NIGERIA CIVIL AVIATION AUTHORITY

ADVISORY CIRCULAR

NCAA-AC-AWS33

10TH APRIL 2023

Reduced Vertical Separation Minima (RVSM) Approval

1.0 PURPOSE

1.1 This Advisory Circular provides guidance for operator who intends to obtain RVSM approval from the NCAA.

2.0 INTRODUCTION

2.1 RVSM is an ICAO sponsored reduction in vertical separation from 2000 ft to 1000 ft between FL. 290 and FL. 410. It will be implemented on a regional basis to become a global standard. All operators must comply with the operating rules of any specific airspace. Generally these rules are compliance with FAA Memorandum 07/04/1994, ICAO Doc. 9574 and JAA Doc. 7030.

2.2 RVSM Approval is not restricted to a region, it is global, but requires that state differences be listed in operator's documentation for Flight Crew information and compliance. Operational Approval by NCAA is based on:

a. The aircraft meeting Vertical Navigation (Altimetry) performance capabilities.

b. The Operator proving the introduction and continuation of a required maintenance and repair program.

c. Flight Crew Training in RVSM procedures.

I. MANDATORY EQUIPMENT FOR RVSM

Before entering RVSM airspace, the flight crew should review the status of the required equipment. The following equipment should be operative:

a) 2 primary altitude measurement systems (Altimeters) with cross-coupled static source system with ice protection plus digital encoding and static source error correction.

b) 1 Instrument Comparator System.

c) 1 ATC Transponder.

d) 1 Altitude Alerting Device.

e) 1 Auto Pilot with Altitude Hold functioning.

f) 1 TCAS.

NOTE: Should any of the required equipment fail prior to the aircraft entering RVSM airspace, the flight crew should request a new clearance or avoid flight in this airspace.

II. FLIGHT PLANNING

During flight planning the flight crew should pay particular attention to conditions that may affect operation in RVSM airspace. These include, but may not be limited to:

a) verifying the validity of approval for RVSM approval through on board documentation,

b) reported and forecast weather on the route of flight, i.e. > Moderate Turbulence,

c) minimum equipment requirements pertaining to height keeping and alerting system, and

d) any MEL or operating restriction related to RVSM approval.

In addition, ensure the letter W appears in Field 10 of the ICAO Flight Plan.

III. PROCEDURES AT THE AIRCRAFT BEFORE FLIGHT

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

a) Review Aircraft logbook and MEL to determine the condition of equipment required for flight in the RVSM airspace. Ensure that maintenance action has been taken to correct defects to required equipment.

b) During the external inspection of aircraft, particular attention should be paid to the condition of static source and the condition of the fuselage skin near each static source and any other component that affect altimetry system accuracy. Technical Services personnel may accomplish this check.

c) Before takeoff, the aircraft altimeter should be set to the QNH of the airfield and should display a known altitude, within the limits specified in the aircraft MEL. Any required functioning check of the altitude indicating system should be performed by Technical Service personnel. The maximum value of this checks cited in operating manuals should not exceed (75ft).

d) Before takeoff, equipment required for the flight in RVSM airspace should be operative, and any indications of malfunction should be resolved.

IV. IN-FLIGHT PROCEDURES

a) Flight crew would need to comply with any aircraft operating restrictions, if required for the specific aircraft fleet.

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

c) In level cruise it is essential that the aircraft is flown at the cleared flight level and Mach No. This requires that particular care is taken to ensure that ATC clearance are fully understood and followed. The aircraft should not intentionally depart from cleared flight level without a positive clearance from ATC unless the crew is conducting contingency or emergency maneuvers.

d) When changing levels, the aircraft should not be allowed to overshoot or undershoot the cleared flight level by more than 150 ft. Vertical speed not to exceed 1500 fpm.

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

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

f) Ensure that the altitude-alerting system is operative.

g) Before entering RVSM airspace, the initial altimeters cross check of primary and standby altimeter shall be made and recorded on the Computer Flight Plan (CFP). At subsequent intervals of approximately one hour, cross check should be made again and recorded. A minimum of two altimeters will need to agree within 200 ft. Failure to meet this requirement will require the altimetry system be reported as defective and ATC notified.

h) In normal operations the altimetry system being used to control the aircraft should be selected for the input altitude reporting transponder transmitting information to ATC. If the Flight crew is advised in real time that the aircraft has been identified by a height-monitoring system as exhibiting a Total Vertical Error (TVE) greater than 300 ft then they should follow established regional procedures to protect the safe operation of the aircraft. This assumes that the monitoring system will identify the TVE within the set limits for accuracy.

i) If the flight crew is notified by ATC of an assigned altitude deviation which exceeds 300 ft then they should take action to return to cleared flight level as quickly as possible.

