MIDDLE EAST REGION

DRAFT
ATC MANUAL FOR A

REDUCED VERTICAL SEPARATION MINIMUM (RVSM) IN MID REGION

Note: These procedures will be applicable only in those FIRs/areas of the MID Region where RVSM will be implemented

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ATC Manual for a Reduced Vertical Separation Minimum (RVSM) in the Middle East Region

This manual represents an operational reference document intended for the use of ATS personnel involved in the planning, implementation and application of a Reduced Vertical Separation Minimum (RVSM) in the Middle East Region.

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LIST OF ABBREVIATIONS

ACAS	Airborne Collision Avoidance System	**IFPS**	Integrated Initial Flight Plan
ACC	Area Control Centre	**IFPZ**	IFPS Zone
ACH	ATC Flight Plan Change Message (IFPS)	**IFR**	Instrument Flight Rules
ACI	Area of Common Interest	**JAA**	Joint Aviation Authorities
ACT	Activation Message (OLDI)	**JAA AMC**	JAA Acceptable Means of Compliance
ADEP	Aerodrome of Departure	**JAR**	Joint Aviation Requirements
ADES	Aerodrome of Destination	**LOA**	Letter of Agreement
AFIL	Flight Plan Filed in the Air	**MASPS**	Minimum Aircraft System Performance Specifications
AFP	ATC Flight Plan Proposal Message (IFPS)	**MECMA**	Middle East Central Monitoring Agency
		MEL	Minimum Equipment List
		MIDANPIRG	Middle East Air Navigation Planning and Implementation Regional Group
		MNPS	Minimum Navigation Performance Specifications
AIC	Aeronautical Information Circular	**MTCD**	Medium Term Conflict Detection
AIP	Aeronautical Information Publication	**NAT**	North Atlantic
AMC	Airspace Management Cell	**NAT CMA**	North Atlantic Region Central Monitoring Agency
ANT	Airspace and Navigation Team	**NATSPG**	North Atlantic Systems Planning Group
APDSG	ATM Procedures Development Sub-Group	**NOTAM**	Notice to Airmen
APL	ATC Flight Plan Message (IFPS)	**OAT**	Operational Air Traffic
ASE	Altimetry System Error	**OLDI**	On-Line Data Interchange
ATC	Air Traffic Control	**RA**	Resolution Advisory (ACAS)
ATM	Air Traffic Management	**REJ**	Reject message (IFPS)
ATS	Air Traffic Services	**RFL**	Requested Flight Level
CDB	Central Data Base	**RGCSP**	Review of the General Concept of Separation Panel
CFL	Cleared Flight Level	**RNAV**	Area Navigation
CFMU	Central Flow Management Unit	**RNP**	Required Navigation Performance
CHG	Modification Message (IFPS)	**RPL**	Repetitive Flight Plan
CMA	Central Monitoring Agency (NAT)		
CVSM	Conventional Vertical Separation Minimum	**RTF**	Radiotelephony
EANPG	European Air Navigation Planning Group	**RVSM**	Reduced Vertical Separation Minimum of 300 m/1 000 ft between FL 290 and FL 410 Inclusive
EATCHIP	European Air Traffic Control Harmonisation and Integration Programme	**SARPs**	Standards and Recommended Practices
EATMP	European Air Traffic Management Programme *(successor to EATCHIP)*	**SDB**	State Data Base
ECAC	European Civil Aviation Conference	**SSEC**	Static Source Error Correction
FAA	Federal Aviation Administration (USA)	**SSR**	Secondary Surveillance Radar
FDPS	Flight Data Processing System	**STCA**	Short Term Conflict Alert
FIR	Flight Information Region	**TA**	Traffic Advisory (ACAS)
FL	Flight Level	**TGL**	Temporary Guidance Leaflet (JAA)
FLAS	Flight Level Allocation Scheme	**TLS**	Target Level of Safety
FMP	Flow Management Position (ACC)	**TSA**	Temporary Segregated Area
FPL	Flight Plan	**TSE**	Total System Error
GAT	General Air Traffic	**TVE**	Total Vertical Error
GMU	GPS Height Monitoring Unit	**UAC**	Upper Area Control Centre
GPS	Global Positioning System	**UIR**	Upper Flight Information Region

HMU	Height Monitoring Unit	**VFR**	Visual Flight Rules
ICAO	International Civil Aviation Organization	**VSM**	Vertical Separation Minimum

DEFINITIONS

Flight Level Allocation Scheme (FLAS)

The scheme whereby specified flight levels may be assigned to specific route segments within the ATS route network.

General Air Traffic (GAT)

Flights conducted in accordance with the rules and provisions of ICAO.

Operational Air Traffic (OAT)

Flights which do not comply with the provisions stated for General Air Traffic (GAT), and for which rules and procedures have been specified by appropriate authorities.

RVSM Approval

The approval that is issued by the appropriate authority of the State in which the Operator is based, or of the State in which the aircraft is registered. To obtain such RVSM approval, Operators shall satisfy the said State that:

1) aircraft for which the RVSM Approval is sought have the vertical navigation performance capability required for RVSM operations through compliance with the criteria of the RVSM Minimum Aircraft Systems Performance Specifications (MASPS);

2) they have instituted procedures in respect of continued airworthiness (maintenance and repair) practices and programmes; and

3) they have instituted flight crew procedures for operations in the MID RVSM Airspace.

Note: An RVSM approval is not restricted to a specific region. Instead, it is valid globally on the understanding that any operating procedures specific to a given region, in this case the MID Region, should be stated in the operations manual or appropriate crew guidance.

DEFINITIONS

RVSM APPROVED AIRCRAFT

Aircraft that have received State approval for RVSM operations within the MID RVSM Airspace.

RVSM Entry Point

The first reporting point over which an aircraft passes or is expected to pass immediately before, upon, or immediately after initial entry into an RVSM Airspace, from a non-RVSM airspace, normally the first reference point for applying a 300 m (1 000 ft) vertical separation minimum between RVSM approved aircraft.

RVSM Exit Point

The last reporting point over which an aircraft passes or is expected to pass immediately before, upon, or immediately after leaving an RVSM Airspace, into a non-RVSM airspace, normally the last reference point for applying a 300 m (1 000 ft) vertical separation minimum between RVSM approved aircraft.

State Aircraft

For the purposes of MID RVSM, only aircraft used in military, customs and police services shall qualify as State aircraft.

Reference: ICAO Convention on International Civil Aviation, Article 3 (b).

Strategic Flight Level

A flight level which may be flight-planned in accordance with the ICAO Tables of Cruising Levels, Annex 2, Appendix 3, and/or a Flight Level Allocation Scheme (FLAS), as specified in the relevant Aeronautical Information Publications (AIPs).

Tactical Flight Level

A flight level which is reserved for tactical use by ATC, and, as such, should not be flight-planned.

EXECUTIVE SUMMARY

The application of a reduced vertical separation minimum in the airspace of the Middle East Region States and other States participating in the MID RVSM Programme, represents a change of major significance to the operational environments of those ACCs/UACs involved. Careful planning in advance of the implementation of RVSM will ensure that benefits in terms of capacity and operating efficiency are optimised, and that controllers will be able to successfully cope with the magnitude of the change to their operational environments, thereby ensuring continued levels of safety.

Text within this manual, highlighted through the use of a shaded box, describe ATC procedures and system support requirements as dictated by identified operational requirements and as endorsed by MIDANPIRG. In support of these ATC procedures and system support requirements, the manual serves as a guidance and reference document for those operational and management ATS personnel involved with the planning for the implementation of RVSM. As well, it will serve as a reference document for those personnel involved with the continuing ATC operations of ACCs/UACs in an RVSM environment.

The manual will address those elements of the MID ATM system which are impacted directly by, or have an impact on, RVSM implementation and application.

While the document describes the MID RVSM airspace, ATC procedures, ATC phraseologies and relevant flight crew procedures associated with the application of RVSM, it does not supersede the relevant ICAO and national documents.

to reflect the application of RVSM within the airspace not only of Member States of the Middle East Region, but also within certain States adjacent to MID, which have decided to participate in the RVSM Programme. Although originally intended for implementation only within the MID Region States as a capacity enhancing element, additional States bordering the MID Region will as well implement RVSM in their airspace, in order to achieve a homogeneous MID RVSM airspace and to share in the expected benefits of RVSM.

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1. INTRODUCTION

1.1 Background

The implementation of a reduced vertical separation minimum represents a major capacity enhancing objective of the MIDANPIRG. Effectively, the introduction of RVSM will permit the application of a 1 000 ft vertical separation minimum (VSM) between suitably equipped aircraft in the level band FL 290-FL 410 inclusive, thereby making available six additional usable flight levels. The purpose of the implementation of RVSM is to increase capacity, through the provision of these six additional flight levels, to reduce controller workload, while maintaining, or improving upon, current levels of safety, and to provide the airspace user community with an improved operating environment for optimising flight profiles.

The making available of these additional levels is one of the means which will enable controllers:

- to efficiently handle both the current and future levels of traffic within their areas of responsibility,
- to de-conflict strategically traffic over the major crossing points of the MID ATS route network more effectively, and
- to accommodate pilot requests for optimal cruising levels.

As described below, and as a pre-requisite to the introduction of RVSM in the MID Region, implementation of RVSM requires that levels of safety of operations within the MID RVSM airspace, when compared to current levels of safety, be either maintained or improved. Work undertaken by the Middle East Central Monitoring Agency (MECMA) in the form of real-time simulations and safety studies have confirmed the feasibility of implementing RVSM, both technically and operationally, within required levels of safety. Experience gained through the application of RVSM within the ICAO North Atlantic (NAT) Region and within European airspace has been used in the development of the relevant associated aspects of the implementation of RVSM in the MID airspace. In this way, consistency in flight operations across the two operational ATC environments was maintained to the maximum extent possible. The material developed as a result of the MID RVSM Programme is in accordance with all relevant ICAO Standards and Recommended Practices (SARPs)

and associated ICAO Guidance Material on both RVSM and ATS. Thus, the implementation of RVSM in the MID airspace is undertaken with due consideration for consistency with applications of the concept, both existing and planned, in other regions.

1.2 The Need for RVSM

OUTLOOK FOR THE MIDDLE EAST REGION

Economic Trends and Prospects

1.2.1 The Middle East economy has been characterized by several pronounced cycles over the past decade. The oil producing countries in the region suffered from declines in crude oil prices during the 1980s and from the effects of the Gulf War in 1990_1991. With a return to political and economic stability in the region, GDP growth recovered quite strongly in 1992. Continuous growth, though varying in strength, was sustained in the following seven years. From 1989 to 1999, the aggregate GDP for the Middle East grew at an average annual rate of 3.2 per cent in real terms, while GDP per capita levelled off at 0.5 per cent per annum. The GDP for the region is expected to increase at an average annual rate of 2.5 per cent for the period 1999-2010.

Air Passenger Traffic Trends and Forecast

1.2.2 Over the 1989-1999 period, scheduled passenger traffic (in PKPs) of the airlines of the Middle East region increased at an average annual rate of 5.9 per cent. The year 2000 witnessed an impressive growth of traffic at 11.0 per cent over 1999.The long term average annual growth rate to the year 2010 is anticipated to be 4.5 per cent.

Aircraft movement forecasts for 2010-2015

1.2.3 The aircraft movement forecasts for the period 2000-2015 were developed assuming some maturity in growth for the route groups concerned. Aircraft movement forecast growth rates are projected to be somewhat lower for the period 2010-2015 compared to the period 2000-2010. These aircraft movements forecasts are shown in **Table 1**.

TABLE 1

AIRCRAFT MOVEMENTS FORECAST BY ROUTE GROUP TO THE YEAR 2015

	2000 (000)	2010 (000)	2015 (000)	Average Annual Growth (%)	
				2000-2010	2010-2015
AFR_MEA	45.2	62.0	70.8	3.2	2.7
ASIA_MEA	86.3	162.0	211.8	6.5	5.5
EUR_MEA	133.2	227.5	283.5	5.5	4.5
INTRA MEA	116.0	228.2	305.4	7.0	6.0
NAM-MEA	6.3	9.3	11.1	4.0	3.5
Total	387.0	689.0	882.6	5.9	5.1

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1.2.4 It is accepted that major changes to the ATM systems will be necessary in order to cope with this continued traffic growth. Of the various measures under consideration, the implementation of RVSM is considered to be the most cost effective means of meeting this need through the provision of six additional flight levels for use in the highly congested airspace from FL 290 to FL 410 inclusive. The RVSM Programme will result in the following benefits:

- Optimum Route Profiles.

  The availability of the additional flight levels in the busiest level band, will allow operators to plan for, and operate at or closer to, the optimum vertical route profile for the particular aircraft type. This will provide fuel economies in terms of both the fuel carried, and the fuel burn, for the flight.

- Increased ATC Capacity

  significant reduction in controller workload. Simulations carried out in France demonstrated that the capacity of those sectors simulated could be increased by approximately 20% when compared to a conventional vertical separation minimum (CVSM) environment[1]. There is also potential for further growth, through a revised

[1] 3rd Continental RVSM Real-Time Simulation, S08, (Conclusions)

airspace structure including, for example, resectorisation and/or the introduction of additional sectors.

1.3 History

In the late 1950s it was recognised that, as a result of the reduction in accuracy of pressure-sensing of barometric altimeters with increasing altitude, there was a need above a certain flight level to increase the prescribed vertical separation minimum (VSM) of 1 000 ft. In 1960, an increased VSM of 2 000 ft was established for use between aircraft operating above FL 290 except where, on the basis of regional air navigation agreement, a lower flight level was prescribed for the increase. The selection of FL 290 was not so much an empirically-based decision but rather a function of the operational ceiling of aircraft at that time. In 1966, this change-over level was established at FL 290 on a global basis. At the same time, it was considered that the application of a reduced VSM above FL 290, on a regional basis and in carefully prescribed circumstances, was a distinct possibility in the not too distant future. Accordingly, ICAO provisions stated that such a reduced VSM could be applied under specified conditions within designated portions of airspace on the basis of regional air navigation agreements.

In the late 1970s, faced with rising fuel costs and growing demands for a more efficient utilisation of the available airspace, ICAO initiated a comprehensive programme of studies to examine the feasibility of reducing the 2 000 ft VSM applied above FL 290, to the same 1 000 ft VSM which is applied below FL 290. Throughout the 1980s, various studies were conducted, under the auspices of ICAO and in Europe, Canada, Japan, and the United States. The underlying approach of the programmes was to:

- determine the height keeping accuracy of the altimetry systems of the then current aircraft population.
- establish the causes of observed height keeping errors.
- determine the required safety levels for the implementation and use of a Reduced Vertical Separation Minimum (RVSM) of 1 000 ft in the level band FL 290 - FL 410 inclusive.
- define a MASPS, for aircraft altimetry and associated height keeping equipment, which would improve height keeping accuracy to a standard compatible with the agreed safety requirements for RVSM.
- determine whether the global implementation and use of RVSM was :
    1. technically feasible, subject to the over-riding need to satisfy the agreed safety standards, and

2. cost beneficial.

The results of these exhaustive studies demonstrated that the reduction of vertical separation was safe, cost beneficial and feasible, - without the imposition of unduly demanding technical requirements.

1.4 The MID Region RVSM Implementation Programme

The Programme consists of a series of co-ordinated activities, performed within the framework the MIDANPIRG RVSM Task Force, MECMA, ICAO, Joint Aviation Authorities (JAA), Participating States and User Organisations.

The programme has followed the general strategy set out in the ICAO Doc. 9574 (First Edition) - 000 ft) Vertical Separation Minimum -step approach within four distinct phases :

Phase 1: Initial Planning

- Step 1: Assessment of Operational System Safety
- Step 2: Assessment of Costs and Benefits from RVSM
- Step 3: Elaboration of programme plans and production of technical specifications.

Phase 2: Advanced Planning and Preparation

In this phase the emphasis of the work programme moved from the theory and initial design of the total system to the practical application and introduction of the system requirements. The objectives of this phase were:

1. to prepare the aircraft for RVSM operations
2. to prepare a monitoring environment to allow confirmation of the technical performance of aircraft
3. to commence the preparation of the ATS environment for RVSM operation.

Note: Points 1 and 2 will allow Phase 3 to start, point 3 is pre-requisite to Phase 4.

Phase 3 : Verification of Aircraft Performance

The purpose of the Verification Phase, is to confirm, in a 2 000 ft vertical separation environment:

- the effectiveness of the RVSM approval process;

- the effectiveness of the MASPS, by measuring the height keeping performance accuracy of the maximum possible number of aircraft which have obtained RVSM airworthiness approval;
- that the safety levels of the proposed RVSM system will remain at, or be better than, those established by the Target Level of Safety (TLS).

This phase will continue until all aspects of the work programme necessary to the successful completion of the verification process have been completed. This is expected to take approximately one year.

Phase 4 : Introduction of RVSM

The introduction of RVSM does not mark the end to the Programme. This phase of the programme will be used to confirm that:

- all elements of the total system are operating satisfactorily,
- is below that tolerated by the TLS.

This phase will support the resolution of any operational issues which might be revealed following the implementation of 1 000 ft VSM.

Phase 4 will continue until it is possible to confirm that the long term safety of 1 000 VSM can be assured without further monitoring.

1.5 Supporting Documentation

The following reference documents contain information pertaining to RVSM:

- ICAO Doc 9574 - Manual on Implementation of a 300 m (1 000 ft) Vertical Separation Minimum between FL 290 and FL 410 Inclusive

- ICAO Doc 7030/4 (EUR) - ICAO Regional Supplementary Procedures for European and MID/ASIA Regions

- ICAO EUR Doc 009 - Guidance Material on the Implementation and Application of a 300 m (1 000 ft) Vertical Separation Minimum in the European RVSM Airspace

- JAA Temporary Guidance Leaflet - Guidance Material on the Approval of Aircraft and Operators for Flight in Airspace above Flight Level 290 where a 300 m (1 000 ft) Vertical Separation Minimum is applied (TGL No.6, Revision 1)

- National Aeronautical Information Circulars (AICs) and/or Aeronautical Information Publications (AIPs)

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2.0 DESCRIPTION OF THE MID RVSM AIRSPACE

2.1 The MID RVSM Airspace

2.1.1 RVSM shall be applicable in that volume of airspace between FL 290 and FL 410 inclusive in the following Flight Information Regions (FIRs)/Upper Information Regions (UIRs):

Amman, Bahrain, Beirut, Cairo, Damas, Emirates, Jeddah, Kuwait, Muscat,

Note: At this phase of the planning process some States/FIRs/UIRs of the MID Region which have not joined the MID RVSM programme or have not met the minimum requirements will not implement RVSM on the tentative date of 27 November 2003 . This list will be accordingly updated based on the progress achieved and the status of implementation of the minimum requirements within each State/FIR/UIR.

2.1.2 RVSM shall be applicable in either all, or part of, that volume of airspace between FL 290 and FL 410 inclusive in the following FIRs/UIRs:

Karachi

2.1.3 The volume of airspace specified in paragraphs 2.1.1 and 2.1.2 is referred to as "MID RVSM Airspace" (Figure 2.a refers).

2.2 The MID RVSM Transition Airspace

2.2.1 Transition tasks associated with the application of a 300 m (1 000 ft) vertical separation minimum within the MID RVSM Airspace shall be carried out in all, or parts of, the following FIRs/UIRs:

2.2.2 The volume of airspace specified in paragraph 2.2.1 is referred to as "MID RVSM Transition Airspace" (Figure 2.a refers).

2.3 The MID/AFI/European/Asia Interface

2.3.1 In addition to the MID RVSM Transition Airspace, as described in paragraph 2.2.1, the State authorities responsible for the following FIRs may establish designated airspace within their FIRs for the purpose of transitioning non-RVSM approved civil aircraft operating to/from the EUR/AFI/Asia Region:

Figure 2.a refers).

Figure 2.a: The MID RVSM Area.

Bahrain
Egypt
Iran
Israel
Jordan
Kuwait
Lebanon
Oman
Qatar
Saudi Arabia
Syria
UAE
Yemen

Figure 2.b: List of the 13 States participating in the MID RVSM Programme.

