Organización de Aviación Civil Internacional
Oficina para Norteamérica, Centroamérica y Caribe

NOTA DE ESTUDIO

GTE/24 — NE/09
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Vigésimo Cuarta Reunión del Grupo de Trabajo de Escrutinio (GTE/24)
del Grupo Regional de Planificación y Ejecución CAR/SAM (GREPECAS)
Ciudad de México, México, del 5 al 9 de agosto de 2024

Cuestión 4 del Orden del Día: **Actividades y tareas a reportar al GREPECAS**
4.2 Revisión de las tareas a reportar al GREPECAS

CERTIFICACIÓN Y OPERACIÓN RVSM DE AERONAVES ESTATALES EN LAS REGIONES CAR/SAM

(Presentada por CARSAMMA)

RESUMEN EJECUTIVO	
Esta nota de estudio presenta una Guía para utilizar en el espacio aéreo RVSM por las aeronaves estatales en las regiones CAR / SAM.	
Acción:	Se describe en la Sección 5
Objetivos Estratégicos:	• Seguridad Operacional • Capacidad y eficiencia de la navegación aérea
Referencias:	• Anexo 6 de la OACI – *Operación de aeronaves* • Anexo 11 de la OACI — *Servicios de tránsito aéreo* • Doc 9574-AN/934 de la OACI, Tercera Edición – 2012. • Doc 9937-AN/477 de la OACI, Primera Edición – 2012. • ©2013 Material de orientación para la certificación y operación de aeronaves de Estado en el espacio aéreo europeo RVSM (EUROCONTROL), utilizado con autorización.

1. Antecedentes

1.1 En lo que se refiere a la Conclusión GTE/16/2, "*USO DEL MANUAL DE CERTIFICACIÓN Y OPERACIÓN DE LAS AERONAVES DE ESTADO EN EL ESPACIO AÉREO RVSM CAR/SAM"*, el informe final del GTE/21 registró "*la reunión considero que la misma debería permanecer válida hasta lograr una divulgación del Manual de certificación y operación de las aeronaves de Estado en el espacio aéreo CAR/SAM, para esto las oficinas de la OACI enviaran una carta de reitero a los Estados de ambas regiones sobre la utilización de este documento guía; asimismo, se procederá a subir el manual a la página del GTE*"

1.2 Sin embargo, en vista de las solicitudes que recibe la RMA en relación con las aprobaciones RVSM para aeronaves estatales y las solicitudes que CARSAMMA hace a los estados de las regiones CAR/SAM, este documento reitera la importancia del texto del informe final del GTE/23, "Q*ue*

los Estados y Organizaciones Internacionales de las Regiones CAR/SAM utilicen el Manual de Certificación y Operación de las Aeronaves de Estado en el Espacio Aéreo RVSM CAR/SAM […]".

1.3 Por lo tanto, la presente nota de estudio pretende proporcionar una referencia para el funcionamiento de las aeronaves de Estado que vuelan bajo las normas generales de tráfico aéreo dentro del espacio aéreo RVSM.

2. Análisis

2.1 En este documento se informa del análisis del uso incorrecto del espacio aéreo RVSM en las Regiones de Información de Vuelo (FIR) del Caribe y Sudamérica. Para este trabajo se utilizó la experiencia de varios años de implementación del espacio aéreo RVSM, especialmente en las Regiones CAR / SAM. Se utilizaron todas las metodologías recomendadas por la OACI en el espacio aéreo RVSM.

2.2 La Agencia de Monitoreo CAR / SAM (CARSAMMA) mantiene una base de datos de todos los operadores y aeronaves que han sido aprobados para operar con una separación vertical de 1.000 pies en el espacio aéreo RVSM por un Estado / entidad acreditados en sus regiones. Los datos de aprobación de RVSM de CARSAMMA se intercambian con otras 12 Agencias Regionales de Monitoreo (RMA) en todo el mundo, y se puede verificar el estado RVSM de cualquier aeronave, sin importar la región RVSM en la que esté operando.

2.3 CARSAMMA verifica el estado de aprobación de la aeronave comparando el Plan de Vuelo actual, los informes de Desviaciones de Altura Grandes (LHD) recopilados y la recopilación de datos de movimiento de aeronaves enviados por los Proveedores de Servicios de Navegación Aérea (ANSP). En el caso de que una aeronave no esté listada como RVSM aprobada, CARSAMMA envía una solicitud de aclaración del estado de aprobación a la oficina competente del Estado o RMA responsable de la región de origen de la aeronave. Los Estados Miembros de la OACI están obligados a adoptar las medidas apropiadas en el caso de una aeronave que esté operando en este espacio aéreo sin una aprobación válida.

2.4 *Regiones CAR/SAM*

2.4.1. El Anexo 11 de la OACI - Servicios de Tránsito Aéreo requiere el establecimiento de una RMA en todas las regiones donde se implementó la RVSM. Los Estados de la misma región están acreditados en la RMA para el intercambio de aprobaciones RVSM y cuando reciben una notificación de la RMA, toman las medidas apropiadas con los operadores de aeronaves aprobados / operadores no aprobados y técnicamente no conformes.

2.4.2. CARSAMMA es responsable de parte del espacio aéreo de Sudamérica y el Caribe donde se implementó la RVSM el 20 de enero de 2005.

2.4.3. Los Estados de registro de aeronaves que están acreditados en la Región RVSM de CAR / SAM se muestran a continuación:
Antigua y Barbuda, Argentina, Barbados, Belice, Bolivia, Brasil, Chile, Colombia, Costa Rica, Cuba, El Salvador, Ecuador, Granada, Guadalupe, Guatemala, Guayana, Guayana Francesa, Haiti, Honduras, Jamaica, Martinica, Antillas Holandesas, Nevis, Nicaragua, Panamá, Paraguay, Perú, República

Dominicana, San Bartolomé, San Cristóbal y Nieves, Santa Lucía, San Vicente y las Granadinas, Surinam, Trinidad y Tabago, Uruguay y Venezuela.

2.5 *Aprobaciones RVSM de aeronaves de Estado*

2.5.1. Otra cuestión que debe presentarse es la utilización del espacio aéreo RVSM por aeronaves estatales que no están certificadas RVSM y que, no obstante, llenan la FPL en el ítem 10 con "W", cuando se recomienda completar el ítem 18 con "STS / NONRVSM HEAD o STS / NONRVSM STATE ", que no ha ocurrido.

2.5.2. El material de orientación en la certificación y operación de aeronaves de Estado en el espacio aéreo RVSM (**Apéndice** - *disponible únicamente en inglés*-), proporciona una referencia general a la operación de aviones de Estado que vuelan bajo reglas generales de tráfico aéreo en el espacio aéreo RVSM.

2.5.3. Los principales temas tratados en el documento son:

a) No existe ninguna exención para que las aeronaves estatales operen como tráfico de Aviación General dentro del espacio aéreo RVSM con una separación vertical mínima de 1000 pies, sin aprobación RVSM. La falta de dicha aprobación no significa que la aeronave estatal no pueda acceder al espacio aéreo RVSM designado, pero requiere una separación de 2000 pies para ser observada y un plan de vuelo por separado para ser archivado.

b) Cualquier aeronave derivada de modificaciones para funciones específicas debe ser validada con los MASP RVSM antes de ser aprobada RVSM.

c) No se permiten vuelos de entrenamiento dentro del espacio aéreo RVSM, con una separación vertical mínima de 1.000 pies.

2.5.4. Desde el año 2007, CARSAMMA recibió varios reportes de otras RMA solicitando el estatus RVSM de aeronaves estatales registradas en las regiones CAR / SAM que llenaron "W" en la FPL e hicieron un vuelo en el espacio RVSM de responsabilidad de estas RMA, y no aparecen en la base de datos de aprobación RVSM de CARSAMMA.

