the Use of a 300 m (1 000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive (Doc 9937)

Performance-Based Communication and Surveillance (PBCS) Manual (Doc 9869)

Performance-based Navigation (PBN) Manual (Doc 9613)

Regional Supplementary Procedures (Doc 7030)

Safety Management Manual (SMM) (Doc 9859)

Global Operational Data Link (Gold) Manual (Doc 10037)

Circulars

Guidelines for the Implementation of Performance-based Longitudinal Separation Minima (Cir 343)

OTHER DOCUMENTS

Airline Coding Directory — IATA

Downloaded from ICAO Doc 10063, 2017-01-01

Chapter 1

INTRODUCTION

1.1 SCOPE AND PURPOSE

1.1.1 This manual provides guidance and information to facilitate uniform application of Standards and Recommended Practices (SARPs) contained in Annex 6 — *Operation of Aircraft*, Annex 8 — *Airworthiness of Aircraft*, Annex 11 — *Air Traffic Services*, Annex 19 — *Safety Management*, the provisions in the *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM) (Doc 4444) and, when necessary, the *Regional Supplementary Procedures* (Doc 7030).

1.1.2 This manual is intended to assist groups of States or regions in describing the functionality needed to monitor the safe application of performance-based horizontal separation minima in procedurally controlled airspace. The procedures for these separation minima apply performance-based navigation performance (PBN) contained in the *Performance-based Navigation (PBN) Manual* (Doc 9613) and performance-based communication and surveillance (PBCS) contained in the *Performance-Based Communication and Surveillance (PBCS) Manual* (Doc 9869).

1.1.3 The tasks as described in this manual for monitoring the application of performance-based horizontal separation minima may refer to system performance monitoring functions described in Doc 9869.

1.1.4 States may also call on the expertise developed for monitoring the application of performance-based horizontal separation minima, to assist in the implementation of new horizontal separation minima. Such an approach, in conjunction with performance-based specifications, such as for area navigation (RNAV), required navigation performance (RNP), required communication performance (RCP) and required surveillance performance (RSP), would assist in globally harmonizing the implementation and application of horizontal separation minima.

1.1.5 This manual applies to groups of States or regions applying performance-based horizontal separation minima in an en-route environment where procedural separation minima are being applied. It is not intended for operations in terminal airspace or en-route environments where ATS surveillance services are provided; any organization intent upon supporting safe operations in these environments should obtain safety-assessment and monitoring guidance elsewhere.

1.1.6 The manual is organized as follows:

- a) Chapter 2 describes the functions necessary to monitor the application of performance-based horizontal separation minima by means of a list of duties and responsibilities;
- b) Chapter 3 provides specific guidance on the duties and responsibilities that support implementation of performance-based horizontal separation minima;
- c) Appendix A provides guidance on managing the status of performance-based operational approvals, and includes forms for collecting information, maintaining the information in electronic form and seeking clarification on operational approval status of an Operator;
- d) Appendix B provides a form for an ATS unit to provide a monthly report of large lateral deviations (LLDs) and large longitudinal errors (LLEs);

- e) Appendix C provides guidance for examining LLDs and LLEs;
- f) Appendix D provides the traffic sample data (TSD) to collect and use to characterize the airspace and traffic movements;
- g) Appendix E provides an example of an analysis that characterizes the airspace and traffic movements to support monitoring the application of performance-based horizontal separation minima;
- h) Appendix F provides an overview of collision risk modeling assumptions when assessing the application of performance-based horizontal separation minima; and
- i) Appendix G and Appendix H provide sample safety assessments for the application of performance-based horizontal separation minima.

1.1.7 This manual does not specify how the monitoring functions for applying performance-based horizontal separation minima are implemented by a group of States or region. The functions performed may be contained within a single organization or may be assigned to different working groups within the region. It is nevertheless recommended that the organization providing monitoring functions report directly to a regional safety oversight group tasked with monitoring overall system performance in light of regional safety goals. In turn, this safety oversight group will report to either the authorized Planning and Implementation Regional Group (PIRG) or the Regional Airspace Safety Group (RASG). For example, in the North Atlantic (NAT) Region, the North Atlantic Central Monitoring Agency (NAT CMA) reports to the NAT Safety Oversight Group (SOG), who is authorized by the NAT Systems Planning Group (SPG). In the Asia/Pacific (APAC) Region, several En-Route Monitoring Agencies (EMAs) report to the Asia/Pacific Regional Airspace Safety Monitoring Advisory Group (RASMAG), who reports to the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG).

Chapter 2

DESCRIPTION OF THE FUNCTIONS NECESSARY TO MONITOR THE APPLICATION OF PERFORMANCE-BASED HORIZONTAL SEPARATION MINIMA

2.1 DESCRIPTION

2.1.1 Groups of States or regions establish a monitoring programme to support the safe use of performance-based horizontal separation minima. Effective provision of this programme relies heavily on safety data provided by States. Such data is contingent on a State having a safety management system (SMS) mature enough to enable a robust safety reporting culture, providing data such as traffic samples, and importantly a means to investigate and develop controls and mitigations for risks identified through this process. Guidance on safety management principles is provided in the *Safety Management Manual (SMM)* (Doc 9859).

2.1.2 The functions defined in this chapter directly support a region or State implementation of safety management principles through the pre-implementation assessment and ongoing performance monitoring of an airspace system. The airspace safety assessment and monitoring functionality enables a measurement of any practical drift from the system safety baseline following operational deployment. These functions should be undertaken using a combination of data collected through predictive, proactive and reactive means.

2.1.3 This manual assumes that groups of States or ICAO regions establish a safety oversight group that is responsible for:

- a) monitoring the safety of performance-based horizontal separation minima deployed in the region; and
- b) taking action when the operational performance of the airspace, where such minima are deployed, has deviated significantly from the system design baseline.

2.1.4 The safety oversight group would, in turn, report periodically the status of separation-related safety to the region's PIRG or RASG.

2.1.5 The safety oversight group would establish a programme for carrying out specific functions and duties to provide these monitoring services. The safety oversight group may establish a separate organization to provide these functions, or allocate these duties and responsibilities to existing groups within the existing PIRG sub-groups. These functions, duties and responsibilities are summarized in this chapter.