2.4 ICAO Table of Cruising Levels applicable to MID RVSM Airspace

2.4.1 With the implementation of RVSM, cruising levels within MID RVSM Airspace will be organised in accordance with the Table of Cruising Levels contained in ICAO Annex 2, Appendix 3, a). The cruising levels appropriate to direction of flight within the MID Region with the implementation of RVSM are illustrated below:

Cruising Levels Appropriate to Direction of Flight - MID Region (FL 280 TO FL 430)

Track* from 180 degrees to 359 degrees**	Track* from 000 degrees to 179 degrees**
← FL 430	*(non-RVSM level)*
	FL 410 →
← FL 400	
	FL 390 →
← FL 380	
	FL 370 →
← FL 360	
	FL 350 →
← FL 340	
	FL 330 →
← FL 320	
	FL 310 →
← FL 300	
	FL 290 →
← FL 280	*(non-RVSM level)*

* Except where, on the basis of regional air navigation agreements, from 090 to 269 degrees and from 270 to 089 degrees is prescribed to accommodate predominant traffic directions and appropriate transition procedures to be associated therewith are specified.

2.4.2 The application of the ICAO Table of Cruising Levels for an RVSM environment has the effect of reversing the direction of flight for FL 310, FL 350 and FL 390. Flight levels 310, 350, and 390 are eastbound cruising levels in an RVSM environment, whereas they are westbound cruising levels in a non-RVSM environment.

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3.0 PROVISION OF SERVICE TO NON-RVSM APPROVED STATE AIRCRAFT

3.1 In consideration of the physical inability (due to limitations in aircraft design) of adapting the large majority of military tactical aircraft to the RVSM MASPS, **State aircraft were exempted** from the requirement to be RVSM approved in order to operate within the MID RVSM Airspace. However, MID Region States have been urged to adapt their State aircraft for RVSM approval, to the extent possible, and especially those aircraft used for GAT operations. Nonetheless, certain types of State aircraft cannot feasibly be adapted to meet the RVSM MASPS. These aircraft will be permitted to operate as either OAT or GAT within the MID RVSM Airspace.

Note: With a view to have consistency of terms used in other adjacent regions, the use of the terms **GAT** and **OAT** will be interpreted as follows:

General Air Traffic (GAT)

Flights conducted in accordance with the rules and provisions of ICAO.

Operational Air Traffic (OAT)

Flights which do not comply with the provisions stated for General Air Traffic (GAT), and for which rules and procedures have been specified by appropriate authorities.

3.2 Within the MID RVSM Airspace, non-RVSM approved State aircraft operating as GAT will be provided with a minimum vertical separation of 600 m (2 000 ft) from all other IFR aircraft. Although the number of non-RVSM approved State aircraft operating as GAT within the MID RVSM Airspace is expected to be very small, the impact of such flights on controller workload is not to be underestimated.

3.3 The requirement for ATC to accommodate non-RVSM approved State aircraft within the MID RVSM Airspace imposes significant operational considerations. Several real-time simulations carried out in support of the RVSM Programme confirm that significant increases in controller workload result from the requirement of having to selectively apply two distinct vertical separation minima (VSM) within the same volume of airspace, specifically:

300 m (1 000 ft): between any two aircraft operating as GAT where both aircraft are RVSM approved, and

600 m (2 000 ft): between any two aircraft operating as GAT where either:

- one of the aircraft involved is non-RVSM approved, or
- both of the aircraft involved are non-RVSM approved.

3.4 Of prime operational importance, therefore, is the need for controllers to be continuously aware of the RVSM approval status of all aircraft operating within, or in close proximity to, the MID RVSM Airspace. To meet this need, operational requirements for ATS systems, and ATC procedures have been developed for the MID RVSM Airspace.

3.5 Specific ATC and flight planning requirements for the MID RVSM Airspace are contained in Section 5, whereas the automated system modifications necessary to support the ATC operational requirements for RVSM are detailed in Section 8.

*Note: See Section 5.5 with regards to the provision of service to non-RVSM approved **civil** aircraft within the MID RVSM transition airspace.*

4.0 FLIGHT OPERATIONS WITHIN THE MID RVSM AIRSPACE

4.1 Except for designated airspace where RVSM transition tasks are carried out, only RVSM approved aircraft and non-RVSM approved State aircraft shall be permitted to operate within the MID RVSM Airspace.

4.2 Except for State aircraft operating as OAT, flights shall be conducted in accordance with **IFR** when operated within or above the MID RVSM Airspace.

References: ICAO Annex 2, Chapter 4, paragraph 4.5
ICAO Regional Supplementary Procedures - Doc 7030/4 (EUR/MID)

4.3 The organisation of cruising levels within the MID RVSM Airspace, as described in paragraph 2.4.1, does not preclude the establishment of uni-directional ATS routes where deemed necessary.

4.3.1 Furthermore, it should be noted that within the MID RVSM Airspace all cruising levels are equally assignable by ATC to either RVSM approved or non-RVSM approved aircraft, provided that the applicable vertical separation minimum is applied.

5.0 RVSM PROCEDURES

5.1 Flight Planning Requirements

General Requirements

5.1.1 For the purpose of providing a clear indication to ATC that where non-RVSM

RVSM Airspace, in addition to military operations, operators of customs or police

M tem 8 of the ICAO Flight Plan.*

5.1.1.1 Only aircraft used in military, customs, or police service shall qualify as State aircraft, and therefore be entitled to operate within the MID RVSM Airspace, regardless of the RVSM status of the aircraft.

5.1.2 All operators filing Repetitive Flight Plans (RPLs) shall include in Item Q of the RPL all equipment and capability information in conformity with Item 10 of the ICAO Flight Plan.

5.1.2.1 ICAO flight planning requirements for the MID Region require the inclusion of all ICAO Flight Plan Item 10 equipment and capability information (e.g. RVSM approved -

possession of this information for each flight on the day of operation.

5.1.3 If a change of aircraft operated in accordance with a repetitive flight plan results in a modification of the RVSM approval status as stated in Item Q, a modification message (CHG) shall be submitted by the operator.

RVSM Approved Aircraft and Non-RVSM Approved State Aircraft

5.1.4 Operators of RVSM approved aircraft shall indicate the approval status by inserting the letter in Item 10 of the ICAO Flight Plan, and in Item Q of the Repetitive Flight Plan (RPL), regardless of the requested flight level.

5.1.4.1

5.1.4.2 Operators are required to indicate their RVSM approval status regardless of the requested flight level (RFL), since ATC must have a clear indication of the non-RVSM approval status of aircraft intending to operate within, or in close vertical proximity to, the MID RVSM Airspace. In the absence of such an indication, the controller shall solicit such information.

5.1.5 Operators of non-RVSM approved State aircraft with a requested flight level of FL in Item 18 of the ICAO Flight Plan.

5.1.5.1 requirement for ATC to provide a minimum vertical separation of 600 m (2 000 ft) between non-RVSM approved State aircraft and any other aircraft operating within the MID RVSM Airspace.

5.1.5.2 Non-RVSM approved State aircraft filing a requested flight level above FL 410 shall also be required to insert in Item 18 of the ICAO Flight Plan, since special handling by ATC (600 m [2 000 ft] vertical separation minimum) shall be required for that portion of the flight pertaining to the climb/descent through the MID RVSM Airspace.

5.1.6 Operators of formation flights of State aircraft shall **not** insert the letter in Item 10 of the ICAO Flight Plan, regardless of the RVSM approval status of the aircraft concerned. Operators of formation flights of State aircraft intending to operate within the MID RVSM Airspace as General Air Traffic (GAT) shall include in Item 18 of the ICAO Flight Plan.

5.1.6.1 Formation flights of State aircraft shall be accommodated within the MID RVSM Airspace, and will be considered as being non-RVSM approved, regardless of the RVSM approval status of the individual aircraft involved. As such, they shall request special handling by ATC, and be provided with a minimum vertical separation of 600 m (2 000 ft) from all other aircraft operating within the MID RVSM Airspace.

5.1.7 Operators of RVSM approved aircraft and non-RVSM approved State aircraft intending to operate within the MID RVSM Airspace shall include the following in Item 15 of the ICAO Flight Plan:

- the **entry point** at the lateral limits of the RVSM Airspace, and the requested flight level for that portion of the route commencing immediately after the RVSM entry point; and
- the **exit point** at the lateral limits of the RVSM Airspace, and the requested flight level for that portion of the route commencing immediately after the RVSM exit point.
- *Note: there are no requirements for the inclusion of entry/exit points between*

5.1.7.1 Due to the differences between the cruising levels applicable within the MID RVSM Airspace to those applicable within adjacent non-RVSM airspace, ATC will require precise information as to the requested flight level for the portion of the route immediately after RVSM entry and exit points.

5.1.7.2 Therefore, RVSM entry and exit points will be established for traffic transiting to/from RVSM and non-RVSM areas, on or near the boundaries of the MID RVSM Airspace for all ATS routes crossing the lateral limits of the MID RVSM Airspace.

5.1.7.3 Additionally, the MID RVSM entry and exit points will be designated as compulsory reporting points, in order to facilitate the application of the ICAO procedures in the event of an air-ground communication failure. Communication failure procedures are addressed in Section 7.0.

Non-RVSM Approved Civil Aircraft

5.1.8 Except for operations within the designated airspace where RVSM transition tasks are carried out, operators of non-RVSM approved civil aircraft shall flight plan to operate outside of the MID RVSM Airspace.

5.1.8.1 Operators of non-RVSM approved civil aircraft intending to operate from a **departure aerodrome outside** of the lateral limits of an RVSM Airspace to a **destination aerodrome within** the lateral limits of an RVSM Airspace shall include the following in Item 15 of the ICAO Flight Plan:

a) the entry point at the lateral limit of an RVSM Airspace; and

b) a requested flight level below FL 290 for that portion of the route commencing immediately after the entry point.

5.1.8.2 Operators of non-RVSM approved civil aircraft intending to operate from a **departure aerodrome to a destination aerodrome which are both within** the lateral limits of an RVSM Airspace shall include, in Item 15 of the ICAO Flight Plan, a requested flight level below FL 290.

5.1.8.3 Operators of non-RVSM approved civil aircraft intending to operate from a **departure aerodrome within** the lateral limits of an RVSM Airspace to a **destination aerodrome outside** of the lateral limits of an RVSM Airspace shall include the following in Item 15 of the ICAO Flight Plan:

a) a requested flight level below FL 290 for that portion of the route within the lateral limits of an RVSM Airspace; and

b) the exit point at the lateral limit of an RVSM Airspace, and the requested flight level for that portion of the route commencing immediately after the exit point.

Note: With a view to facilitate the integration of earlier generation aircraft, not approved for RVSM operations, and intending to operate on domestic flights within RVSM airspace, non exclusion areas will be established with a view to accommodate these operations.

5.1.8.4 Operators of non-RVSM approved civil aircraft intending to operate from a **departure aerodrome to a destination aerodrome which are both outside** of the lateral limits of an RVSM Airspace, with a portion of the route within the lateral limits of an RVSM Airspace, shall include the following in Item 15 of the ICAO Flight Plan:

a) the entry point at the lateral limit of an RVSM Airspace, and a requested flight level below FL 290 or above FL 410 for that portion of the route commencing immediately after the entry point; and

b) the exit point at the lateral limit of an RVSM Airspace, and the requested flight level for that portion of the route commencing immediately after the exit point.

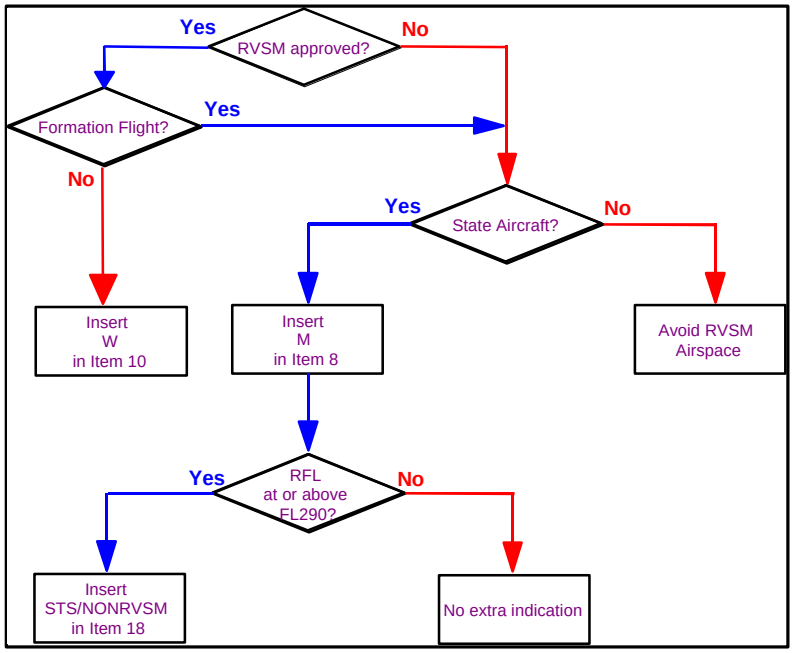


Figure 3: Overview of RVSM Flight Planning Requirements for Operators.

5.2 ATC Clearances

5.2.1 Except for operations within the MID RVSM Transition Airspace, as specified in paragraph 2.2.1, and within the airspace designated for the AFI/Asia/European interface, as specified in paragraph 2.3.1, only RVSM approved aircraft and non-RVSM approved State aircraft shall be issued an air traffic control clearance into the MID RVSM Airspace.

5.2.1.1 Except for designated airspace where RVSM transition tasks are carried out, operations within the MID RVSM Airspace are restricted to RVSM approved aircraft and non-RVSM approved State aircraft. Flight planning requirements in relation to RVSM will make possible the display of the RVSM-related flight plan information, to enable controllers to be systematically a -RVSM approval status.

5.2.1.2 Where ATC has reason to doubt the RVSM approval status of an aircraft, the controller shall solicit such information from the pilot. If the pilot confirms , the controller shall consider the flight as being RVSM approved.

5.2.1.3 Non-RVSM approved **civil** aircraft, operating from a departure aerodrome to a destination aerodrome, both of which are situated outside of the lateral limits of an RVSM Airspace, could be cleared to a flight level **above** an RVSM Airspace, i.e. FL 430.

5.2.2 Formation flights of **civil** aircraft shall **not** be issued an air traffic control clearance into the MID RVSM Airspace.

5.2.2.1 ICAO Annex 2, Chapter 3, paragraph 3.1.8, provides that aircraft participating in formation flights are permitted to operate within 30 m (100 ft) above or below the flight leader. Consequently, formation flights could exceed the total vertical error (TVE) allowed within the MID RVSM Airspace (Appendix E refers). Formation flights shall therefore be considered as being non-RVSM approved.

5.3 Vertical Separation Minima (MID RVSM AREA)

5.3.1 The applicable vertical separation minimum between RVSM approved aircraft operating within an RVSM Airspace shall be 300 m (1 000 ft).

5.3.1.1 Within the MID RVSM Airspace, a vertical separation minimum of 300 m (1 000 ft) is applicable only when **both** aircraft are RVSM approved.

5.3.2 The applicable vertical separation minimum between non-RVSM approved State aircraft and any other aircraft operating within an RVSM Airspace shall be 600 m (2 000 ft).

5.3.3 Within the designated airspace where RVSM transition tasks are carried out, the applicable vertical separation minimum shall be 300 m (1 000 ft) between RVSM approved aircraft, and 600 m (2 000 ft) between any non-RVSM approved aircraft (civil or State) and any other aircraft.

5.3.4 The applicable vertical separation minimum between all formation flights of **State** aircraft and any other aircraft operating within an RVSM Airspace shall be 600 m (2 000 ft).

5.3.4.1 For the reason stated in paragraph 5.2.2.1, formation flights of State aircraft shall be considered as non-RVSM approved, regardless of the RVSM approval status of the individual aircraft concerned. Formation flights of State aircraft will be accommodated within the RVSM Airspace on the basis of an applicable vertical separation minimum of 600 m (2 000 ft), as described in paragraph 5.3.4.

5.3.5 The applicable vertical separation minimum between an aircraft experiencing a communication failure in flight and any other aircraft, where both aircraft are operating within the RVSM Airspace, shall be 600 m (2 000 ft), unless an appropriate horizontal separation minimum exists.

5.3.5.1 Since ATC is unable to determine the extent of any equipment failure for an aircraft experiencing a communication failure in flight, ATC shall provide a vertical separation minimum of 600 m (2 000 ft), as described in paragraph 5.3.5, unless an appropriate horizontal separation minimum exists.

5.4 State Aircraft operating as Operational Air Traffic (OAT) within MID RVSM Airspace

5.4.1 The majority of State aircraft operating as OAT will be non-RVSM MASPS compliant. Therefore, as a basic principle, and unless otherwise notified, State aircraft operating as OAT shall be considered as being non-RVSM approved.

5.4.1.1 It is not possible, for physical design limitation reasons, to adapt a majority of tactical military aircraft to meet the RVSM MASPS.

5.4.2 The applicable vertical separation minimum between State aircraft operating as OAT and any other aircraft operating as GAT, where both are operating within the MID RVSM Airspace, shall be 600 m (2 000 ft).

5.4.3 However, in an airspace environment where both the civil and military ATC units are fully aware as to the RVSM approval status of all traffic involved, a vertical separation minimum of 300 m (1 000 ft) may be applied between an RVSM approved State aircraft operating as OAT, and RVSM approved aircraft operating as GAT.

5.4.3.1 This provides for the application of a vertical separation minimum of 300 m (1 000 ft) between OAT and GAT aircraft where either advanced civil-military co-ordination systems which systematically display the RVSM approval status of all aircraft involved to the respective controllers are in use, or where verbal co-ordination, including RVSM approval information of the individual aircraft, is accomplished.

Note: With a view to have consistency of terms used in other adjacent regions, the use of the terms **GAT** and **OAT** will be interpreted as follows:

General Air Traffic (GAT)

Flights conducted in accordance with the rules and provisions of ICAO.

Operational Air Traffic (OAT)

Flights which do not comply with the provisions stated for General Air Traffic (GAT), and for which rules and procedures have been specified by appropriate authorities.

5.5 Transition of Aircraft operating to/from the MID RVSM Airspace

5.5.1 ACCs/UACs whose area of responsibility includes airspace where RVSM transition tasks are carried out shall ensure that:

a) both RVSM approved aircraft and non-RVSM approved aircraft entering the MID RVSM Airspace from adjacent non-RVSM airspace are accommodated within the MID RVSM Transition Airspace;

b) the appropriate vertical separation minimum is applied, based on the RVSM approval status of the aircraft;

c) aircraft are established at cruising levels appropriate for the MID RVSM Airspace or adjacent non-RVSM airspace, as applicable, and that the appropriate vertical separation minimum is achieved before the aircraft passes the transfer of control point to the adjacent ACC/UAC; and

d) non-RVSM approved civil aircraft operating from an adjacent non-RVSM environment to the MID RVSM Airspace are established at a cruising level outside the vertical dimensions of the MID RVSM Airspace before the aircraft passes the transfer of control point to the adjacent ACC/UAC.

Cruising Levels Appropriate to Direction of Flight

5.5.2 The cruising levels appropriate to direction of flight for RVSM and non-RVSM environments are contained in ICAO Annex 2, Appendix 3.

5.5.2.1 The organization of cruising levels appropriate to direction of flight where non-RVSM airspace is located adjacent to, and east of, RVSM airspace is illustrated in Figure 4. Figure 5 illustrates the scenario where non-RVSM airspace is located adjacent to, and west of, RVSM airspace.

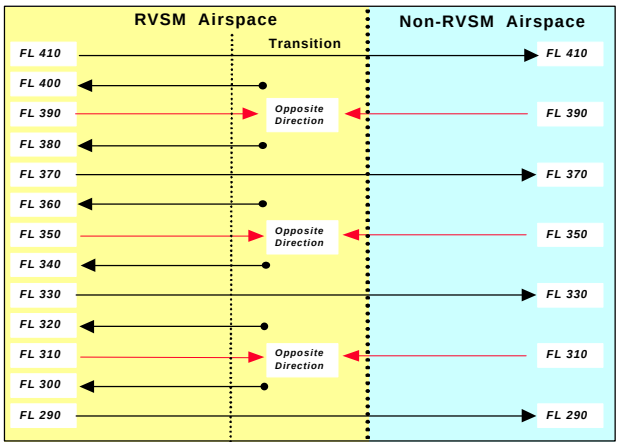


Figure 4: Scenario where non-RVSM airspace is located adjacent to, and east[1] of, RVSM airspace.