2.5.5 El Cuadro 1 muestra las aeronaves de Estado en las que se solicitó la condición RVSM por otra RMA o por CARSAMMA:

RMA Year	Registration	Type	FL	Number of Flights	Operator	Current Status
EurRMA Q2_2021	FAH001	E35L	390	6	FUERZA AEREA HONDURAS	*no aprobada*
EurRMA Q2_2021	T23	LJ35	340	5	FUERZA AEREA ARGENTINA	*no aprobada*
EurRMA Q3_2021	T99	B737	380	4	FUERZA AEREA ARGENTINA	*no aprobada*
EurRMA Q4_2021	FAE052	FA7X	410	3	FUERZA AEREA DE ECUADOR	** aprobada*
EurRMA Q4_2021	FAH001	E35L	370	4	FUERZA AEREA HONDURAS	*no aprobada*
EurRMA Q4_2021	T23	LJ35	320	1	FUERZA AEREA ARGENTINA	*no aprobada*
EurRMA Q1_2022	FAE052	FA7X	410	2	FUERZA AEREA DE ECUADOR	** aprobada*
EurRMA Q1_2022	FAC0001	B737	330	8	FUERZA AEREA COLOMBIANA	** aprobada*
EurRMA Q1_2022	FACh985	B767	410	8	FUERZA AEREA DE CHILE	*no aprobada*
EurRMA Q2_2022	FAE052	FA7X	410	4	FUERZA AEREA DE ECUADOR	** aprobada*
EurRMA Q3_2022	FACh985	B763	390	4	FUERZA AEREA DE CHILE	*no aprobada*

EurRMA Q3_2022	**BRS2901**	**A332**	**410**	**3**	**FUERZA AEREA BRASILEÑA**	**** aprobada***
EurRMA Q3_2022	**T99**	**B737**	**380**	**8**	**FUERZA AEREA ARGENTINA**	***no aprobada***
EurRMA Q1_2023	**BRS2901**	**A332**	**410**	**2**	**FUERZA AEREA BRASILEÑA**	**** aprobada***
EurRMA Q1_2023	**FAC0001**	**B737**	**400**	**3**	**FUERZA AEREA COLOMBIANA**	**** aprobada***
EurRMA Q1_2023	**FAE052**	**FA7X**	**410**	**5**	**FUERZA AEREA DE ECUADOR**	**** aprobada***
EurRMA Q1_2023	**T99**	**B737**	**380**	**12**	**FUERZA AEREA ARGENTINA**	***no aprobada***
EurRMA Q3_2023	**ARG01**	**B752**	**400**	**3**	**FUERZA AEREA ARGENTINA**	**** aprobada***
EurRMA Q3_2023	**FAE052**	**FA7X**	**410**	**4**	**FUERZA AEREA DE ECUADOR**	**** aprobada***
Carsamma Jan/24	**BRS2854**	**KC39**	**330**	**1**	**FUERZA AEREA BRASILEÑA**	***no aprobada***
Carsamma Feb/24	**BRS2854**	**KC39**	**290**	**14**	**FUERZA AEREA BRASILEÑA**	***no aprobada***
Carsamma Feb/24	**BRS2858**	**KC39**	**290**	**10**	**FUERZA AEREA BRASILEÑA**	***no aprobada***
Carsamma Feb/24	**T99**	**B737**	**360**	**9**	**FUERZA AEREA ARGENTINA**	***no aprobada***
Carsamma Mar/24	**BRS2854**	**KC39**	**350**	**35**	**FUERZA AEREA BRASILEÑA**	***no aprobada***
Carsamma Abr/24	**BRS2854**	**KC39**	**300**	**10**	**FUERZA AEREA BRASILEÑA**	***no aprobada***
* Aprobado después de que CARSAMMA solicitara el *status* RVSM de la aeronave a la Autoridad Estatal de Certificación.						

3. Acciones Sugeridas

3.1. Se invita a la reunión a:

a) tomar nota y revisar el contenido de este documento de trabajo;
b) compartir experiencias y expresar opiniones sobre las acciones de CARSAMMA en esta materia;
c) y aprobar el envío de esta NE y su Apéndice para consideración del GREPECAS.

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APÉNDICE

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Material for the Certification and Operation of State Aircraft in the CAR/SAM RVSM airspace

Index

Abbreviations

AoA	Angle of Attack
AAD	Assigned Altitude Deviation
ACAS	Airborne Collision Avoidance System
ADC	Air Data Computer
ASE	Altimetry System Error
ATM	Air Traffic Management
DECEA	Department of Air Space Control (Brazil)
FMS	Flight Management System
FMP	Flow Management Position (ACC)
FPL	Flight Plan
GAT	General Air Traffic
GMU	GPS Monitoring Unit
GPS	Global Positioning System
GREPECAS	Group of Planning and Implementation of Caribbean and South American Regions
HMU	Height Monitoring Unit
ICAO	International Civil Aviation Organization
JAA	Joint Aviation Authorities
MASPS	Minimum Aircraft System Performance Specification
MEL	Minimum Equipment List
MMEL	Master Minimum Equipment List
OAT	Operational Air Traffic
OEM	Original Equipment Manufacturer
RPL	Repetitive Flight Plan
RCO	RVSM Coordination Officer
RMA	Regional Monitoring Agency
RVSM	Reduced Vertical Separation Minimum of 300 m (1000 ft) between FL 290 and FL 410 inclusive
ARPS	Standards and Recommended Practices
SB	Service Bulletin
SDB	State Data Base
SSE	Static Source Error
SSEC	Static Source Error Correction
STC	Supplementary Type Certificate
STCA	Short-Term Conflict Alert
TC	Type Certificate
TCAS	Traffic Collision Avoidance System
TGL	Temporary Guidance Leaflet (JAA)
TLS	Target Level of Safety
TVE	Total Vertical Error
VSM	Vertical Separation Minimum

Definitions

Altimetry System Error (ASE)	The difference between the pressure altitude displayed to the flight crew when referenced to the ISA standard ground pressure setting (1013.2hPa/29.92in.Hg) and the free stream pressure altitude.
Assigned Altitude Deviation (AAD)	The difference between the transmitted Mode C/S altitude and the assigned altitude/flight level.
Basic RVSM Envelope	The range of Mach numbers and gross weights within the altitude ranges FL 290 to FL 410 (or maximum attainable altitude) where an aircraft can reasonably expect to operate most frequently.
Flight Level Allocation Scheme (FLAS)	The scheme whereby specific flight levels may be assigned to specific route segments within the route network.
General Air Traffic (GAT)	Flights conducted in accordance with the rules and provisions of ICAO.
Height-Keeping Capability	Aircraft height-keeping performance which can be expected under nominal environmental operating conditions with proper aircraft operating practices and maintenance.
Height-Keeping Performance	The observed performance of an aircraft with respect to adherence to a flight level.
Operational Air Traffic (OAT)	Flights which do not comply with the provisions for GAT and for which rules and procedures have been specified by the appropriate authorities.
Monitoring Group	A group of aircraft which are made RVSM MASPS compliant by a common compliance method. A group may include more than one aircraft type designator, although it more often includes specific aircraft series or variants. The height keeping performance characteristics should be the same for all aircraft in the group. Aircraft are referred to as group-approved aircraft
Non-Group Aircraft	An aircraft which has been made RVSM-compliant by a unique method. Non-group aircraft are assessed on an individual basis and must all be regularly height-monitored.
Aberrant Aircraft	Aircraft for which the height-keeping performance characteristics are significantly different from the core distribution of aircraft.
Non-Compliant Aircraft	Aircraft which have a TVE of 300 feet or greater or an ASE of 245 feet or greater.
RVSM Approval	The approval to operate within RVSM-designated airspace with a 1000 ft vertical separation minimum, 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 must demonstrate to the said State: 1) that aircraft for which 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 Specification (MASPS); 2) that they have instituted procedures in respect of continued airworthiness (maintenance and repair) practices and programmes; 3) that they have instituted flight crew procedures for operations in the EUR RVSM airspace.

