CIVIL AVIATION GUIDANCE MATERIAL – 6008(I)

REDUCED VERTICAL SEPERATION MINIMA

RVSM

CIVIL AVIATION AUTHORITY OF MALAYSIA

ISSUE 01
REVISION 01 – 15TH NOVEMBER 2021

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Introduction

This Civil Aviation Guidance Material 6008 Part I (CAGM – 6008 (I)) is issued by the Civil Aviation Authority of Malaysia (CAAM) to provide guidance for the application of Reduced Vertical Separation Minimum (RVSM), pursuant to Civil Aviation Directives 6 Part 1 – Commercial Air Transport (CAD 6 Part 1 – CAT) and Civil Aviation Directives 6 Part 2 – General Aviation (CAD 6 Part 2 – GA (collectively referred to as "CAD").

Organisations may use these guidelines to ensure compliance with the respective provisions of the relevant CAD's issued. Notwithstanding the Regulation 204 and Regulation 205 of the Malaysian Civil Aviation Regulations 2016 (MCAR 2016), when the CAGMs issued by the CAAM are complied with, the related requirements of the CAD's may be deemed as being satisfied and further demonstration of compliance may not be required.

(Captain Chester Voo Chee Soon)
Chief Executive Officer
Civil Aviation Authority of Malaysia

Civil Aviation Guidance Material components and Editorial practices

This Civil Aviation Guidance Material is made up of the following components and are defined as follows:

Standards: Usually preceded by words such as *"shall"* or *"must"*, are any specification for physical characteristics, configuration, performance, personnel or procedure, where uniform application is necessary for the safety or regularity of air navigation and to which Operators must conform. In the event of impossibility of compliance, notification to the CAAM is compulsory.

Recommended Practices: Usually preceded by the words such as "*should"* or "*may*", are any specification for physical characteristics, configuration, performance, personnel or procedure, where the uniform application is desirable in the interest of safety, regularity or efficiency of air navigation, and to which Operators will endeavour to conform.

Appendices: Material grouped separately for convenience, but forms part of the Standards and Recommended Practices stipulated by the CAAM.
Definitions: Terms used in the Standards and Recommended Practices which are not self-explanatory in that they do not have accepted dictionary meanings. A definition does not have an independent status but is an essential part of each Standard and Recommended Practice in which the term is used, since a change in the meaning of the term would affect the specification.

Tables and Figures: These add to or illustrate a Standard or Recommended Practice, and which are referred to therein, form part of the associated Standard or Recommended Practice and have the same status.

Notes: Included in the text, where appropriate, Notes give factual information or references bearing on the Standards or Recommended Practices in question but not constituting part of the Standards or Recommended Practices;

Attachments: Material supplementary to the Standards and Recommended Practices or included as a guide to their application.

The units of measurement used in this document are in accordance with the International System of Units (SI) as specified in CAD 5. Where CAD 5 permits the use of non-SI alternative units, these are shown in parentheses following the basic units. Where two sets of units are quoted it must not be assumed that the pairs of values are equal and interchangeable. It may, however, be inferred that an equivalent level of safety is achieved when either set of units is used exclusively.

Any reference to a portion of this document, which is identified by a number and/or title, includes all subdivisions of that portion.

Throughout this Civil Aviation Guidance Material, the use of the male gender should be understood to include male and female persons

Record of revisions

Revisions to this CAGM shall be made by authorised personnel only. After inserting the revision, enter the required data in the revision sheet below. The *'Initials'* has to be signed off by the personnel responsible for the change.

ISS/REV No.	Revision Date	Revision Details	Initials
ISS01/REV01	15th November 2021	Refer to Summary of Changes	

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Summary of Changes

ISS/REV No.	Item no.	Revision Details
ISS01/REV01	Paragraph 2.10.1	Editorial Changes
	Paragraph 2.10.2 b)	Editorial Changes
	Paragraph 2.10.5	Editorial Changes
	Paragraph 2.10.6	Editorial Changes
	Paragraph 5.1.3	Changed the word “Approval” to “recommendation”
	Paragraph 5.3.2 a)	Editorial changes
	Paragraph 5.3.3	Changed the word “Approval” to “recommendation”
	Attachment A	Removed and link provided.

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1 Reduced Vertical Separation Minimum. (RVSM)

1.1 Introduction

1.1.1 RVSM airspace is any airspace or route where aircraft are separated by 1,000 ft vertically, between FL 290 and FL 410, inclusive. Generally, aircraft and operators that have not been authorised to conduct RVSM operations cannot operate at flight levels where RVSM is applied.

1.1.2 RVSM was first implemented in the North Atlantic in March 1997. Since that time, it has been implemented in most regions of the world, and RVSM approval is required for flight operations conducted between FL 290 and FL 410.

1.1.3 In 1982 the ICAO initiated a series of world-wide studies to assess the feasibility of a reduction of the VSM above FL 290 from 2,000 ft to 1,000 ft. The studies were co-ordinated by the review RGCSP which included representation from the IATA, IFALPA and the IFATCA.

1.1.4 The principal benefits which the implementation of the RVSM were expected to provide were:

a) a theoretical doubling of the airspace capacity between FL 290 and FL 410

b) the opportunity for aircraft to operate at/closer to their optimum flight levels, with resulting fuel economy.

1.1.5 Studies and data collections were conducted in Canada, Japan, USA, USSR and four-member states of Euro control: France, Germany, Netherlands and United Kingdom. These studies were essentially intended to determine the following:

a) the height keeping accuracy of the current aircraft population at/above FL 290

b) the causes of height deviations greater than 300 ft and to define corrective measures

c) the basis of the MASPS to support the use of a 1,000 ft vertical separation above FL 290.

1.1.6 As a result, the RGCSP concluded that a 1,000 ft VSM between FL 290 and FL 410 was technically feasible without imposing unreasonably demanding technical or operational requirements. The ICAO Air Navigation Commission endorsed these findings in 1990.

1.1.7 With the exception of a small number of states, RVSM was progressively introduced globally between 1997 and 2011, and operation within this airspace is prohibited unless the operator has RVSM approval for the aircraft being flown, or an exception has been granted for a specific flight. Regulation 108 MCAR prohibits

the operation of an aircraft within RVSM airspace unless authorisation has been received from CAAM.

1.2 Purpose

1.2.1 This CAGM provides guidance and information to the operator to demonstrate compliance with the requirements regarding, and information related to an application for an approval for operations in RVSM airspace, in accordance with MCAR part IX, regulation 108, 109 and CAD 6 part 1 and/or CAD 6 part 2.

1.3 Applicability

1.3.1 This CAGM is applicable to an operator seeking approval for RVSM operations.

1.4 Definitions

Aircraft type groupings mean aircraft are considered to belong to the same group if they are designed and assembled by one manufacturer and are of nominally identical design and build with respect to all details which could influence the accuracy of height-keeping performance.

Airworthiness approval is the process of assuring the CAAM that aircraft meet an RVSM MASPS. Typically, this would involve an operator meeting the requirements of the aircraft manufacturer service bulletin for that aircraft and having the State authority verify the successful completion of that work.

Airworthiness inspector (AWI) is a representative of the Civil Aviation Authority of Malaysia in charge of initial authorisation and/or continued oversight of the operator's maintenance and engineering organisation and processes. The assessment performed by the AWI may include (but not be limited to):

a) the adequacy of maintenance facilities, equipment and procedures;
b) the adequacy of the training programmes and competence of employees;
c) the adequacy of the programme or schedule for periodic maintenance and overhauls; and
d) the airworthiness of the aircraft.

Altimetry system error (ASE) 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.