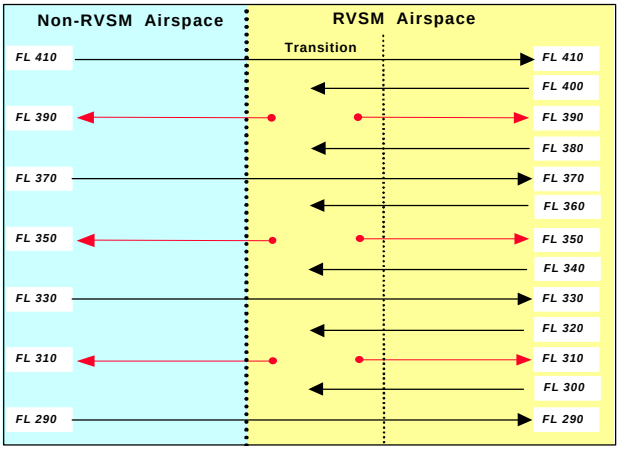


Figure 5: Scenario where non-RVSM airspace is located adjacent to, and west[2] of, RVSM airspace.

~~[1] or south, where predominate traffic flows prescribe the use of flight levels, with regard to direction of flight, on a north/south basis.~~

~~[2] or north, where predominate traffic flows prescribe the use of flight levels, with regard to direction of flight, on a north/south basis.~~

5.5.2.2 It is important to note the "opposite direction" cruising levels at flight levels 310, 350 and 390, as illustrated in Figure 4. Air traffic management options to facilitate the transition of aircraft operating from RVSM airspace to adjacent non-RVSM airspace and vice-versa, where non-RVSM airspace is adjacent to and east of RVSM airspace, are addressed in Section 9.

RVSM Approved Aircraft and Non-RVSM Approved State Aircraft

5.5.3 RVSM approved aircraft and non-RVSM approved State aircraft **entering the MID RVSM Airspace** from a non-RVSM environment shall be established at a flight level in accordance with:

a) the ICAO Tables of Cruising Levels, as published in ICAO Annex 2, Appendix 3. a); and/or

b) a flight level allocation scheme, if applicable; and/or

c) the Inter-Centre Letter of Agreement.

5.5.4 Any changes from non-RVSM cruising levels to RVSM cruising levels shall be initiated by the first ACC/UAC providing air traffic control service to the aircraft within an RVSM Airspace, and shall be achieved before the aircraft passes the transfer of control point to the adjacent ACC/UAC, unless otherwise specified in an Inter-Centre Letter of Agreement.

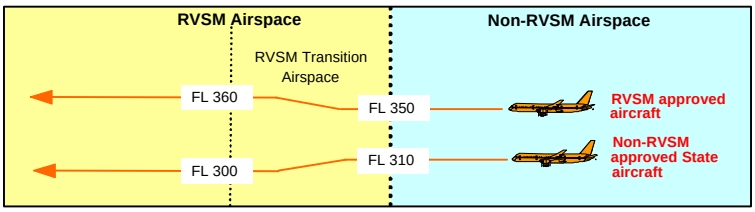


Figure 6: Transition of RVSM approved aircraft and non-RVSM approved State aircraft from non-RVSM airspace to RVSM airspace, where non-RVSM airspace is east of the RVSM airspace.

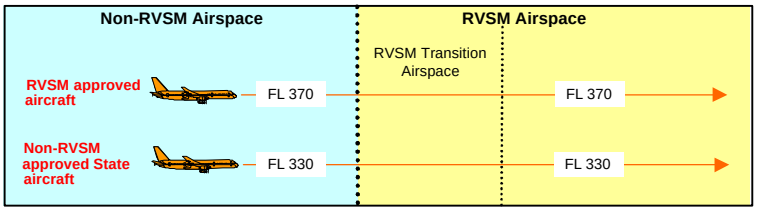


Figure 7: Transition of RVSM approved aircraft and non-RVSM approved State aircraft from non-RVSM airspace to RVSM airspace, where non-RVSM airspace is west of the RVSM airspace.

5.5.5 RVSM approved aircraft and non-RVSM approved State aircraft **entering a non-RVSM environment** from the MID RVSM Airspace shall be established with the applicable vertical separation minimum by the last ACC/UAC providing air traffic control service to the aircraft within the MID RVSM Airspace, and before the aircraft passes the transfer of control point to the adjacent non-RVSM ACC.

Such aircraft shall be established at a flight level in accordance with:

a) the ICAO Tables of Cruising Levels, as published in ICAO Annex 2, Appendix 3b): and/or

b) a flight level allocation scheme, if applicable; and/or

c) the Inter-Centre Letter of Agreement.

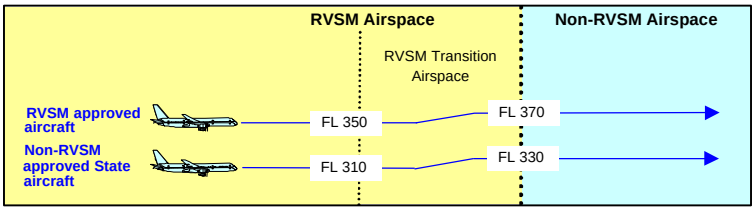


Figure 8: Transition of RVSM approved aircraft and non-RVSM approved State aircraft from RVSM airspace to non-RVSM airspace, where non-RVSM airspace is east of the RVSM airspace.

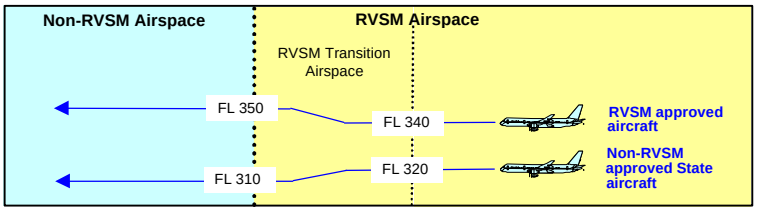


Figure 9: Transition of RVSM approved aircraft and non-RVSM approved State aircraft from RVSM airspace to non-RVSM airspace, where non-RVSM airspace is west of the RVSM airspace.

Non-RVSM Approved Civil Aircraft

5.5.6 Non-RVSM approved **civil** aircraft operating **from a departure aerodrome to a destination aerodrome which are both outside** of the lateral limits of the MID RVSM Airspace, with a portion of the route within the lateral limits of the MID RVSM Airspace:

a) shall be cleared to a flight level below FL 290 or above FL 410 by the first ACC/UAC providing air traffic control service to the aircraft within the MID RVSM Airspace, and any such flight level changes shall be achieved before the aircraft passes the transfer of control point to the adjacent ACC/UAC, in accordance with the flight level allocation scheme (FLAS), if applicable, and/or as specified in an Inter-Centre Letter of Agreement, and

b) may subsequently be cleared to a flight level within, or through, the MID RVSM Airspace by the last ACC/UAC providing air traffic control service to the aircraft within the MID RVSM Airspace, and any such flight level changes shall be achieved before the aircraft passes the transfer of control point to the adjacent ACC/UAC.

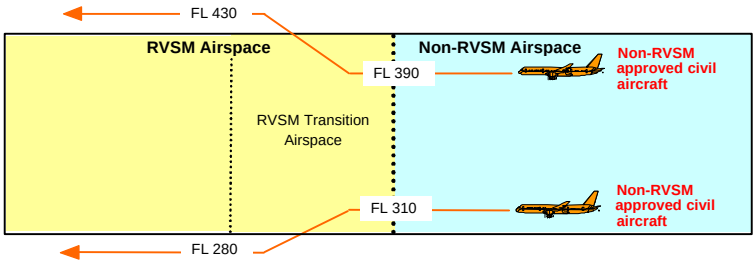


Figure 10: Transition of non-RVSM approved civil aircraft from non-RVSM airspace to RVSM airspace, with departure and destination aerodromes outside of the laterals limits of the RVSM airspace.

5.5.7 Non-RVSM approved **civil** aircraft operating **from a departure aerodrome outside of the lateral limits of the MID RVSM Airspace with a destination aerodrome within** the lateral limits of the MID RVSM Airspace:

a) shall be cleared to a flight level below FL 290; and

b) any such flight level changes shall be initiated by the first ACC/UAC providing air traffic control service within the MID RVSM Airspace, before the aircraft passes the transfer of control point to the adjacent ACC/UAC.

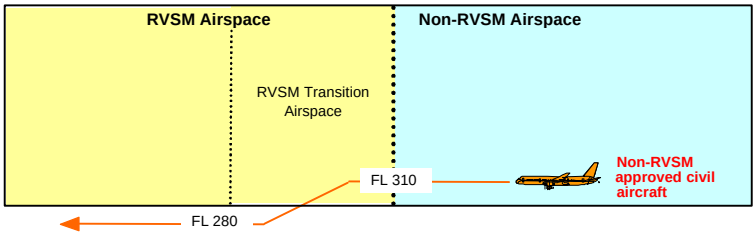


Figure 11: Transition of non-RVSM approved civil aircraft from non-RVSM airspace to RVSM airspace, with a departure aerodrome outside of the lateral limits of the RVSM airspace and a destination aerodrome within the lateral limits of the RVSM airspace.

5.5.8 Non-RVSM approved civil aircraft operating from a departure aerodrome to a destination aerodrome which are both within the lateral limits of the MID RVSM Airspace shall be cleared to a flight level below FL 290.

5.5.9 Non-RVSM approved **civil** aircraft operating **from a departure aerodrome within the lateral limits of the MID RVSM Airspace to a destination aerodrome outside** of the lateral limits of the MID RVSM Airspace:

a) shall be cleared to a flight level below FL 290; and

b) may be cleared to FL 290 or above by the last ACC/UAC providing air traffic control service to the aircraft within the MID RVSM Airspace, and any such flight level changes shall be achieved before the aircraft passes the transfer of control point to the adjacent ACC/UAC.

5.5.9.1 ACCs/UACs which perform RVSM transition tasks may consider accommodating, within the MID Transition RVSM Airspace, non-RVSM approved civil aircraft proceeding directly into adjacent non-RVSM airspace, so as to permit such aircraft to reach a requested flight level of FL 290 or higher prior to the transfer of control point with the first ACC/UAC within the adjacent non- RVSM airspace.

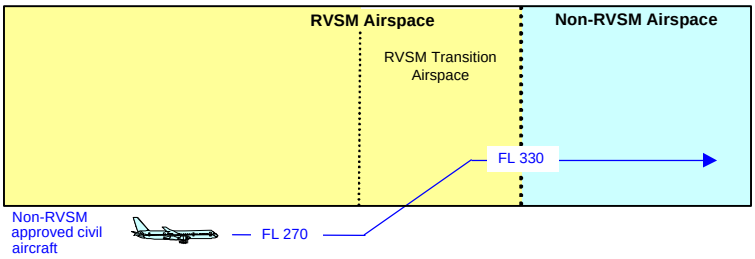


Figure 12: Transition of non-RVSM approved civil aircraft from RVSM airspace to non-RVSM airspace, with a departure aerodrome within the lateral limits of RVSM airspace and a destination aerodrome outside of the lateral limits of the RVSM airspace.

AFI/Asia/European Interface Non-RVSM Approved Civil Aircraft

5.5.10 ACCs/UACs providing air traffic control service within the airspace designated for the purpose of transitioning non-RVSM approved civil aircraft operating to/from the AFI/Asia or European Regions may clear such non-RVSM approved civil aircraft to climb/descend through RVSM Airspace.

Such climbs/descents through RVSM Airspace shall be achieved before the aircraft passes the transfer of control point to the adjacent ACC/UAC, if applicable, unless otherwise specified in an Inter-Centre Letter of Agreement.

5.6 In-flight Contingency Procedures

General

5.6.1 An in-flight contingency affecting flight in an RVSM Airspace pertains to unforeseen circumstances which directly impact on the ability of one or more aircraft to operate in accordance with the vertical navigation performance requirements of the MID RVSM Airspace.

5.6.1.1 Degradation of aircraft equipment or turbulent atmospheric conditions could negate an aircraft's ability to meet the vertical navigation performance requirements of RVSM airspace.

5.6.1.2 The RTF phraseology which shall be used by the pilot to inform ATC of the cause of an in-flight contingency is contained in paragraph 5.7.1.

5.6.2 The pilot shall inform ATC as soon as possible of any circumstances where the vertical navigation performance requirements for the RVSM Airspace cannot be maintained. In such cases, the pilot shall obtain a revised air traffic control clearance prior to initiating any deviation from the cleared route and/or flight level, whenever possible. Where a revised ATC clearance could not be obtained prior to such a deviation, the pilot shall obtain a revised clearance as soon as possible thereafter.

5.6.3 ATC shall render all possible assistance to a pilot experiencing an in-flight contingency. Subsequent air traffic control actions will be based on the intentions of the pilot, the overall air traffic situation, and the real-time dynamics of the contingency.

5.6.4 In this Manual, reference to suspension of RVSM refers to a discontinuance of the use of a vertical separation minimum of 300 m (1 000 ft) between RVSM approved aircraft operating within the MID RVSM Airspace.

5.6.4.1 During any period when RVSM has been suspended, a vertical separation minimum of 600 m (2 000 ft) shall be applied between all aircraft operating within the portion of the RVSM Airspace where RVSM has been suspended, regardless of the RVSM approval status of the aircraft.

5.6.4.2

(290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, and 410) remain assignable levels by ATC, in accordance with:

a. the Tables of Cruising Levels, ICAO Annex 2, Appendix 3. a.; and/or

b. a flight level allocation scheme, or a contingency flight level allocation scheme, if applicable; and/or

c. Inter-Centre Letter(s) of Agreement.

Degradation of Aircraft Equipment

5.6.5 The Minimum Equipment List (MEL) for operations within the MID RVSM Airspace is as follows:

1. two independent altitude measurement systems;
2. one secondary surveillance radar transponder, with an altitude reporting system that can be connected to the altitude measurement system in use for altitude keeping;
3. an altitude alerting system;
4. an automatic altitude-control system.

(Reference: JAA Temporary Guidance Leaflet No. 6, Revision 1)

5.6.5.1 The failure in flight of any component of the above minimum equipment list required for RVSM operations shall render the aircraft non-RVSM approved. Pilots experiencing such in-flight equipment failure(s) shall inform ATC as soon as possible.

5.6.6 90 m (300 ft) or more, the controller shall inform the pilot accordingly and the pilot

5.6.6.1 from the cleared flight level by 90 m (300 ft) or more, ATC will follow the existing ICAO procedures prescribed for the failure of Mode C in flight.

5.6.7 The allowable tolerance for Mode C readout of 90 m (300 ft) remains applicable within MID RVSM Airspace. The 90 m (300 ft) parameter relates solely to SSR transponder operation. It does not relate to the height-keeping accuracy required by the RVSM MASPS.

5.6.8 When informed by the pilot of an RVSM approved aircraft operating in the MID RVSM Airspa
the controller shall consider the aircraft as non-RVSM approved.

5.6.8.1 Air traffic control shall take action immediately to provide a minimum vertical separation of 600 m (2 000 ft), or an appropriate horizontal separation minimum, from all other aircraft concerned operating in the MID RVSM Airspace.

5.6.8.2 An aircraft rendered non-RVSM approved shall normally be cleared out of the MID RVSM Airspace by air traffic control, when it is possible to do so.

5.6.8.3 Pilots shall inform air traffic control, as soon as practicable, of any restoration of the proper functioning of equipment to meet the RVSM MASPS.

5.6.8.4 shall co-ordinate with adjacent ACCs/UACs, as appropriate.

5.6.9 When an equipment-related contingency requires that an RVSM approved aircraft operating within the MID RVSM Airspace be considered as non-RVSM approved, as specified in paragraph 5.6.8, ATC shall manually apply the display of the

purpose of clearly distinguishing such radar label and/or radar position symbol, in accordance with established local radar display features applicable to non-RVSM approved aircraft.

Note: See paragraph 8.3 - Radar Display Systems.

5.6.10 It is imperative that ATC co-ordinate specific information related to the inability of an RVSM approved aircraft to continue to meet the vertical navigation required for operation within the MID RVSM Airspace, through the use of the appropriate associated co-ordination messages, as follows:

or , (*as applicable)*

5.6.11 When informed by the pilot of any eventual restoration of the proper functioning of equipment required for operation within the MID RVSM Airspace, ATC will be in a position to consider clearing the aircraft into the MID RVSM Airspace, applying a 300 m (1 000 ft) vertical separation minimum. In such cases, ATC will manually remove the application of the locally adapted distinguishing feature associated with non-RVSM approved aircraft from the radar display, and co-ordinate with adjacent ACCs/UACs, as appropriate.

Severe Turbulence Not Forecast (single aircraft)

5.6.12 When an aircraft operating in the MID RVSM Airspace encounters severe turbulence due to weather or wake vortex which the pilot believes will impact the hall inform ATC.
ATC shall establish either an appropriate horizontal separation minimum, or an increased vertical separation minimum of 600 m (2 000 ft).

5.6.12.1 ATC shall, to the extent possible, accommodate pilot requests for flight level and/or route changes, and pass traffic information, as required.

5.6.12.2 ATC shall solicit reports from other aircraft to determine whether RVSM should be suspended entirely, or within a specific flight level band and/or area.

5.6.12.3 An ACC/UAC suspending RVSM shall co-ordinate any such suspension(s), and any required adjustments to sector capacities with adjacent ACCs/UACs, as appropriate, to ensure an orderly progression to the transfer of traffic.

5.6.12.4 The specific actions to be taken by ATC will be dictated by the actual weather-related circumstances and the traffic situation existing at the time. ATC is expected to use best judgement to safeguard separation between aircraft in such circumstances.

5.6.13 ATC shall co-ordinate the circumstances of an RVSM approved aircraft that is unable to maintain its cleared flight level due to severe turbulence by verbally supplementing the estimate message with:

5.6.14 ATC shall manually apply the distinguishing feature of the radar label associated with non-RVSM approved aircraft and/or the radar position symbol to such an aircraft until such time as the pilot reports ready to resume RVSM.

5.6.15 An aircraft experiencing severe turbulence while operating within an RVSM Airspace need not be cleared out of RVSM airspace. If the pilot has informed

cleared flight level, the establishment of an appropriate horizontal separation minimum, or an increased vertical separation minimum may be accomplished within the RVSM Airspace, traffic permitting.

Severe Turbulence Not Forecast (multiple aircraft)

5.6.16 When a controller receives pilot reports of severe turbulence which had not been forecast, and which could impact multiple aircraft with regards to their ability to maintain cleared flight level within the MID RVSM Airspace, the controller shall provide for an increased vertical separation minimum or an appropriate horizontal separation minimum. Additionally, the following action(s), although not exhaustive, should be considered:

- since each real time situation will demand very specific, distinct actions, the controller should use his/her best judgement to ensure the safety of the aircraft under his/her responsibility;
- the controller should pass traffic information to the extent possible;
- the controller will co-ordinate with the Supervisor for the purpose of determining whether RVSM operations will be suspended entirely or within a specific level band and/or area;
- if a reversion to a 600 m (2 000 ft) vertical separation minimum is deemed necessary, co-ordination with adjacent ACCs/UACs shall be accomplished to ensure an orderly progression to the transfer of traffic using a 600 m (2 000 ft) vertical separation minimum;
- Supervisors may co-ordinate, to the extent deemed necessary, a request for the deactivation of any airspace restrictions and/or reservations required to provide additional radar vectoring airspace necessary to facilitate the transition to a 600 m (2 000 ft) vertical separation minimum;
- the Supervisor should co-ordinate with the parent Flight Management Position (FMP) to adjust the applicable sector capacities.