	Note: For the purposes of the application of RVSM, the term "*RVSM-APPROVED*" will be used to indicate that an aircraft has been granted RVSM approval.
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 European RVSM airspace, normally the first reference point for applying a reduced vertical separation minimum.
RVSM Exit Point	The last reporting point over which an aircraft passes or is expected to pass immediately before, upon, or immediately after leaving European RVSM airspace, normally the last reference point for applying a reduced vertical separation minimum.
State Aircraft	For the purposes of European RVSM, only aircraft used by the military, customs and police services will qualify as State aircraft and will therefore be entitled to claim exemption from RVSM approval status. (ref. – ICAO Convention on International Civil Aviation, Article 3 (b)).
Strategic Flight Level	A flight level which is available for flight planning purposes in accordance with the Table of Cruising Levels of ICAO Annex 2, Appendix 3 and the FLAS, as specified in the relevant Aeronautical Information Publications (AIPs).
Tactical Flight Level	A flight level which is not available for flight planning purposes and which is reserved for tactical use by ATC.
Target Level of Safety (TLS)	A generic term representing the level of risk which is considered acceptable under particular circumstances.
Total Vertical Error (TVE)	Vertical geometric difference between the actual pressure altitude flown by an aircraft and its assigned pressure altitude (flight level).

Executive Summary[1]

To increase airspace capacity and to reduce delays and fuel costs, the Reduced Vertical Separation Minimum (RVSM) Program provided an additional six flight levels between FL 290 and FL 410 inclusive on 20 January 2005. RVSM is now applicable within all airspace in the CAR/SAM region.

The Caribbean and South America Regional Monitoring Agency operated by DECEA is responsible for the safety oversight of operations within RVSM airspace. In addition to completing an annual safety assessment, the RMA is responsible for verifying the approval status and the height keeping performance of aircraft operating with a 1000 ft vertical separation minimum between FL 290 and FL 410.

Since 2007 a number of issues have arisen regarding the operation of State aircraft within RVSM airspace, in particular the validation of height-keeping performance requirements for derivative aircraft types and the necessity for an RVSM approval to be issued by the appropriate State airworthiness authority.

This document is intended to provide a general reference for the operation of State aircraft[1] flying under general air traffic rules within RVSM airspace. The main issues to be conveyed are:

- There is no exemption for State aircraft to operate as GAT within RVSM airspace with a 1000 ft vertical separation minimum without an RVSM approval. The absence of such approval does not mean that State aircraft cannot access RVSM designated airspace, but it does require a separation of 2000 ft to be observed and a separate flight plan to be filed.
- Any derivative aircraft modified for specific functions must be validated against the RVSM MASPS before being granted an RVSM approval.
- Formation flights are not permitted within RVSM airspace with a 1000 ft vertical separation minimum.

[1] *State aircraft means any aircraft used for military, customs and police purposes.*

Objective and Scope

The objective of this document is to provide guidance to State airworthiness authorities and operators regarding the requirements for operation with a 1000 ft vertical separation minimum within RVSM airspace. To facilitate comprehension, this document combines information from various ICAO Annexes and guidance documents to present a clear overview of the responsibilities of both airworthiness authorities and operators.

The focus of this document is primarily the certification and approval of an aircraft height-keeping performance requirement for State aircraft operating in Caribbean and South America RVSM airspace. It describes flight planning requirements (valid at the time of writing) but does not describe ATC procedures or the transition between civil/military areas or RVSM/non-RVSM airspace.

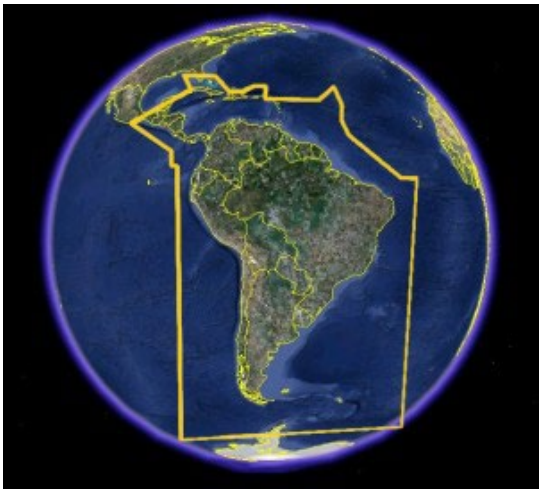
The material in this document is applicable to all State aircraft flights planned as GAT and operating with a 1000 ft vertical separation in RVSM airspace (i.e. excluding OAT and non-approved State aircraft operating within RVSM airspace with a 2000 ft vertical separation which is also possible under the agreed exemption regime but without a flight plan claiming RVSM compliance).

1 Introduction

a. Background

The Reduced Vertical Separation Minimum Program was introduced in the CAR/SAM region in January 2005. It introduced an additional 6 flight levels between FL 290 and FL 410 by reducing the vertical separation between those flight levels from 2000 ft to 1000 ft. As the risk of collision is inherently greater in an RVSM environment, stringent aircraft height keeping performance requirements were introduced to maintain the level of risk within acceptable limits. The aircraft height-keeping performance requirements were embodied in standards known as Minimum Aircraft System Performance Specifications (MASPS).

By 2005 all Caribbean and South American airspace between FL 290 and FL 410 are RVSM. This means that all operators wishing to file an ICAO flight plan between these flight levels must have an RVSM approval; otherwise they will be operating in contravention of the requirements of the ICAO Doc. 9574.



The Caribbean and South American Regional Monitoring Agency, operated by DECEA on behalf of the GREPECAS Planning Group, is tasked with the safety oversight of operations within RVSM airspace.

The RMA conducts an annual safety assessment, monitors aircraft height-keeping performance and also verifies the RVSM approval status of aircraft operating in RVSM airspace.

One of the greatest risks to safety within RVSM airspace is the operation of an aircraft declared as RVSM-approved when the aircraft does not meet the technical performance criteria as defined in the MASPS. The RMA has noted with concern that a very significant number of aircraft operating as RVSM-approved without a known technical compliance method are military aircraft, often airframe derivatives (e.g. fuselage modifications or add-ons) whose height-keeping performance characteristics are not proven to be like the original design.

The importance for airworthiness authorities of understanding the process for approving an aircraft type or derivative cannot be overstated. This document is intended to provide guidance to national military authorities on the certification of new aircraft types and variants, the reporting of RVSM

approvals and remedial action in the event of a poor altimetry system error (ASE) report submitted by the RMA.

b. Related Material

The requirements for the certification and operation of RVSM aircraft are contained in a number of ICAO Annexes and other guidance material. These are summarized bellow.

Document	Description	Status
ICAO Annex 6, Appendix 4	Describes generic minimum aircraft height-keeping performance requirements	Regulatory
ICAO Annex 6, Section 7.2.4	Minimum RVSM equipment requirements	Regulatory
ICAO Annex 6, Section 7.2.5	RVSM approval requirements	Regulatory
ICAO Annex 6, Section 7.2.6	State responsibility for non-compliant aircraft	Regulatory
ICAO Annex 6, Section 7.2.7	Minimum height-keeping monitoring requirements	Regulatory
ICAO Annex 6, Section 7.2.8	State responsibility with regard to non-approved operators	Regulatory
ICAO Annex 11, Section 3.3.5.1	Requirements for initiation of an RVSM height monitoring program	Regulatory
JAA TGL No. 6	Recognized MASPS compliance method	Guidance
AC 91-85	Authorization of aircraft and operators for flight in RVSM	Guidance
FAA 91	RVSM Recognized MASPS compliance method	Guidance
ICAO Doc. 9574	Implementation of RVSM	Guidance
ICAO Doc. 9937	Operating procedures for an RMA	Guidance

Table 1: Certification and operating requirements for RVSM airspace

2 Caribbean and South American Regional Monitoring Agency (RMA)

a. Function

The RMA was established by GREPECAS in 2004 at the request of the ICAO. The main responsibilities of the RMA are to conduct statistical safety assessments, monitor height-keeping performance and verify the approval status of aircraft operating with 1000 ft vertical separation in CAR/SAM RVSM airspace.