Altimetry system error stability means altimetry system error for an individual aircraft is considered to be stable if the statistical distribution of altimetry system error is within agreed limits over an agreed period of time.

Altitude-keeping device is any equipment which is designed to automatically control the aircraft to a referenced pressure altitude.

Assigned altitude deviation (AAD) is the difference between the transponder Mode C altitude and the assigned altitude/flight level.

Automatic altitude-keeping device is any equipment which is designed to automatically control the aircraft to a referenced pressure-altitude.

Collision risk is the expected number of mid-air aircraft accidents in a prescribed volume of airspace for a specific number of flight hours due to loss of planned separation.

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

Flight technical error (FTE) is the difference between the altitude indicated by the altimeter display being used to control the aircraft and the assigned altitude/flight level.

Flight operations inspector (FOI) Is a representative of the Civil Aviation Authority of Malaysia in charge of initial authorisation and/or continued oversight of the operator's flight operations organisation and processes. The assessment performed by the FOI may include (but not be limited to):

a) the adequacy of flight operations facilities, equipment and procedures;
b) the adequacy of the training programmes and competence of employees; and
c) the adequacy of the programme to ensure safe operations of the aircraft.

Height-keeping capability is the aircraft height-keeping performance that can be expected under nominal environmental operating conditions with proper aircraft operating practices and maintenance.

Height-keeping performance is the observed performance of an aircraft with respect to adherence to cleared flight level.

Non-compliant aircraft is an aircraft configured to comply with the requirements of an RVSM MASPS which, through height monitoring, is found to have a total vertical error (TVE) or an assigned altitude deviation (AAD) of 90 m (300 ft) or greater or an altimetry system error (ASE) of 75 m (245 ft) or more.

NOTAM is a notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations

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

Operational error is defined as any vertical deviation of an aircraft from the correct flight level as a result of incorrect action by air traffic control (ATC) or the aircraft crew.

Overall risk is the risk of collision due to all causes, which includes the technical risk (see definition) and all risk due to operational errors and in-flight contingencies.

Passing frequency is defined as the frequency of events in which two aircraft are in longitudinal overlap when travelling in the opposite or same direction on the same route at adjacent flight levels and at the planned vertical separation.

RVSM approval is the term used to describe the successful completion of airworthiness approval and operational approval (if required).

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

Technical risk is the risk of collision associated with aircraft height-keeping performance

Total vertical error (TVE) is the vertical geometric difference between the actual pressure altitude flown by an aircraft and its assigned pressure altitude (flight level).

Track means the projection on the earth's surface of the path of an aircraft, the direction of which path at any point is usually expressed in degrees from North (true, magnetic or grid).

Vertical separation is the spacing provided between aircraft in the vertical plane to avoid collision.

Vertical separation minimum (VSM) is documented in the *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444) as being a nominal 300 m (1 000 ft) below FL 290 and 600 m (2 000 ft) above FL 290 except where, on the basis of regional agreement, a value of less than 600 m (2 000 ft) but not less than 300 m (1 000 ft) is prescribed for use by aircraft operating above FL 290 within designated portions of the airspace.

Altimetry system error is the difference between the altitude indicated by the altimeter display (assuming the altimeter barometric setting is correct) and the pressure altitude corresponding to the undisturbed ambient pressure; "Total vertical error" or "TVE" means the vertical geometric difference between the actual pressure altitude flown by an aircraft and its assigned pressure altitude (flight level).

1.5 Abbreviations

AAD	=	Assigned altitude deviation
AC	=	Advisory circular
ACAS	=	Airborne collision avoidance system
ACU	=	Aircraft Certification Unit
ADC	=	Air data computer
AFM	=	Airplane flight manual
ADS-B	=	Automatic dependent surveillance - broadcast
AGHMEs	=	Aircraft geometric height measurement elements
AHMS	=	ADS-B height monitoring system
ASE	=	Altimetry system error
ATC	=	Air traffic control
AWI	=	Airworthiness Inspector
BITE	=	Built-in test equipment
CFL	=	Cleared flight level
CAAM	=	The Civil Aviation Authority of Malaysia
FAA	=	Federal Aviation Administration
FL	=	Flight level
FOI	=	Flight Operations Inspector
GMU	=	Global positioning system monitoring unit
GPS	=	Global positioning system
HME	=	Height monitoring element
HMU	=	Height monitoring unit
IATA	=	International Air Transport Association
ICA	=	Instructions for continued airworthiness
ICAO	=	International Civil Aviation Organisation
IFALPA	=	International Federation of Airline Pilots Associations
IFATCA	=	International Federation of Air Traffic Controllers Associations
MAAR	=	Monitoring Agency for Asia Region
MASPS	=	Minimum aircraft system performance specification

MEL	=	Minimum equipment list
MNPS	=	Minimum navigation performance specification
NM	=	Nautical mile
PEC	=	Position correction error
PIC	=	Pilot in command
QFE	=	Atmospheric pressure at aerodrome elevation (or at runway threshold)
QNH	=	Altimeter sub-scale setting to obtain elevation when on the ground
RGCSP	=	Review of the general concept of separation panel
RMA	=	Regional monitoring agency
RVSM	=	Reduced vertical separation minimum of (300m) 1,000 ft between flight levels
SAM	=	Specific Approval Manager
SB	=	Service bulletin
SL	=	Service letter
SLOP	=	Strategic lateral offset procedures
SSEC	=	Static source correction error
SSR	=	Secondary surveillance radar
STC	=	Supplemental type certificate
TCAS	=	Traffic alert and collision avoidance system
TCDS	=	Type certificate data sheet
TLS	=	Target level of safety
TMU	=	Total vertical error monitoring unit
TVE	=	Total vertical error
VHF	=	Very high frequency
VSM	=	Vertical separation minimum

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2 Aeroplane and its Equipment

2.1 Aircraft eligibility

2.1.1 All approvals will be applicable to an individual aircraft or to a group of aircraft, as defined in 2.1.2, that are nominally identical in aerodynamic design and items of equipment contributing to height- keeping accuracy.

2.1.2 For aircraft to be considered as part of a group for the purposes of airworthiness approval, the following conditions shall be satisfied:

a) the aircraft shall have been constructed to a nominally identical design and shall be approved on the same Type Certificate (TC), TC amendment or Supplemental TC, as applicable;

b) the static system of each aircraft shall be nominally identical. The static source error (SSE) corrections shall be the same for all aircraft of the group; and

c) the avionics units installed on each aircraft to meet the minimum RVSM equipment criteria shall comply with the manufacturer's same specification and have the same part number.

Note — Aircraft that have avionics units which are of a different manufacturer or part number may be considered part of the group if it can be demonstrated that this standard of avionics equipment provides equivalent system performance.

2.1.3 If an airframe does not meet the conditions of 2.1.2 a) to c) to qualify as a part of a group, and is presented as an individual airframe for approval, it will be considered to be a non-group aircraft. The significance of this is that the certification processes for group and non-group aircraft are different.

2.1.4 Aircraft where the RVSM approval Type Certificate holder is other than FAA or EASA, a further detailed evaluation may be required to be carried out by the CAAM.

2.1.5 In such cases where the aircraft is bought into RVSM compliance through the application of an OEM Service Bulletin with appropriate updates to the Aircraft Flight Manual (AFM) may be acceptable. However, the use of documents other than OEM is subjected to the acceptance by the CAAM.

2.2 Equipment requirements for RVSM operations

2.2.1 For navigation equipment requirements refer to CAD 6 part 1, 7.2. CAD 6 Part 2, 2.5

2.3 Height keeping performance monitoring

2.3.1 Requirements

2.3.1.1 Once the operational approval to conduct RVSM operations is granted by CAAM, the operator will complete a MAAR Form F2 (USC Form 2 for

EUROCONTROL User Support Cell) for the Authority to submit to the RMA (Regional Monitoring Agency), MAAR for Asia region, for conduct of Aircraft Height-Keeping Performance Monitoring flight.