2.1.6 Within a region, these functions could be combined with the functions of the Regional Monitoring Agency (RMA), established to provide airspace safety assessment and monitoring services to support the continued safe use of the reduced vertical separation minimum (RVSM), and supported by other monitoring programmes, such as the performance-based communication and surveillance (PBCS) monitoring programme established by air navigation service providers detailed in Doc 9869.

2.2 DUTIES AND RESPONSIBILITIES FOR MONITORING THE APPLICATION OF PERFORMANCE-BASED HORIZONTAL SEPARATION MINIMA

The associated duties and responsibilities are:

- a) establish and maintain a database of operational approvals specific to the horizontal separation minima being applied in the airspace;
- b) receive reports of large horizontal deviations identified during monitoring; take the necessary action with the relevant State authority and operator to determine the likely cause of the lateral deviation and/or longitudinal error; and verify the approval status of the relevant operator;
- c) proactively undertake data collections as required by the regional oversight group that oversees the safety of regional airspace to:
 - 1) analyse data collected on a predictive and proactive basis to detect lateral and longitudinal deviation trends and, hence, to take action as specified in 2.1.3 b);
 - 2) investigate the navigational performance of the aircraft in the core of the distribution of lateral deviations;
 - 3) establish or add to databases of operational performance, including lateral navigation and/or communication and/or surveillance performance for:
 - i) all flight operations;
 - ii) operators/aircraft types; and
 - iii) individual airframes;
 - 4) determine the appropriate method to monitor longitudinal errors;
- d) archive results of performance monitoring and conduct periodic risk assessments that proactively identify aberrant changes in operational performance from agreed regional safety goals;
- e) initiate necessary remedial actions and coordinate with oversight groups as necessary in the light of monitoring results;
- f) monitor the level of risk as a consequence of operational errors and in-flight contingencies identified from a range of available safety data as follows:
 - 1) determine, wherever possible, the root cause of each lateral deviation or longitudinal error together with its size and duration;
 - 2) calculate the frequency of occurrence;
 - 3) assess the overall risk in the system against the overall safety objectives; and
 - 4) initiate remedial action as required;

- g) initiate checks of the approval status of aircraft operating in the relevant airspace, identify non-approved operators and aircraft using the airspace and notify the appropriate State of Registry/State of the Operator accordingly; and
- h) submit reports as required to the PIRG/RASG through the region's safety oversight group.

2.3 PROCESS FOR ESTABLISHING THE FUNCTIONS NECESSARY TO MONITOR THE APPLICATION OF PERFORMANCE-BASED HORIZONTAL SEPARATION MINIMA

2.3.1 An organization should perform these functions either locally or on the basis of a bilateral, multilateral or regional air navigation agreement, as applicable, depending on the area of operations.

2.3.2 In order to effectively carry out the necessary duties and responsibilities, an acceptable level of competence must be demonstrated. Competence may be demonstrated by:

- a) previous airspace safety performance monitoring experience; or
- b) participation in ICAO technical panels or other bodies which develop horizontal separation requirements or criteria for establishing separation minima based on performance-based operations; or
- c) establishment of a formal relationship with an organization qualified under a) or b), resulting in the latter organization being confident to provide an endorsement of the new organization as capable of carrying out the duties and responsibilities detailed in 2.2.

2.3.3 Once competence has been demonstrated, including presentation of sufficient material to the regional oversight group on which to make a reasoned assessment, the safety oversight group and the PIRG should provide a formal approval.

2.3.4 Monitoring organizations should publish a list of flight information regions (FIRs) and/or ICAO Member States for which they provide monitoring services for the application of performance-based horizontal separation minima.

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Chapter 3

RESPONSIBILITIES AND STANDARDIZED PRACTICES

3.1 PURPOSE OF THIS CHAPTER

3.1.1 The purpose of this chapter is to document experience gained by organizations assisting the introduction of horizontal separation minima and supporting its continued safe use in order to describe the specific functions necessary to support the implementation and monitor the continued safe use of the separation minima. To ensure standardized practices where necessary, detailed guidance is elaborated further in the appendices.

3.1.2 This chapter describes activities an organization may use to fulfill either pre- or post- implementation responsibilities. The main difference between the pre- and post- implementations is the frequency of the analyses. Throughout the pre-implementation phase, the organization should expect to perform frequent analyses in support of the introduction of the reduced horizontal separation minima. The monitoring organization should expect to perform the described activities on a periodic basis (e.g. annually) during the post-implementation phase.

3.1.3 Figure 3-1* provides a flow chart of the implementation process and the post-implementation monitoring process for horizontal separation minima. The flow chart draws attention to the interrelationships between the implementation activities of the air navigation services provider (ANSP) and the safety assessment and monitoring responsibilities. The oversight body should be informed of any aspects of the operational concept which it considers important in this respect.

3.2 ESTABLISHING THE COMPETENCE NECESSARY TO CONDUCT A SAFETY ASSESSMENT IN A REGION

3.2.1 Conducting a safety assessment is a complex task requiring specialized skills which are not practiced widely. As a result, prior to receiving approval from the regional safety oversight group to perform the functions described in this manual, the organization will need to demonstrate to that group the necessary competence to complete the required tasks.

3.2.2 Ideally, a monitoring organization will have the internal competence to conduct a safety assessment. However, recognizing that personnel with the required skills may not be available internally, a monitoring organization may find it necessary to augment its staff, through the use of personnel assigned by States to the region's PIRG, through arrangements with another established organization possessing the necessary competence.

3.2.3 If it is necessary to use another established organization to conduct a safety assessment, that organization must have the competence to judge that such an assessment is valid. Such competence may be acquired through an arrangement with an organization with experience in conducting safety assessments.

* All figures are located at the end of this chapter.

3.2.4 The safety assessment must reflect the factors that influence collision risk within the airspace where the horizontal separation will be applied. Thus, a method to collect and organize pertinent data and other information descriptive of these airspace factors needs to be established. Data sources from other airspace where horizontal separation has been implemented may assist in conducting a safety assessment. However, such data may not be used as the sole justification for concluding that the target level of safety (TLS) will be met in another airspace unless it is determined that the assumptions made in the safety assessment for the other airspace are applicable and valid for the relevant airspace.