The height-keeping performance function can be further divided into a number of individual activities including:

1. Establish and maintain a list of RVSM monitoring groups defined by different compliance methods or height-keeping performance characteristics;
2. Monitor compliance with global and regional monitoring targets;
3. Conduct continuous monitoring group performance analysis; and
4. Monitor individual airframe performance.

The RMA has developed proactive procedures to positively encourage safe operation and compliance with international requirements. However, the RMA cannot operate in isolation and it is necessary for aircraft operators and airworthiness authorities to ensure that approval records are accurate and that adequate procedures are in place to respond to concerns regarding height-keeping performance or compliance with monitoring targets.

b. RVSM Approval Status

Under its Terms of Reference, the RMA is obliged to maintain a database of RVSM approvals. Periodically the RMA compares samples of flight plan data where RVSM approval has been stated with the database of approvals. Any aircraft not listed in the database of approvals is considered non-approved and reported to the appropriate State authority. ICAO Annex 6 requires State authorities responsible for the issuing of RVSM approvals to establish provisions and procedures to ensure that appropriate action is taken in respect of operators and aircraft operating in RVSM airspace without a valid RVSM approval.

c. Compliance with Monitoring Targets

Every operator of group-approved aircraft is required to participate in regional height-monitoring programs. The global requirement (contained in ICAO Annex 6) states that every operator of RVSM group-approved aircraft is required to have a minimum of 2 aircraft of each monitoring group operated height-monitored either every 2 years or every 1000 flying hours, whichever is the greater.

The RMA maintains a table of regional minimum monitoring requirements which includes 2 main categories. The first category is equivalent to the global monitoring requirement, i.e. 2 aircraft every 2 years, and is reserved for monitoring groups for which sufficient evidence exists that the RVSM MASPS is valid. A second category contains monitoring groups for which full verification of MASPS is incomplete. This includes new aircraft types with relatively little monitoring data and/or less than 2 years of stable ASE performance data. The RMA recommends a monitoring target of 60% of the operator fleet every 2 years.

The RMA conducts annual monitoring group performance reviews in cooperation with the others RMA and recommends transfers of monitoring groups from the second category to the first where

sufficient evidence exists to support final verification of the RVSM MASPS. Very occasionally, monitoring group performance deteriorates and groups are sometimes moved back from category 1 to category 2. Any aircraft approved as a non-group aircraft (category 3) is required to be height monitored every 2 years.
The RMA monitors operator compliance with global and regional monitoring requirements and submits reports on non-compliant operators to the competent State authorities. A summary of non-compliance with monitoring targets is included in the annual safety assessment. It is a State responsibility to ensure that operators comply with global and regional monitoring targets.

d. Height-keeping Performance

The database of RVSM approvals provides not only a reference when verifying the approval status of aircraft, but also allows height-keeping performance data to be correlated with individual airframes. Height-monitoring results include the ICAO 24-bit address (also known as the Mode S address) extracted from the aircraft down-linked parameters. This data provides a link to a known aircraft approval. If the RMA does not have the correct 24-bit address then the results cannot be correlated to one specific airframe.

If a monitoring group fails to meet the global height-keeping performance requirements then the RMA contacts the manufacturer, or approved design organization, as well as the authority responsible for the initial airworthiness approval to initiate an investigation.

With regard to individual airframe performance, the RMA has 3 categories of result; fully compliant, aberrant or non-compliant. Should an aircraft be height-monitored and found to be non-compliant, the operator and appropriate State authority must be notified within 21 days. Any subsequent action is the responsibility of the appropriate State authority; however, the RMA recommends an immediate investigation and inspection of the aircraft. The RMA can provide technical advice as well as height-monitoring data to support any investigation.

An aircraft that is aberrant either has an ASE characteristic that is significantly different from the core performance of the appropriate monitoring group or exhibits a performance trend that if continued will result in the aircraft becoming non-compliant. The RMA reviews all aberrant height-monitoring results monthly and determines which aircraft, if any, require additional investigation. Once an investigation is initiated the procedure is like that for a non-compliant aircraft.

Whenever an RMA individual airframe height-keeping performance investigation is initiated, the competent authority should ensure that appropriate action is taken. This should include an initial acknowledgement followed by confirmation of what action is being taken to address the problem. Again, the RMA can provide technical advice as well as height monitoring data to support any investigations.

3 Aircraft Certification

a. MASPS and Performance Requirements

All operators intending to fly aircraft with 1000 ft vertical separation in RVSM airspace must have a valid RVSM approval from the appropriate State authority. An RVSM approval has 3 components:

1. The aircraft has a vertical navigation performance capability compliant with the criteria of the RVSM Minimum Aircraft Systems Performance Specification (MASPS);
2. The operator has instituted procedures relating to continued airworthiness practices and programs; and
3. The operator has instituted flight crew procedures for operation in CAR/SAM RVSM airspace.

The CAR/SAM RVSM MASPS is embodied in Doc 9574 and Doc 9937.

These Documents provides detailed information on:

1. The RVSM approval process;
2. RVSM performance requirements;
3. Aircraft system requirements;
4. Airworthiness approval;
5. Continued airworthiness (maintenance); and
6. Operational approval.

Most aircraft manufactured since the 1990s have been constructed in accordance with an approved RVSM MASPS compliance method. All aircraft for which the RVSM MASPS has been verified using the same compliance method and which have similar height-keeping performance characteristics are in the same classification or monitoring group for performance evaluation. Aircraft with a unique airframe and altimetry system fit are classified as non-group. ICAO Annex 6, Appendix 4 defines the statistical performance requirements that must be met by RVSM monitoring groups and individual non-group aircraft.

The RVSM MASPS includes requirements for continued airworthiness approval and long term ASE stability. Initial verification of the RVSM MASPS is considered part of the approval process. However, the final verification can only be made following confirmation that the continued airworthiness procedures are valid and ASE is stable.

Individual airframes manufactured based on a common compliance method (i.e. group aircraft) that has been evaluated for compliance with RVSM MASPS should not require additional performance evaluation prior to approval.

However, authorities are still required to confirm that the initial certification is valid and to ensure that operator procedures for continued airworthiness and flight crew operations are correct before airworthiness or operational approval is granted.

The following should apply for an aircraft to be considered part of a monitoring group:

1. The aircraft should be constructed to the same type certificate (TC), TC amendment or supplementary TC;
2. Static source errors (SSE) and static source error corrections (SSEC) should be identical; and
3. The avionics installed on each aircraft should comply with the same specification or at least be verified as demonstrating equivalent performance.

Any aircraft that does not meet these requirements must be individually approved with particular emphasis on evaluation of the altimetry system error characteristics of the aircraft throughout the flight envelope.

Authorities should take additional steps to verify the ASE characteristics of derivative aircraft which have been ordered or modified for specific functions and which may include differences that prevent the aircraft from being included in an existing monitoring group. An aircraft originally classified as a group aircraft may need to be re-classified if it is subject to any kind of modification that changes the ASE characteristics. Modifications or design changes to derivative aircraft that will require a re-evaluation of the ASE characteristic include:

1. Additional external fittings that may alter the air flow over static ports or the attitude of the aircraft;
2. Changes that may affect the SSE, requiring a review of SSECs;
3. Changes to the flight envelope or weight characteristics; and
4. Changes to avionics hardware and/or software.