2.3.1.2 This Height-Keeping Performance monitoring flight must be conducted within 6 months of the RVSM operational approval.

2.3.1.3 All operators that operate or intend to operate in airspace where RVSM is applied are required to participate in the Height-Keeping Performance Monitoring (HKPM) programme, as stated in the **Asia/Pacific Minimum Monitoring Requirements (MMR)**. Monitoring should be completed as soon as possible but **not later than 6 months** after the issue of RVSM approval and thereafter as directed by the RMA. Moreover, aircraft operators who wish to maintain RVSM approval for their aircraft/aircraft fleet are required to satisfy the long-term monitoring requirement.

2.4 Minimum Aircraft Systems Performance Specifications (MASPS)

2.4.1 As outlined in Appendix 4 of this CAGM.

2.5 RVSM maintenance, inspection programme and continuing airworthiness

2.5.1 When establishing a RVSM maintenance and inspection programme, as required in CAD 6 Part 1, 7.2 and CAD 6 part 2, 2.5 the integrity of the altimetry design features should be verified by scheduled tests and inspections. The operator should review its maintenance procedures and address all aspects of continuing airworthiness affected by RVSM requirements.

2.5.2 All RVSM equipment shall be maintained in accordance with the component manufacturer's maintenance requirements.

2.5.3 The maintenance programme should at least include the following items:

a) Any modification, repair or design change that affects in any way the RVSM approval should be subjected to a design review by CAAM or organisations approved by CAAM;

b) Refer any maintenance practices that may affect the integrity of the continuing RVSM approval, e.g., those affecting the alignment of pitot/static probes, repairs to dents, or deformation around static plates to CAAM or organisations approved by CAAM;

c) BITE testing is not an acceptable basis for system calibrations, (unless it is shown to be acceptable by the airframe manufacturer with the approval of CAAM) and should only be used for fault isolation and troubleshooting purposes;

d) Some aircraft manufacturers have determined that the removal and replacement of components utilising quick disconnects and associated

fittings, when properly connected, will not require leak check. While this approach may allow the aircraft to meet static system certification standards when properly connected, it does not always ensure the integrity of the fittings and connectors, nor does it confirm system integrity during component replacement and reconnections. Therefore, a system leak check or visual inspection should be accomplished any time a quick disconnect static line is broken. If both quick disconnects are broken, a leak-check must be done.

e) Maintain airframe and static systems in accordance with the airframe manufacturer's inspection standards and procedures;

f) If necessary, to ensure the proper maintenance of airframe geometry for proper surface contours and the mitigation of altimetry system error, surface measurements or skin waviness checks should be made to ensure adherence to the airframe manufacturer's RVSM tolerances. Perform these tests and inspections as established by airframe manufacturer. Perform these checks following repairs, or alterations that affect RVSM by influencing airframe surface and airflow.

g) The maintenance inspection programme for the autopilot should ensure continued accuracy and integrity of automatic altitude control system to meet the height-keeping standards for RVSM operations. The requirement will typically be satisfied with equipment inspections to ensure the equipment is serviceable; and

h) Where applicant demonstrates the performance of existing equipment is satisfactory for RVSM approval, the existing maintenance practices shall be consistent with continued RVSM approval integrity. Examples include:

1) Altitude alert
2) automatic altitude control system
3) ATC altitude reporting equipment
4) altimetry systems

2.6 Maintenance practices for non-compliant aircrafts

2.6.1 Aircrafts that have been identified as exhibiting height-keeping performance errors which require investigation by CAAM should not be operated under an RVSM approval in airspace where RVSM is applied until the following actions have been taken:

a) The failure or malfunction is confirmed and isolated by maintenance action

b) Corrective action is carried out and verified to ensure RVSM approval integrity

2.6.2 The operator should ensure that the contracted maintenance organisations are competent to maintain the aircraft and equipment's relevant to RVSM, and use adequate test equipment for the maintenance of the RVSM systems. The

adequacy of the test equipment should be established in accordance with the type certificate holder recommendations and taking into consideration the required test equipment accuracy and the test equipment calibration.

2.7 Maintenance Training Requirements

2.7.1 The operator shall ensure that all personnel performing maintenance on RVSM equipment (including maintenance contractor) are properly trained, qualified, and knowledgeable of RVSM especially on the maintenance requirements that the operator needs to incorporate to ensure continuous compliance with RVSM requirements.

2.7.2 The operator shall emphasise on the following areas for initial and recurrent training for personnel involved in RVSM maintenance:

a) Aircraft geometric inspection techniques

b) Test equipment calibration/usage techniques

c) Any special documentation or procedures introduced by RVSM approval

2.8 Test equipment

2.8.1 The test equipment should have the capability to demonstrate continuing compliance with the parameters established for RVSM approval in the initial data package or as approved by the approving authority.

2.8.2 Test equipment should be calibrated using approved reference standards traceable to the national standard. Calibration to be carried out at a periodic intervals as specified by the manufacturer of the equipment or as agreed by CAAM. The approved aircraft maintenance programme should incorporate effective quality control measures including the following:

a) Definition of required test equipment accuracy.

b) Regular calibrations of test equipment traceable to the approved standard.

Note: Determination of calibration interval should be a function of the stability of the test equipment. Establish the calibration interval based on historical data so that degradation is small in relation to the required accuracy.

c) Procedures to ensure conducting of regular audits of calibration facilities both in-house and outside.

d) Adherence to acceptable workshop, base and line maintenance practices.

e) Procedures for controlling operator errors and unusual environmental conditions that may affect calibration accuracy.

2.9 Continued compliance of MASPs

2.9.1 Requirements

2.9.1.1 The operator shall set in place a programme to ensure that a minimum of two aeroplanes of each aeroplane-type grouping undergo height-keeping performance monitoring at least once every two years or within intervals of 1000 flight hours per aeroplane, whichever period is the longer.

2.9.1.2 If the operator's aeroplane-type grouping consists of a single aeroplane, the height-keeping monitoring of that aeroplane shall be accomplished within the specified period.

2.10 Airworthiness review

2.10.1 This paragraph details out the requirements of an Engineering Report required to be submitted to Airworthiness Division as part of the process in obtaining an RVSM approval. The engineering report shall be submitted together with the application for an RVSM operational approval for CAAM. The engineering report shall be prepared in accordance with the guides specified in paragraph 2.9.2 2.10.2 of this CAGM and Section E of the 'Specific Approvals Form'.