3.2.5 When data from other airspace are used, a comparative safety assessment should be conducted to demonstrate that the assumptions made for the other airspace are valid for the relevant airspace. Basic airspace characteristics should be included in the comparative study, i.e. estimates of annual flying hours, number of flight operations, and traffic densities. The key assumptions to evaluate depend on capabilities, such as required communication performance (RCP), required surveillance performance (RSP) and required navigation performance (RNP)/area navigation (RNAV), and the specific reduced separation. For the relevant airspace, the comparative study should examine the observed system behaviour, such as the controller-pilot data link communication (CPDLC) transaction times, data link outages and durations, and occurrences of navigational errors.

3.3 RESPONSIBILITIES AND STANDARDIZED PRACTICES FOR THE PRE-IMPLEMENTATION PHASE

3.3.1 Review of operational concept

3.3.1.1 Experience has shown that the operational concept for the application of horizontal separation minima adopted by bodies overseeing these applications can substantially affect the collision risk in airspace.

3.3.1.2 The operational concept agreed by the body overseeing horizontal separation implementation, generally the ANSP, should be reviewed carefully with a view to identifying any features of airspace use which may influence risk.

3.3.2 Steps for conducting a pre-implementation safety assessment

3.3.2.1 When implementing a performance-based horizontal separation minima, it is recommended to conduct a safety assessment in accordance with the requirements detailed in Annex 11, Doc 4444, Annex 19 and the supporting guidance material contained in Doc 9859, including the development of hazard identification, risk management and mitigation procedures tables.

3.3.2.2 Table 3-1 provides an overview of the minimum steps considered necessary for a region to undertake a safety assessment. These steps are provided to describe the entire safety assessment process for the region. The monitoring organization should expect to participate in the process beginning with steps 3 and 4.

Table 3-1. Steps for conducting a safety assessment

<i>Ref.</i>	<i>Description</i>
Step 1	Undertake widespread regional consultation with all possible stakeholders and other interested parties.
Step 2	Develop an airspace design concept or ensure that the proposed separation minima will fit the current airspace system and regional or State airspace planning strategy.
Step 3	Review related material for performance-based horizontal separation minima. These documents include Annex 11, Doc 4444, Doc 9869, Doc 9613 and ICAO circulars that provide guidance on the implementation of certain separation minima. Note the specific assumptions, constraints, enablers and system performance requirements in the reference documents.
Step 4	Compare assumptions, enablers and system performance requirements in the documents cited in Step 3 with the regional operational environment, infrastructure and capability.
Step 5	If a region has determined that the change proposal for that region is equal to or better than the requirements and system performance in the documents cited in Step 3, then the region must undertake safety management activities, including: a) formal hazard and consequence(s) identification and safety risk analysis activities, including identification of controls and mitigators; b) implementation plan; c) techniques for hazard identification/safety risk assessment which may include: 1) the use of data or experience with similar services/changes; 2) quantitative modeling based on sufficient data, a validated model of the change, and analysed assumptions; 3) the application and documentation of expert knowledge, experience and objective judgment by specialist staff; and 4) a formal analysis in accordance with appropriate safety risk management techniques as set out in Doc 9859; d) identification and analysis of human factors issues identified with the implementation including those associated with Human Machine Interface matters; e) simulation where appropriate; f) operational training; and g) regulatory approvals.

Step 6	If a region has determined that the change proposal for that region is not equal to the requirements and system performance in the documents cited in Step 3, then the region must: a) consider alternative safety risk controls to achieve the technical and safety performance that matches the documents cited in Step 3; or b) conduct appropriate quantitative risk analysis for the development of a local standard in accordance with Doc 9689.
Step 7	Develop suitable safety assessment documentation, including a safety plan and associated safety cases.
Step 8	Implementation activities should include: a) trial under appropriate conditions; b) expert panel to undertake scrutiny of proposals and development of identified improvements to the implementation plan; c) development of an appropriate backup plan to enable reversion if necessary; and d) continuous reporting and monitoring results of incidents, events and observations.
Step 9	Develop suitable post-implementation monitoring and review processes.

3.4 RESPONSIBILITIES AND STANDARDIZED PRACTICES FOR BOTH PRE-IMPLEMENTATION AND POST-IMPLEMENTATION PHASES

3.4.1 Establishment and maintenance of database of performance-based operational approvals

3.4.1.1 The experience gained through the introduction of the RVSM has shown that the concept of utilizing monitoring organizations is effective in ensuring safety in a region. Monitoring organizations have a significant role to play in all aspects of the safety monitoring process. One of the functions for monitoring the application of performance-based horizontal separation minima is to establish a database of operators and aircraft types/systems approved for performance-based communications (PBC), performance-based navigation (PBN) and performance-based surveillance (PBS) operations by the appropriate authority. Guidance on these approvals is contained in Doc 9613 and Doc 9869.

3.4.1.2 Aviation is a global industry — many operators may be approved for performance-based operations and their approvals registered with an organization performing regional monitoring functions to support the application of horizontal separation minima that rely on performance-based operations. Thus, there is considerable opportunity for sharing the information from monitoring functions among the regions. A region or sub-region introducing horizontal separation predicated on performance-based specifications may need its own designated monitoring organization to act as a focal point for the collection and collation of approvals for aircraft operators operating solely in that region. However, because some aircraft operators may have approvals from States outside the region, the organization will need to coordinate with other regional monitoring organizations to determine the aircraft operator approval status.

3.4.1.3 To avoid duplication by States in registering approvals with any specific regional monitoring organization, the concept of a designated monitoring organization for processing approval data has been established. Under this concept, all States are associated with a specified designated monitoring organization for reporting performance-based

operational approvals. Monitoring organizations should publish a list of ICAO Member States for which they provide monitoring services for application of performance-based horizontal separation minima. Designated monitoring organizations should contact the appropriate monitoring organization for a State to address safety matters for operators registered with that State.