Procurement authorities should ensure that specifications for derivative aircraft clearly indicate whether the delivered aircraft are to be RVSM MASPS-compliant.

b. RVSM Approval

The RVSM approval process varies depending on whether the aircraft is a new build or already in service. For new builds, the manufacturer will submit to the competent authority in the State of manufacture the performance and analytical data supporting RVSM airworthiness approval of a defined build standard for approval. In the case of an aircraft already in service, the constructor will submit to the competent authority in the State of manufacture or State of registry for approval the performance and analytical data supporting RVSM airworthiness approval of a defined build standard. In all cases, it is necessary for every authority issuing an RVSM approval to ensure that the initial type/derivative RVSM airworthiness approval has been completed.

If a one-off production run of a special variant is required, it is particularly important that the customer clearly indicates whether the variant is required to operate in RVSM airspace and which authority is to provide the initial airworthiness approval.

Before issuing an RVSM approval the competent authority should ensure that the RVSM approval data package is valid. As a minimum this package should contain:

1. A declaration of the aircraft RVSM MASPS compliance method and build standard, including the RVSM monitoring group to which the aircraft belongs (if any);
2. A definition of the RVSM flight envelope;
3. Performance and analytical data showing compliance with RVSM performance criteria;
4. Procedures to verify that all aircraft submitted for approval comply with RVSM criteria, including a reference to the applicable service bulletin (or equivalent) and amendments to the approved aircraft flight manual; and
5. The maintenance instructions to ensure continued airworthiness for RVSM approval.

All the requirements of the approval authority should be met after verification of all the elements of the RVSM approval data package before an RVSM approval is issued.

c. RVSM Approval Method

The RVSM approval data package should contain sufficient data to show compliance with the height-keeping performance criteria described in ICAO Annex 6, across the entire operational flight envelope.

There are three acceptable methods for precision flight calibration to quantify altimetry system performance. These are:

1. Precision tracking radar;
2. Trailing cone; and
3. Pacer aircraft.

However, it is ultimately for the State approval authority to decide whether any other methods are acceptable as a means of determining the ASE characteristics.

The RMA does not permit HMU data to be used instead of detailed performance or analytical data to support height-keeping performance for certification purposes[2].
The main reasons for this are:

1. An HMU result provides a snapshot of only one point in the flight envelope;
2. Aircraft flight configuration is unknown;
3. The HMU systems are not certified or calibrated for precision performance evaluation[3]; and
4. The airspace over the HMU systems is already restricted to RVSM-approved aircraft, although there are numerous examples of non-approved aircraft operating in the airspace for height-monitoring purposes prior to receiving RVSM approval.

d. Aircraft System Requirements

Some State aircraft may fulfil the performance requirements but their system does not fulfil the aircraft system requirements set out in ANNEX 6. In particular, military fighters often have a single altimetry chain. This lack of redundancy may be a safety issue if not appropriately mitigated. Moreover, their height-measuring performance may be strongly influenced by the aircraft external carriage configuration.

Military authorities willing to issue an RVSM approval for such aircraft types must first demonstrate that the technical fit of the aircraft is fully compliant with the ICAO provisions and that this aircraft type does not hamper the level of safety in the RVSM airspace.

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[2] *Same conditions apply to the GPS monitoring unit (GMU).*
[3] *Any errors introduced by external influences are considered minor and in most cases are compensated for; however, absolute HMU accuracy cannot be guaranteed when compared to calibrated systems specifically designed for this purpose.*

4 Guidance

a. Coordination with the CAR/SAM RMA

State aircraft operators willing to fly RVSM operations with the 1000 ft vertical separation minimum in RVSM airspace must comply with a set of basic requirements in order to maintain the level of safety in RVSM airspace[4].

RVSM-REQ1: State aircraft operators shall have RVSM operational approval from the competent authority to fly RVSM operations. This approval shall be based on evidence from the competent technical authority of the compliance to the RVSM requirements.

RVSM-REQ2: State aircraft operators shall ensure consistency between the RVSM approval status of the aircraft and the flight plan filed by the crew.

RVSM-REQ3: State aircraft operators should nominate a national RVSM coordination officer[5] to the CAR/SAM RMA to resolve monitoring or safety issues that may occur while operating in RVSM airspace.
CAR/SAM RMA FORM F1 is to be used to nominate this coordinating officer (PoC).

RVSM-REQ4: For RVSM operations, the Mode S 24-bit address should not be different than the one provided to the CAR/SAM RMA. That means that within RVSM airspace when operating GAT/IFR the 24 bit addresses should not rotate and should remain unique and unchanged for each aircraft.

b. RVSM Approval Database

ICAO Doc. 9574, "(Manual about a Vertical Minimum Separation of a 300 m (1 000 ft) Between FL 290 and FL 410 Inclusive)", requires State authorities to maintain a database of RVSM approvals. To reduce workload and enable RMA resources to be most efficiently utilized, it is important that all airworthiness authorities ensure that this database is regularly updated and available to the RMA. As far as practically possible, approval databases should be centralized, reducing the amount of communication between RMA and approval authorities.

To minimize workload and enable the RMA to best support the States, relevant authorities should ensure that valid contact information and regular updates to approval records are provided to the RMA. This includes de-registrations and withdrawals of approval as well as new approvals. CAR/SAM Form 2 and 3 (Appendix D) must be filled in and sent to the CAR/SAM RMA to declare approved aircraft prior to RVSM operations.

In relation to new aircraft types or variants, airworthiness authorities should provide details of any new RVSM MASPS compliance methods, including STCs and service bulletins, to the RMA so that any adjustments required can be made to the monitoring group configuration. If it is not possible to determine the compliance method and hence the correct monitoring group from the approval data, the aircraft must be classified as non-group and subject to mandatory height monitoring every 2 years.

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[4] *Without prejudice to the possibility to fly within RVSM airspace with 2000 ft separation if operating with exemption status.*

[5] *The State authorities are requested to nominate as far as practicable a single RVSM coordination officer (PoC). If internal national organization requires more than one PoC, the CAR/SAM RMA must be informed of the list of aircraft or aircraft types each PoC is responsible for.*

c. Monitoring Program and Maintenance of the RVSM Approval Database

The monitoring program defines three categories with two different monitoring approval methods and requirements.

A newly approved aircraft type starts in category 2 and may be upgraded to category 1 by a decision of the CAR/SAM RMA once a sufficient number of aircraft have been monitored and have generated a high level of confidence in the group monitoring data.

MONITORING IS REQUIRED IN ACCORDANCE WITH THIS TABLE		
Category		Minimum operator monitoring for each aircraft group
1	Group approved: monitoring data indicates compliance with the RVSM MASPS	A minimum of 10% or two airframes from each fleet of an operator to be monitored, whichever is the greater
2	Group approved: insufficient monitoring data on approved aircraft	60% of airframes (round up if fractional) from each fleet of an operator or individual monitoring
3	Non-group	100% of aircraft shall be monitored

For questions regarding categories, contact CAR/SAM RMA at carsamma@cgna.decea.mil.br

Different monitoring requirements must be met for RVSM-approved aircraft depending on their category defined in the previous table.

Approval method	Monitoring requirement
Group-approved aircraft	Every 2 years or 1000 flying hours, whichever is the greater
Non-group approved aircraft	Every 2 years

The competent authority for the State aircraft should ensure that appropriate action is taken when informed of a non-approved aircraft in the RVSM airspace by the RMA. This should include an initial acknowledgement followed by confirmation of the approval status of the aircraft in question. If the aircraft holds a valid approval, then this information, including date of issue of the RVSM approval, should be provided to the RMA as soon as possible so that the database of approvals can be updated; no further action would then be required.