V. CONTINGENCY PROCEDURES IN RVSM AIRSPACE

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

Examples of equipment failures, which should be notified, to ATC are:

a. Failure of all automatic altitude-control system aboard the aircraft.

b. Loss of redundancy of altimetry systems.

c. Loss of thrust on an engine necessitating descent, or

d. Any other equipment failure affecting the ability to maintain cleared flight level.

The flight crew should notify ATC when encountering greater than moderate turbulence. If unable to notify ATC and obtain an ATC clearance prior to deviating from the cleared flight level, the flight crew should follow any established contingency procedures and obtain ATC clearance as soon as possible.

VII. WEATHER DEVIATION PROCEDURES

General procedures

The following procedures are intended to provide guidance. All possible circumstances cannot be covered. The pilot's judgment shall ultimately determine the sequence of actions taken and ATC shall render all possible assistance.

If the aircraft is required to deviate from track to avoid weather and prior clearance cannot be obtained, an air traffic control clearance shall be obtained at the earliest possible time. In the meantime, the aircraft shall follow the procedures detailed below:

The pilot shall advise ATC when weather deviation is no longer required, or when a weather deviation has been completed and the aircraft returned to the centerline of its cleared route.

Obtaining ATC priority

When the pilot initiates communications with ATC, rapid responses may be obtained by stating "WEATHER DEVIATION REQUIRED" to indicate that priority is desired on the frequency and for ATC response.

The pilot still retains the option of initiating the communication using the urgency call "PAN PAN" (preferable spoken three times) to alert all listening parties to a special handing condition which may receive ATC priority for issuance of a clearance or assistance.

When controller-pilot communication are established, the pilot shall notify ATC and request clearance to deviate from track, advising, when possible, the extent of the deviation expected. ATC will take one of the following actions:

a. If there is no conflicting traffic in the horizontal dimension, ATC will issue clearance to deviate from track, or

b. If there is conflicting traffic in the horizontal dimension, ATC will separate aircraft by establishing vertical separation, or

c. If there is conflicting traffic in the horizontal dimension and ATC is unable to establish vertical separation, ATC shall advise the pilot unable, to issue clearance for requested deviation, advise the pilot of conflicting traffic, and request pilot intentions.

The pilot will take the following actions:

a. Advise ATC of intentions by the most expeditious means available.

b. Comply with air traffic control clearance issued, or

c. Execute the procedures detailed below (ATC will issue essential traffic information to all affected aircraft)

d. If necessary, establish voice communications with ATC to expedite dialogue on the situation.

If contact was not established prior to deviation, continue to attempt to contact ATC to obtain clearance. If contact was established, continue to keep ATC advised of intentions and obtain essential traffic information.

WAKE TURBULENCE OR DISTRACTING AIRCRAFT SYSTEM ALERTS.

The following special procedures are applicable to reduce the effect of wake turbulence or distractive aircraft system alerts (e. g TCAS, GPWS).

NOTE: In the contingency circumstances below, ATC will not issue clearance for lateral offsets and will not normally respond to actions taken by pilots.

An aircraft that encounters wake turbulence or experiences distracting aircraft system alerts should notify ATC and request a flight level, track or speed change to avoid the conflict. However in situations where such a change is not possible or practicable, the pilot may initiate the following temporary lateral offset procedure with the intention of returning to centerline as soon as practicable:

a. The pilot should establish contact with other aircraft, if possible, on the appropriate VHF interpilot air-to-air frequency; and

b. One or both aircraft may initiate lateral offset (not to exceed 2 nm from the assigned track, provided that:

1. as soon as practicable to do so, the offsetting aircraft notify ATC that temporary lateral offset action has been taken and specify the reason for doing so, ATC will not normally respond; and

2. the offsetting aircraft notify ATC when re-established on assigned route(s) or track (ATC will not normally respond).

VIII. RVSM AIRSPACE

In European airspace it is expected that aircraft will be in continuous radio contact with ATC on the assigned or emergency frequency (121.5 MHz). Crew will therefore be able to advise ATC of any abnormal circumstances where RVSM performance requirements cannot be met, including encounters with turbulence greater than ‘moderate’. ATC can than respond with a revised clearance before the crew deviate from the original clearance. Some events, such as rapid depressurization will occur with little or no prior notice to ATC. A revised clearance should be obtained as soon as possible after the deviation.

IX. POST FLIGHT

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

The following information should be recorded when appropriate:

a. Primary and standby altimeter readings,

b. Barometric setting on altimeters,

c. Altitude selected,

d. Differences in altimeter readings, if alternate static ports selected,

e. Use of air data computer selector for fault diagnosis procedures,

f. Autopilot use to control the airplane and any differences when an alternative autopilot system was selected, and

g. The transponder selected to provide altitude information to ATC and any difference noted when an alternative transponder was selected.