3.4.1.4 In airspace where implementation of performance-based separation is planned, not all aircraft may have the required approvals. Therefore, a State's designated monitoring organization is required to establish a means to coordinate with the State authority to maintain a precise description of the approval information required. Appendix A, A.1 provides typical forms, with a brief description of their use, that can be transmitted to a State authority to obtain information on aircraft performance-based operational approval status.

3.4.1.5 To avoid duplication of work effort, wherever possible, any regional monitoring organization should collect State approval information from the regional monitoring organization associated with the State of the Operator. This collection will be facilitated if the regional monitoring organization maintains a database of these State approvals in a similar electronic form.

3.4.1.6 Appendix A, A.2 describes the minimum database content required, the format in which it should be maintained, a description of the data to be shared, and procedures for data sharing.

3.4.2 Monitoring of operator compliance with State approval requirements

3.4.2.1 Once the database described in 3.4.1 has been established, monitoring of operator compliance with State approval requirements should begin and be maintained while performance-based horizontal separation minima is being applied in the airspace. The aircraft approval status as listed in the database is compared with the aircraft equipment and capability filed in the flight plan. This is required if State approval for performance-based operations is a prerequisite for applying the horizontal separation in such airspace.

3.4.2.2 Two sources of information are needed to perform this monitoring:

- a) aircraft identification (Item 7), aircraft type (Item 9), aircraft registration and PBC, PBN, and/or PBS capability indicated in Items 10 and 18 of the flight plan; and
- b) the database of State PBC, PBN, or PBS approval status, which is obtained from the State of the Operator or State of Registry.

3.4.2.3 As a minimum, compliance monitoring of the complete airspace for at least a 30-day period annually should be conducted. More frequent monitoring of operator approvals enables non-compliant operators to be efficiently identified and any risk associated with their operation in the airspace mitigated. Figure 3-2 provides a flow chart depicting the process required for monitoring of operator compliance with State approvals.

3.4.2.4 When conducting compliance monitoring, the filed equipment and capability indicated in the flight plan for each aircraft movement should be compared to the database of State approval status for the operator and the particular aircraft type/system within the operator's fleet. When a flight plan shows a performance-based operational approval not confirmed in the database, the monitoring organization should officially notify the appropriate organization using a letter similar to that shown in Appendix A, A.1.5 to resolve the discrepancy. The appropriate organization is as follows:

- a) State of the Operator or State of Registry, as appropriate, if the State is assigned to the designated monitoring organization; or

- b) the designated monitoring organization to which the State of the Operator or State of Registry is assigned.

3.4.2.5 The responsibility to take any action should an operator be found to have filed an incorrect declaration of State approval for performance-based operations lies clearly with the State authority, not the designated monitoring organization. The responsibility of the monitoring organization is only to officially notify the appropriate State authority of the discrepancy, and provide advice or information as requested by the State authority.

3.4.3 Monitoring of communication, navigation and surveillance performance

3.4.3.1 General

The monitoring functions include the collection of information necessary to monitor communication, navigational and surveillance performance as part of the risk assessment. Procedures must be instituted to monitor core navigational performance, speed variations, related communication and surveillance performance, and to collect information descriptive of LLDs and LLEs.

3.4.3.2 Monitoring core navigational performance

As required by the regional oversight group, the navigational performance of the aircraft in the core of the distribution of lateral navigational accuracy by comparing aircraft reported position information with non-aircraft-generated position information such as radar data will be investigated. The analysis of core navigation performance contributes to the determination of lateral overlap probability used in conducting a safety assessment. Cooperation of States and ANSPs in monitoring horizontal core navigational performance through the use of appropriate ATS surveillance systems (e.g. secondary surveillance radar (SSR)) must be enlisted. States and ANSPs have the responsibility to supply any requested data that will contribute to the evaluation of core navigational performance.

3.4.3.3 Monitoring longitudinal performance — speed variation*

3.4.3.3.1 The safety assessment process will require evaluation of aircraft speed variation in the airspace. The analysis of aircraft speed variation contributes to the determination of horizontal overlap probability used in conducting a safety assessment. To accomplish this task, the cooperation of ANSPs must be enlisted in monitoring aircraft speed variation performance through the position reports and flight plan data, where appropriate. States and ANSPs have the responsibility to contribute to the analyses and supply any requested data that will contribute to the evaluation of longitudinal performance.

3.4.3.3.2 Aircraft speed variation can be monitored using aircraft position reports that contain estimates of next position. It may be necessary to utilize the instantaneous Mach speed information found in automatic dependent surveillance – contract (ADS-C) reports, and when appropriate the cleared Mach speed, to evaluate adherence to assigned Mach speed. The regional monitoring organization must institute procedures to monitor speed variations, related communication and surveillance performance, and to collect information descriptive of LLEs. Appendix F contains a description of the assumed speed variation distribution and other parameters used in the collision risk modeling.

* Refer to the *Guidelines for the Implementation of Performance-based Longitudinal Separation Minima* (Cir 343) for further detail on the implementation of performance-based longitudinal separation minima.

3.4.3.4 Monitoring of LLDs and LLEs

3.4.3.4.1 Experience has shown that LLDs and LLEs have had significant influence on the outcome of safety assessments before implementation of performance-based separation minima. Accordingly, a principal monitoring function is to ensure the existence of a programme to collect this information, assess the occurrences and initiate remedial action to correct systemic problems. Guidance for initiating such remedial actions as may be necessary to resolve systemic problems uncovered by this programme is found in 3.4.4.4. One way to ensure the existence of such a programme is to develop letters of agreement (LOAs) between States.

3.4.3.4.2 Within the airspace for which it is responsible, each ANSP will need to establish the means to detect and report the occurrence of LLDs and LLEs. Experience has shown that the primary sources for reports of LLDs and LLEs are the ATS units providing air traffic control services in the airspace where the performance-based separation will be applied. The surveillance information available to these units — in the form of voice reports or ADS-C reports and, where available, surveillance radar data or automatic dependent surveillance – broadcast (ADS-B) data — provide the basis for identifying LLDs and LLEs.

3.4.3.4.3 A programme to assess the occurrence of LLDs and LLEs may include a regional Scrutiny Group to support the monitoring functions. A Scrutiny Group is comprised of operational and technical subject matter experts that support the evaluation and classification of LLDs and LLEs to determine their applicability to the collision risk estimate and for other purposes. Guidance on the functions of a Scrutiny Group is contained in Appendix C.