If an aircraft is found to be operating without an approval, the operator should immediately be instructed to stop flying RVSM. An investigation should be initiated by the competent authority into the circumstances surrounding the breach of flight rules. Any action resulting from the investigation is the responsibility of the approval authority. The RMA includes a summary report regarding operations by non-approved aircraft in the annual safety assessment.

Figure 1 shows a flowchart of recommended action upon receipt of a report of possible non-approved aircraft operating with 1000 ft vertical separation in RVSM airspace.

5 Flight Planning

a. General Procedures

Flight planning for RVSM airspace must be clear and unequivocal:

1) Only operators and aircraft with a valid RVSM approval may submit a flight plan requesting 1000 ft vertical separation in RVSM airspace.

2) No formation flights are permitted to operate with 1000 ft vertical separation in RVSM airspace.

3) State aircraft which are not RVSM-compliant may file a flight plan to fly inside RVSM airspace with 2000 ft vertical separation with exemption status.

State aircraft filing GAT flight plans in RVSM airspace fall into one of three categories: RVSM-approved, non-RVSM approved and formation flights.

RVSM-Approved State Aircraft:
Operators of RVSM-approved aircraft must list a 'W' in item 10 of the ICAO flight plan, irrespective of the requested flight plan. Operators submitting repeat flight plans must include a "W" in item 10 of the flight plan irrespective of the requested flight level.

Non-RVSM Approved State Aircraft:
Operators of non-RVSM approved aircraft wishing to operate in RVSM airspace must submit an "M" in item 8 of the ICAO flight plan, and in addition "STS/NONRVSM" in item 18. No "W" needs to be submitted. These aircraft will be provided with 2000 ft vertical separation.

State Formation Flights:
Regardless of the RVSM approval status of any individual aircraft, no "W" needs to be submitted for any flight plan relating to formation flights.

A simple flowchart indicating the flight planning and separation minima for State aircraft is contained in Figure 2.

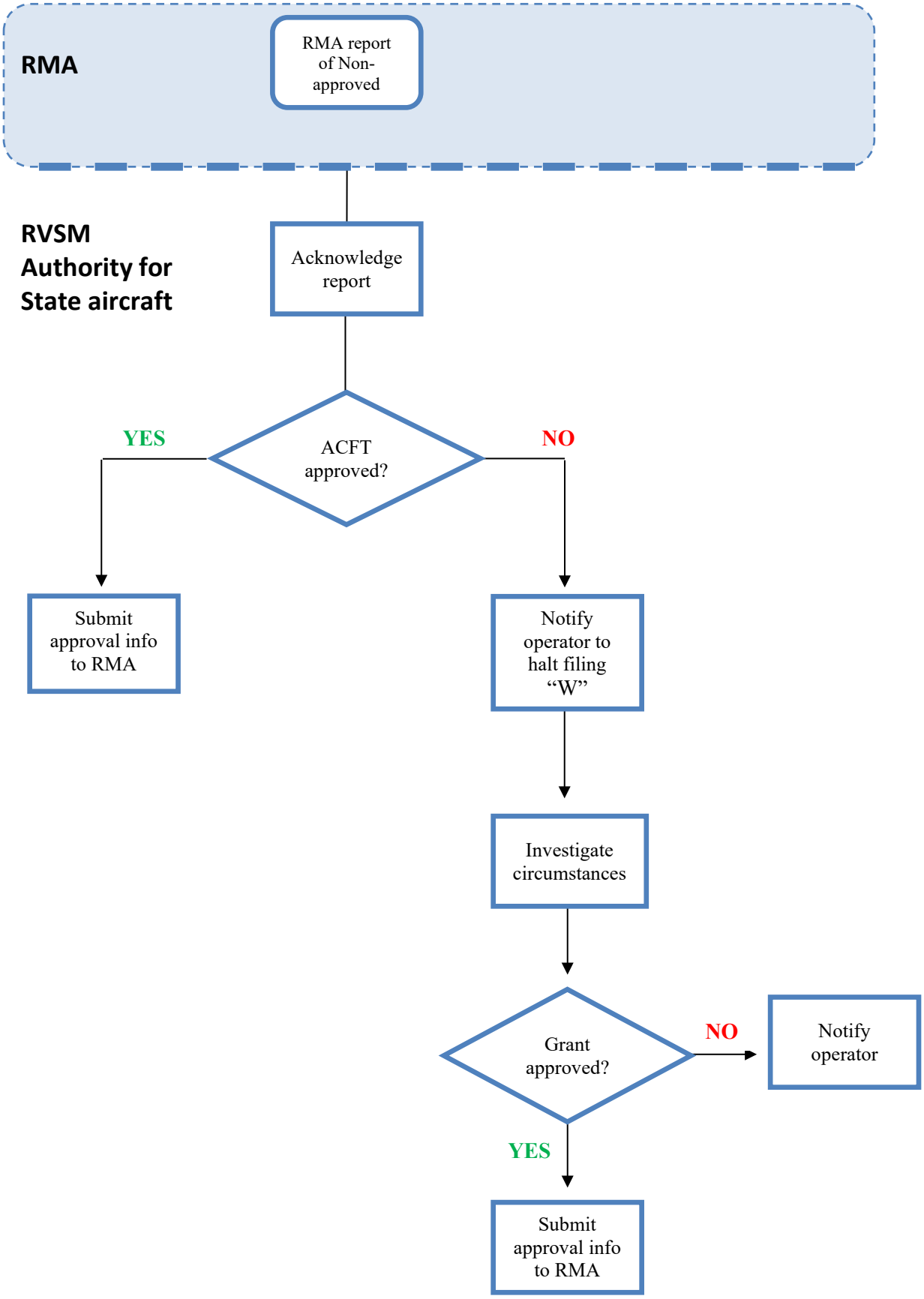

RMA
RMA report of Non-approved
RVSM Authority for State aircraft
Acknowledge report
ACFT approved?
YES
NO
Submit approval info to RMA
Notify operator to halt filing "W"
Investigate circumstances
Grant approved?
NO
Notify operator
YES
Submit approval info to RMA

Figure 1: Action upon receipt of a report of non-approved aircraft in RVSM airspace