2.10.2 The engineering report shall have a reference number, date and shall be verified by the Quality Assurance Manager to ensure that the report has been reviewed by a competent person. The engineering report shall contain the following to substantiate the application form declaration.

a) the aircraft details (operator, aircraft type, manufacturer, serial number and registration number) to be operated;

b) evidence that the identified aircraft meet this is certified for RVSM requirements operations via TC holder or by data package holder approval, or has a vertical navigation performance in accordance with Appendix 2 of this CAGM

c) evidence of repairs or modifications that has been embodied on the aircraft that affects RVSM capability;

d) the list of navigation equipment in a form of compliance matrix to paragraph 7.2 of CAD 6 installed on the aircraft for RVSM operations. The applicant is required to list and specify the name, part number serial number, and quantity of the equipment installed;

e) the initial and recurrent training program for CAMO and maintenance personnel involved in RVSM operations. The applicant shall provide training syllabi for initial and recurrent training programmes. The maintenance training requirements shall cover elements specified in 2.7 of this CAGM;

f) evidence that the approved minimum equipment list (MEL) includes items pertinent to operating in RVSM airspace such as procedures to dispatch with inoperative RVSM components (where applicable), and the process for upgrade/downgrade of RVSM due to system failures within the RVSM critical systems;

g) the maintenance programme required in paragraph **Error! Reference source not found** of this CAGM. The applicant shall provide evidence that the organisation has an approved maintenance program relevant to RVSM inspection and equipment maintenance. This shall also include pre-flight and post flight procedures as specified in paragraph **Error! Reference source not found** of this CAGM;

h) evidence that the organisation has an approved reliability programme that monitors all equipment and systems relevant for RVSM operations (if applicable);

i) evidence that the maintenance organisation is capable to carry out maintenance pertaining to RVSM capability in accordance with the approved aircraft maintenance programme. If maintenance is contracted, maintenance contract shall be included;

j) Relevant details of the organisation procedures for ensuring the requirements of CAD 6 Part 1, 7.2, CAD 6 Part 2, 2.5 and guidelines in this CAGM are continuously complied with. This shall include reporting procedure MOR/ISDR; and

k) any other document as required by CAAM relevant to the RVSM approval.

2.10.3 The supporting documents as required to substantiate Section E of the application form are to be included in the Engineering Report and clearly referenced.

2.10.4 The Engineering report shall include the Technical Declaration by the appropriate person(s) as specified in Section E, Part B of the application form.

2.10.5 The Engineering Report must be prepared by the Continuing Airworthiness Management Organisation (CAMO). The Quality Assurance Manager (QAM) shall verify the content of the Engineering Report to ensure that the submission has been reviewed and verified sufficient and satisfactory.

2.10.6 The content of the RVSM application may be sufficient to verify the aircraft performance and procedures. However, if a verification flight is required, Airworthiness Division may assign an inspector for a verification flight in RVSM airspace to verify that all relevant procedures are applied effectively.

3 Operations of the Aeroplane

3.1 Flight crew training programmes, operating practices and procedures

Note: The following items (detailed in 3.1.1 to 3.1.7) (pre-flight- Special emphasis items: flight crew training) should be standardised and incorporated into training programme and operating practices and procedures. Certain items may already be adequately standardised in existing operator programmes and procedures. New technologies may also eliminate the need for certain crew actions. If this is the case, then the intent of this guidance can be considered to be met.

3.1.1 Flight planning

3.1.1.1 During flight planning, the flight crew and dispatchers, if applicable, should pay particular attention to conditions which may affect operation in RVSM airspace. These include, but may not be limited to:

a) verifying that the aircraft is approved for RVSM operations

b) item 10 (equipment) of the ICAO flight plan should be annotated with the letter W for filing in RVSM airspace.

c) reported and forecast weather conditions on the route of flight

d) minimum equipment requirements pertaining to height-keeping systems

e) if required for the specific aircraft group; accounting for any aircraft operating restrictions related to RVSM airworthiness approval.

3.1.2 Pre-flight procedures

3.1.2.1 Accomplish the following actions during pre-flight.

a) Review maintenance logs and forms to ascertain the condition of equipment required for flight in the RVSM airspace. Ensure that maintenance action has been taken to correct defects to required equipment and that minimum equipment requirements pertaining to height-keeping systems are met.

b) During the external inspection of aircraft, pay particular attention 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. (A qualified and authorised person other than the pilot, for example: flight engineer or maintenance personnel may perform this check).

c) Before take-off, the aircraft altimeters should be set to the local altimeter atmospheric pressure at nautical height (QNH) setting and should display a known elevation (for example: field elevation) within the limits specified in aircraft operating manuals. The difference between the known elevation and the elevation displayed on the altimeters should not exceed 75 ft. The

two primary altimeters should also agree within limits specified by the aircraft operating manual. An alternative procedure using atmospheric pressure at field elevation (QFE) may also be used.

d) Before take-off, equipment required for flight in RVSM airspace should be operational, and indications of malfunction should be resolved.

3.1.3 Procedures before RVSM airspace entry

3.1.4 If any of the required equipment fails prior to the aircraft entering RVSM airspace, the pilot should request a new clearance so as to avoid flight in this airspace. The following equipment should be operating normally at entry into RVSM airspace:

a) two serviceable independent primary altitude measurement systems

b) one automatic altitude-keeping system

c) one altitude-alerting device.

d) At least one altitude-reporting transponder, the operator should ascertain the requirement for an operational transponder in each RVSM area where operations are intended.

Note: Single source dependency following ADC failure does not meet the criteria for RVSM operation.

3.1.5 In-flight Procedure

3.1.5.1 Incorporate the following policies into flight crew training and procedures.

a) Flight crews should comply with aircraft operating restrictions (if required for the specific aircraft group) related to RVSM airworthiness approval.

b) Place emphasis on promptly setting the sub-scale on all primary and standby altimeters to 29.92 in. Hg/1013.2 (hPa) when passing the transition altitude and rechecking for proper altimeter setting when reaching the initial cleared flight level (CFL).

c) In level cruise, it is essential that the aircraft is flown at the CFL. This requires that particular care is taken to ensure that ATC clearances are fully understood and followed. Except in contingency or emergency situations, the aircraft should not intentionally depart from CFL without a positive clearance from ATC.

d) During cleared transition between levels, the aircraft should not be allowed to overshoot or undershoot the CFL by more than 150 ft (45 m).

Note 1.- It is recommended that the level off be accomplished using the altitude capture feature of the automatic altitude-control system, if installed.

Note2. - High rates of climb or descent may result in nuisance TCAS alerts on older TCAS equipment (TCAS 7.0) when in vicinity of other traffic or in areas of high traffic density. For this reason, it may be advisable to reduce

the rate of climb/descent to less than 1,000 ft/min within 1,000 ft of the cleared flight level.

e) An automatic altitude-keeping system should be operative and engaged during level cruise, except when circumstances such as the need to re-trim the aircraft or turbulence require its disengagement. In any event, adherence to cruise altitude should be done by reference to one of the two primary altimeters.

f) The altitude-alerting system should be operating and engaged.

g) At intervals of approximately one hour, make cross-checks between the primary altimeters and the stand-by altimeter. A minimum of two primary altimeters should agree within 200 ft (60 m) or a lesser value if specified in the aircraft operating manual. (Failure to meet this condition will require that the altimetry system be reported as defective and notified to ATC). Annotation of the difference between the primary and stand-by altimeters for use in contingency situations.

1) Some aircraft have automatic comparators that compare the two primary altimetry systems. The comparators include a monitoring, warning, and fault function. The faults may be recorded automatically by the system but a record of the differences in the primary altimetry systems may not be easily derived.

2) Notwithstanding 3.1.5.1 g) 1), altimeter readings should be documented by the flight crew during the hourly crosschecks.

3) When operating under positive radar control, the initial altimeter cross-check should be performed after level off. The readings of the primary and standby altimeters should be recorded and available for use in contingency situations.

h) Crew should ensure the autopilot used and the transponder selected use the same air data source for altitude information.

i) If ATC notifies the pilot of an AAD error that equals or exceeds 300 ft (90 m) then the pilot should take action to return to CFL as quickly as possible.

j) the following contingency procedures should be adhered to after entering RVSM airspace:

1) the pilot should notify ATC of contingencies (equipment failures, weather conditions) in which the ability to maintain CFL is affected and coordinate a plan of action;

2) notwithstanding the requirements of 3.16, equipment failures should be notified to ATC. Some examples are:

i) failure of all automatic altitude-keeping devices on board the aircraft;

ii) loss of redundancy of altimetry systems, or any part of these, on board the aircraft;
iii) failure of all altitude-reporting transponders;
iv) loss of thrust on an engine necessitating descent; and
v) any other equipment failure affecting the ability to maintain CFL;

3) the pilot should notify ATC when encountering severe turbulence; and

4) if unable to notify ATC and obtain an ATC clearance prior to deviating from the assigned CFL, the pilot should follow established contingency procedures as defined by the region of operation and obtain ATC clearance as soon as possible.