3.4.3.4.4 The ANSP should provide reports of the occurrence of LLDs and LLEs where the magnitude of the deviation or error meets or exceeds the regionally agreed value. It is noted that several horizontal separation minima are available for application in oceanic and procedural airspace depending on the eligibility of the aircraft operator and the capability of the ATC support systems. The regionally agreed value for reporting LLDs and LLEs should be based on the smallest separation minimum possible to relieve ATC from the responsibility of deciding whether a deviation or error occurred based on the RNP specification and the separation minima applied.

3.4.3.4.5 The ANSP should establish a programme for ATS units to provide monthly reports of LLDs and LLEs. An example of such reports is shown in Appendix B. These reports should contain, as a minimum, the following information:

- a) reporting unit;
- b) location of deviation, either as latitude/longitude, ATS route waypoint or other ATC fix;
- c) date and time of LLDs and LLEs;
- d) sub-portion of airspace, such as established route system, if applicable;
- e) aircraft identification (or call sign) and aircraft type;
- f) actual flight level or altitude;
- g) horizontal separation being applied;
- h) size of deviation;
- i) duration of large deviation;
- j) cause of deviation;

- k) any other traffic in potential conflict during deviation;
- l) crew comments when notified of deviation;
- m) fields 10 and 18 from the ICAO filed flight plan; and
- n) remarks from the ATS unit making the report.

3.4.3.4.6 Other sources for reports of LLDs and LLEs should also be explored. A monitoring organization is encouraged to determine if operators within the airspace for which it is responsible are willing to share pertinent summary information from internal safety oversight databases. In addition, a monitoring organization should inquire about access to State databases of safety incident reports which may be pertinent to the airspace. Voluntary reporting safety databases should also be examined, where these are available, as possible sources of LLDs and LLEs incidents in the airspace for which it is responsible.

3.4.3.4.7 While a monitoring organization will be the recipient and archivist for reports of LLDs and LLEs, it is important to note that it alone cannot be expected to conduct all activities associated with a comprehensive programme to detect and report large horizontal deviations. Rather, the support of the regional oversight group overseeing the safety of separation minima, the ICAO Regional Office, appropriate implementation task forces, scrutiny groups or any other organization that can assist in the establishment of such a programme should be enlisted.

3.4.3.5 *Communication and surveillance performance monitoring*

3.4.3.5.1 Performance-based operations that are predicated on the performance of communication and surveillance systems, such as those used for CPDLC, ADS-C and/or satellite voice (SATVOICE), require approvals to show initial compliance with performance specifications and post-implementation monitoring to show continued compliance. Means for obtaining initial approval and continued monitoring should be established prior to the introduction of reduced separation minimum. Guidance material for these initial approvals and for establishing PBCS monitoring programmes is provided in Doc 9869. In the assessment of risk levels, it may be necessary to use data from PBCS monitoring programmes.

3.4.3.5.2 The safety assessment process will require evaluation of observed communication and surveillance system behaviour, such as:

- a) CPDLC uplink transit times;
- b) overdue ADS-C reports;
- c) uplink messages with no response or an UNABLE response; and
- d) communication service provider outages and the effect on operations in the airspace.

3.4.4 Conducting safety assessments and reporting results

3.4.4.1 *Assembling a sample of traffic movements from the airspace*

3.4.4.1.1 Samples of traffic movement data should be collected for the entire airspace where the horizontal separation will be implemented. As a result, ANSPs providing services within the airspace are required to cooperate in providing such data.

3.4.4.1.2 In planning the timing and duration of a traffic movement data sample, the importance of capturing any periods of heavy traffic flow which might result from seasonal or other factors should be taken into account. The duration of any traffic sample should be at least 30 days, with a longer sample period left to the judgment of the experts. As an example, by regional agreement, traffic sample data within the APAC Region are collected by all States for the month of December each year for purposes of RVSM monitoring. During 2009, the APANPIRG expanded the usage of these data under certain conditions to support regional implementations, including the horizontal separation minima.

3.4.4.1.3 The following information should be collected for each flight in the sample:

- a) date of flight;
- b) aircraft identification (or call sign), in standard ICAO format;
- c) aircraft registration mark, if available;
- d) PBC approval type;
- e) PBN approval type;
- f) PBS approval type;
- g) aircraft type conducting the flight, as listed in Doc 8643;
- h) origin aerodrome, as listed in Doc 7910;
- i) destination aerodrome, as listed in Doc 7910;
- j) entry point (fix or latitude/longitude) into the airspace;
- k) time (UTC) at entry point;
- l) flight level (and assigned Mach number if available) at entry point;
- m) route after entry point;
- n) exit point from the airspace;
- o) time (UTC) at exit point;
- p) flight level (and assigned Mach number if available) at exit point;
- q) route before exit fix; and
- r) additional fix/time/flight-level/route combinations that the monitoring organization determines are necessary to capture the traffic movement characteristics of the airspace.

3.4.4.1.4 Where possible, in coordinating collection of the sample, information should be provided in electronic form (i.e. spreadsheet). Appendix D contains a sample specification for collection of traffic movement data in electronic form, where the entries in the first column may be used as column headings on a spreadsheet template.

3.4.4.1.5 Acceptable sources for the information required in a traffic movement sample could include one or more of the following: ATC observations, ATC automation system data, automated air traffic management (ATM) system data and surveillance data such as SSR or ADS-B reports.

3.4.4.2 *Safety assessment*

3.4.4.2.1 A State or a group of States within a region may call on the expertise developed for monitoring the application of performance-based horizontal separation minima to assist in the implementation of new separation minima. In order to conduct an implementation safety assessment, an in-depth knowledge of the use of the airspace is needed. For example, knowledge of expected operators and aircraft types, traffic flows, typical meteorological effects (such as equatorial meteorological effects, location of jet stream, etc) within the airspace which the horizontal separation will be implemented will inform the safety assessment process. Experience has shown that such knowledge can be gained through acquisition of charts and other material describing the airspace, and through periodic collection and analysis of samples of traffic movements within the airspace. The collation and consideration of this information results in a Know Your Airspace (KYA) analysis that documents matters of relevance to the horizontal separation implementation being proposed. An example of a typical KYA analysis appears in Appendix E.