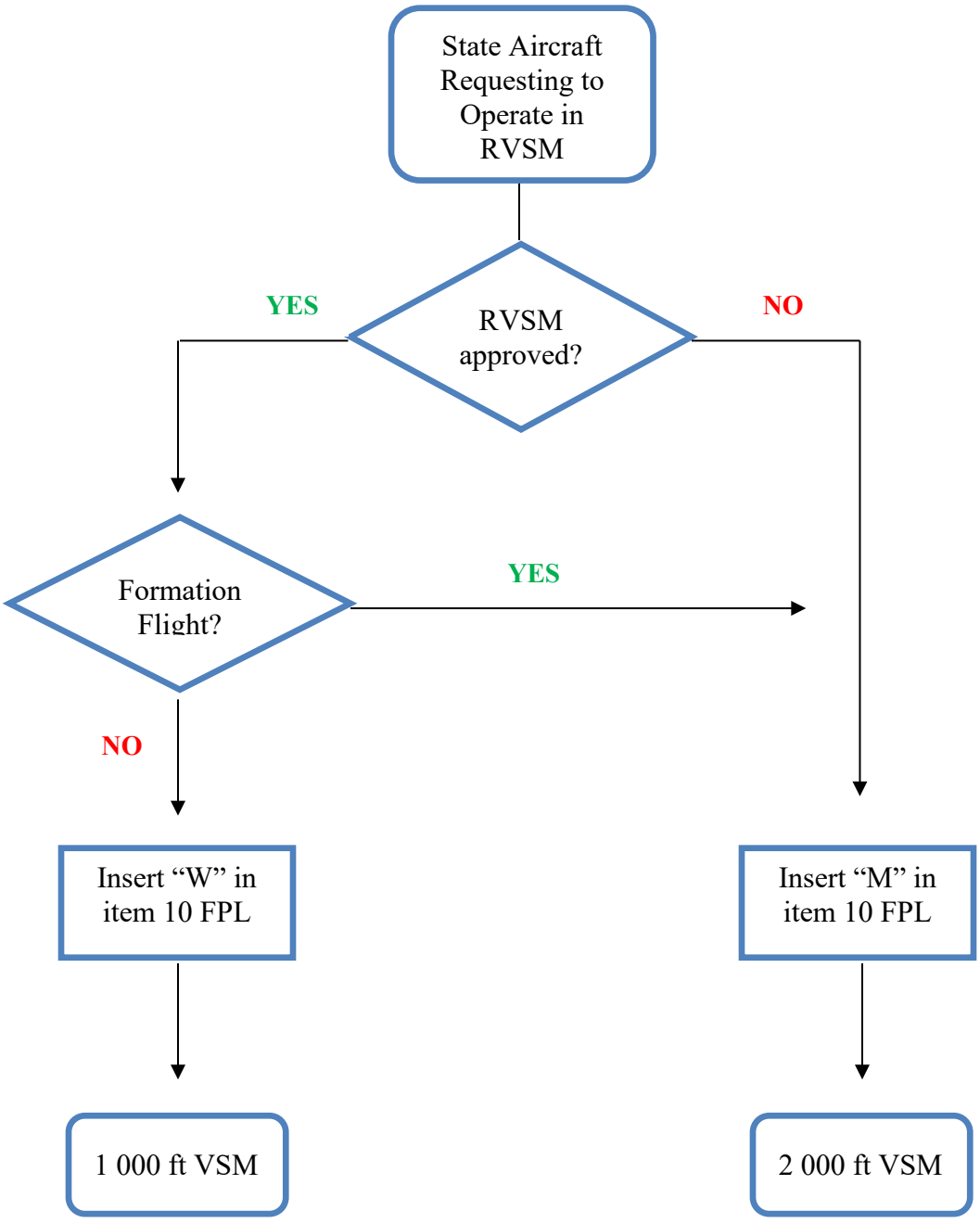


Figure 2: Flight planning requirements for State aircraft in RVSM airspace

b. Altimetry System Error (ASE)

Altimetry system error is the difference between the altitude indicated by the altimeter display assuming a correct altimeter barometric setting and the pressure altitude corresponding to the undisturbed ambient pressure. Errors in measuring the ambient air pressure or converting this into the altitude readout are major sources of ASE.

The major concern with ASE is that it is in most circumstances invisible to pilots, ground controllers and other aircraft (TCAS), so that any increased risk due to ASE cannot be mitigated operationally. To complicate matters, ASE is extremely difficult to measure in an operational environment.

c. Causes of ASE

Altimetry system error does not normally manifest itself in any way which is detectable by the flight crew, the ground controller, radar data processing equipment or onboard collision avoidance systems. It is also the experience of the RMAs that some basic ground checks do not satisfactorily identify the causes of ASE.

Following many years of investigating ASE problems, the RMAs has compiled a list of factors contributing to ASE. The following list is provided to all operators of aircraft identified as aberrant, requiring investigation, and all non-compliant aircraft. It is possible that more than one of the following contribute to the overall altimetry system error budget:

1) Aircraft skin waviness;
2) Aircraft skin flexing in critical areas near to the pitot heads and static vents;
3) Decals or company logos fixed to aircraft skin in aerodynamically critical areas which cause micro turbulence and disruption of airflow;
4) Paint not to specification;
5) Loose or damaged rivet heads;
6) Rigging of static vents out of tolerance;
7) Damage in the sterile area of the static vents;
8) Fuselage damage;
9) Incorrect pitot head alignment;
10) Corrosion or erosion in pitot heads and static vents;
11) Humidity or leaks in static lines;
12) Air data computers (ADCs) drifting out of value often due to transducer deterioration;
13) Changes to the SSEC algorithms contained in ADCs or wrong version (dash number) of units fitted;
14) Operation of the aircraft outside the defined RVSM flight envelope;
15) Altimeters out of tolerance;
16) Addition of external units to skin surface;
17) Other changes to airframe configuration (winglets, cargo doors);
18) Faults in other mechanical and electrical components;
19) Angle of attack vane alignment;
20) ATC transponders (in certain classes of airspace);

Investigations conducted by the RMAs in recent years have highlighted a number of issues for airworthiness authorities. The issues of greatest concern to the RMAs experts are undetected rapid deterioration of ‘no life limit’ components, particularly modern integrated pitot/static probes, and the rapid rate of deterioration associated with them (up to 50 ft per month), and the inability of some in situ checks to adequately identify faults.

d. Resolving ASE Problems

It is now standard procedure to issue a checklist for operators and regulators to follow when trying to identify why an aircraft has an excessive ASE.

Not all of the following items will be required, although investigators should be aware that there may be more than one contributory factor:

1) Is the approved maintenance program compliant with the requirements to maintain RVSM MASPS?

2) Are the aircraft minimum equipment list (MEL) and master minimum equipment list (MMEL) RVSM-compliant?

3) Basic checks to ensure that an approved RVSM MASPS compliance method has been incorporated into the aircraft. The compliance method may be applicable to a single airframe or to a group of aircraft having the same or similar performance characteristics and equipment fit. MASPS compliance documents are typically service bulletins, supplemental type certificates, aircraft service changes, type certification compliant or similar regulator approved documents. MASPS compliance methods have been formulated to be in line with the requirements contained in JAA TGL 6 rev.1 or FAA AC91 RVSM.

4) Is the data package submitted by the operator in full compliance with the requirements of JAA TGL 6 rev.1 or the equivalent FAA document, AC 91-85, Authorization of Aircraft and Operators for Flight in RVSM?

5) Has the airframe been modified since it was made MASPS-compliant?

6) Are there added external devices in RVSM-sensitive areas which will change the airflow, resulting in high low ASE?

7) Is there a MASPS compliance document in the maintenance records along with a correct reference number?

8) Have approved continuous maintenance program requirements been logged into the maintenance records?

9) Have all technical log items been resolved and all required SBs applied?

10) Is the paint scheme to the required RVSM specifications?

11) Have decals or company logos been applied to “sterile” areas of the fuselage?

12) Are the pitot heads within the allowable tolerance range? (requires test gauges).

13) Is the radome correctly seated and secured to OEM standards?

14) Do AoA vanes have correct and free movement?

15) Has a pitot static leak test been done?

16) Are the static vents rigged to the required settings?

17) Does the FMS have the correct software version installed?

The RMAs will support authorities in completing any ASE investigations and resolving any technical issues.

Table A- 1 describes the data which an RVSM approval authority is required to submit for an RMA to include the RVSM approval in the database of CAR/SAM approved aircraft.