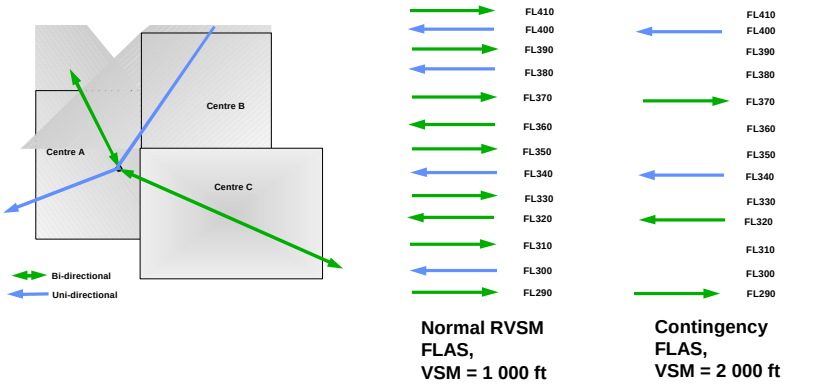
Severe Turbulence Forecast

5.6.17 Where a meteorological forecast is predicting severe turbulence within the MID RVSM Airspace, ATC shall determine whether RVSM should be suspended, and, if so, the period of time, and specific flight level(s) and/or area.

5.6.17.1 In cases where RVSM will be suspended, the ACC/UAC suspending RVSM shall co-ordinate with adjacent ACCs/UACs with regards to the flight levels appropriate for the transfer of traffic, unless a contingency flight level allocation scheme has been determined by Inter-Centre Letter of Agreement. The ACC/UAC suspending RVSM shall also co-ordinate applicable sector capacities with the parent Flight Management Position, and adjacent ACCs/UACs, as appropriate. The issuance of a NOTAM should be considered.

5.6.18 Consideration should be given to the development of a contingency FLAS to supplement any existing FLAS between ACCs/UACs. A contingency FLAS should be described in appropriate Inter-Centre Letters of Agreement for the purpose of being applied, after the necessary inter-centre co-ordination, during times of weather-related contingency events (forecast or not forecast). A contingency FLAS would facilitate the transition to a 600 m (2 000 ft) vertical separation minimum within the MID RVSM Airspace.

5.6.18.1 The application of a contingency FLAS will be facilitated through the designation of cruising levels within the contingency FLAS that are consistent with their designations in the corresponding normal RVSM FLAS, with regard to their intended use for direction of flight.



The application of the contingency FLAS, when required, is facilitated by virtue of the fact that the

Example: When informed by Centre A that the Contingency FLAS is to be applied, Centre C would be required to discontinue the use of FL 360 for traffic to be transferred to Centre A, however Centre B would **not** be required to alter the use of FL 320. In this way, the operational impact upon

greatly facilitated.

Figure 13: Example of a Contingency Flight Level Allocation Scheme.

5.6.19 With regards to facilitating the co-ordination and establishment of new capacity figures for the ACC/UAC during contingency events requiring the reversion to a 600 m (2 000 ft) vertical separation minimum within the MID RVSM Airspace, ACCs/UACs should consider pre-determining such capacity figures for the purpose of permitting rapid co-ordination with the local Flight Management Position.

5.6.20 The importance of obtaining timely accurate forecasts of severe turbulence should be stressed within agreements with the appropriate meteorological services office responsible for the dissemination of such information for the area concerned.

5.7 Phraseology

5.7.1 Controller/Pilot Radiotelephony Phraseology

(** indicates a pilot transmission)*

Meaning	Phraseology
For a controller to ascertain the RVSM approval status of an aircraft.	*(callsign)* **CONFIRM RVSM APPROVED**
For a pilot to report non-RVSM approval status: I. on the initial call on any frequency within the MID RVSM Airspace (*controllers shall provide a read-back with this same phrase)*; and II. in all requests for flight level changes pertaining to flight levels within the MID RVSM Airspace; and III. in all read-backs to flight level clearances pertaining to flight levels within the MID RVSM Airspace. Additionally, except for State aircraft, pilots shall include this RTF phrase to read-back flight level clearances involving the vertical transit through FL 290 or FL 410. *(See examples below)*	**NEGATIVE RVSM***
For a pilot to report RVSM approval status.	**AFFIRM RVSM***
For a pilot of a non-RVSM approved State aircraft to report non-RVSM approval status, in response to the RTF phrase (*callsign*) CONFIRM RVSM APPROVED.	**NEGATIVE RVSM STATE AIRCRAFT***
Denial of ATC clearance into the MID RVSM Airspace.	*(callsign)* **UNABLE CLEARANCE INTO RVSM AIRSPACE, MAINTAIN [***or* **DESCEND TO,** *or* **CLIMB TO] FLIGHT LEVEL** *(number)*

For a pilot to report when severe turbulence affects -keeping requirements for RVSM.	**UNABL E RVSM DUE TURBU ENCE***
degraded below the MASP S required for flight within the MID RVSM Airspace. *(The phrase is to be used to convey both the initial indication of the non-MASPS compliance, and henceforth, on initial ontact on all frequencies within the lateral limits of the MID RVSM Airspace until such time as the roblem ceases to exist, or the aircraft has exited M D RVSM Airspace)*	**UNABL E RVSM DUE EQUIPM IENT***
For a pilot to report the ab lity to resume operations within the MID RVSM airsp ace after an equipment or weather-related contingenc /.	**READY TO RESUME RVSM***
For a controller to conf m that an aircraft has regained its RVSM approv l status, or to confirm that the pilot is ready to resume RVSM operations.	**REPOR T ABLE TO RESUME RVSM**

Example 1: A non-RVSM approved State aircraft operating as GAT, maintaining FL 260, subsequently requests a climb to FL 320.

Pilot RTF:	(*callsign*) **REQUEST FL 320, NEGATIVE RVSM**
Controller RTF:	(*callsign*) **CLIMB TO FL 320**
Pilot RTF:	(*callsign*) **CLIMB TO FL 320, NEGATIVE RVSM**

Example 2: A non-RVSM approved State aircraft operating as GAT, maintaining FL 260, subsequently requests a climb to FL 430.

Pilot RTF:	(*callsign*) **REQUEST FL 430, NEGATIVE RVSM**
Controller RTF:	(*callsign*) **CLIMB TO FL 430**
Pilot RTF:	(*callsign*) **CLIMB TO FL 430, NEGATIVE RVSM**

Example 3: A non-RVSM approved State aircraft operating as GAT, maintaining FL 360, subsequently requests a climb to FL 380.

Pilot RTF:	(*callsign*) **REQUEST FL 380, NEGATIVE RVSM**
Controller RTF:	(*callsign*) **CLIMB TO FL 380**
Pilot RTF:	(*callsign*) **CLIMB TO FL 380, NEGATIVE RVSM**

Example 4: A non-RVSM approved civil aircraft maintaining FL 280 subsequently requests a climb to FL 320.

Pilot RTF:	(*callsign*) **REQUEST FL 320, NEGATIVE RVSM**
Controller RTF:	(*callsign*) **UNABLE CLEARANCE INTO RVSM AIRSPACE, MAINTAIN FL 280**

5.7.2 Co-ordination between ATS Units

Meaning	Phraseology
To verbally supplement an automated estimate message exchange that does not automatically transfer Item 18 flight plan information.	**NEGAT /E RVSM** *or* **NEGAT /E RVSM STATE AIRCRA FT [***as applicable***]**
To verbally supplement estimate messages of non-RVSM approved aircraft.	**NEGAT /E RVSM** *or* **NEGAT /E RVSM STATE AIRCRA FT [***as applicable***]**
To communicate the cause of a contingency relating to an aircraft that is unable to conduct RVSM operations due to severe turbulence or other severe weather-related phenomenon [or equipment failure, as applicable].	**UNABL RVSM DUE TURBU ENCE [***or* **EQUIPMENT,** *as appli able***]**

5.8 Inter-Centre Co-ordination

Flight Plans

Note: Detailed procedures for the handling/ verification of flight plans for traffic origination within and outside of the MID Region are further elaborated under Para.8.2.

5.8.1 If the receiving unit has not received a flight plan, the sending air traffic control unit shall verbally inform the receiving unit of whether or not the aircraft is RVSM approved.

Computer-assisted Co-ordination of Estimate Messages

5.8.2 The On-Line Data Interchange (OLDI) System should support the co-ordination of requests for special handling (i.e. STS) as filed in Item 18 of the ICAO Flight Plan.

5.8.2.1 Since the Activation (ACT) Message replaces the verbal estimate message, and notwithstanding the fact that the information should be contained within the local -RVSM approval status and its request for special handling, should be included as an integral part of the automated estimate message:

- as confirmation of the data filed in the flight plan, as it is safety critical;
- where degradation of capability in the performance of flight planning systems has occurred for a particular flight;
- where, for whatever reason, the accepting unit has not received the flight plan.

5.8.3 When an automated message does not contain the information filed in Item 18 of the ICAO flight plan relevant to RVSM operations, the sending ATC unit shall inform the receiving ATC unit of that information by supplementing the ACT

Verbal Co-ordination of Estimate Messages

5.8.4 When a verbal co-ordination process is being used, the sending ATC unit shall include the information filed in Item 18 of the ICAO flight plan relevant to RVSM operations at the end of the verbal estimate message, using the ter

5.8.5 When a single aircraft is experiencing an in-flight contingency which impacts on RVSM operations, the associated co-ordination messages shall be supplemented verbally by a description of the cause of the contingency.

5.8.5.1 The associated co-ordination messages shall incorporate either:

- **UNABLE RVSM DUE EQUIPMENT,** or
- **UNABLE RVSM DUE TURBULENCE**, as appropriate.

6. VERTICAL SPACING FROM TSAS, PROHIBITED, RESTRICTED AND DANGER AREAS

All activities occurring within airspace restrictions and/or reservations are to be considered as being non-RVSM approved.

Consequently, the minimum vertical spacing required between the vertical limits of the activities contained within such airspace restrictions and/or reservations and non-participating aircraft operating within the RVSM airspace is:

- 2 000 ft, above the upper limit of such activities, for upper limits of FL 290 or above, and
- 2 000 ft, below the lower limit of such activities, for lower limits of FL 300 or above.

Therefore, the application of RVSM will continue to require that the same minimum vertical spacing be applied between activities occurring within airspace restrictions and/or reservations and non-participating aircraft, as were being applied prior to RVSM implementation.

States will, as stipulated in the ASM Handbook, promulgate the first usable flight levels above/below airspace restrictions and/or reservations, in the definition of the associated ATS routes. Depending on the methodology used to delineate and promulgate such airspace restrictions and/or reservations, the first usable flight levels will be situated either 1 000 ft or 2 000 ft above/below the *published* vertical limits of the airspace restrictions and/or reservations. Nevertheless, operation by non-participating aircraft at such first usable flight levels, defined as a function of one of the two delineation methodologies, will guarantee the application of the required minimum 2 000 ft vertical spacing from the activities occurring within airspace restrictions and/or reservations.

However, in an airspace environment where the responsible ATS units are fully aware as to the RVSM approval status of all traffic involved, a reduced vertical separation of 1 000 ft may be applied between RVSM approved aircraft.

7.0 COMMUNICATION FAILURE

7.1 Communication Failure Procedures - MID Region

7.1.1 The proposed procedures are intended for application throughout the MID Region, including the airspace between FL 290 and FL 410 inclusive. This proposal is subject to the ICAO procedure for the amendment of Regional Supplementary Procedures, which ultimately requires the approval of the President on behalf of the Council of ICAO. Amendment proposals approved in accordance with this procedure are then promulgated in ICAO Doc 7030/4.

7.2 Communication Failure Procedures - MID RVSM Airspace

7.2.1 The implementation of RVSM within an RVSM Airspace has implications with regards to air-ground communication failure procedures.

7.2.2 For example, the ICAO Regional Supplementary Procedures for MID Region specify that the applicable vertical separation minimum between an aircraft experiencing a communication failure in flight and any other aircraft, where both aircraft are operating within the MID RVSM Airspace, shall be 600 m (2 000 ft), unless an appropriate horizontal separation minimum exists.

7.2.3 Furthermore, within RVSM airspace there are thirteen cruising levels which may be assigned by ATC, as compared to seven within non-RVSM airspace between flight levels 290 and FL 410 inclusive. Flight levels 310, 350, and 390 are "eastbound" cruising levels within RVSM airspace, whereas they are "westbound" cruising levels within non-RVSM airspace. This is an important consideration, particularly where non-RVSM airspace is located adjacent to, and east of, RVSM Airspace.

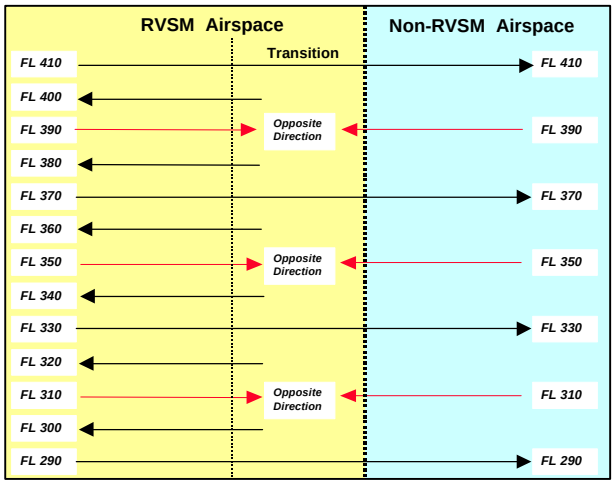


Figure 14: Scenario where non-RVSM airspace is adjacent to, and east[1] of, RVSM airspace.

[1] or south, where predominate traffic flows prescribe the use of flight levels, with regard to direction of flight, on a north/south basis.

COMPULSORY REPORTING POINTS

7.2.4 One means used to determine that two-way communication between an aircraft and ATC has failed is the aircraft's failure to report its position over a compulsory reporting point.

7.2.5

ability to detect air-ground communication failures on a timely basis, taking into account ATC separation and co-ordination requirements. Paragraphs 7.2.6, 7.2.7 and 7.2.8 contain options with regards to the placement of compulsory reporting points in the context of RVSM implementation, for consideration.

7.2.6 There is a requirement to establish RVSM entry/exit points at or near the boundaries **between the MID RVSM Airspace and adjacent non-RVSM airspace** for all ATS routes which cross the lateral limits of the MID RVSM Airspace. The designation of these points as compulsory reporting points could enhance ATC's ability to detect air-ground communication failures.

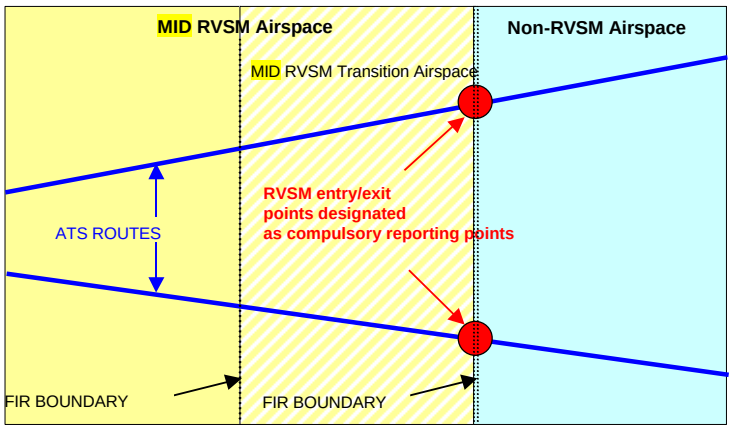


Figure 15: Compulsory reporting points on ATS routes at the boundary between MID RVSM Airspace and adjacent non-RVSM Airspace.

7.2.7 Where non-RVSM airspace is located adjacent to, and east of, the MID RVSM Airspace, the establishment of compulsory reporting points at or near the boundaries **between the MID RVSM Airspace and the MID RVSM Transition Airspace** for all ATS routes which cross such boundaries could also enhance ATC's ability to detect air-ground communication failures.

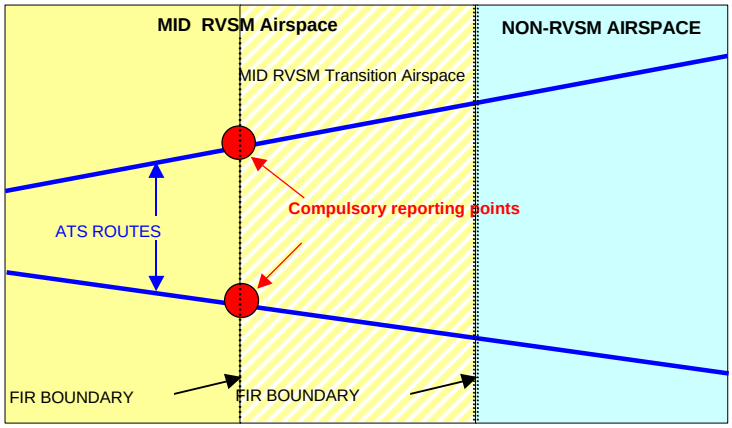


Figure 16: Compulsory reporting points on ATS routes at the boundary between MID RVSM Airspace and MID RVSM Transition Airspace.

7.2.8 Additionally, where non-RVSM airspace is located adjacent to, and east of, the MID RVSM Airspace, the establishment of compulsory reporting points **within the adjacent non-RVSM airspace** for all ATS routes which cross the lateral limits of the MID RVSM Airspace could further enhance ATC's ability to detect air-ground communication failures.

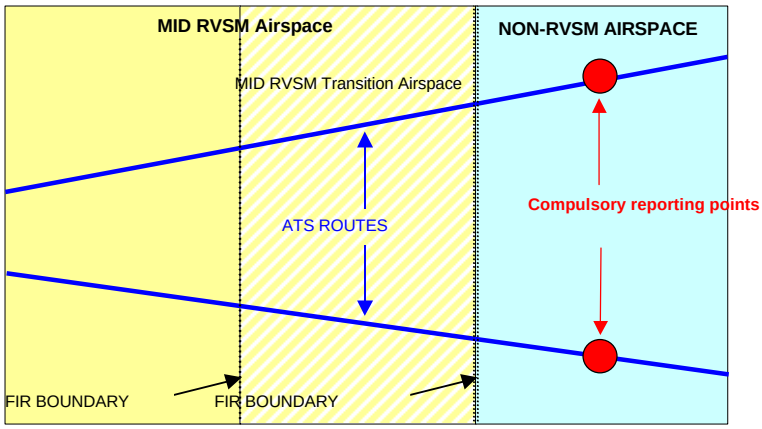


Figure 17: Compulsory reporting points within adjacent non-RVSM airspace on ATS routes which cross the lateral limits of the MID RVSM Airspace.

7.2.9 With regards to the establishment and location of compulsory reporting points, the proposed amendment to the ICAO Regional Supplementary Procedures for MID Region pertaining to air-ground communication failure procedures, and specifically the proposed should be taken into account (page 7-8, paragraph 5.3.1 b) refers). Although, radio communication failure (RCF) procedures in the MID region will be aligned with procedures applicable in the European RVSM airspace, when operating in the oceanic

maintain the last assigned speed and level or minimum flight altitude for a period of 20 minutes instead of 7 minutes.

LATERALLY-SPACED, UNI-DIRECTIONAL ATS ROUTES

7.2.10 The use of laterally-spaced, uni-directional ATS routes as a means of strategically separating opposite-direction traffic operating to/from the MID RVSM Airspace is addressed in Section 9. In the context of air-ground communication failure procedures, laterally-spaced, uni-directional ATS routes between MID RVSM Transition Airspace and adjacent non-RVSM airspace could help mitigate the differences between cruising levels appropriate for direction of flight within the MID RVSM Airspace versus the cruising levels applicable within adjacent non-RVSM airspace (paragraph 7.2.3 refers).

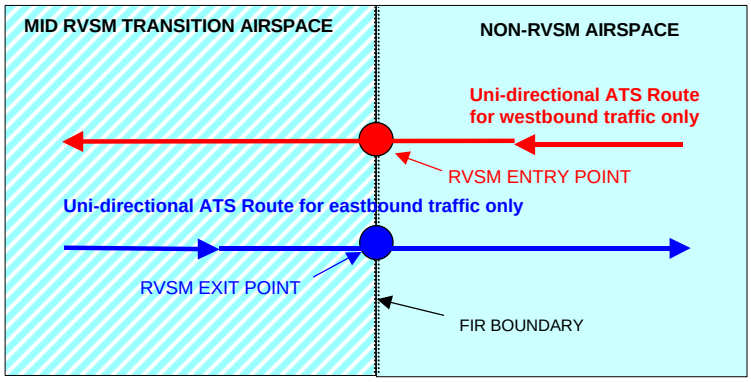


Figure 18: Laterally-spaced, uni-directional ATS routes between MID RVSM Transition Airspace and adjacent non-RVSM airspace.