3.4.4.2.2 For some implementations of separation minima specified in Doc 4444, collision risk modeling is required when it is determined that the assumptions made when developing the separation standards are not representative for the area where the standards are being implemented. A safety assessment should include an estimate of the risk of collision associated with the horizontal separation standard and a comparison of this risk to the established regional TLS or other associated safety metrics. The safety assessment will utilize collision risk methodologies that complement the SMS processes that are in place within the region. Appendix F contains a summary of the parameters used in the performance-based collision risk models for horizontal separation minima. Examples of internationally recognized collision risk models (CRMs) used to support the development, implementation, and continued safe use of horizontal separation minima are found in Appendices G and H and in Doc 9689. Appendices G and H also contain sample safety assessments for the South China Sea and New York oceanic airspace, respectively.

3.4.4.2.3 The regional safety oversight group will determine the safety reporting requirements (e.g. format and periodicity).

3.4.4.3 *Determining whether the safety assessment satisfies the TLS*

3.4.4.3.1 *Technical risk* is the term used to describe the risk of collision associated with aircraft performance. Some of the factors which contribute to technical risk are:

- a) errors in aircraft communication, navigation and surveillance systems; and
- b) aircraft equipment failures resulting in unmitigated deviation from the cleared flight path, including those where not following the required procedures further increases the risk.

3.4.4.3.2 *Operational risk* is the term used to describe the risk of collision due to operational errors and in-flight contingencies. The term *operational error* is used to describe any horizontal deviation of an aircraft from the correct flight path as a result of incorrect action by ATC or the flight crew. Examples of such actions include:

- a) a flight crew misunderstanding an ATC clearance, resulting in the aircraft operating on a flight path other than that issued in the clearance;
- b) ATC issuing a clearance which places an aircraft on a flight path where the separation minimum with other aircraft cannot be maintained;

- c) a coordination failure between ATS units in the transfer of control responsibility for an aircraft, resulting in either no notification of the transfer or in transfer at an unexpected transfer point; and
- d) weather deviation. *Note.— these deviations may be instances where the aircraft captain initiates the manoeuvre using operational authority but without advising ATC, and are not necessarily deemed as being incorrect action. However, they still contribute to operational risk and should be reported.*

3.4.4.3.3 The TLS, which must be satisfied, is established by regional agreement and documented in Doc 7030. For example, the generic APAC TLS is presently established, for each dimension (lateral, longitudinal and vertical), as 5×10^{-9} fatal accidents per flight hour (fapfh) due to loss of planned separation; however, specific TLS values may be determined by ICAO for application of a particular separation minimum.

3.4.4.4 Remedial actions

3.4.4.4.1 Remedial actions are those measures taken to remove causes of systemic problems associated with factors affecting the implementation of the performance-based horizontal separation minima. Remedial actions may be necessary to control or mitigate the causes of problems, such as:

- a) failure of an aircraft to comply with performance-based operation requirements;
- b) aircraft operating practices resulting in LLDs and LLEs; and
- c) operational errors.

3.4.4.4.2 Monitoring results should be periodically reviewed by the designated monitoring organization and the associated regional Scrutiny Group in order to determine if there is evidence of any recurring problems or adverse trends. Guidance on the functions of a Scrutiny Group is contained in Appendix C.

3.4.4.4.3 As a minimum, an annual review of reports of LLDs and LLEs should be conducted with a view toward uncovering systemic problems and initiating remedial action. Should such problems be identified, the findings should be reported to the body overseeing horizontal separation implementation, or to the regional oversight group charged with monitoring the safety of separation minima. Included in the report should be the details of LLDs and LLEs suggesting the root cause of the problem.