3.1.6 Equipment failures

3.1.6.1 ATC shall be informed as soon as practicable of the following equipment failures:

a) loss of one or more primary altimetry systems

b) failure of any relevant altitude control systems.

3.1.7 Post flight procedures

3.1.7.1 In making maintenance logbook 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. Note the following information when appropriate:

a) primary and standby altimeter readings

b) altitude selector setting

c) subscale setting on altimeter

d) autopilot used to control the airplane and any differences when the alternate system was selected

e) differences in altimeter readings if alternate static ports selected

f) use of air data computer selector for fault diagnosis procedure

g) transponder selected to provide altitude information to ATC and any difference if alternate transponder or altitude source is manually selected.

3.1.8 Special emphasis items: flight crew training

3.1.8.1 The following items should also be included in flight crew training programmes.

a) Area of operations specific policy and procedures including standard ATC phraseology.

b) Importance of crew members cross checking each other to ensure that ATC clearances are promptly and correctly complied with.

c) Use and limitations in terms of accuracy of standby altimeters in contingencies. Where applicable, the pilot should review the application of SSEC/PEC through the use of correction cards.

d) Problems of visual perception of other aircraft at 1,000 ft (300 m) planned separation during night conditions, when encountering local phenomena such as northern lights, for opposite and same direction traffic, and during turns.

e) Characteristics of aircraft altitude capture systems that may lead to the occurrence of overshoots.

f) Operational procedures and operating characteristics related to TCAS / ACAS operation in an RVSM operation.

g) Relationship between the altimetry, automatic altitude control, and transponder systems in normal and abnormal situations.

h) Aircraft operating restrictions (if required for the specific aircraft group) related to RVSM airworthiness approval.

i) For those operators authorised to conduct oceanic operations – use of SLOP in oceanic airspace to mitigate the effect of wake turbulence and the effect of operational errors.

j) Specific procedures for oceanic airspace as outlined in Appendix 1 of this CAGM.

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4 System Performance Monitoring

4.1 RVSM height monitoring programmes

4.1.1 A programme to monitor or verify aircraft height-keeping performance is considered a necessary element of RVSM. RVSM monitoring programmes have the primary objective of observing and evaluating aircraft height-keeping performance to gain confidence that airspace users are applying the airplane/operator RVSM approval in an effective manner and that an equivalent level of safety will be maintained.

4.2 Initial height validation monitoring

4.2.1 The RVSM airworthiness review requires that the aircraft and operator be involved in an RVSM initial height validation monitoring programme. The initial height validation monitoring programme validates the aircraft's height performance for RVSM operations. For most aircraft types, monitoring is not required to be completed prior to operational approval being granted. The categories of monitoring are detailed below:

a) Aircraft type group approved aircraft (data indicates compliance with RVSM MASPS). Two airframes from each fleet of an operator are to be monitored as soon as possible but not later than 6 months after the issue of an RVSM approval.

b) Aircraft type group approved aircraft (insufficient data on approved aircraft). Sixty percent of airframes (round up if fractional) from each fleet of an operator are to be monitored or individually monitored, as soon as possible but not later than six months after the issue of an RVSM approval.

c) Bespoke / non-group aircraft. One hundred percent of aircraft shall be monitored prior to the granting of an RVSM approval.

Note: Contact with the CAAM is required to clarify / confirm that the operator's aircraft are in the appropriate category.

d) Aircraft status for monitoring. Aircraft engineering work required for the aircraft to receive RVSM airworthiness approval must be completed prior to the aircraft being monitored.

e) Monitoring of airframes that are RVSM compliant on delivery. If an operator adds new RVSM compliant airframes of a type for which it already has RVSM approval, providing the operator has completed monitoring requirements for the type, the new airframes are not required to be monitored – except as targeted at a later date in the continued monitoring programme. If an operator adds new RVSM compliant airframes of an aircraft type for which it has not previously received RVSM approval, then the operator is to complete monitoring in accordance with this CAGM.

f) Applicability of monitoring from other regions. Monitoring data obtained in conjunction with monitoring programmes from other regions can be used to meet pacific monitoring requirements. MAAR administers the monitoring programme in the FIRs for which it is responsible and has access to monitoring data from other regions and will coordinate with states and operators to inform them on the status of individual operator monitoring requirements.

4.3 Continued height monitoring programme.

4.3.1 As Outlined in CAD 6, 7.2.

4.4 RVSM monitoring methods

4.4.1 There are multiple methods and agencies for performing RVSM height monitoring. There are four categories:

a) Height monitoring units (HMUs). In operation in Europe, US and Japan. HMU is a ground-based system consisting of two main components – height monitoring element (HME) and total vertical error monitoring unit (TMU).

1) The HME captures SSR transponder signals from aircraft replying to Interrogations from radar stations. The signals contain the information from mode S and mode A / C transmissions. The HME determines the geometric height and position of an aircraft by comparing the time of reception of the SSR transponder signals at different receiver locations. This information is transmitted to the TMU as one plot per second. The data is collated by the TMU to create a track history of the aircraft passing through the area of coverage. The track information is then combined with meteorological data to evaluate the overall value for TVE.
2) When completed, the monitoring process produces TVE, AAD and ASE readings for each aircraft measured. This data is fed to the region's monitoring agency. Currently there are no HMUs in the pacific region but there are multiple HMUs available in other regions. Contact CAAM for further information.

b) Aircraft geometric height measurement elements (AGHMEs). A ground-based height monitoring system in operation in the US and Canada. The AGHME system does not require that any special monitoring devices be installed on an aircraft in order that it is monitored. It is necessary, however, transponder. Straight and level flight through the centre of the AGHME coverage area between FL 290 and FL 410 is required. Contact CAAM for further information.

c) ADS-B height monitoring system (AHMS). A ground-based height keeping performance monitoring system that utilises geometric height data available from automatic dependant surveillance - broadcast (ADS-B) equipped aircraft in order to calculate the ASE. Monitoring in airspace where a wide-area ADS-B network is available will not require an aircraft to specifically overfly any specific AHMS site, as normal flight operations can be monitored on a continuous basis with no operational impact. The use of ADS-B as a means to estimate ASE and comply

with the CAD 6. 'Continued height-keeping monitoring requirements' has been endorsed by ICAO. Currently, the use of ADS-B for continued height keeping monitoring purposes is operational in the US, Australia, China and Asian RVSM regions. Contact CAAM for further information.

Note: ICAO has endorsed AHMS (ADS-B) as a means for continued height-keeping monitoring. AHMS (ADSB) is also a means to meet the initial validation height keeping monitoring requirements.

d) GPS monitoring units (GMU). GMUs are a portable aircraft-based height monitoring unit. The GMU process requires straight and level flight between FL 290 and FL 410 where the GMU provider or operator will monitor the aircraft's height performance. The GMU provider will then process the data by applying differential corrections to the raw GPS data. They then submit it to PARMO where they determine the TVE. GMU monitoring is conducted globally. Contact CAAM for further information.

4.5 RVSM regional monitoring agencies (RMAs)

4.5.1 RMAs are agencies that ICAO has approved following the global implementation of RVSM. These agencies ensure the safe use of specific airspace designated by regional agreement by assessing how successfully the airspace meets the agreed TLS. The target is determined by ICAO and depends on satisfactory aircraft height keeping performance and measurement of risk associated with operational errors.