Flight Level Allocation Schemes (FLAS)

7.2.11 The strategic use of Flight Level Allocation Schemes is addressed in Section 9. FLAS could also be used in the context of air-ground communication failure procedures. For example, where non-RVSM airspace is located adjacent to, and east of, the MID RVSM Airspace, FLAS could be used to establish the distance/time from the boundary of non-RVSM airspace at which the use of flight levels 310, 350, and 390 as eastbound cruising levels would be discontinued.

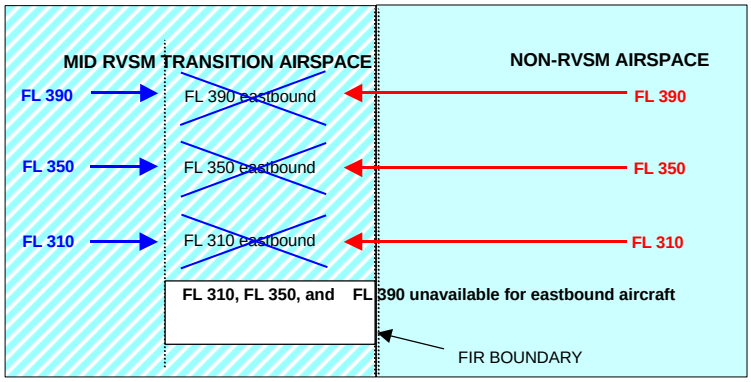


Figure 19: FLAS depicting FL 310, FL 350, and FL 390 discontinued for eastbound aircraft within a portion of the MID RVSM Transition Airspace.

DRAFT

PROPOSAL FOR AMENDMENT OF THE

REGIONAL SUPPLEMENTARY PROCEDURES

(DOC 7030/4)

(Serial No.: MID/ASIA-S -)

a) Regional Supplementary Procedures:

Doc 7030/4 MID/ASIA Regional Supplementary Procedures Part 1 RAC as

b) Proposed amendment:

1) Delete Sections 5.1 and 5.2 in their entirety.

2) Add the following provisions for Air-Ground Communication Failure

"5.0 Action In The Event Of Air-Ground Communication Failure
(A2 - 3.6.5.2)

5.1 As soon as it is known that two-way communication has failed, ATC shall maintain separation between the aircraft having the communication failure and other aircraft based on the assumption that the aircraft will operate in accordance with 5.2 or 5.3.

5.2 Visual Meteorological Conditions (VMC)

5.2.1 Except as provided for in 5.3.1, a controlled flight experiencing communication failure in VMC shall:

a) set transponder to Code 7600;

b) continue to fly in VMC;

c) land at the nearest suitable aerodrome;

d) report its arrival time by the most expeditious means to the appropriate ATS unit.

5.3 Instrument Meteorological Conditions (IMC)

5.3.1 A controlled IFR flight experiencing communication failure in IMC, or where it does not appear feasible to continue in accordance with 5.2, shall:

a) set transponder to Code 7600; and

b) maintain for a period of 7 minutes the last assigned speed and level or the minimum flight altitude, if the minimum flight altitude is higher than the last assigned level.
**See Note 2 for applicable proc*
FIRs.

The period of 7 minutes commences:

i) if the aircraft is operating on a route without compulsory reporting points or has been instructed to omit position reports:

1) at the time the last assigned level or minimum flight altitude is reached, or

2) at the time the aircraft sets transponder to Code 7600,

whichever is later; or

ii) if the aircraft is operating on a route with compulsory reporting points and has not been instructed to omit position reports:

1) at the time the last assigned level or minimum flight altitude is reached, or

2) at the previously reported pilot estimate for the compulsory reporting point, or

3) at the time the aircraft fails to report its position over a compulsory reporting point,

whichever is later;

Note 1:-The period of 7 minutes is to allow the necessary air traffic control and co-ordination measures.

Note 2:-
instrument meteorological conditions (IMC), aircraft will maintain the last assigned speed and level or minimum flight altitude for a period of 20 minutes instead of 7 minutes.

c) thereafter adjust level and speed in accordance with the filed flight plan;

Note: As regards changes to levels and speed, the Filed Flight Plan, which is the flight plan as filed with an ATS unit by the pilot or a designated representative, without any subsequent changes will be used.

d) if being radar vectored or proceeding offset according to RNAV without a specified limit, proceed in the most direct manner possible to rejoin the current flight plan route no later than the next significant point, taking into consideration the applicable minimum flight altitude;

Note: As regards the route to be flown or the time to begin descent to the arrival aerodrome, the Current Flight Plan, which is the flight plan, including changes, if any, brought about by subsequent clearances, will be used.

e) proceed according to the current flight plan route to the appropriate designated navigation aid serving the destination aerodrome and, when required to ensure compliance with 5.3.1 f), hold over this aid until commencement of descent;

f) commence descent from the navigation aid specified in 5.3.1.e) at, or as close as possible to, the expected approach time last received and acknowledged; or, if no expected approach time has been received and acknowledged, at, or as close as possible to, the estimated time of arrival resulting from the current flight plan;

g) complete a normal instrument approach procedure as specified for the designated navigation aid; and

h) land, if possible, within thirty minutes after the estimated time of arrival specified in 5.3.1 f) or the last acknowledged expected approach time, whichever is later.

Note: Pilots are reminded that the aircraft may not be in an area of secondary surveillance radar coverage."

8.0 ATS SYSTEMS SUPPORT

8.1 General

8.1.1 Given the requirement for ATC to accommodate non-RVSM approved State aircraft as GAT within the MID RVSM Airspace, it is essential that ATC be systematically aware as to the RVSM approval status of all aircraft operating within the MID RVSM Airspace, as well as outside of and in close proximity to the RVSM Airspace. The ATS systems adaptations described in this section have been developed to support this safety critical operational requirement.

8.1.2

status as being that of a State aircraft, where such an aircraft is requesting operation within the MID RVSM Airspace and has not indicated that it is RVSM approved.

8.1.3 The requirement for ATC to selectively apply two vertical separation minima within the MID RVSM Airspace, as a result of the requirements to accommodate non-RVSM approved State aircraft within the MID RVSM Airspace, and non-RVSM approved civil aircraft within MID RVSM Airspace where RVSM transition tasks are carried out, renders flight-planning requirements for the MID Region RVSM Airspace safety critical.

8.1.4 The ATS systems adaptations will be applied as a function of the RVSM-related flight plan information filed.

8.2 Flight Data Processing Systems (FDPS) and Procedures

Flights originating within the MID Region

8.2.1 In order to ensure the safe application of 300 m (1 000 ft) vertical separation minimum between RVSM approved aircraft only, it is important that ACCs/UACs verify the correctness of the information contained in all items of the flight plan for the purpose of:

- rejecting flight plans filed, which do not qualify for operation within the MID RVSM Airspace on the basis of the information filed;
- annotating flight plans and, in consultation with the operator, amending as necessary the data, for flights which do not qualify for operation within the MID RVSM Airspace on the basis of the information filed; and
- ensuring the timely and accurate distribution of the relevant RVSM associated flight plan information.

Flights originating outside the MID Region

8.2.2 For flights originating outside the MID Region intending to over-fly or land within the Region, the ACCs/UACs concerned shall ensure that the relevant RVSM flight plan information (data provided under item 8, 10, 15 and 18) has been properly filed.

8.2.3 In support of these requirements, the appropriate agency or AIS unit will distribute all relevant flight plan information, including the RVSM approval status (ICAO Flight Plan Item 10 or Item Q of the RPL), filed in accordance with the flight planning requirements contained in Section 5.1, to the Flight Data Processing Systems of appropriate ACCs/UACs.

Note: In addition to the procedures contained in the Procedures for Air Navigation, Doc4444, ATM/501, regarding the use of repetitive flight plans, (Chapter 16.4-Implementation of RPL procedures), the receiving unit/,agency, or AIS Office, as appropriate, shall, as soon as an RPL is received, verify the correctness of the data.

8.2.4 Controllers, having received an estimate message for which no flight plan was available, shall be aware as to the likelihood of no flight plan being available in adjacent ACCs/UACs. As a consequence, the sending controller shall use a verbal co-ordination as a means of ensuring that the receiving controller is aware -RVSM approval status.

8.2.5 States within the MID Region, extracting their own RPLs, shall ensure that the flight plan (FPL) created by their local FDPS is in conformance with the requirements pertaining to the filing of RPLs in regards to RVSM.

8.2.6 FDPSs **shall** be able to process and make available for display all flight levels within the MID RVSM Airspace.

8.3 Radar Display Systems

8.3.1 The operational requirements regarding radar display systems are applicable to those radar display systems of ACCs/UACs whose areas of responsibility include MID RVSM Airspace.

8.3.2 Furthermore they shall apply, at a minimum, to the radar position symbols and/or radar labels associated with GAT.

8.3.3 The operational requirements associated with radar display systems are essential to ATC being able to maintain a continuous, systematic and unambiguous level of awareness as to the RVSM approval status of all aircraft under its responsibility.

8.3.4 In a radar environment, the radar position symbols and/or radar labels associated with aircraft operating within the MID RVSM Airspace **shall** provide a clear indication of the current non-RVSM approval status.

Note 1: Non-RVSM approved aircraft operating within the MID RVSM Airspace could include State aircraft operating as GAT and/or civil aircraft operating within MID RVSM Airspace where RVSM transition tasks are carried out.

Note 2: The RVSM approval status of an aircraft, as reflected in the current flight plan, may be downgraded from RVSM approved to non-RVSM approved, based on information received directly from the pilot. Only for those circumstances associated with equipment-related contingency events may an aircraft's RVSM approval status be upgraded.

8.3.5 Where radar is used as the primary tool for applying separation, the radar position symbols and/or radar labels **should** provide a clear indication of the current non-RVSM approval status of aircraft operating within such level bands above and below the MID RVSM Airspace, as defined by the local ATS authority.

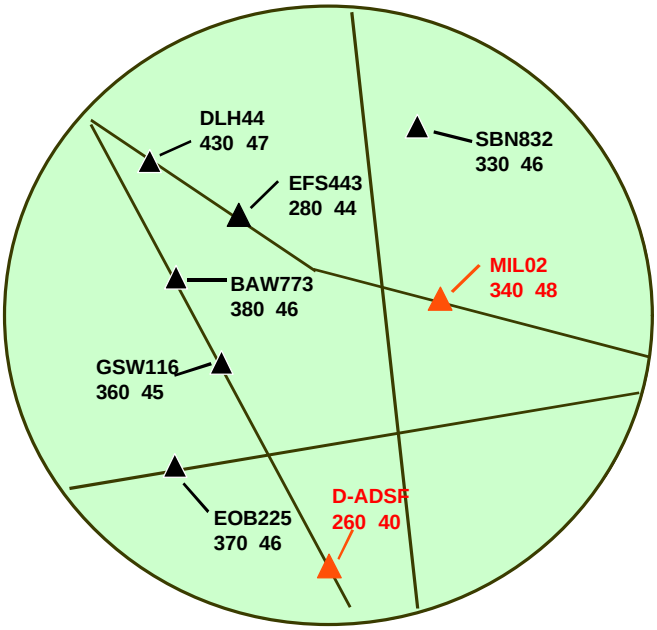
Note: The vertical extent of the level bands will have been determined locally as a function of specific local operational requirements in terms of sectorisation, etc.

8.3.6 The means by which the distinguishing feature is applied to the radar position symbols and/or radar labels of the aircraft concerned **shall** be automatic.

Note: It is understood that, during the initial period of RVSM implementation, for certain radar display systems, it may be required to accomplish the application of this distinguishing feature manually, provided clear and validated procedures are in place to ensure that this safety critical information is available to the relevant radar control positions.

8.3.7 The possibility for the manual manipulation of the radar position symbols and/or radar labels of aircraft **shall** be available.

Note: The manual manipulation will be used as a means of updating the radar position symbols and/or radar labels of aircraft experiencing in-flight equipment-related contingencies which result in the loss of RVSM approval status.



Radar Position Symbols and Radar Labels, red colour:	***non-RVSM approved***
Radar Position Symbols and Radar Labels, black colour:	***RVSM approved***

Figure 20: Example of Radar Display which uses colour to distinguish radar labels of non-RVSM approved aircraft.

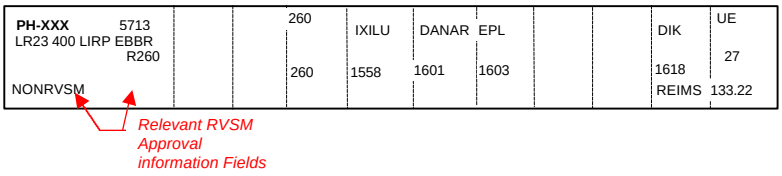
8.4 Flight Strips (Paper or Electronic)

8.4.1 These operational requirements are applicable to the flight progress strips generated within ACCs/UACs whose areas of responsibility include MID RVSM Airspace.

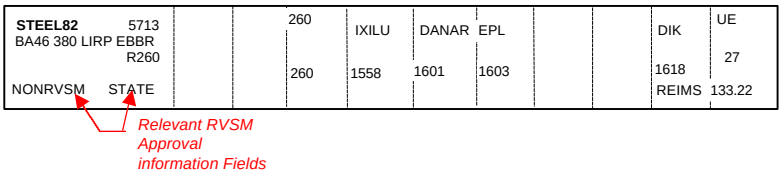
Note: If there are no paper or electronic strips, these requirements shall be applied

8.4.2 Local FDPS shall indicate on all flight strips (paper, electronic or, in the absence of either, extended label) for non-RVSM approved aircraft the information filed by operators in respect of both their RVSM approval status and their status as that of a State aircraft (if applicable).

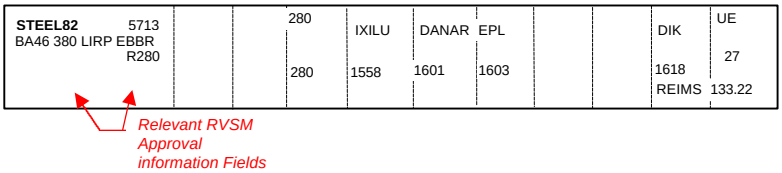
8.4.3 Information regarding a -RVSM approval status **shall** be displayed on the flight strip. (Message example: **NONRVSM**).



8.4.4 Where applicable, the indication that a non-RVSM approved aircraft is a State aircraft **shall** be displayed on the flight strip. (Message example: **STATE AIRCRAFT**)



8.4.5 For all RVSM approved aircraft, no indication is required:



8.4.6 ACCs/UACs should also consider the adoption of additional visual cues that could support the requirement of remaining continually aware of the RVSM approval status of all aircraft within its area of responsibility. Such methods might include assigning a dedicated colour to strip holders for such flights where paper flight strips are used or to assigning a dedicated colour to the electronic strips associated with such aircraft.

8.5 On-Line Data Interchange (OLDI)

Note: Although recognising that OLDI is not the ICAO recommended protocol to be used for the transfer of data, MIDANPIRG has endorsed the use of OLDI as an interim measure pending the use/availability of AIDC.

8.5.1 OLDI **should** include the current RVSM approval status of an aircraft, as well as the information regarding an aircr
applicable.

8.5.2 OLDI **should** support the systematic transfer of information related to requests

Plan (Item 18 message: **STS/NONRVSM**).

8.5.2.1 Since the automated OLDI message replaces the verbal estimate message, information regarding the request for special handling (STS/NONRVSM), as indicated by Item 18, should be transmitted to emulate the information which would have been pas

8.5.3 The support of OLDI in the forwarding of RVSM-related information will be beneficial:

- as confirmation of the data filed in the flight plan, as it is safety critical;
- where degradation of capability has occurred for a particular aircraft;
- where, for whatever reason, the accepting unit does not have the flight plan.

8.5.4 In consideration of the significant operational impact associated with the accommodation of non-RVSM approved State aircraft within the MID RVSM Airspace, where automated co-ordination dialogue facilities are in use, such aircraft could be the subject of a referral to the controller in the receiving unit for his/her explicit acceptance, and as such, co-ordination procedures to this effect could be agreed and included in Inter-Centre Letters of Agreement.

8.6 ATS Systems Overview

8.6.1 The following matrix provides an overview of the automated systems adaptations required to support the application of RVSM:

Red non-italics: mandatory ***Blue italics: highly desirable***		Flight Strip (Electronic, Paper or Extended Label[1]), indicate:	OLDI Message (Item 22)	Radar Position Symbols and/or Radar Labels
RVSM approved aircraft	All Levels	no requirements		
Non-RVSM approved State aircraft (operating as GAT)	FL 430 and above	• non-RVSM approval status (e.g.: **NONRVSM)** • Indicate state aircraft status (e.g.: **STATE A/C)**	*transmit:* • ***STS/NONRVSM*** • ***current RVSM approval and***	*apply distinguishing feature[2]*
	FL 290 - 410	• non-RVSM approval (e.g.: **NONRVSM)** • Indicate state aircraft status (e.g.: **STATE A/C)**	*transmit:* • ***STS/NONRVSM*** • ***current RVSM approval and***	apply distinguishing feature
	FL 280 and below	• non-RVSM approval status (e.g.: **NONRVSM)** • Indicate state aircraft status (e.g.: **STATE A/C)**	*transmit:* • ***current RVSM approval and***	*apply distinguishing feature[2]*
All formation flights of State aircraft[3] (operating as GAT)	FL 430 and above	• non-RVSM approval status (e.g.: **NONRVSM)** • Indicate state aircraft status (e.g.: **STATE A/C)**	*transmit:* • ***STS/NONRVSM*** • ***current RVSM approval and***	*apply distinguishing feature[2]*
	FL 290 - 410	• non-RVSM approval status (e.g.: **NONRVSM)** • Indicate state aircraft status (e.g.: **STATE A/C)**	*transmit:* • ***STS/NONRVSM*** • ***current RVSM approval and***	apply distinguishing feature
	FL 280 and below	• non-RVSM approval status (e.g.: **NONRVSM)** • Indicate state aircraft status (e.g.: **STATE A/C)**	*transmit:* • ***current RVSM approval and***	*apply distinguishing feature[2]*
Non-RVSM approved civil aircraft	FL 430 and above	• non-RVSM approval status (e.g.: **NONRVSM)**	*transmit:* • ***current RVSM approval status***	*apply distinguishing feature[2]*
	FL 290 - 410 (in airspace where RVSM transition tasks are carried out)	• non-RVSM approval status (e.g.: **NONRVSM)**	*transmit:* • ***current RVSM approval status***	apply distinguishing feature
	FL 280 and below	• non-RVSM approval status (e.g.: **NONRVSM)**	*transmit:* • ***current RVSM approval status***	*apply distinguishing feature[2]*

Note [1]: This information may be included in an extended label if no paper or electronic strips exist.

Note [2]: To be applied between level bands above and/or below MID RVSM Airspace according to individual ACC/UAC specified vertical limits, as defined by the local ATS authority.

*Note [3]: Only formation flights of **State** aircraft shall be accommodated within the MID RVSM Airspace.*

8.7 Short Term Conflict Alert (STCA), and Medium Term Conflict Detection (MTCD)

Short Term Conflict Alert (STCA)

8.7.1 STCA systems of ACCs/UACs applying RVSM **should** be able to selectively assess the applicable vertical separation minimum of either 300 m (1 000 ft) or 600 m (2 000 ft), as determined by the current RVSM approval or non-approval status of the aircraft concerned, operating in the level band between FL 290 to FL 410 inclusive.

8.7.2 Where the STCA system of an ACC/UAC applying RVSM does not meet the requirements of paragraph 8.7.1, it **shall** be able to assess a vertical separation minimum of 300 m (1 000 ft) up to and including FL 410.

8.7.2.1 The serious disruptions to those operational environments applying RVSM, caused by STCA systems generating alerts based on an assessment of a vertical separation minimum of 600 m (2 000 ft) in the flight level band 290 to 410 inclusive, would be too numerous to be sustainable.

8.7.2.2 ACCs/UACs will be aware, for those STCA systems not adapted to meet the requirement described in paragraph 8.7.1, that alerts for those encounters involving at least one non-RVSM approved aircraft, operating between FL 290 to FL 410 inclusive, would be based on a vertical separation minimum which would not be applicable to the encounter in question. Nevertheless, in keeping with the concept of STCA as a safety net, alerts would however be generated as a function of a VSM assessment sufficient to assist in the prevention of collision.