X. SPECIAL EMPHASIS ITEMS: FLIGHT CREW TRAINING

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

a) knowledge and understanding of standard ATC phraseology used in area of operations;

b) importance of crew members cross checking 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 static source error correction/ position error correction through the use of correction cards;

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

d) problem of visual perception of other aircraft at 30m (100 ft) planned separation during darkness, when encountering local phenomena such as northern lights, for opposite and same direction traffic, and during turns; and

e) characteristics of aircraft capture system which may lead to overshoots;

f) relationship between the aircraft's altimetry, automatic control and transponder system in normal and abnormal conditions;

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

XI. RVSM PHRASEOLOGY

CIRCUMSTANCE	PHRASEOLOGY
ATC wish to know RVSM status of flight	CONFIRM RVSM APPROVED
Pilot indication that flight is RVSM approved	AFFIRM RVSM
Pilot indication that flight is NON RVSM approved	NEGATIVE RVSM
Pilot state aircraft indicating that flight is NON RVSM approved	NEGATIVE RVSM STATE AIRCRAFT
ATC denial of clearance into RVSM Airspace	UNABLE CLEARANCE INTO RVSM AIR-SPACE, MAINTAIN (or DESCEND TO, or CLIMB TO) FL…
Pilot reporting severe turbulence / weather affecting ability to maintain RVSM height-keeping requirements.	UNABLE RVSM DUE TURBULENCE
Pilot reporting equipment degraded below RVSM requirements.	UNABLE RVSM DUE EQUIPMENT
ATC requesting pilots to report when unable to resume RVSM	REPORT ABLE TO RESUME RVSM
Pilot ready to resume RVSM after equipment / weather contingency	READY TO RESUME RVSM

XII AIRCRAFT AND MAINTENANCE REQUIREMENTS

(A) THE APPROVAL PROCESS

Airspace where RVSM is applied should be considered special qualification airspace. Both the individual operator and the specific aircraft type or types which the operator intends to use should be approved by the NCAA before the operator conducts flight in RVSM airspace.

(B) AIRCRAFT APPROVAL

Each aircraft type that an operator intends to use in RVSM airspace should have received airworthiness approval in accordance with the established criteria. Individuals or operators seeking approval for its aircraft should contact the manufacturer of the specific aircraft type to obtain airworthiness approval issued by the State of Design that indicates the newly built aircraft, conforms to that type and build standard and complies with the RVSM airworthiness criteria and apply to the NCAA to obtain approval.

For aircraft already operating the application will need to be supported by evidence confirming that the specific aircraft has been inspected and, where necessary, modified in accordance with applicable Service Bulletins, and is of a type and build standard that meets the RVSM airworthiness criteria. The operator will need to confirm also that the continued airworthiness instructions are available and that the approved Flight Manual amendment or supplement has been incorporated. Approval by the authority indicates that the

aircraft is eligible for RVSM operations. The authority will notify the designated monitoring cell accordingly.

The operator must ensure the aircraft has installed the required equipment and instruments in accordance with **Nig. CARs Part 7.4.1.3.** The mandatory equipment includes:

a) 2 primary altitude measurement systems (Altimeters) with cross-coupled static source system with ice protection plus digital encoding and static source error correction.

b) 1 Instrument Comparator System.

c) 1 ATC Transponder.

d) 1 Altitude Alerting Device.

e) 1 Auto Pilot with Altitude Hold functioning.

f) TCAS

(C) CONTENT OF OPERATOR RVSM MAINTENANCE APPLICATION

The following paragraphs describe the material which an operator applying for RVSM authorisation should provide to the NCAA for review and evaluation at least 60 days prior to the intended start of RVSM operations.

1) Description of Aircraft Equipment. The applicant should provide a configuration list which details all components and equipment relevant to RVSM operations.
2) Past Performance. An operating history should be included in the application. The applicant should show any events or incidents related to poor height keeping performance which may indicate weaknesses in training, procedures, maintenance, or the aircraft group intended to be used.
3) Minimum Equipment List. A minimum equipment list (MEL), adopted from the master minimum equipment list (MMEL), should include items pertinent to operating in RVSM airspace.
4) Airworthiness Documents and a Maintenance Programme. Sufficient documentation should be available to show that the aircraft and maintenance programme has been approved in accordance with Nigeria CARs Part 8.
5) Plan for participation in Monitoring Programs
6) Plan for reporting altitude-keeping errors

(D) DEFINITIONS

The following definitions are intended to clarify certain specialized terms used in this advisory material:

1) Aircraft Group. A group of aircraft that are of normally identical design and build with respect to all details that could influence the accuracy of height keeping performance .
2) Altimetry System Error (ASE) The difference between the pressure altitude displayed to the flightcrew when referenced to ISA standard ground pressure setting (29.92 in. Hg/1013.23 hPa) and free stream pressure altitude.