4.6 Monitoring Agency for Asia Region (MAAR)

4.6.1 As outlined in CAD 6, 7.2

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5 Certification of RVSM

5.1 General

5.1.1 In this CAGM, RVSM operations mean all procedures applied for the purpose of ensuring safe aircraft operations in RVSM airspace.

5.1.2 CAAM certification procedures are outlined in this manual.

5.1.3 The RVSM approval process consists of two discrete approvals, an airworthiness Recommendation and an operational approval.

5.1.4 The required information shall be provided to the CAAM by an air operator applying for RVSM approval at least 60 working days prior to the intended start of RVSM operations.

5.1.5 Any questions not covered herein, or any point of apparent conflict requiring resolution, should be referred to the CAAM.

5.2 Application for RVSM

5.2.1 The approval process consists of the following phases:

5.2.1.1 ***Step 1 — Pre-application phase:*** Prior to initiating the approval process, the operator will review the requirements and guidelines outlined in the relevant regulations, CADs, and CAGMs which are published by the CAAM.

A pre-application usually commences when a prospective applicant makes his initial inquiries regarding application for an approval in the form of a letter or a personal visit to the CAAM. If the proposed application is complex, the operator may need to obtain advice and assistance from OEMs or other design organisations, training establishments, data providers, etc.
This Phase will include both Flight Operations and Airworthiness division to assist the applicant in queries and highlighting the requirements.

5.2.1.2 ***Step 2 — Formal application phase:*** The operator submits to the CAAM a formal, written application for approval, the CAAM will then appoint a Specific Approvals Manager (SAM) to oversee the application

Note. – An example application form is contained in Attachment A.

5.2.1.3 ***Step 3 — Document evaluation phase:*** The CAAM FOI and AWI evaluate the formal written application for approval to determine if all the requirements are being met. The FOI and AWI, may need to obtain advice and assistance from other departments within CAAM or organisations such as regional agencies or experts in other States.

5.2.1.4 ***Step 4 – Demonstration and inspection phase:*** During a formal inspection by the FOI and AWI (assisted as necessary by a team from the CAAM), the operator demonstrates how the requirements are being met.

5.2.1.5 ***Step 5 – Approval phase:*** Following a successful formal inspection by the CAAM, approval is given via:

a) an amendment to the OM; and

b) an Ops Spec associated with the AOC; or

c) a Specific Approval attached along with the Certificate of Approval.

Note 1. – The demonstration and inspection phase may not be required depending upon the type of operation used, subject to the consideration of the CAAM.

5.3 Approval criteria

5.3.1 Requests for RVSM approval will be considered if the following criteria (set out in greater detail in the chapters in this CAGM) are met:

a) The aircraft has suitable flight characteristics, an approved list of equipment and acceptable continuing maintenance programme;

b) The aircraft is operated by a qualified crew in conformity with laid down procedures; and

c) The aeroplane is suitably equipped and maintained.

5.3.2 For the purpose of obtaining an approval from the CAAM, an operator shall submit the application form along with evidence that:

a) The aircraft is qualified for RVSM operation and the organisation has in place the policy and procedures to operate with RVSM capability. This shall be justified by submitting the Engineering Report in accordance with paragraph 2.10.2 of this Leaflet and completing Section E of the application form

b) procedures for monitoring and reporting height-keeping errors have been established.

c) The operator shall provide a plan for participation in the regional monitoring programme.

d) a training programme for the flight crew members involved in these operations has been established. The required training programme is contained in 3.1 of this CAGM.

e) operating procedures have been established specifying:

1) the equipment to be carried, including its operating limitations and appropriate entries in the MEL;
2) flight crew composition and experience requirements;
3) flight planning;
4) pre-flight procedures;
5) procedures prior to RVSM airspace entry;
6) in-flight procedures;
7) post-flight procedures;

8) incident reporting; and
9) specific regional operating procedures

5.3.3 When all the requirements of the airworthiness recommendation and operational approval have been assessed as satisfactory, CAAM will issue a letter of authorisation or the operator's air operator certificate – operations specifications will be updated to reflect the RVSM approval. An RVSM approval issued by the CAAM is valid for all regions operating RVSM airspace provided specific restrictions have not been imposed on the operator by CAAM.

5.3.4 Once an RVSM approval has been granted, the CAAM will notify MAAR. The notification will include:

a) state of registry of the aircraft

b) name of the operator

c) state of the operator

d) aircraft type

e) aircraft series

f) aircraft serial number(s)

g) registration mark

h) Mode S address code(s)

i) date of RVSM airworthiness approval

j) date of RVSM approval.

Note: The date of airworthiness approval issued by the CAAM should be the actual date that the modifications/inspections were completed for each airframe.

5.4 RVSM approval limitation

5.4.1 RVSM operational approval is aircraft and operator specific; any changes to the identity of the aircraft or operator shall render the RVSM operational approval invalid and CAAM shall be informed of such changes without delay.

5.5 Operational approval

5.5.1 The RVSM operational approval ensures that the operator can maintain the RVSM integrity of each aircraft that is to be operated in RVSM airspace. During the RVSM operational approval process CAAM will assess the operator's flight crew procedures, maintenance procedures, training programmes and RVSM continued height monitoring programme for each aircraft type. Operators are to provide supporting documentation to demonstrate RVSM operational compliance, relevant documents include:

a) operations manual (RVSM flight operations)

b) maintenance programme (RVSM continued airworthiness)

c) RVSM continued height monitoring plan

d) RVSM training programmes:

1) maintenance training
2) flight crew training.

Note: In 2010 ICAO identified the requirement for continued height-keeping performance monitoring of RVSM capable aircraft in order to ensure continued RVSM suitability; Chapter 4 provides more detail on continued height monitoring. The operator is to have a programme in place to ensure that their RVSM approved aircraft are involved in a continued RVSM height monitoring programme.

5.5.2 Chapter 2.2 provides detailed information on flight crew training programmes, operating practices and procedures. Appendix 1 provides detailed information on RVSM specific procedures for oceanic airspace and Chapter 4 provides detailed information on RVSM monitoring.

5.6 Revocation of RVSM approval

5.6.1 The incidence of height-keeping errors that can be tolerated in an RVSM environment is very small. It is incumbent upon each operator to take immediate action to rectify the conditions that caused the error. The operator should also report the event to CAAM within 48 hours with initial analysis of the causal factors and measures to prevent further events. CAAM will determine the requirement for follow up reports. Errors which should be reported and investigated are:

a) TVE equal to or greater than ±300 ft (±90 m),

b) ASE equal to or greater than ±245 ft (±75 m), and

c) AAD equal to or greater than ±300 ft (±90 m).

5.6.2 An operator who consistently commits errors of either variety may lose its approval for RVSM operations. If a problem is identified that is related to one specific aircraft, then RVSM approval may be removed from the operator for that specific aircraft

6 Appendices

6.1 Appendix 1: Specific procedures for oceanic airspace

1 RVSM was initially implemented in North Atlantic MNPS airspace in March 1997. The guidance that follows has been applied in the North Atlantic region since that time. It is also applied to RVSM operations in the Pacific, West Atlantic and other oceanic airspace. This appendix contains information on procedures that are unique to oceanic RVSM airspace where direct voice communications between pilots and ATC is not available.

2 Contingency Procedures

2.1 Specific guidance for contingencies

2.1.1 The basic concepts for contingencies described in this paragraph were developed from the specific guidance contained in ICAO Document 4444, Chapter 15, Special In-Flight Contingencies. Contingency procedures become complicated when specific situations are detailed. However, if the details are examined in the context of certain basic concepts, then they are more easily understood.