Medium Term Conflict Detection (MTCD)

8.7.3 Medium Term Conflict Detection systems of ACCs/UACs applying RVSM **shall** be able to assess the selective application of a vertical separation minimum of either 300 m (1 000 ft) or 600 m (2 000 ft), as determined by the current RVSM approval or non-approval status of the aircraft concerned operating in the level band between FL 290 to FL 410 inclusive.

8.7.4 Individual ACCs/UACs should undertake early planning to ensure that the necessary software adaptations are accomplished within the defined timeframes for the initial implementation of MID RVSM. Implementation of MID RVSM prior to the completion of the necessary adaptations to STCA/MTCD systems would result in nuisance alerts being generated to an extent that severe operational disruptions could result.

9.0 AIR TRAFFIC MANAGEMENT CONSIDERATIONS

9.1 General

9.1.1 The introduction of RVSM will require that individual ACCs/UACs undertake a critical evaluation of operating practices so as to identify areas where adjustments and/or changes are required.

9.1.2 Individual ACCs/UACs may wish to take the opportunity to maximise the operational benefits to be gained from the introduction of RVSM by undertaking an extensive critical operational analysis.

9.2 Optimisation of the ATS Route Network

9.2.1 It is expected that the optimisation of the existing ATS route network will be realised through a combination of Flight Level Allocation Schemes, sectorisation, and, to a lesser extent, changes to the ATS route network itself. In general, it is expected that following the implementation of RVSM there will be a vertical re-distribution of traffic with more aircraft reaching their optimum flight levels. This vertical re-distribution of traffic may require changes to ATC sector boundaries in order to balance controller workload.

9.2.2 On bi-directional ATS routes, climbing and descending aircraft will cross more cruising levels in an RVSM environment than in a non-RVSM environment. Therefore, consideration should be given to the potential benefit of expanding the use of uni-directional ATS routes. Local needs (e.g. availability of airspace, ATC sectorisation, crossing points) will dictate whether or not this is practicable, but on those ATS route segments where the majority of the traffic is in the evolutionary stages of flight, the creation of laterally-spaced, uni-directional ATS routes to facilitate climb/descent to/from cruising levels could reduce controller workload.

9.2.3 The introduction of MID RVSM will permit an optimization of any existing Flight Level Allocation Schemes (FLAS) through the designation of new flight levels for specified ATS route segments. Strategic de-confliction at major crossing points will be facilitated through the availability of the additional cruising levels. FLAS could also be considered where RVSM airspace is adjacent to non-RVSM airspace, and particularly where the adjacent non-RVSM airspace is located to the east of the MID RVSM Airspace.

9.3 ATC Sectorisation

9.3.1 The implementation of MID RVSM may require an analysis of the optimal levels to be used for delineating the vertical limits of control sectors within ACCs/UACs. Operational experts should evaluate the requirement to re-define such vertical limits as a function of adaptations to FLAS, or predicted changes in the vertical profiles of major traffic flows expected from the implementation of RVSM.

9.3.2 In addition to the requirement to provide a vertical separation minimum of 300 m (1 000 ft) between RVSM approved aircraft operating within the MID RVSM Airspace, States shall ensure that the vertical limits of control sectors within ACCs/UACs also facilitate the requirement to provide a vertical separation minimum of 600 m (2 000 ft) between:

a. non-RVSM approved State aircraft and any other aircraft operating within the MID RVSM Airspace;

b. all formation flights of State aircraft and any other aircraft operating within the MID RVSM Airspace;

c. non-RVSM approved civil aircraft and any other aircraft operating within the MID RVSM Airspace where RVSM transition tasks are carried out.

9.3.3 Consideration should be given to the impact on ATC co-ordination workload resulting from the requirement to provide a 600 m (2 000 ft) vertical separation minimum, as described in paragraph 9.3.2, for such aircraft operating at levels immediately above or below vertical sector boundaries within the MID RVSM Airspace. Vertically adjacent sectors will require continuous awareness, through co-ordination, of the presence of traffic operating at flight levels immediately above or below a vertical sector boundary, in order to facilitate the provision of the required vertical separation minimum. As an example, consideration could be given to adjusting the lower limit of a sector from FL 300 to FL 285 with the implementation of RVSM, so as to reduce ATC co-ordination requirements for aircraft that require a 600 m (2 000 ft) vertical separation minimum within the MID RVSM Airspace. Alternatively, ACCs/UACs may wish to consider the designation of FL 275 as a suitable division flight level between

two sectors. Such designation would make available, to the sector responsible -RVSM level experiencing an equipment-related in-flight contingency.

9.3.4 The implementation of MID RVSM will render those cruising levels in the flight level band between FL 290 and FL 410 inclusive, which were vertical limits of sectors prior to RVSM implementation, as assignable cruising levels. As a consequence, ACCs/UACs will be required to designate vertical sector limits based on 500 ft intervals situated between two assignable cruising levels.

e.g.: Prior to RVSM implementation, upper limit of sector: FL 300
After RVSM implementation, upper limit of sector: FL 295

9.3.5 Areas of Common Interest (ACIs) described in Inter-Centre Letters of Agreement must be amended to reflect any changes to sector boundaries, where applicable.

9.4 Air Traffic Management Options for MID RVSM Transition Airspace

9.4.1 States on the periphery of the MID RVSM Airspace are faced with additional ATC tasks, as compared to States within the MID RVSM Airspace whose area of responsibility does not include RVSM transition airspace. States responsible for MID RVSM Transition Airspace may wish to evaluate the potential increase in controller workload on busy bi-directional ATS routes which cross the RVSM/non-RVSM boundary.

9.4.2 Controllers will need to adjust the cruising levels for aircraft operating from the MID RVSM Airspace to adjacent non-RVSM airspace and vice-versa, due to the differences between the cruising levels applicable within the MID RVSM Airspace to those which are applicable within the adjacent non-RVSM airspace. Furthermore, where non-RVSM airspace is located adjacent to, and east of, the MID RVSM Airspace, the fact that FL 310, FL 350 and FL 390 are westbound cruising levels within non-RVSM airspace and eastbound cruising levels within the MID RVSM Airspace is an important safety consideration.

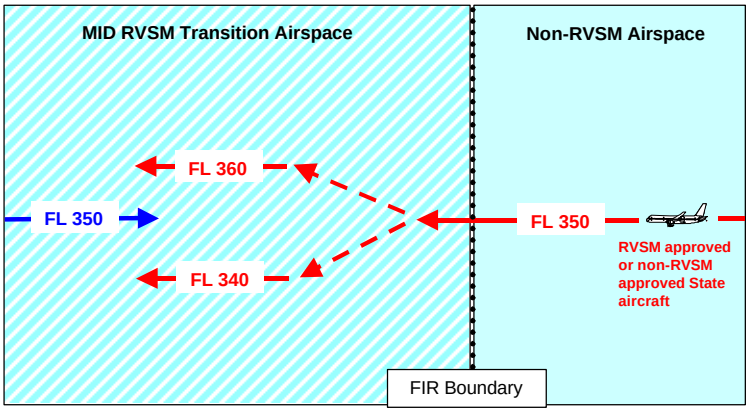


Figure 21: Traffic operating from adjacent non-RVSM airspace at FL 350 westbound is established at FL 340 or FL 360 within MID RVSM Transition Airspace.

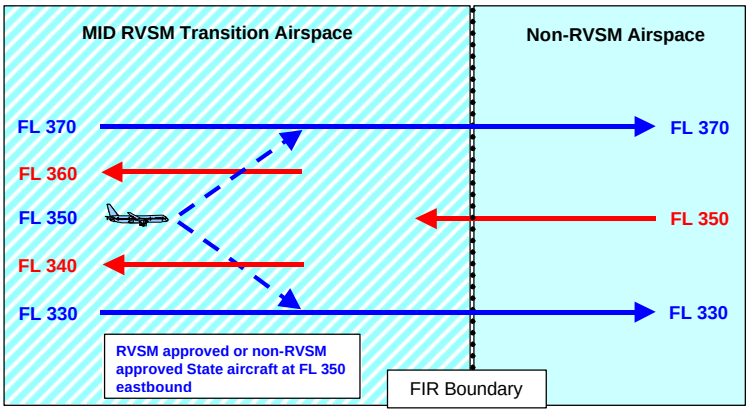


Figure 22: Traffic within the EUR RVSM Transition Airspace at FL 350 eastbound is established at FL 330 or FL 370 prior to the boundary with adjacent non-RVSM Airspace.

9.4.3 ACCs/UACs which perform RVSM transition tasks should consider the following options:

1. laterally-spaced, uni-directional ATS routes; and
2. flight level allocation scheme(s).

Laterally- Spaced, Uni-directional ATS Routes

9.4.4 States whose area of responsibility includes MID RVSM Transition Airspace may wish to consider the establishment of laterally-spaced, uni-directional ATS routes to facilitate the transition of traffic operating from the MID RVSM Airspace to adjacent non-RVSM airspace and vice-versa, if traffic levels and/or the complexity of RVSM transition tasks warrant it. This could be achieved either cross-border after co-ordination with adjacent non-RVSM States, or within the FIR of an individual State. Illustrations of laterally-spaced, uni-directional ATS routes are as follows:

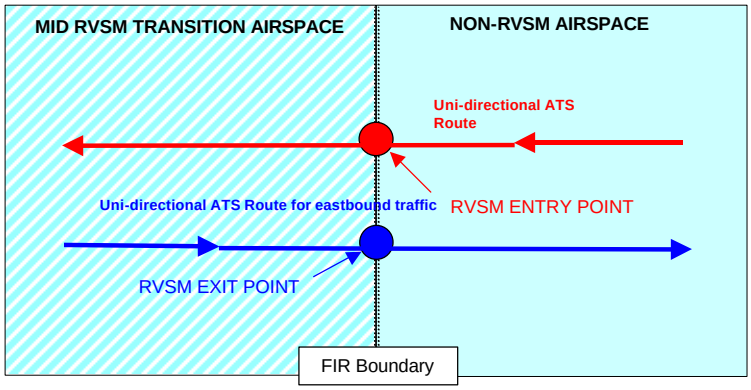


Figure 23: Laterally-spaced, uni-directional ATS routes between MID RVSM Transition Airspace and adjacent non-RVSM airspace.

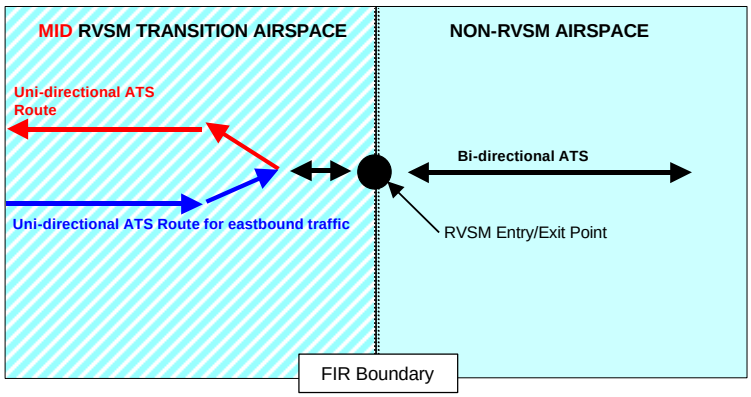


Figure 24: Laterally-spaced, uni-directional ATS routes within MID RVSM Transition Airspace.

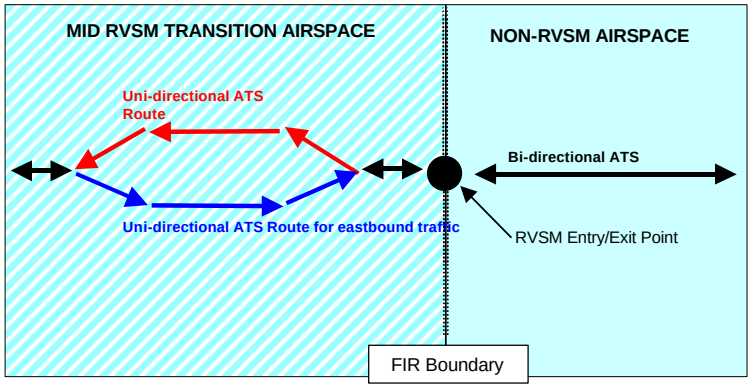


Figure 25: Laterally-spaced, uni-directional route section on a bi-directional ATS route within MID RVSM Transition Airspace.

Flight Level Allocation Schemes (FLAS)

9.4.5 Where an alternative and/or a supplement to the laterally-spaced, uni-directional ATS route network option may be required, consideration should be given to the application of a Flight Level Allocation Scheme. A FLAS is a scheme whereby specific flight levels are applied to specific segments within the ATS route network. By organizing the use and non-use of flight levels on specific route segments, potential traffic conflicts can be avoided.

9.4.6 The implementation of RVSM makes it necessary for ACCs/UACs to review, and, if necessary, revise existing FLAS, taking into account the additional cruising levels available. Additionally, ACCs/UACs responsible for MID RVSM Transition Airspace which is adjacent to non-RVSM airspace should consider the differences in cruising levels appropriate to direction of flight between RVSM airspace and non-RVSM airspace. ACCs/UACs should also determine whether there is a requirement to develop and implement any new FLAS.

9.4.7 It is recommended that where it is appropriate to do so, strategic solutions should be developed as to when to discontinue the use of FL 310, FL 350, and FL 390 as eastbound cruising levels. Both opposite direction and crossing traffic scenarios at these flight levels should be taken into account. Any such strategic solutions agreed to should be contained in Inter-Centre Letters of Agreement, and/or Flight Level Allocation Schemes, as appropriate.

Illustrations of FL 310, FL 350, and FL 390 discontinued as eastbound cruising levels are as follows:

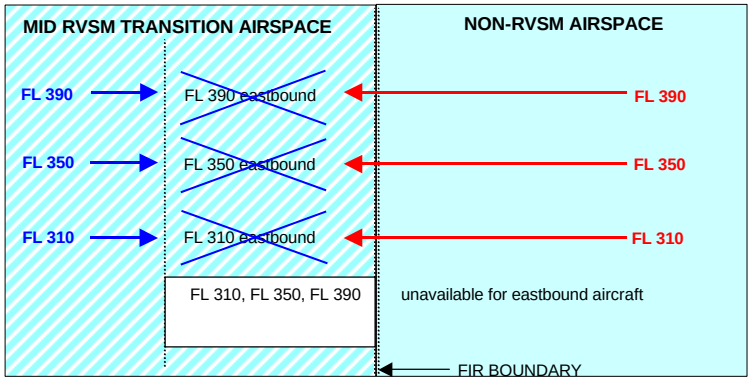


Figure 26: FLAS depicting FL 310, FL 350, and FL 390 discontinued for eastbound aircraft within a portion of the MID RVSM Transition Airspace.

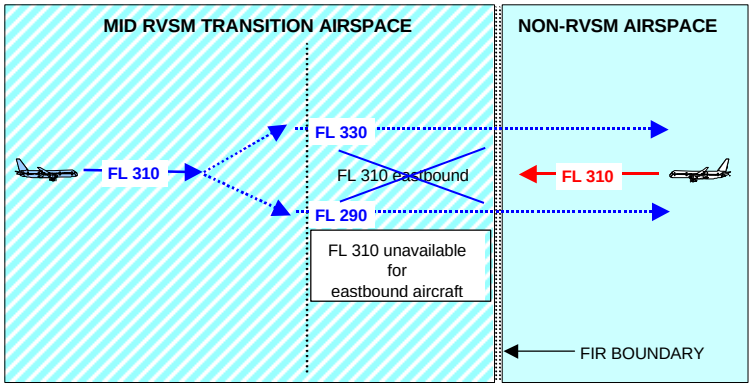


Figure 27: Opposite direction aircraft at FL 310. FLAS discontinues FL 310 for eastbound aircraft within a portion of the MID RVSM Transition Airspace.

9.5 Inter-Centre Letters of Agreement

9.5.1 Prior to the implementation of MID RVSM, ACCs/UACs should review their existing Inter-Centre Letters of Agreement for the purpose of updating the content to encompass RVSM-related changes, as appropriate.

9.5.2 Inter-Centre Letters of Agreement. A contingency FLAS could be applied during periods of meteorological conditions requiring a suspension in the use of 300 m (1 000 ft) vertical separation minimum within MID RVSM Airspace. In this way, co-ordination of levels appropriate to the transfer of traffic requiring a minimum of 600 m (2 000 ft) vertical separation minimum from adjacent ACCs/UACs can be facilitated.

9.5.3 Additionally, ACCs/UACs should consider whether there is a requirement to increase the pre-notification time parameter(s) for the passing of estimate messages involving non-RVSM approved aircraft intending to operate within the MID RVSM Airspace, as a means of facilitating planning for the integration of such traffic in accordance with a 600 m (2 000 ft) vertical separation minimum.

9.5.4 ACCs/UACs should also consider the inclusion of precise co-ordination procedures related to RVSM in their Inter-Centre Letters of Agreement with adjacent ACCs/UACs which do not receive flight plan information from IFPS, so as to ensure that the RVSM approval status of each aircraft is accurately communicated.

10.0 AIRBORNE COLLISION AVOIDANCE SYSTEMS (ACAS)

10.1 The provisions of the ICAO Regional Supplementary Procedures, Doc 7030/4 (MID/ASIA), Chapter 8 title

from 1 July 2001 by all aircraft that meet the following criteria:

- All civil fixed-wing turbine-engined aircraft having a maximum take-off mass exceeding 15000 kg or maximum approved passenger seating configuration of more than 30.

Note: Except when operating wholly within an FIR for which the State responsible has notified in its AIP or by NOTAM that these provisions do not apply.

10.2 However, in order to permit resolution of practical implementation issues involving supply, installation and certification of ACAS II equipment, aircraft may be granted special exemptions from compliance with the ACAS II requirement within the transition period, under specific conditions until 1 January 2003.

10.3 It is relevant to note that TCAS II, Version 6.04A (or earlier), is **not** ICAO ACAS II SARPs compliant, and, as such, will require upgrading to TCAS II, Version 7.

10.4 TCAS II, Version 6.04A (or earlier) models, which generate Traffic Advisories (TAs) and Resolution Advisories (RAs) were designed for an operating environment where a minimum vertical separation of 600 m (2 000 ft) is applied above FL 290. Analysis of TCAS II, Version 6.04A (or earlier) performance has revealed that, in an RVSM environment, it would generate a high number of nuisance Traffic Advisories (TAs) and Resolution Advisories (RAs).

10.5 TCAS II, Version 7, includes modifications intended to address operational issues, including its compatibility for operations within RVSM Airspace. Comprehensive work is underway to confirm TCAS II, Version 7 performance in the MID RVSM Airspace. Initial analysis indicates that the modifications introduced are effective, and it is considered important that TCAS II, Version 7 should be in widespread use before RVSM is implemented in the MID Region.

10.6 Controllers should be aware that, notwithstanding the MID ACAS provisions referred to in paragraph 10.1, a small population of aircraft will continue to operate within the MID RVSM Airspace while operating either TCAS II, Version 6.04A (or earlier), or no ACAS, by virtue of the fact that they are not included in the criteria for mandatory carriage and operation, i.e. *civil, fixed-wing turbine aircraft of more than 15000 kg or maximum passenger load of more than 30*. *Safety studies initiated by EUROCONTROL are currently underway to define the operational impact such aircraft will have on the EUR RVSM Airspace.*

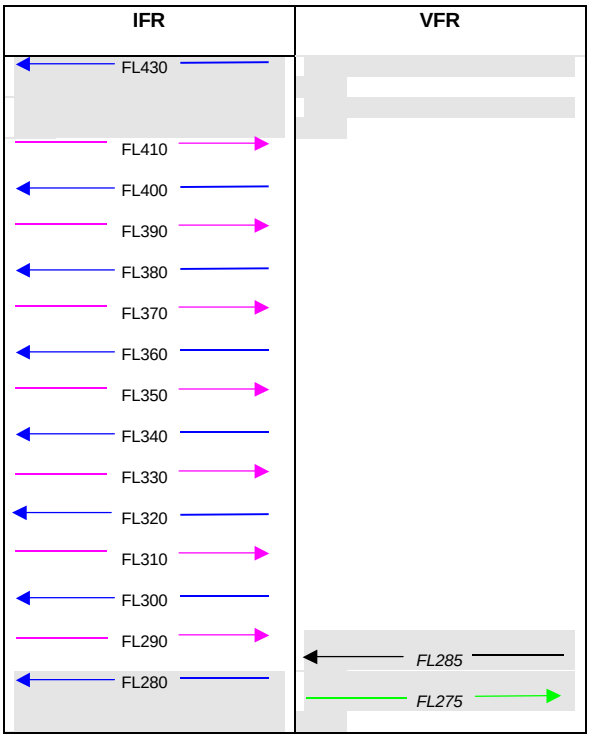
10.7 The implementation of MID RVSM is being undertaken with due regard for the operational performance of ACAS II. The mandatory carriage and operation of ICAO Standards And Recommended Practices (SARPs) compliant ACAS II in MID Region, as specified in paragraph 10.1, precedes the implementation of MID RVSM.