FIGURES FOR CHAPTER 3

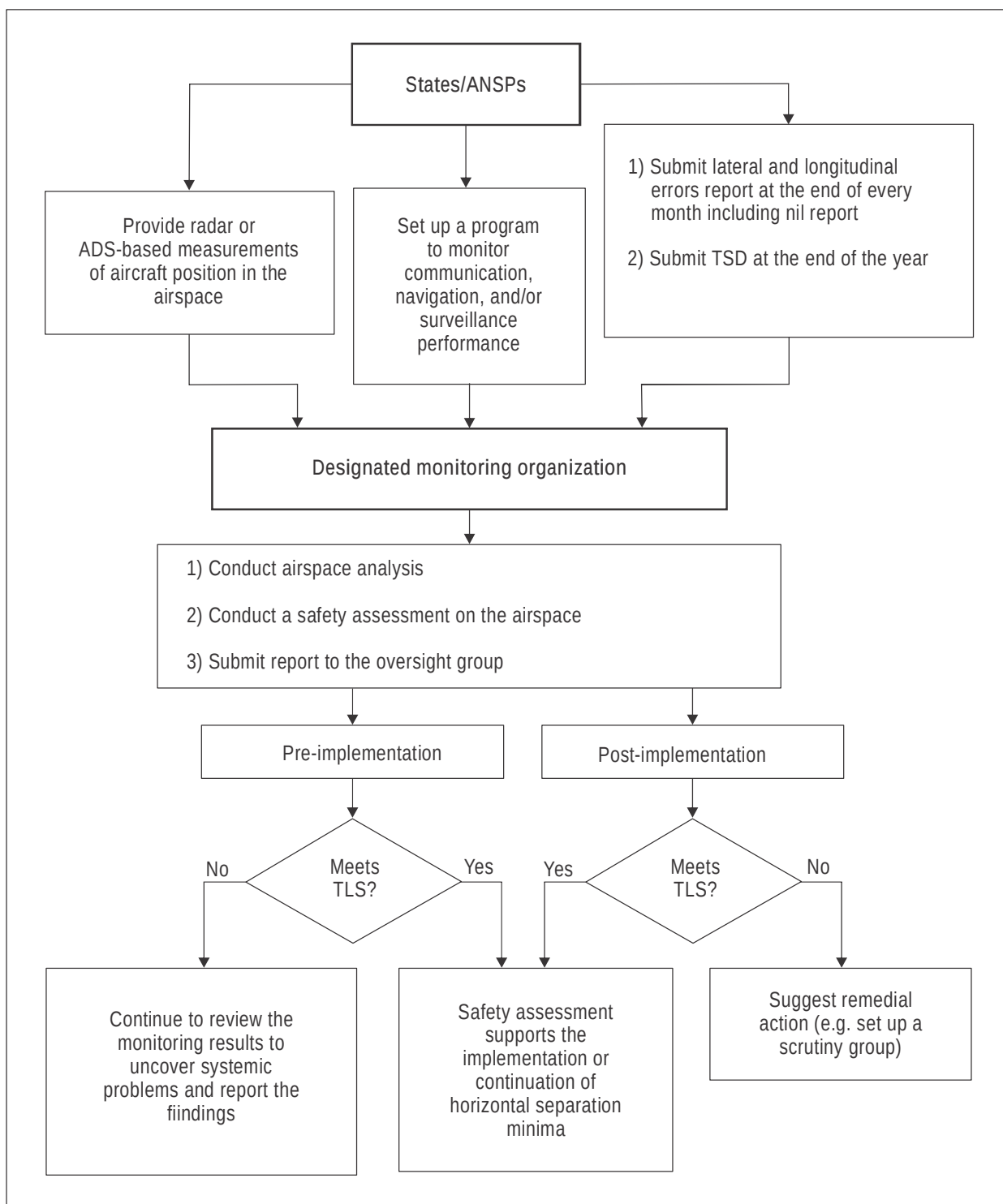


Figure 3-1. Pre/post-implementation horizontal separation minima flow chart

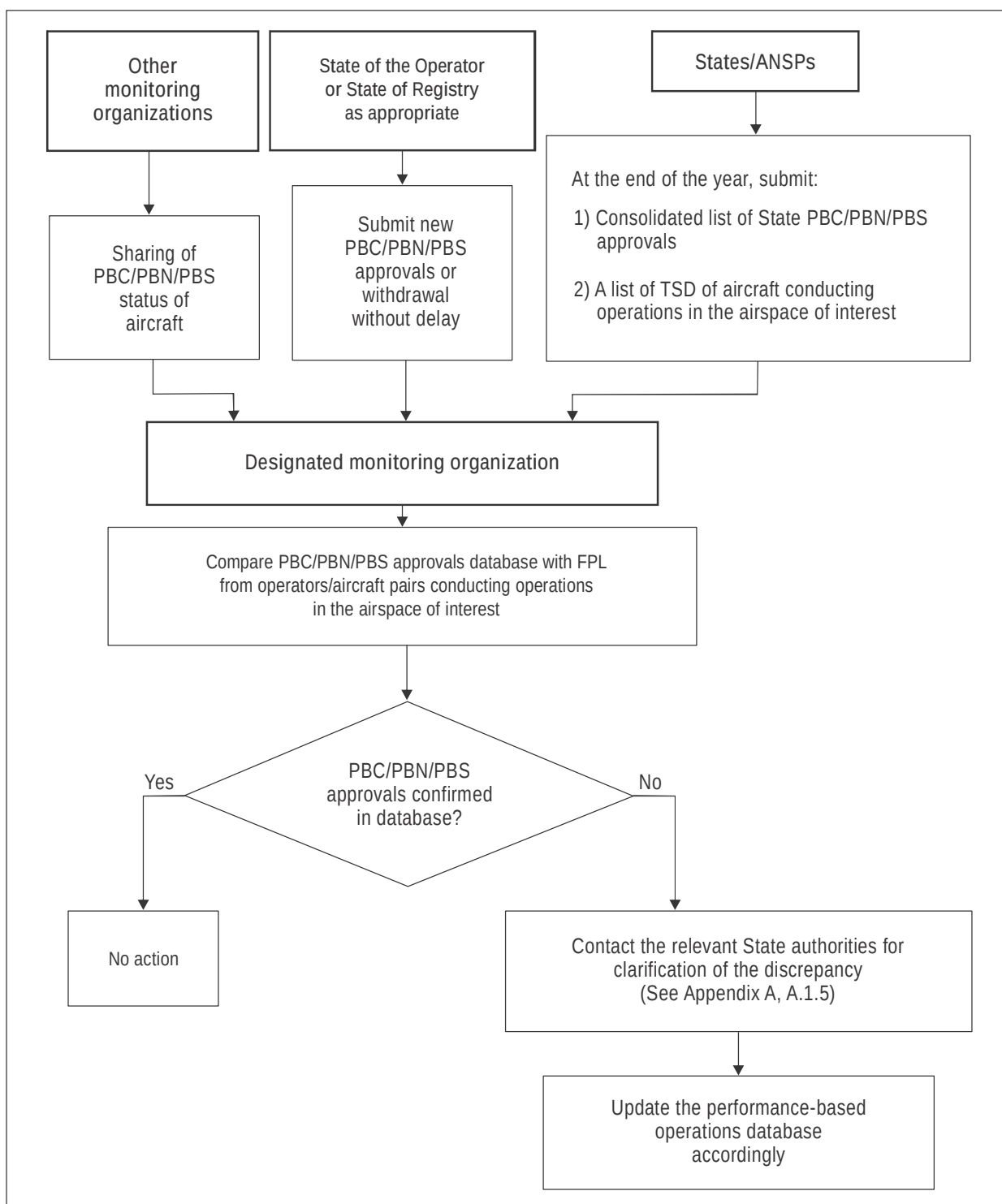


Figure 3-2. Monitoring of operator compliance with State approval requirements flow chart

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Appendix A

MANAGING PERFORMANCE-BASED OPERATIONAL APPROVALS

This appendix provides:

- a) forms for use in obtaining records of performance-based operational approvals from a State authority (A.1); and
- b) minimal informational content for each State performance-based operational approval to be maintained in electronic form (A.2).