2.1.2 Reviewing these concepts should serve to aid pilots' understanding of the specific contingency procedures detailed in ICAO Document 4444. Contingency procedures published in ICAO Document 7030, Regional Supplementary Procedures, provide differences for individual regions of the world.

2.2 Basic concepts for contingencies

2.2.1 Do not interpret guidance for contingency procedures in any way that prejudices the final authority and responsibility of the PIC for the safe operation of the aircraft. If the pilot is unsure of the vertical or lateral position of the aircraft or the aircraft deviates from its assigned altitude or track for cause without prior ATC clearance, then the pilot must take action to mitigate the potential for collision with aircraft on adjacent routes or flight levels.

Note: In this situation, the pilot should alert adjacent aircraft by making maximum use of aircraft lighting and broadcasting position flight level, and intentions on 121.5 megahertz (MHz) (as a back-up, the appropriate VHF inter-pilot air-to-air frequency may be used).

2.2.2 Unless the nature of the contingency dictates otherwise, the pilot should advise ATC as soon as possible of a contingency situation and if possible, request an ATC clearance before deviating from the assigned route or FL.

2.2.3 If a revised ATC clearance cannot be obtained in a timely manner and action is required to avoid potential conflict with other aircraft, then the aircraft should be flown at a flight level and on an offset track where other aircraft are least likely to be encountered. Specifically, the pilot shall do the following actions.

a) Acquire and maintain in either direction a track laterally separated by 9.3 km (5 NM) from the assigned route

b) Once established on the offset track, climb or descend to select a FL which differs from those normally used by 150 m (500 ft)

c) Also consider descending below FL 285 or climbing above FL 410. (The vast majority of oceanic traffic operates between FL 290 and 410. Flight above FL 410 or below FL 285 may limit exposure to conflict with other aircraft.).

2.2.4 When executing a contingency manoeuvre, the pilot should:

a) watch for conflicting traffic both visually and by reference to ACAS or TCAS, if equipped

b) continue to alert other aircraft using 121.5 MHz (as a back-up, the VHF interpilot air-to-air frequency (VHF 123.45) may be used) and aircraft lights

c) continue to fly offset tracks or altitudes until an ATC clearance is obtained

d) obtain an ATC clearance as soon as possible.

3 Guidance to the pilot in the event of equipment failures or encounters with turbulence after entry into RVSM airspace (including expected ATC actions)

3.1 In addition to emergency conditions that require immediate descent, such as loss of thrust or pressurisation, make ATC aware of the less explicit conditions that may make it impossible for an aircraft to maintain its CFL appropriate to RVSM. Controllers should react to such conditions, but these actions cannot be specified, as they will be dynamically affected by the real-time situation.

4 Objective of the guidance material

4.1 The following material is provided with the purpose of giving the pilot guidance on actions to take under certain conditions of equipment failure and encounters with turbulence. It also describes the expected ATC controller actions in these situations. It is recognised that the pilot and controller will use judgment to determine the action most appropriate to any given situation. The guidance material recognises that for certain equipment failures, the safest course of action may be for the aircraft to maintain the assigned FL and route while the pilot and controller take precautionary action to protect separation.

4.2 For extreme cases of equipment failure, however, the guidance recognises that the safest course of action may be for the aircraft to depart from the cleared FL or route by obtaining a revised ATC clearance or if unable to obtain prior ATC clearance, executing the established ICAO Document 4444 and Document 7030 contingency manoeuvres for the area of operation.

5 Contingency scenarios

5.1 The following paragraphs summarise pilot actions to mitigate the potential for conflict with other aircraft in certain contingency situations. They should be reviewed in conjunction with the expanded contingency scenarios.

a) Scenario 1: The pilot is unsure of the:

1) vertical position of the aircraft due to the loss or degradation of all primary altimetry systems, or

2) capability to maintain CFL due to turbulence or loss of all automatic altitude control systems.

The pilot should do the following actions:	ATC can be expected to do the following actions:
Maintain CFL while evaluating the situation.	
Watch for conflicting traffic both visually and by reference to ACAS (TCAS), if equipped.	
If considered necessary, alert nearby aircraft by: (i) making maximum use of exterior lights (ii) broadcasting position, FL, and intentions on 121.5 MHz (as a back-up, the VHF inter-pilot air-to-air frequency may be used).	
Notify ATC of the situation and intended course of action. Possible courses of action include.	Obtain the pilot's intentions and pass essential traffic information.

a) Maintaining the CFL and route provided that ATC can provide lateral, longitudinal or conventional vertical separation.	a) If the pilot intends to continue in RVSM airspace, assess traffic situation to determine if the aircraft can be accommodated through the provision of lateral, longitudinal, or increased vertical separation, and if so, apply the appropriate minimum.
b) Requesting ATC clearance to climb above or descend below RVSM airspace if the aircraft cannot maintain CFL and ATC cannot establish adequate separation from other aircraft.	b) If the pilot requests clearance to exit RVSM airspace, accommodate expeditiously, if possible.
c) Executing the ICAO Document 4444 contingency manoeuvres to offset from the assigned track and FL, if ATC clearance cannot be obtained and the aircraft cannot maintain CFL.	c) If adequate separation cannot be established and it is not possible to comply with the pilot's request for clearance to exit RVSM airspace, advise the pilot of essential traffic information, notify other aircraft in the vicinity and continue to monitor the situation.
	d) Notify adjoining ATC facilities/sectors of the situation.

b) Scenario 2: A failure or loss of accuracy of one primary altimetry system (for example: greater than 200 ft difference between primary altimeters)

The pilot should:
Cross check standby altimeter, confirm the accuracy of a primary altimeter system and notify ATC of the loss of redundancy. If unable to confirm primary altimeter system accuracy, follow pilot actions listed in the preceding scenario.

5.2 Expanded equipment failure and turbulence encounter scenarios (operators may consider this material for use in training programs)

a) Scenario 1: All automatic altitude control systems fail (for example: automatic altitude hold)

The pilot should do the following action:	ATC can be expected to do the following:
Initially maintain CFL, and	
Evaluate the aircraft's capability to maintain altitude through manual control.	
Subsequently watch for conflicting traffic both visually and by reference to TCAS, if equipped.	
If considered necessary, alert nearby aircraft by: (i) making maximum use of exterior lights (ii) broadcasting position, FL, and intentions on 121.5 MHz (as a back-up, the VHF inter-pilot air-to-air frequency may be used).	
Notify ATC of the failure and intended course of action. Possible courses of action include:	
a) Maintaining the CFL and route, provided that the aircraft can maintain level.	a) If the pilot intends to continue in RVSM airspace, assess traffic situation to determine if the aircraft can be accommodated through the provision of
	lateral, longitudinal, or increased vertical separation, and if so, apply the appropriate minimum.
b) Requesting ATC clearance to climb above or descend below RVSM airspace if the aircraft cannot maintain CFL and ATC cannot establish lateral, longitudinal or conventional vertical separation.	b) If the pilot requests clearance to exit RVSM airspace, accommodate expeditiously, if possible.
c) Executing the ICAO Document 4444 contingency manoeuvre to offset from the assigned track and FL, if ATC clearance cannot be obtained and the aircraft cannot maintain CFL.	c) If adequate separation cannot be established and it is not possible to comply with the pilot's request for clearance to exit RVSM airspace, advise the pilot of essential traffic information, notify other aircraft in the vicinity and continue to monitor the situation.
	d) Notify adjoining ATC facilities/ sectors of the situation.

b) Scenario 2: Loss of redundancy in primary altimetry systems

The pilot should do the following actions:	ATC can be expected to do the following actions:
If the remaining altimetry system is functioning normally, couple that system to the automatic altitude control system, notify ATC of the loss of redundancy and maintain vigilance of altitude keeping.	Acknowledge the situation and continue to monitor progress.