---***END***---

Appendix A

RVSM Table of Cruising Levels

(Reference: ICAO Annex 2, Appendix 3, Paragraph a))

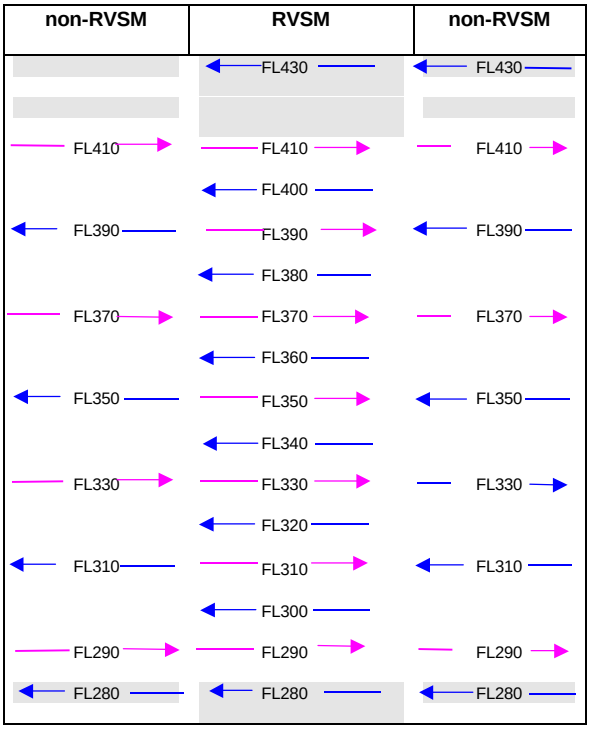


Note 1: The provisions of ICAO Annex 2 preclude VFR flight above FL 290. Accordingly, attention is drawn to the absence of VFR cruising levels above FL410, where the VSM reverts to 2 000 ft.

Note 2: Lower minima for VFR flights have been adopted in the MID Region and are indicated in the respective AIPs.

Appendix B

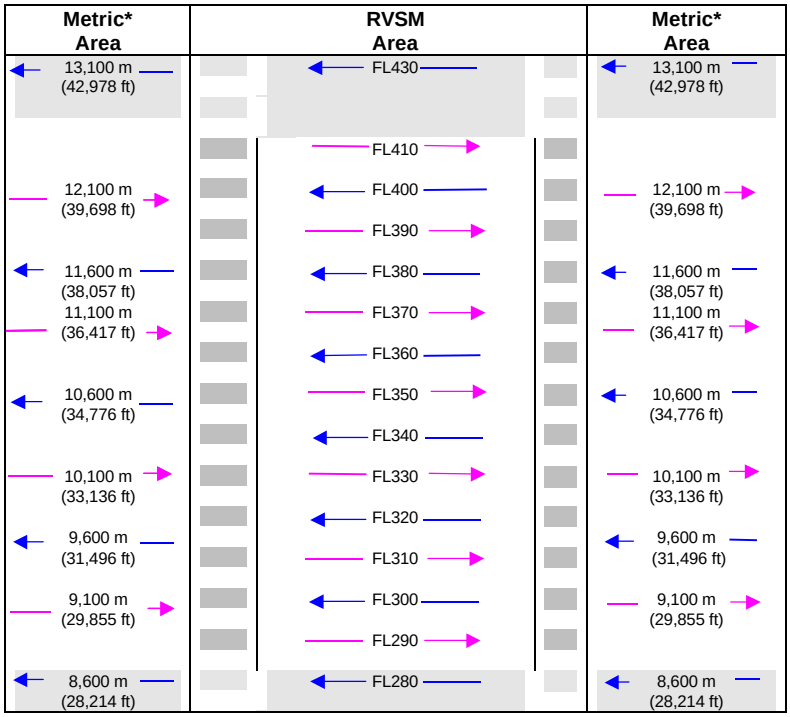
RVSM/non-RVSM Transition



conflict to be resolved during transition

Appendix C

Feet - Metric Transition



* system of metric cruising levels as applied, for instance, in the Russian Federation

Airspace where Transition Tasks are carried out

Appendix D

Guidance

Material on the Implementation of a 300m (1000ft) Vertical Separation Minimum in the

: Airworthiness

It is intended as a means of providing background material of sufficient detail to allow operational ATC personnel to gain an appreciation of the subject. The contents of this appendix, therefore should not be considered as authoritative.

AIRWORTHINESS

Introduction

This material has been prepared in conjunction with the Joint Airworthiness Authority (JAA) and it provides an overview of the development, and content, of JAA Temporary Guidance Leaflet (TGL) No.6. which is the authoritative document on all issues relating to the European MASPS and on the approval of aircraft and operators for flight in designated RVSM airspace.

Background

1 The initial MASPS, for the height keeping accuracy necessary for RVSM operations, was established by the ICAO RGCSP. It was further refined by the NAT SPG by means of a group of technical specialists from State authorities, aircraft and avionics manufacturers, and airline and pilot associations. This group developed material which was then published by the Federal Aviation Administration (FAA) as FAA Document 91 - RVSM : Interim Guidance for Approval of Operators/Aircraft for RVSM Operations, and by the JAA as Information Leaflet No. 23 (I.L.No. 23). These documents detailed the airworthiness, continuing airworthiness, and operations programmes necessary to approve operators and aircraft for RVSM operations in the NAT RVSM airspace.

2 JAA TGL No.6

2.1 JAA TGL No.6 was published in mid 1998. It extends the area of applicability of the requirements of I.L. No. 23, to any region in which RVSM operations are introduced. Regional differences (e.g. ATC Procedures) are addressed in separate Annexes to the main body of TGL No.6, which will ultimately be re-issued as a JAA Acceptable Means of Compliance (AMC) with Joint Aviation Requirements (JAR Ops 1 Subpart L). The requirements detailed in the main body of TGL No.6 are unchanged from those set out in IL No. 23. which were developed in accordance with the conclusions of the RGCSP/6 Meeting (Doc 9536).

TGL No.6 provides detailed guidance on :

- the process for the approval of Aircraft and Operators, for RVSM operations.
- RVSM performance requirements
- Aircraft System requirements
- Airworthiness Approval
- Continued Airworthiness (Maintenance Requirements)
- Operational Approval (ATC and Flight Crew) aspects.

together with the following Appendices :

Appendix 1 - Explanation of W/δ
Appendix 2 - Altimetry System Error (ASE) Components
Appendix 3 - Establishing and Monitoring Static Source Errors
Appendix 4 - Training Programmes and Operating Practices and Procedures
Appendix 5 - Review of ICAO Doc.9574 - Height Keeping Errors
Appendix 6 - Specific Procedures [ATC] for European RVSM Airspace
Appendix 7 - Specific Procedures for the North Atlantic Airspace

TGL No.6 Para 8 details the following minimum equipment fit for aircraft seeking airworthiness approval for RVSM operations :

a) Two independent altitude measurement systems. Each system will need to be composed of the following elements:

- Cross-coupled static source/system, provided with ice protection if located in areas subject to ice accretion;

- Equipment for measuring static pressure sensed by the static source, converting it to pressure altitude and displaying the pressure altitude to the flight crew:

- Equipment for providing a digitally coded signal corresponding to the displayed pressure altitude, for automatic altitude reporting purposes;

- Static source error correction (SSEC), if needed to meet the performance criteria.

- Signals referenced to a pilot selected altitude for automatic control and alerting. These signals should be derived from an altitude measurement system meeting the criteria of this document [TGL No. 6], and, in all cases, enabling the criteria relating to Altitude Control Output and Altitude Alerting to be met.

b) One Secondary Surveillance Radar (SSR) transponder with an altitude reporting system that can be connected to the altitude measurement system in use for altitude for height keeping.

c) An altitude alerting system

d) An automatic altitude control system.

Appendix E

Following is an extract of the relevant section (Part 4), State Approval of Aircraft for RVSM Operations, Guidance Material on the Implementation of a 300m

It is intended as a means of providing background material, of sufficient detail, to allow operational ATC personnel to gain an appreciation of the subject. The contents of this appendix, therefore should not be considered as authoritative.

STATE APPROVAL OF AIRCRAFT FOR RVSM OPERATIONS

1 The State Approval Process

1.1. With effect from the agreed date of the implementation of RVSM in European airspace, Operators intending to conduct flights within the notified RVSM airspace shall require an RVSM Approval either from the State in which the aircraft is registered, or from the State in which the Operator is based. Whilst the primary responsibility for gaining the necessary approval must rest with the aircraft operator, State aviation authorities will be expected to initiate such procedures as necessary to publicise the requirement for, and the means of obtaining, such approvals. In addition, State aviation authorities should maintain regular checks and records of the approvals which they have granted, and ensure that the relevant data is passed to the designated central data base.

2 RVSM Approvals. An RVSM approval will encompass the following elements:

2.1 Airworthiness Requirements (including continuous airworthiness)

2.1.1 The European RVSM Airworthiness requirements are detailed in the JAA TGL No 6. Para. 9. This provides guidance for the approval of newly built aircraft and for aircraft

that have already in service. Aircraft may be granted an airworthiness approval against these requirements, or those of equivalent State documentation.

2.1.2 State Airworthiness authorities should also confirm that aircraft altimetry and height-keeping equipment will be maintained in accordance with approved procedures and servicing schedules as detailed in TGL No 6 Para 10.

2.1.3 Whilst meeting the airworthiness requirements of an RVSM approval is, by itself, not sufficient to authorise flight in RVSM airspace, it will qualify the aircraft to enter the Airspace User Preparation & Performance Verification Phase (P1) of the monitoring programme. It is important therefore that the appropriate State Authority should advise the designated monitoring cell accordingly.

2.2 Operational Requirements

2.2.1 To meet the operational requirements of an RVSM approval, the operator will need to satisfy the appropriate authority that that they have instituted flight crew procedures for operations in the European RVSM airspace.

3. Content of Operator RVSM Application

3.1

No.6 Para 11.3, and summarised below. The application should be submitted in sufficient time to permit evaluation before the intended start of RVSM operations and should include :

- Airworthiness Documents - to show that the aircraft holds an RVSM airworthiness approval

- Description of Aircraft Equipment - appropriate to RVSM operations

- Training Programmes and Operating Practices and Procedures - holders of Air Operators Certificates (AOC) should submit training syllabi and other appropriate material to the responsible authority to show that the operating practices, procedures and training items related to RVSM operations are incorporated in initial, and where

appropriate, recurrent training programmes. Other operators will need to comply with local procedures to satisfy the responsible authority that their knowledge of RVSM operating procedures and practices is equivalent to that set for AOC Holders, sufficient to hold approval to conduct RVSM operations. Guidance on the content of Flight Crew training programmes and operating practices and procedures is given in Section 5 of this document. This material is identical to Appendix 4 of TGL No.6. The European RVSM ATC Procedures which are set out in Section 6 of this document are copied in Appendix 6 to TGL No.6.

- Operations Manuals and Checklists - the appropriate manuals and checklists should be revised to include information/guidance on standard operating procedures for RVSM operations.

- Past Performance - relevant operating history, where available, should be included in the application. The applicant should show that changes needed in training, operating or maintenance practices to improve poor height keeping performance, have been made.

- Minimum Equipment List (MEL) - where applicable, an MEL, adapted from the Master Minimum Equipment List (MMEL) and relevant operational regulations, should include items pertinent to operating in RVSM airspace.

- Maintenance - when application is made for operational approval, the operator should establish a maintenance programme acceptable to the responsible authority.

- Plan for participation in the Performance Verification/Monitoring Programmes - this plan will need to include, as a minimum, a check on a sample of the operators fleet by an independent height monitoring system.

3 The application of the RVSM approval process and the monitoring programmes may be sufficient to verify the height keeping performance of an aircraft. However, the final step of the approval process may require a demonstration flight. The responsible authority may appoint an inspector for a flight in RVSM airspace to verify that all procedures are applied effectively. If the performance is satisfactory, the operator will be eligible for RVSM approval.

4 Issue of RVSM Approval.

- For AOC Holders - approvals will be issued by the appropriate authority in accordance with Joint Airworthiness Requirements (JAR OPS 1). Each aircraft group for which the operator is granted approval will be listed in the Approval.

- For Non AOC Holders - these operators will be issued with an Approval as required by national regulations or with JAR OPS 2 when this is published. These approvals will be valid for a period specified in National Regulations, typically 2 years, and may require renewal.

5 Suspension or Revocation of Approval for RVSM Operations.

5.1 The incidence of height keeping errors that can be tolerated in an RVSM environment is small. Thus Operators will be expected to take immediate action to rectify the conditions which cause an error. The operator should report an occurrence involving poor height keeping to the responsible authority within 72 hours. The report should include an initial analysis of causal factors and measures taken to prevent any reoccurrence. The need for follow up reports will be determined by the responsible authority.

5.2 Occurrences that should be reported and investigated are height keeping errors which display a :

- TVE equal to or greater than 300 ft (90m)
- ASE equal to or greater than 245 ft (75m)
- AAD equal to or greater than 300 ft (90m)

5.3 An Operator that consistently experiences height keeping errors, whether they are due to technical or operational causes, will have approval for RVSM operations revoked. If a problem is related to one specific aircraft type, then RVSM operational approval may be revoked for that specific typ

a notification of an height keeping error is not timely or effective, then the relevant authority may consider suspending or revoking RVSM approval.

6 Provision for the monitoring of aircraft:

6.1 A programme to monitor or verify aircraft height-keeping performance is considered a necessary element of European RVSM implementation. Verification and monitoring programmes have the basic objective of observing and evaluating the height-keeping performance of MASPS equipped aircraft to :

a) confirm the efficacy of the RVSM MASPS
b) monitor the effectiveness of the approval process.
c) confirm that required safety levels will be achieved when RVSM is implemented.

7 Data base of State approvals

7.1 State aviation authorities will be expected to maintain a State Data Base (SDB) of all approvals which they have granted for operations in RVSM airspace. The details of the compilation and formatting of the data and the system operating parameters are under development. Ideally, the SDBs will provide data to one or more Central Data Bases (CDBs), including the NAT Central Monitoring Agency (CMA). This would facilitate the tactical monitoring of the approval status of those aircraft which have flight planned to operate in RVSM airspace, should such monitoring be considered necessary.

Appendix F

Guidance Material on the Implementation of a 300m (1000ft) Vertical Separation Minimum in the *Flight Crew Training Programmes and Operating Practices and Procedures*

It is intended as a means of providing background material of sufficient detail to allow operational ATC personnel to gain an appreciation of the subject. The contents of this appendix, therefore should not be considered as authoritative.

FLIGHT CREW TRAINING PROGRAMMES AND OPERATING PRACTICES AND PROCEDURES

1. Introduction

1.1 Flight crews will need to have an awareness of the criteria for operating in RVSM airspace and be trained accordingly. The items detailed in paragraphs 2 to 6 should be standardised and incorporated into training programmes and operating practices and procedures. Certain items may already be adequately standardised in existing procedures. New technology may also remove the need for certain actions required of the flight crew. If this is so, then the intent of this guidance can be considered to be met.

Note: *This guidance material has been developed for all users of RVSM airspace, and as such is designed to present all required actions. It is recognised that some material may not be necessary for larger public transport operators.*

2. Flight Planning

2.1 During flight planning the flight crew should pay particular attention to conditions that may affect operation in RVSM airspace.

2.1.1 These include, but may not be limited to:

- verifying that the airframe is approved for RVSM operations;
- reported and forecast weather on the route of flight;
- minimum equipment requirements pertaining to height keeping and alerting systems; and
- any airframe or operating restriction related to RVSM approval.

3. Pre-flight procedures at the aircraft for each flight

3.1 The following actions should be accomplished during the pre-flight procedure:

- review technical logs and forms to determine the condition of equipment required for flight in the RVSM airspace. Ensure that maintenance action has been taken to correct defects to required equipment;
- during the external inspection of aircraft, particular attention should be paid to the condition of static sources and the condition of the fuselage skin near each static source and any other component that affects altimetry system accuracy. This check may be accomplished by a qualified and authorised person other than the pilot (e.g. a flight engineer or ground engineer);
- before takeoff, the aircraft altimeters should be set to the QNH of the airfield and should display a known altitude, within the limits specified in the aircraft operating manuals. The two primary altimeters should also agree within limits specified by the aircraft operating manual. An alternative procedure using QFE may also be used. Any required functioning checks of altitude indicating systems should be performed.
- Note. *The maximum value for these checks cited in operating manuals should not exceed 23m (75 ft).*
- before take-off, equipment required for flight in RVSM airspace should be operative, and any indications of malfunction should be resolved.

4. Procedures prior to RVSM airspace entry

4.1 The following equipment should be operating normally at entry into RVSM airspace:

- Two primary altitude measurement systems.
- One automatic altitude-control system.
- One altitude-alerting device.

Note: *Dual equipment requirements for altitude-control systems will be established by regional agreement after an evaluation of criteria such as mean time between failures, length of flight segments and availability of direct pilot-controller communications and radar surveillance.*

- Operating Transponder. An operating transponder may not be required for entry into all designated RVSM airspace. The operator should determine the requirement for an operational transponder in each RVSM area where operations are intended. The operator should also determine the transponder requirements for transition areas next to RVSM airspace.

  Note: *Should any of the required equipment fail prior to the aircraft entering RVSM airspace, the pilot should request a new clearance to avoid entering this airspace;*

5 In-Flight Procedures

5.1 The following practices should be incorporated into flight crew training and procedures:

- Flight crews will need to comply with any aircraft operating restrictions, if required for the specific aircraft group, e.g. limits on indicated Mach number, given in the RVSM airworthiness approval.

- Emphasis should be placed on promptly setting the sub-scale on all primary and standby altimeters to 1013.2 (hPa) /29.92 in. Hg when passing the transition altitude, and rechecking for proper altimeter setting when reaching the initial cleared flight level;

- In level cruise it is essential that the aircraft is flown at the cleared flight level. This requires that particular care is taken to ensure that ATC clearances are fully understood and followed. The aircraft should not intentionally depart from cleared flight level without a positive clearance from ATC unless the crew are conducting contingency or emergency manoeuvres;

- When changing levels, the aircraft should not be allowed to overshoot or undershoot the cleared flight level by more than 45 m (150 ft);

  Note: *It is recommended that the level off be accomplished using the altitude capture feature of the automatic altitude-control system, if installed.*

- An automatic altitude-control system should be operative and engaged during level cruise, except when circumstances such as the need to re-trim the aircraft or turbulence require disengagement. In any event, adherence to cruise altitude should be done by reference to one of the two primary altimeters. Following loss of the automatic height keeping function, any consequential restrictions will need to be observed.

- Ensure that the altitude-alerting system is operative;

- At intervals of approximately one hour, cross-checks between the primary altimeters sh m).
  Failure to meet this condition will require that the altimetry system be reported as defective and notified to ATC;

  the usual scan of flight deck instruments should suffice for altimeter cross-checking on most flights.

- In normal operations, the altimetry system being used to control the aircraft should be selected for the input to the altitude reporting transponder transmitting information to ATC.

- If the pilot is advised in real time that the aircraft has been identified by a height- m) and/or
  m) then the pilot should follow established regional procedures to protect the safe operation of the aircraft. This assumes that the monitoring system will identify the TVE or ASE within the set limits for accuracy.

- If the pilot is notified by ATC of an assigned altitude deviation of 300 ft (90 m) or more then the pilot should take action to return to cleared flight level as quickly as possible.

