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WORKING PAPER

ASSEMBLY — 41ST SESSION

TECHNICAL COMMISSION

Agenda Item 33: Other issues to be considered by the Technical Commission

THE OPERATION OF STATE AIRCRAFT IN REDUCED VERTICAL SEPARATION MINIMUM (RVSM) AIRSPACE

(Presented by Czechia on behalf of the European Union and its Member States[1], the other Member States of the European Civil Aviation Conference[2] and EUROCONTROL)

EXECUTIVE SUMMARY

The Convention on International Civil Aviation (Chicago Convention) and its Annexes provide the legal and operational framework for Member States, inter alia, to operate aircraft in airspace where a reduced vertical separation minimum (RVSM) is applied. The Convention shall be applicable only to civil aircraft, and shall not be applicable to State aircraft. Regional Monitoring Agencies (RMA), tasked with RVSM height monitoring, reported cases of technically non-compliant aircraft, flying as RVSM approved and accordingly being assigned a 1 000 ft. vertical separation in RVSM airspace. This may represent a significant safety threat since the technical height keeping performance limitation is not visible to the flight crew, aircraft systems, air traffic control or other nearby aircraft, thus potentially compromising the vertical separation with another aircraft at an adjacent flight level. Corrective measures provided by ICAO focus on civil aircraft. The purpose of this Working Paper is to enhance the awareness of and to share guidance to be of use to Member States, when issuing regulations for their State aircraft to operate with due regard for the safety of navigation of civil aircraft in RVSM airspace. The paper addresses aircraft RVSM performance verification in particular of derivative aircraft designs, it encourages, to the maximum extent possible, the inclusion of State aircraft in the regional RVSM monitoring programmes, and invites ICAO to clarify material regarding the filing of flight plans.

Action: The Assembly is invited to adopt the attached Resolution.

Strategic Objectives:	This Working Paper relates to Strategic Objectives of Safety and Air Navigation Capacity and Efficiency.
Financial implications:	The activities referred to in this Paper will continue subject to the resources available in the 2023-2025 Regular Programme Budget and/or from extra-budgetary contributions.
References:	A37-15, A38-12, A40-4 - *Consolidated statement of continuing ICAO policies and associated practices related specifically to air navigation*

[1] Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden

[2] Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Georgia, Iceland, Republic of Moldova, Monaco, Montenegro, North Macedonia, Norway, San Marino, Serbia, Switzerland, Türkiye, Ukraine and the United Kingdom

	Doc 9574, *Manual on Implementation of a 300 m (1 000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive* Doc 9937, *Manual of Operating Procedures and Practices for Regional Monitoring Agencies in Relation to the Use of a 300 m (1 000 ft) Vertical Separation Minimum between FL 290 and FL 410 Inclusive* Doc 10088, *Manual on Civil-Military Cooperation in Air Traffic Management*

1. INTRODUCTION

1.1 The global application of a reduced vertical separation minimum (RVSM) of 1 000 ft. between FL 290 and FL 410 provides many benefits including six additional flight levels offering increased *en-route* airspace capacity, improved fuel efficiency, cost savings and reduced environmental impacts. Target levels of safety (TLS) were developed to ensure the safe implementation and continued use of RVSM airspace, with regional monitoring programmes established to assess compliance with safety objectives and the TLS. The efficacy of these programmes is important to provide a safe operating environment and maintain public and passenger confidence.

1.2 All aircraft operating a 1 000 ft. vertical separation minima in RVSM airspace would need to demonstrate a level of height keeping performance to satisfy the TLS. This applies to all aircraft categories, both civil and State.

1.3 Operators of civil aircraft intending to operate in RVSM airspace are required by Annex6 – *Operation of Aircraft* to the Chicago Convention to hold a specific RVSM approval, indicating that they meet all the technical and operational requirements. Technical compliance is verified at the design and construction phase of the aircraft certification process. In addition, civil operators are required to have aircraft height keeping performance monitored. regional monitoring agencies (RMA) have implemented procedures to monitor compliance and report violations directly to the appropriate authorities.

1.4 State aircraft are governed by regulations and procedures established by Member States. The Chicago Convention stipulates that "*contracting States undertake, when issuing regulations for their state aircraft, that they will have due regard for the safety of navigation of civil aircraft*". Adequate measures must be adhered to also by State aircraft operated in RVSM airspace with 1 000 ft. vertical separation minima in an equivalent manner. Non-RVSM approved State aircraft are accommodated with a 2 000 ft. vertical separation minimum, but with potential impact on air traffic control (ATC) workload and airspace capacity.