c) Scenario 3: All primary altimetry systems are considered unreliable or fail

The pilot should do the following actions:	ATC can be expected to do the following actions:
Maintain CFL by reference to the standby altimeter (if the aircraft is so equipped).	
Alert nearby aircraft by: (i) making maximum use of exterior lights (ii) broadcasting position, FL, and intentions on 121.5 MHz (as a back-up, the VHF inter-pilot air-to-air frequency may be used).	
Consider declaring an emergency. Notify ATC of the failure and intended course of action. Possible courses of action include the following.	Obtain pilot's intentions, and pass essential traffic information.
a) Maintaining CFL and route provided that ATC can provide lateral, longitudinal, or conventional vertical separation.	a) If the pilot intends to continue in RVSM airspace, assess traffic situation to determine if the aircraft can be accommodated through the provision of lateral, longitudinal, or increased vertical separation, and if so, apply the appropriate minimum.
b) Requesting ATC clearance to climb above or descend below RVSM airspace if ATC cannot establish adequate separation from other aircraft.	b) If the pilot requests clearance to exit RVSM airspace, accommodate expeditiously, if possible.
c) Executing the ICAO Document 4444 contingency manoeuvre to offset from the assigned track and FL, if ATC clearance cannot be obtained.	c) If adequate separation cannot be established and it is not possible to comply with the pilot's request for clearance to exit RVSM airspace, advise the pilot of essential traffic information, notify other aircraft in the vicinity and continue to monitor the situation.
	d) Notify adjoining ATC facilities/sectors of the situation.

d) Scenario 4: The primary altimeters diverge by more than 200 ft (60 m)

The pilot should do the following actions:
Attempt to determine the defective system through established trouble-shooting procedures and/or comparing the primary altimeter displace to the standby altimeter (as corrected by the correction cards, if required). □
If the defective system can be determined, couple the functioning altimeter system to the altitude keeping device. □
If the defective system cannot be determined, follow the guidance in Scenario 3 for failure or unreliable altimeter indications of all primary altimeters.

f) Scenario 5: Turbulence (greater than moderate) which the pilot believes will impact the aircraft's capability to maintain FL.

The Pilot should:	The Controller should:
Watch for conflicting traffic both visually and by reference to ACAS, if equipped. If considered necessary, alert nearby aircraft by: 1. Making maximum use of exterior lights 2. Broadcasting position, FL, and intentions on 121.5 MHz (as a back-up, the VHF inter-pilot air-to-air frequency, 123.45 MHz, may be used) Notify ATC of intended course of action as soon as possible. Possible courses of action include:	
a) Maintaining CFL and route provided the ATC can provide lateral, longitudinal and conventional vertical separation.	a) Assess traffic situation to determine if the aircraft can be accommodated through the provision of lateral, longitudinal, or conventional vertical separation, and if so, apply the appropriate minimum.
b) Requesting flight level change.	b) If unable to provide adequate separation, advise the pilot of essential raffic information and request pilot's intention.
c) Executing the contingency maneuver to offset from the assigned track and FL, if ATC clearance cannot be obtained and the aircraft cannot maintain the CFL.	c) Notify other aircraft in the vicinity and monitor the situation. Notify adjoining ATC facilities/sectors of the situation.

6 Special procedures for in-flight contingencies published for individual ICAO regions in Document 7030

6.1 Basic contingency procedures are in ICAO Document 4444, Chapter 15, Procedures Relating to Emergencies, Communications Failures and Contingencies. ICAO Document 4444 and Document 7030 are the source documents for specific contingency procedures applicable to individual ICAO regions. Always consult Document 7030 before training material or manuals are developed.

The pilot should do the following action:	ATC can be expected to do the following:
Watch for conflicting traffic both visually and by reference to TCAS, if equipped.	
If considered necessary, alert nearby aircraft by: (i) making maximum use of exterior lights (ii) broadcasting position, FL, and intentions on 121.5 MHz (as a back-up, the VHF inter-pilot air-to-air frequency may be used).	
Notify ATC of intended course of action as soon as possible. Possible courses of action include:	
a) Maintaining CFL and route provided ATC can provide lateral, longitudinal or conventional vertical separation.	a) Assess traffic situation to determine if the aircraft can be accommodated through the provision of lateral, longitudinal, or increased vertical separation, and if so, apply the appropriate minimum.
b) Requesting flight level change, if necessary.	b) If unable to provide adequate separation, advise the pilot of essential traffic information and request pilot's intentions.
c) Executing the ICAO Doc.4444 contingency maneuverer to offset from the assigned track and FL, if ATC clearance cannot be obtained and the aircraft cannot maintain CFL.	c) Notify other aircraft in the vicinity and monitor the situation. d) Notify adjoining ATC facilities/ sectors of the situation

7 Wake turbulence procedures

7.1 SLOP allows aircraft to offset from the centre line of its track by one NM or two NMs to the right for wake turbulence avoidance and for increased safety.

8 Transponder failure

8.1 The provider states will determine the specific actions that ATC will take in the event of transponder failure in RVSM.

6.2 Appendix 2 : Minimum Aircraft Systems Performance Specifications (MASPS)

1 Definitions

“Altimetry system error” or ASE” means the difference between the altitude indicated by the altimeter display (assuming the altimeter barometric setting is correct) and the pressure altitude corresponding to the undisturbed ambient pressure; “Total vertical error” or “TVE” means the vertical geometric difference between the actual pressure altitude flown by an aircraft and its assigned pressure altitude (flight level).

2 In respect of a group of aeroplanes that are nominally of identical design and build with respect to all details that could influence the accuracy of an aeroplane’s height-keeping performance capability, the performance of the altimeter system for operation by the group of aeroplanes in RVSM airspace is such that the total vertical error for the group of aeroplanes.

a) has a mean no greater than 25 m (80 ft) in magnitude; and
b) has a standard deviation (z) with a magnitude no greater than:
   i. if the mean Total Vertical Error (TVE) is measured in metres, the value of $28 - 0.013z^2$ for $0 \leq z \leq 25$; or
   ii. if the mean TVE is measured in feet, the value of $92 - 0.004z^2$ for $0 \leq z \leq 80$.

3 The components of total vertical error mentioned in paragraph 1 must have the following characteristics:

a) the mean Altimetry System Error (ASE) of the group must not exceed 25 m (80 ft) in magnitude;
b) the sum of the absolute value of the mean ASE and 3 standard deviations of altimetry system error must not exceed 75 m (245 ft);
c) the differences between cleared flight level and the indicated pressure altitude actually flown must be symmetric about a mean of 0 m (0 ft), with a standard deviation no greater than 13.3 m (43.7 ft);
d) the frequency of the differences occurring must decrease exponentially with the increase in the magnitude of the differences.

4 In respect of any aeroplane that cannot be classified as belonging to a group of aeroplanes as the characteristics of the aeroplane’s airframe and altimetry system fit are unique, the height-keeping performance capability of the aeroplane must be such that the components of the TVE for the aeroplane have the following characteristics:

a) the magnitude of the aeroplane’s ASE must not exceed 60 m (200 ft) under any flight condition;
b) the difference between the cleared flight level and the indicated pressure altitude actually flown must be symmetric about a mean of 0 m (0 ft), with a standard deviation no greater than 13.3 m (43.7 ft);
c) the frequency of the differences occurring must decrease exponentially with the increase in the magnitude of the differences.

7 Attachments

7.1 Attachment A: RVSM Application Form

7.1.1 The Latest Application form (CAAM/BOP/SPA/RVSM) may be obtained from the CAAM Website. https://www.caam.gov.my/e-services-forms/air-operations/