RMA RVSM APPROVAL DATA REQUIREMENTS		
State of registry	Mandatory	
Operator name	Mandatory	Name and 3-letter ICAO code, if appropriate
State of operator	Mandatory	
Type	Mandatory	ICAO type designator
Series	Recommended	
Serial No.	Mandatory	
Registration	Mandatory	
24-bit ICAO address	Mandatory	In hexadecimal format Note: For tracking efficiency, the Mode S address should remain the same for each airframe.
Airworthiness approval	Mandatory	Yes/No
Date of airworthiness approval	Mandatory	
Date of emission	Mandatory	
RVSM-approved	Mandatory	Yes/No
Date of RVSM approval	Mandatory	
Date of expiry of RVSM approval	Mandatory	If appropriate
Observations	If appropriate	
RVSM approval authority	Recommended	

Table A- 1: Information on individual aircraft RVSM approval to be submitted to an RMA

GENERAL REQUIREMENTS FOR RVSM OPERATIONS

1 CERTIFICATION PHASE

- Technical work: compliance with RVSM MASPS, airworthiness issues
- Crew proficiency: education, procedures and training
- Authority: issuing of RVSM approvals, organization of contacts with CAR/SAM RMA (PoCs)

2 RVSM OPERATIONS PHASE

Authority:

- provide RVSM approvals to RMA, update list of approved aircraft
- provide relevant information to CAR/SAM RMA as described in Fig. 1

Operator:

- participate in monitoring program
- organize flights using GMU
- collaborate with CAR/SAM RMA whenever necessary
- maintain crew proficiency
- maintain list of RVSM-approved aircraft / submit list to CAR/SAM RMA
- maintain aircraft airworthiness in line with maintenance program

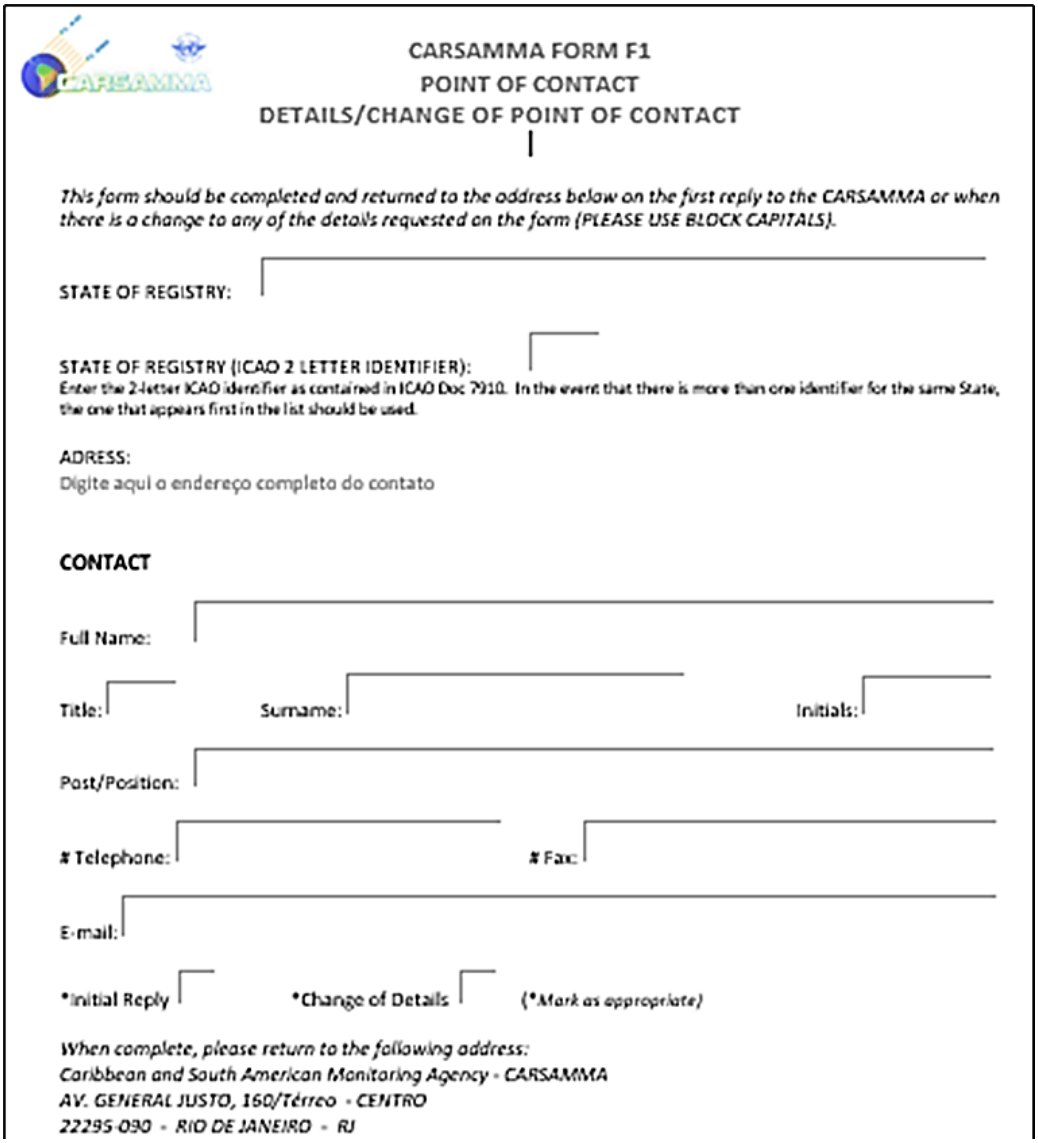
Crews: file flight plans as described in Fig. 2

CAR/SAM RMA F1

CONTACT DETAILS FOR MATTERS RELATING TO RVSM APPROVALS

This form should be used to supply the contact information of people/positions responsible for issuing RVSM approvals, or who are responsible for dealing with requests for RVSM approvals. This form should be used by States accredited to the CAR/SAM RMA but may also be used by operators of aircraft which have received RVSM approval from a State accredited to the CAR/SAM RMA[6].

A new form should be submitted whenever any of the required information changes. Where there are multiple contacts, please submit separate forms for each one. (PLEASE USE BLOCK LETTERS.)



CARSAMMA FORM F1
POINT OF CONTACT
DETAILS/CHANGE OF POINT OF CONTACT

This form should be completed and returned to the address below on the first reply to the CARSAMMA or when there is a change to any of the details requested on the form (PLEASE USE BLOCK CAPITALS).

STATE OF REGISTRY:

STATE OF REGISTRY (ICAO 2 LETTER IDENTIFIER):
Enter the 2-letter ICAO identifier as contained in ICAO Doc 7910. In the event that there is more than one identifier for the same State, the one that appears first in the list should be used.

ADRESS:
Digite aqui o endereço completo do contato

CONTACT

Full Name:

Title: Surname: Initials:

Post/Position:

Telephone: # Fax:

E-mail:

*Initial Reply *Change of Details (*Mark as appropriate)*

When complete, please return to the following address:
Caribbean and South American Monitoring Agency - CARSAMMA
AV. GENERAL JUSTO, 160/Térreo - CENTRO
22295-090 - RIO DE JANEIRO - RJ

[6] *The CAR/SAM RMA does not accept approval information directly from operators without supporting evidence from the appropriate State authority.*

CAR/SAM RMA F2

FOR USE BY APPROVAL-ISSUING AUTHORITIES ONLY

This form must be completed and returned to the regional monitoring agency to which the State is accredited. For a full list of State/ RMA accreditations, please see ICAO Doc. 9937. For States accredited to the CAR/SAM RMA, please forward this form to the address below.
(PLEASE USE BLOCK LETTERS.)

CARSAMMA F2 FORM
RECORD OF APPROVAL TO OPERATE IN CAR/SAM AIRSPACE

1. When a State of Registry approves or amends the approval of an operator/aircraft for operations within the CAR/SAM airspace, details of that approval must be recorded and sent to CARSAMMA to reach it by the tenth day of the month following the month that the approval was issued.

State of Registry[1]:	
Name of Operator[2]:	
State of Operator[3]:	
Aircraft Type[4]:	
Aircraft Series[5]:	
Manufacturer's Serial Number[6]:	
Registration Number[7]:	
Mode S Address Code[8]:	
Airworthiness Approval[9]:	
Date Issued[10]:	
RVSM Approval[11]:	
Date Issued[12]:	
Date of Expiry[13] (if applicable):	
Approval to Operate in PBCS Airspace[14]:	
Date PBCS Approval Issued [15]:	
Date RCP240 Authorization Issued [16]	
Date RSP180 Authorization Issued [17]	
Date of Expiry of PBCS Approval (if any) [18]	

Edition: 1.2
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Class: Restricted

Certification and operation of State aircraft in the CAR/SAM RVSM airspace