1.5 A technically non-RVSM compliant aircraft, being assigned a 1 000 ft. vertical separation in RVSM airspace could represent a significant safety threat since the height keeping performance limitation is not visible to the flight crew, aircraft systems such as airborne collision avoidance system (ACAS), air traffic control or other nearby aircraft, thus potentially compromising the vertical separation with another aircraft at an adjacent flight level. The current monitoring programme focuses on civil aircraft. Operators are required to provide evidence of RVSM approval, and the RMA continuously monitor the compliance with the height keeping performance requirements. However, the operation of a technically non-RVSM compliant State aircraft being assigned a 1 000 ft vertical separation in RVSM airspace, increases the level of risk. Examples of technically non-compliant State aircraft being assigned a 1 000 ft. vertical separation have been observed. In the European region, RMAs are tasked to follow up on such cases and provide annual reports to EASPG[3].

[3] The European Region Aviation System Planning Group (https://www.icao.int/EURNAT/Pages/EURNAT-Meetings-EASPG.aspx): EUR and EURASIA RMA Safety Monitoring Reports provide details to EASPG for review on an annual basis.

1.6 The ICAO guidance[4] on the conduct of safety assessments recommend to adequately assess all relevant airspace factors for the estimation of collision risk and compliance with the TLS. The consideration of data related to State aircraft will therefore further improve the reliability of the safety assessment.

2. CERTIFICATION AND APPROVAL OF AIRCRAFT FOR RVSM

2.1 To achieve pre-defined TLS, all aircraft intended to operate with 1 000 ft. vertical separation minima in RVSM airspace must satisfy minimum aircraft technical height keeping performance. Civilian aircraft are required to hold an RVSM approval, which consists of three parts - compliance with RVSM technical height keeping performance requirements, continued airworthiness procedures to ensure continued compliance during service and flight crew procedures in RVSM airspace. The first of these is considered to be of critical importance in these discussions, as an aircraft, which is not technically compliant, will contribute to an increased level of risk of collision in RVSM airspace.

2.2 Technical compliance with RVSM height keeping performance requirements is impacted by inherent error characteristics of the aircraft's physical design and external configuration. Software corrections are modelled and embedded in the avionics to mitigate this error, during the design and testing process, prior to final certification. Any change to the aircraft's physical design, either through modification, or construction of a modified version, must be accompanied by re-modelling of the new error characteristics and validation of new software corrections, prior to final validation for compliance with RVSM height keeping performance requirements. In the absence of this additional process, the aircraft may have an inherent altitude error of several hundred feet (which for a fully compliant aircraft is typically less than 100 ft.). This error, known as altimetry system error (ASE), is a safety risk.

2.3 The confirmation of compliance with technical height keeping performance is normally embedded in the airworthiness certification of the aircraft design. It is important to stress that although a fundamental design (e.g. type certificate (TC)) may be RVSM compliant, it may not automatically be assumed that a new design based on the parent design (e.g. supplementary type certificate (STC)) will remain RVSM compliant. To ensure compliance additional actions will be required to verify the performance of the derivative design, taking into account the factors that may affect the height keeping characteristics, particularly the error characteristics of the physical design and development of new software corrections. The same process needs to apply in a situation when an aircraft is modified in such a way as which may affect the aircraft height keeping performance characteristics.

2.4 RVSM height monitoring has identified by chance a small number of aircraft with very large ASE (up to 900 ft.). The follow-up investigation revealed that these flights were performed by derivative State aircraft that had been modified and constructed to special purpose STC. Although the number of technically non-compliant aircraft identified is small, the magnitude of the error has a significant impact on the TLS.

2.5 Member States and ICAO are encouraged to raise awareness, particularly to ensure the correct validation of derivative and modified aircraft designs, the performance of which may not be equivalent to the original design.

2.6 Consequently, it is recommended to invite Member States and ICAO to initiate a high-level discussion with civil and military authorities to address the safety issues and develop/update guidance material on best practices to enhance awareness and best rule application. The

[4] See ICAO Doc 9574 and ICAO Doc 9937.

"EUROCONTROL Guidelines for the Certification and Operation of State Aircraft in European RVSM Airspace"[5] is offered as a template for subsequent activities.

3. COORDINATION WITH RMA

3.1 The participation of State operators of aircraft flying RVSM, in the RVSM monitoring programmes – including sharing information related to aircraft RVSM status and participation in technical height monitoring programmes – will support safety monitoring programmes. By coordination with their accredited Regional Monitoring Agency, operators of State aircraft would benefit directly by independent ongoing monitoring of aircraft height keeping performance as well as the identification of incorrect flight planning of non-RVSM approved aircraft, thus ensuring the safety of crew and passengers. There are obviously political and security considerations which could impact the level of inclusion of State aircraft in RMA approval databases, however, the safety impact on civil operations equally cannot be ignored.

3.2 It is of critical importance to aviation safety that RMAs be able to quickly ascertain the RVSM approval status of a particular aircraft flying RVSM airspace. Member States as well as civil and State aircraft operators are therefore invited to cooperate with RMAs and timely respond to their information requests. Specific points of contact available to the RMAs are considered essential to swiftly coordinate the receipt of reports of potentially non-RVSM approved aircraft, and reports of technically non-compliant aircraft, so that appropriate action can be taken by appropriate Member State Authorities.