5.2 Contingency procedures after entering RVSM airspace are:

5.2.1 The pilot should notify ATC of contingencies (equipment failures, weather) which affect the ability to maintain the cleared flight level, and co-ordinate an appropriate plan of action.

5.2.2 Examples of equipment failures which should lead to notification to ATC:

- failure of all automatic altitude-control systems aboard the aircraft;
- loss of redundancy of altimetry systems,
- loss of thrust on an engine necessitating descent; or
- any other equipment failure affecting the ability to maintain cleared flight level

5.2.3 The pilot should notify ATC when encountering greater than moderate turbulence.

5.2.4 If unable to notify ATC and obtain an ATC clearance prior to deviating from the assigned cleared flight level, the pilot should follow the established contingency procedures and obtain ATC clearance as soon as possible.

6. Post Flight

6.1 In making technical log entries against malfunctions in height keeping systems, the pilot should provide sufficient detail to enable maintenance to effectively troubleshoot and repair the system. The pilot should detail the actual defect and the crew action taken to try to isolate and rectify the fault.

6.2 The following information should be recorded when appropriate:

- Primary and standby altimeter readings.
- Altitude selector setting.
- Sub-scale setting on altimeter.
- Auto-pilot used to control the aeroplane and any differences when an alternative auto-pilot system was selected.
- Differences in altimeter readings, if alternate static ports selected.
- Use of air data computer selector for fault diagnosis procedure.
- The transponder selected to provide altitude information to ATC and any difference noted when an alternative transponder was selected.

7 Special Emphasis Items: Flight Crew Training

7.1 The following items should also be included in flight crew training programmes:

- knowledge and understanding of standard ATC phraseology used in each area of operations;
- importance of crew members cross checking to ensure that ATC clearances are promptly and correctly complied with;
- use and limitations in terms of accuracy of standby altimeters in contingencies. Where applicable, the pilot should review the application of static source error correction/ position error correction through the use of correction cards;

  Note: Such correction data will need to be readily available on the flight deck.

- problems of visual perception of other aircraft at 300m (1,000 ft) planned separation during darkness, when encountering local phenomena such as northern lights, for opposite and same direction traffic, and during turns; and

- characteristics of aircraft altitude capture systems which may lead to overshoots.

- relationship between the aircraft's altimetry, automatic altitude control and transponder systems in normal and abnormal conditions.

- any airframe operating restrictions, if required for the specific aircraft group, related to RVSM airworthiness approval.

Appendix G

Guidance

Material on the Implementation of a 300m (1000ft) Vertical Separation Minimum in the *System Performance Monitoring*

It is intended as a means of providing background material of sufficient detail to allow operational ATC personnel to gain an appreciation of the subject. The contents of this appendix, therefore should not be considered as authoritative.

SYSTEM PERFORMANCE MONITORING

1 Introduction

1.1 This Part provides guidance on the monitoring of operations in European RVSM airspace. The objectives of the monitoring programme are to ensure that the level of collision risk does not exceed the TLS and to assess the compliance of aircraft with the global height keeping performance specification (paragraph 2.2 refers). This information will be taken into account by decision makers in judging whether overall safety goals applicable to the European RVSM airspace are being achieved.

1.2 The overall criterion for safety in the European RVSM area is that the TLS of 5×10^{-9} fatal accidents per flight hour (representing the risk due solely to the loss of vertical separation from any cause) is not exceeded. The agreed method of assessing actual collision risk is by the use of a variant of the Reich collision risk model (CRM) suitable to the area.

1.3 The height-keeping errors which will contribute to collision risk in the European RVSM area can be divided into two categories; technical errors and operational errors. Technical errors, i.e. Altimetry System Errors (ASE) are caused by inaccuracies in the height-keeping equipment of aircraft, whereas, operational errors, i.e. Assigned Altitude Deviation (AAD), are caused by mistakes, by ATC or Flight Crew, which result in

aircraft being flown at incorrect flight levels. ASE and AAD are the main constituents of Total Vertical Error (TVE). As aircraft operations in the European area are, for the larger part, conducted under tactical radar control together with some procedural separation, the frequency of occurrence, size and duration of operational errors can be greatly reduced. Nevertheless, operational errors can, and do, occur and may make a significant contribution to the overall collision risk. The TLS has been chosen to take account of the risk from both technical errors and operational errors.

1.4 In order to ensure that the TLS is not being exceeded, it is necessary to monitor both the occurrence of vertical errors and the CRM parameter values on a continuing basis. Many of the parameter values used in the CRM are based on a planning horizon of approximately 10 years and require periodic monitoring.

1.5 The CRM parameters fall into two groups from the stand-point of monitoring requirements. The first group consists of two important parameters which are critical for safety assessment, in the sense that the actual risk in the airspace changes in proportion to changes in their values. The first of these parameters is an estimate of the proportion of flight time spent by aircraft, nominally separated by 1 000 ft, in vertical overlap. This parameter is a function of the height-keeping performance of the overall aircraft population. It is termed the "vertical overlap probability" and denoted by the term

plan overlap events per aircraft flight hour.

1.6 The second group of CRM parameters is less demanding either because the CRM is relatively insensitive to their values, or because they are not expected to change substantially over the planning horizon of this document. They should be re-assessed periodically to ensure that their values reflect the current European RVSM airspace system.

1.7 It must be emphasised that the monitoring requirements, in particular the measurement of TVE, have been established at a stringent level appropriate to the first application of RVSM in a complex, high density continental airspace. As a result of initial work done in the NAT, and the additional data and operational experience which will be gained in Europe, it may be possible in the future to relax some of the

monitoring requirements in the European area and in other regions where the RVSM is introduced as a part of the global implementation process.

1.8 All of the measures which combine to constitute, or to verify, the height-keeping performance of an aircraft play a part in the concept of monitoring which is expected to make a significant contribution to risk reduction. The measures include:

- the requirement for aircraft to carry and use the equipment defined in the MASPS;
- the initial installation procedures, tests and, where necessary, flight checks of aircraft altimetry equipment;
- the compliance with State airworthiness approval procedures;
- the compliance with continued airworthiness requirements;
- the adherence to ATC procedures; and
- the completion of in-flight operating drills by crews.

1.9 All of the foregoing measures are addressed in the relevant parts of this guidance material. However, these measures do not give a direct indication that the overall criterion for safety is met. This can be achieved only through independent system performance monitoring.

2 The Collision Risk Model

2.1 The risk of a mid-air collision due to a loss of vertical separation, from any cause, will be estimated using a CRM which is currently being adapted to meet the specific requirements of European airspace. The model brings together factors of the operational system, through probabilistic and deterministic elements, to produce an estimate of the long-term average system risk of aircraft collision.

2.2 The TLS for the European RVSM airspace, of 5 $x10^{-9}$ fatal accidents per flight hour, embodies the collision risk due to the loss of vertical separation from all causes. This represents the upper limit for the value of N_{az} which results when the collision risk equation is evaluated. That is, the N_{az} can not be larger than the TLS.

3 Monitoring the Parameters of the CRM specification

In order to ensure that the collision risk with European RVSM operations does not exceed the TLS, the parameters of the CRM must be monitored and assessed on a continuing basis.

3.1 MONITORING OF PZ(1 000)

3.1.1 Monitoring of height keeping performance in the European RVSM airspace

3.1.1.1 The agreed TLS of 5 x 10^{-9} fatal accidents per flight hour requires that an assessment of total system vertical overlap probability (Pz(1000)) be performed. This requires that the duration of all large errors in the vertical plane be reported and assessed. Thus, in addition to errors detected through the height monitoring system, all operational errors which occur in European RVSM airspace and which result in aircraft flying at or close to a flight level other than the one to which they were assigned, or were assigned to in error, must be reported.

3.1.1.2 The contribution of operational errors to the overall risk is not yet known but could be high in the European area. However, because the majority of aircraft in the region are controlled tactically using radar surveillance, it is anticipated that controller intervention will limit or reduce the size and duration of operational errors. Nonetheless, it is vital that reports of all operational errors should be sent by provider States to the designated monitoring agency.

3.1.1.3 System risk is directly proportional to the amount of total flight time spent by aircraft at an incorrect flight level. The estimates of such times will be one of the key elements to be used in determining whether or not the system is in compliance with the TLS, using appropriate mathematical and statistical methods.

3.1.1.4 Data sources for estimating time spent by aircraft at incorrect flight levels will include reports to the designated monitoring agency by ATC authorities and airlines, as well as the results of special data gathering exercises using HMUs and other suitable systems.

3.1.2 Monitoring of Compliance with the Global System Performance Specification

3.1.2.1 In addition to the requirement that total system performance meets the overall TLS, the monitoring process will be used to ensure that the fleet of aircraft flying in the European RVSM airspace meets the global system performance specification from which the RVSM MASPS was derived (paragraph 2.2.3 above also refers).

3.1.2.2 Because the global system performance specification, and in particular the Pz(1000) of 1.7×10^{-8}, was used to derive aircraft height keeping performance specifications, only errors resulting from incorrectly operating equipment are included in this aspect of the monitoring programme.

3.1.2.3 An assessment of TVE is critical to an assessment of Pz(1 000). As a result, the accuracy with which TVE can be measured is an important concern. TVE can be measured by comparing the geometric height of an aircraft, as measured by an HMU, or any other suitable system, to the geometric height of its assigned flight level. The accuracy of the measurement should be such that the mean error is 0 ft and the SD of the error does not exceed 50 ft.

3.1.2.4 These measured TVE data are fundamental to the monitoring process. Large amounts of such TVE data are needed to draw inference from the monitoring process with a high level of confidence.

3.1.2.5 Given a measured TVE and a simultaneous difference between automatically reported Mode C altitude and assigned flight level (i.e. the AAD), it is possible to estimate the aircraft's ASE, i.e., the difference between its TVE and AAD. Thus it is important to obtain as much measured TVE data as possible, in order to calculate typical ASE values for airframes and for aircraft types, before and during initial applications of the RVSM, to determine whether these ASE values are constant and repeatable. If this can be shown it will become possib
the Mode C (or Mode S or ADS) altitude.

3.2 MONITORING AIRCRAFT PASSING EVENTS INVOLVING PLAN OVERLAP

3.2.1 In addition to an upper bound for Pz(1000), the original form of the global system performance specification provided upper bounds for aircraft passing frequency and the probability of lateral overlap. These values were derived for opposite direction traffic.

3.2.2 However, because the majority of traffic in European RVSM airspace will fly on crossing routes and because a growing proportion of traffic is expected to be flying direct routes in the future, the global system performance specification has been reformulated in terms of passing events involving plan overlap.

3.2.3 The aircraft passing frequency involving plan overlap in the European area will be assessed on a monthly basis by the designated monitoring agency using traffic data supplied by the ATC authorities. It is anticipated that the level of this parameter may be close to that used to derive the aircraft height-keeping performance in the global system performance specification.

3.3 MONITORING OTHER CRM PARAMETERS

3.3.1 The remaining CRM parameters are average aircraft speed, relative speed between aircraft, and the average length, width and height of the aircraft operating in the European airspace. As stated previously, the risk of a mid-air collision is either relatively insensitive to these parameter values, or the values are not expected to change substantially over the planning horizon of this document. Intensive monitoring of the values of these parameters should not be necessary. The designated monitoring agency should be aware of the relative importance of these parameters in the overall process of ensuring that system safety is maintained, and should assess their likely values, on a periodic basis, using whatever means are deemed appropriate.

4 Assessment of the safety of European RVSM operations

4.1 The airspace parameters which are derived from the monitoring procedures outlined above allow the collision risk, in the vertical plane, in the airspace system to be

assessed against the TLS. The height-keeping performance of aircraft can also be assessed and compared to the requirements of the global height-keeping performance specification outlined in paragraph 2.2.2 above.

4.2 Prior to implementation of RVSM in the European area, mathematical and statistical techniques will be used to provide detailed information on the forecast performance of the system in terms of collision risk and aircraft height-keeping performance. After implementation of RVSM the monitoring of the CRM parameters and the assessment of the system performance will continue so that any adverse trends may be quickly identified and corrected.

4.3 During the performance verification programme, and after implementation of RVSM, periodic reports will be issued to provide an analysis of the information obtained from routine monitoring procedures (HMU and GMU), mandatory occurrence reports, air-miss data, near mid-air collision reports or any other similar source of information on aircraft height-keeping performance. The appropriate European body should take action as necessary to ensure that the level of collision risk is maintained below the TLS.

5 Responsibilities of the designated monitoring agency

5.1 The designated monitoring agency will be responsible for the efficient and effective performance of the above monitoring tasks. To this end it will be necessary to :

- ensure the availability of all data required for the monitoring system,
- ensure the availability of monitoring system output,
- process the monitoring system output,
- take follow-up action after the detection of large height deviations,
- perform safety assessment.
- make recommendations to improve height keeping performance.
- issue periodic reports

6 Objectives of the Height Monitoring System

6.1 In order to recommend a monitoring system, it was necessary first to define overall monitoring targets. Following a review of information and data collected in the vertical studies programme and the monitoring activities in the NAT Region, it was assumed that ASE for individual airframes would be stable for a period of two years. Two important objectives of the Performance Verification programme (P1) were therefore to establish the ASE performance of the airframes which will operate the European RVSM airspace and to confirm the assumptions concerning the stability of ASE.

6.2 On the basis of the above assumption, it was possible to establish the objectives of the monitoring programme and to consider how these objectives could be met. Firstly, the ultimate objective was to carry out a complete census of airframes. The monitoring system should therefore be designed to be capable, in principle, of performing such a census over a period of one year. Because a complete census may prove to be an impractical target during the performance verification programme, the minimum targets, listed below, were agreed. These should enable the monitoring cell to collect sufficient information on the height keeping performance of aircraft operating in the European Region:

6.2.1 Monitoring Targets

6.2.1.1 Monitoring targets for the Performance Verification programme for those aircraft considered to be members of an Aircraft Group.[1]

6.2.1.1.1 A minimum target of 60%* of the airworthiness approved airframes of each aircraft group from each operator is required in order to generate sufficient monitoring data to confirm whether a particular group is compliant with the MASPS.

* Note :Alternatively, this percentage may be reduced (to a minimum of 10% or 2 aircraft whichever is greater) if it can be shown, based on the ASE results, that a sufficient number of aircraft of the same group have been sampled to satisfy the requirement that the aircraft group meets the MASPS with a high level of confidence.

6.2.1.1.2 The method to determine whether a group[1] is compliant with the MASPS, and the organisational aspects of the application of that method, will have to be defined, taking into account the need for a strong coherence with NAT practices.

6.2.1.1.3 Any airworthiness approved group aircraft failing individual requirements (i.e. the absolute value of ASE > 245ft) would be deemed non-compliant. In making this decision allowance would have to be made for the measurement error of the height monitoring system.

6.2.1.2 Monitoring targets for the Performance Verification programme for aircraft which do not qualify as members of an aircraft group[2.]

6.2.1.2.1 All airworthiness approved aircraft need to be monitored on an individual basis unless flight test evidence can be provided to show that each airframe is compliant with ASE targets.

6.2.1.2.2 Any airworthiness approved aircraft failing individual requirements (i.e., the absolute value of ASE > 200ft) would be deemed non-compliant. In making this decision allowance would have to be made for the measurement error of the height monitoring system.

6.2.1.3 Use of NAT experience - After consideration of the data and experience gained in the monitoring of the NAT RVSM operations, the following principles were adopted for the European Region : :

- the European RVSM monitoring programme will not be part of the European RVSM approval process for airframes. The monitoring output will only be used to determine the go-ahead for the introduction of RVSM (P2.6).
- the number of aircraft of a particular operator which were monitored in the NAT programme should be taken into account in determining how many aircraft of that operator should be monitored in the European monitoring programme;
- in general, any operator-group pairings, or non-group aircraft, already satisfying the monitoring requirements through participation in the NAT RVSM programme would not require any further monitoring; and

- those aircraft groups, for
  the NAT monitoring programme, will satisfy the European RVSM monitoring requirements with that same rule.

6.2.1.4 Conclusion of Performance Verification programme - Subject to a satisfactory collision risk assessment and other operational considerations, the introduction of RVSM could be made provided that 90% of the flights in the area of interest would be made by operator-aircraft group pairings or non-group aircraft that have satisfied the monitoring requirements during the verification programme.

Notes :

(1) Group aircraft are those of nominally identical design and build with respect to all details that could influence the accuracy of height keeping performance. A detailed explanation is given in JAA TGL No.6 Para 9.3.1.

(2) Non group aircraft are those aircraft not falling under the definition of group aircraft.

6.3 These targets are considered to be the minimum necessary to ensure that a representative sample of MASPS approved aircraft will be obtained. The data obtained from a monitoring programme that meets these targets will be sufficient to provide:

- further evidence of the stability of ASE;
- guidance on the efficacy of the MASPS and on the effectiveness of altimetry system modifications; and
- confidence that the TLS will be met.

6.4 It is important to note that these minimum targets have been agreed on the assumption that the observed aircraft height keeping performance would meet the global requirements and consequently that the collision risk due to technical errors would be less than the technical aspect of the TLS. If the observed performance proved to be significantly worse than the global height keeping requirements, then the minimum sampling requirements might have to be increased to determine both the cause of the errors and whether or not the regional TLS would be threatened.

7 Description of the Height Monitoring System

1 Currently there are two accepted methods of measuring aircraft height keeping performance. These are :

- Height Monitoring Unit (HMU). This is a fixed ground based system which employs a network of a Master and 4 Slave Stations to receive aircraft SSR Mode A/C signals to establish the three dimensional position of the aircraft. The geometric height of the aircraft is measured to an accuracy of 50 ft (1 Standard Deviation (SD)). This is compared, in near real time, with meteorological input data on the geometric height of the assigned Flight (Pressure) Level to obtain a measurement of the Total Vertical Error (TVE) of the target aircraft. The aircraft SSR Mode C data is also recorded to determine the extent of any Assigned Altitude Deviation (AAD) and for subsequent aircraft identification, when the SSR Mode S response is not available.

- GPS Monitoring
  approximately 45 x 40 x 30 cm^3) which contains a GPS receiver, a device for recording and storing the GPS three dimensional position data, and two separate GPS receiver to be attached to aircraft windows using suction pads. The GMU is positioned on board the candidate aircraft and, being battery powered, functions independently of the aircraft systems. Following the flight the recorded GPS data are sent back to a central site where, using differential post processing, aircraft geometric height is determined. A network of not more than 25 GMUs will make up the GPS Monitoring System (GMS).

2 It is intended that the European Height Monitoring System should be a hybrid system of HMUs and GMUs which makes optimum use of the advantages offered by each. Thus the strategic and inflexible characteristics of the HMUs, which can provide a large and predictable rate of collection of high quality data at relatively high installation and low maintenance/ongoing operating costs, can be blended with the tactical flexibility of the GMU which permits the targeting of specific aircraft at a low initial purchase price, but with relatively high operating costs in both manpower and logistics.

The resultant system will be capable of acquiring a representative sample of the height keeping performance of the aircraft population by operator, type or airframe. or if required, a complete census of RVSM approved aircraft.

3 Over a period of time the HMUs will provide repeat samples of the height keeping performance of individual aircraft. These data will establish the typical ASE range for a variety of aircraft types and will be the basis of the studies to determine whether the assumptions regarding the stability and repeatability of ASE are valid.

4 Those aircraft which normally operate on routes which do not pass within the effective range of one of HMUs will be candidates for monitoring by the GMS. The GMS can also be used to obtain repeat measurements of airframes and aircraft types which have been shown to be poor performers.

4 A combination of HMUs and a GMS is expected to provide the most efficient means of achieving the verification and monitoring objectives. Furthermore, because of the complementary nature of the systems, both elements (HMU/GMS) are equally critical to the composition of the hybrid system.

5 It is currently planned that the height monitoring system for the European RVSM airspace will consist of four HMUs, of which one (Strumble, United Kingdom) also belongs to the NAT height monitoring system. The other three HMUs with an extended coverage area, will be placed near Nattenheim (Germany), Geneva (Switzerland) and Linz or Sollenau (Austria). The GMS will consist of not more than 25 GMUs, together with GPS reference stations, post-flight processing facilities and adequate logistic support.

Appendix H

List of Contacts

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