A.1 FORMS FOR USE IN OBTAINING RECORDS OF PERFORMANCE-BASED OPERATIONAL APPROVALS FROM A STATE AUTHORITY

A.1.1 General

A.1.1.1 The following forms are provided for the collection of essential information relating to State performance-based operational approvals:

- a) point of contact details for matters relating to performance-based operational approvals (A.1.2);
- b) record of State performance-based operational approval (A.1.3);
- c) withdrawal of State performance-based operational approval (A.1.4); and
- d) letter to State authority requesting clarification of the State performance-based operational approval status of an operator (A.1.5).

A.1.1.2 The following provides guidance for completing the forms provided in this appendix:

- a) It is important to have an accurate record of a point of contact for any queries that might arise from the monitoring of horizontal separation. Recipients are therefore requested to include a completed form (A.1.2) with their first reply to the designated monitoring organization. Thereafter, there is no further requirement unless there has been a change to the information requested on the form.
- b) The form provided in A.1.3 must be completed for each operator/aircraft granted a performance-based operational approval.
- c) The form provided in A.1.4 must be completed and submitted immediately whenever a State of the Operator or State of Registry has cause to withdraw its performance-based operational approval for a specific aircraft type/system within a specific operator's fleet.

- d) The form provided in A.1.5 should be used to confirm the performance-based operational approval status that may be shown in a filed flight plan but not in the database of State approvals.

Note.— The fields in the forms provided in A.1.2, A.1.3 and A.1.4 should be completed as indicated in the following table.

Instructions for completing the fields in the forms under A.1.2, A.1.3 and A.1.4

<i>Field</i>	<i>Instruction</i>
State of Registry State of Operator State of Performance-based Operational Approval	Enter the 2-letter ICAO identifier as contained in ICAO Doc 7910. If more than one identifier is designated for the State, use the letter identifier that appears first.
Operator Identifier	Enter the operator's 3-letter ICAO identifier as contained in ICAO Doc 8585. For international general aviation, enter "IGA". If none, place an X in this field and enter the name of the operator/owner in the remarks row.
Operator Type	Enter or select operator type, e.g. civil or military.
Registration Date* Date of Approval* Date of Expiry*	Enter date in dd/mm/yyyy format, e.g. for 26 October 2013 enter 26/10/2013.
Date of Withdrawal*	Enter date in dd/mm/yyyy format, e.g. for 26 October 2013 enter 26/10/2013.
Aircraft Series	Enter series of aircraft type or manufacturer's customer designation, e.g. for Airbus A320-211 enter 211; for Boeing B747-438 enter 400 or 438.
Aircraft Address (Hex)	Enter ICAO-allocated aircraft address (often referred to as Mode S or ICAO 24-bit code) in hexadecimal format.
PBC Approval Type*	Enter or select the type of PBC approval, e.g. RCP 240, RCP 400 or other. Enter new line for each approval type.
PBN Approval Type*	Enter or select the type of PBN approval, e.g. RNP 2, RNP 4, RNAV 10 or other. Enter new line for each approval type.
PBS Approval Type*	Enter or select the type of PBS approval, e.g. RSP 180, RSP 400, or other. Enter new line for each approval type.
Approval Withdrawn	Enter or select the type of PBC/PBN/PBS approval, e.g. RCP 240, RCP 400, RNP 2, RNP 4, RNAV 10, RSP 180, RSP 400 or other. Enter new line for each approval type.
Remarks	Any remarks.

*where applicable

A.1.2 Point of contact details for matters relating to State performance-based operational approvals

A.1.2.1 This form should be completed and returned to the address below on the first reply to the designated monitoring organization and when there is a change to any of the details requested on the form.

A.1.2.2 Please refer to the table at A.1.1.2 for instructions on how to complete the form below. **PLEASE USE BLOCK CAPITALS.**

NAME OF STATE AUTHORITY OR ORGANIZATION			
STATE OF REGISTRY			
STATE OF REGISTRY (ICAO 2-letter identifier)			
If there is more than one identifier for the State, please use the first identifier that appears in the list.			
ADDRESS DETAILS			
STREET			
CITY			
STATE/PROVINCE			
ZIP/POSTAL CODE			
COUNTRY/REGION			
CONTACT PERSON			
TITLE			
FIRST NAME			
MIDDLE NAME			
LAST NAME			
JOB TITLE			
EMAIL			
PHONE DETAILS			
COUNTRY CODE		AREA CODE	
DIRECT LINE		FAX NUMBER	

Once completed, please return to the following address:

Address:

Telephone:

Fax:

Email:

A.1.3.1 When a State of Registry approves or amends the approval of an operator/aircraft for State performance-based operations, details of that approval must be recorded and sent to the appropriate organization without delay.

AVA Documents
Document Sharing Hub

A.1.4.1 When a State of Registry has cause to withdraw the State performance-based operational approval of an operator/aircraft, the details requested below must be sent to the designated monitoring organization without delay.

Reason for Withdrawal:

[illegible]

**A.1.5 Letter to State authority requesting clarification of the State
performance-based operational approval status of an operator**

When the State performance-based operational approval status shown in the filed flight plan is not confirmed in the database of State approvals, a letter similar to the following should be sent to the relevant State authority.

<STATE AUTHORITY ADDRESS>

1. The (monitoring organization name) has been established by the ICAO (Appropriate group name, e.g. Asia/Pacific Regional Airspace Safety Monitoring Advisory Group (RASMAG)) to support safe implementation and use of the horizontal separation in (airspace where the monitoring organization has responsibility), in accordance with guidance published by the International Civil Aviation Organization.
2. Among its other activities, the (monitoring organization name) conducts a comparison of the State performance-based operational approval status, provided by an operator to an air traffic control unit, to the record of State performance-based operational approval available to us. This comparison is considered vital to ensuring the continued safe use of horizontal separation.
3. This letter is to advise you that an operator which we believe is on your State registry provided notice of State performance-based operational approval which is not confirmed by our records. The details of the occurrence are as follows:
 - a) Date:
 - b) Operator name:
 - c) Aircraft identification (or call sign):
 - d) Aircraft type:
 - e) Filed performance-based operational approval type:
 - f) ATS unit receiving notification:
4. We request that you advise this office of the State performance-based operational approval status of this operator. In the event that you have not granted a State performance-based operational approval to this operator, we request that you advise this office of any action which you propose to take.

Sincerely,

(monitoring organization official)