4. HEIGHT KEEPING PERFORMANCE OF STATE AIRCRAFT

4.1 Independent height monitoring provides early detection of altimetry system degradation as well as providing confidence in the validity of the certification process. It is therefore recommended that State aircraft operating in RVSM airspace with 1 000 ft. vertical separation minima are encouraged to participate in technical height monitoring programmes to ensure continued compliance with RVSM height keeping performance requirements. In the event that such participation is not supported, then States are invited to make use of adequate internal processes that would ensure compliance with the RVSM height keeping performance or equivalent.

5. FLIGHT PLANNING

5.1 The application of the correct vertical minima by ATC in RVSM airspace is based upon the information filled in the flight plans. RVSM approval is indicated by filing "W" in item 10. Such aircraft may then be assigned 1 000 ft. vertical separation minima. State aircraft with no RVSM approval, require an assignment of a vertical separation minima of 2 000 ft. and shall not file "W" in item 10, but STS/NONRVSM in item 18 instead. Most problematic are flights of non-RVSM compliant aircraft, which indicate the existence of an RVSM approval in the flight plan. It is suggested that all reference material including the *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444), flight plan guidance material and regional supplementary procedures, should be assessed and if necessary revised, in particular, to provide clarity on the definition and procedures to be used by a non-RVSM compliant State aircraft intending to operate in RVSM airspace.

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[5] https://www.eurocontrol.int/publication/eurocontrol-guidelines-certification-and-operation-state-aircraft-european-rvsm

APPENDIX

PROPOSED ASSEMBLY RESOLUTION

A40-4: Consolidated statement of continuing ICAO policies and associated practices related specifically to air navigation

NEW APPENDIX

Operation of State aircraft in RVSM airspace

Whereas Article 3 a) of the Convention states that "*This Convention shall be applicable only to civil aircraft, and shall not be applicable to state aircraft" and Article 3 d) requires that "contracting States undertake, when issuing regulations for their state aircraft, that they will have due regard for the safety of navigation of civil aircraft*";

Noting that the application of a reduced vertical separation minimum (RVSM) provides many benefits including additional airspace capacity, cost savings and reduced environmental impacts, but require aircraft to comply with stringent height keeping performance requirements;

Conscious of the desirability of improving coordination between military and civil authorities and air traffic control agencies so as to enhance the safety of civil and State aircraft in RVSM airspace;

Whereas the airspace is a resource common to both civil and State aircraft; to operate safely in an RVSM environment certain measures should be adhered to also by State aircraft in an equivalent manner;

Recognising that for all airspace where a reduced vertical separation minimum of 300 m (1 000 ft.) is applied between FL 290 and FL 410 inclusive, a programme shall be instituted, on a regional basis, for monitoring the height-keeping performance of aircraft operating at these levels, in order to ensure that the continued application of this vertical separation minimum meets the safety objectives;

Whereas Regional Monitoring Agencies (RMAs) have been tasked to monitor the RVSM approval status of aircraft and to evaluate compliance with RVSM technical height keeping performance requirements, the consideration of data related to State aircraft approved for RVSM operations will further improve the reliability of the safety assessment; and

Recalling that States use flight plan information to manage access to their RVSM airspace so as air traffic control to apply the required vertical separation minima, accurate flight plan filing regarding aircraft RVSM capabilities is essential.

The Assembly resolves that:

1. the common use by civil and State aircraft of airspace and of certain facilities and services should be arranged to the maximum extent possible so as to ensure the safety of civil aviation as well as to ensure the requirements of State aircraft are met;

2. the regulations and procedures for which Member States are responsible to govern the operation of State aircraft in RVSM airspace have due regard to the need to maintain the safety of international civil air traffic;

3. ICAO shall provide guidance on best practices for civil and military coordination and cooperation; and

4. ICAO serves as an international forum in facilitating improved civil/military cooperation, collaboration and the sharing of best practices, and to provide the necessary follow-up activities with the support of civil and military partners.

Associated practices

1. Member States are encouraged to assess their needs for improved coordination and cooperation between their civil and military authorities and air traffic services to meet the policy objectives in Resolving Clauses 1 and 2 above.

2. When establishing the regulations and procedures mentioned in Resolving Clause 2, Member States are invited to ensure that airworthiness authorities responsible for approving State aircraft to operate in RVSM airspace with a reduced vertical separation minimum meet compliance with RVSM height keeping performance requirements, or equivalent.

3. To the maximum practicable extent and without prejudicing the confidentiality and the security of State aircraft data, Member States are invited to consider the participation of State aircraft operating in RVSM airspace with 1 000 ft. vertical separation minima in technical height monitoring programmes to ensure continued compliance with RVSM height keeping performance requirements thus maintaining an acceptable safety level.

4. Member States are invited to cooperate with RMAs, provide points of contact and timely respond to RMAs requests for information regarding the RVSM approval status of a particular aircraft operating in RVSM airspace.

5. Member States are encouraged to remind, as necessary, their civil and State aircraft operators of their obligation to file accurate information on RVSM approval status in the flight plan.

— END —