3) Assigned Altitude Deviation (AAD). The difference between the transponded Mode C altitude and the assigned altitude/flight level.

4) Automatice Altitude Control System. Any system which is designed to automatically control the aircraft to a referenced pressure altitude.

5) Avionics Error (AVE). The error in the processes of converting the sensed pressure into an electrical output, of applying any static source error correction (SSEC) as appropriate, and of displaying the corresponding altitude.

6) Basic RVSM Envelope. The range of Mach numbers and gross masses within the altitude ranges FL 290 to FL 410 (or max available altitude) where an aircraft can reasonably be expected to operate most frequently.

7) Full RVSM Envelope. The entire range of operational Mach numbers, w/δ. and altitude values over which the aircraft can be operated within RVSM airspace.

8) Height-Keeping Capability. Aircraft height-keeping performance which can be expected under nominal environment and operating conditions with proper aircraft operating practices and maintenance.

9) Height-Keeping Performance. The observed performance of an aircraft with respect to adherence to a flight level.

10) Non-Group Aircraft An aircraft for which the operator applies for approval on the characteristics of the unique airframe rather than on a group basis.

11) Residual Static Source Error. The amount by which static source error (SSE) remains undercorrected or overcorrected after the application of SSEC.

12) Static Source Error. The difference between the pressure sensed by the static system at the static port and the undisturbed ambient pressure.

13) Static Source Error Correction (SSEC). A correction for static source error.

14) Total Vertical Error (TVE) Vertical geometirc difference between the actual pressure altitude flown by an aircraft and its assigned pressure altitude (flight level).

15) W/δ. Aircraft weight/mass (e/m), divided by the atmospheric pressure ratio, δ, or mass

16) Approved Data Package. A package developed by the aircraft manufacturer or design organization through which RVSM airworthiness approval is sought from the regulatory authority of the manufacturer. Once the regulatory authority approves the package, the operator applies the procedures defined in the package to obtain approval from the operator's regulatory authority to utilize its aircraft to conduct flight in the RVSM airspace.

(E) MAINTENANCE REQUIREMENTS

i. General.

(1) The integrity of the design features necessary to ensure that altimetry systems continue to meet RVSM standards should be verified by scheduled tests and/or inspections in conjunction with an approved maintenance programme. The operator should review its maintenance procedures and address all aspects of continuing airworthiness which are affected by RVSM requirements.

(2) Each person or operator should demonstrate that adequate maintenance facilities are available to ensure continued compliance with the RVSM maintenance requirements.

ii. Maintenance Programme Approval Requirements. Each operator requesting RVSM operational approval should submit a maintenance and inspection

programme which includes any maintenance requirements defined in the approved data package as part of a continuous airworthiness maintenance programme approval. The maintenance and inspection programme will incorporate altimeter system and altitude reporting equipment tests and inspections as a requirement for maintenance programme approval.

iii. Maintenance documents Requirements: The following items should be submitted as appropriate for RVSM maintenance approval:

(1) Maintenance Manuals and Aircraft Service Bulletins
(2) Structural Repair Manuals.
(3) Standards Practices Manuals
(4) Illustrated Parts Catalogues.
(5) Maintenance Programme.
(6) MMEL/MEL.

iv. Maintenance Practices.

1) If the operator is subject to an ongoing approved maintenance program, that programme should contain the maintenance practices outlined in the applicable aircraft and component manufacturer's maintenance manuals for each aircraft type. The following items should be reviewed for compliance for RVSM approval and if the operator is not subject to an approved maintenance programme the following items should be followed:

(i) All RVSM equipment should be maintained in accordance with the component manufacturer's maintenance requirements and the performance requirements outlined in the approved data package.
(ii) Any modification, repair, or design change which in any way alters the initial RVSM approval, should be subject to a design review by persons approved by the approving authority for the manufacturer.
(iii) Any maintenance practices which may affect the continuing RVSM approval integrity, e.g., the alignment of pitot/static probes, dents, or deformation around static plates, should be referred to the approving authority or persons delegated by the authority for the manufacturer.
(iv) Built-in Test Equipment (BITE) testing is not an acceptable basis for system calibrations, (unless it is shown to be acceptable by the airframe manufacturer with the approval authorities agreement) and should only be used for fault isolation and troubleshooting purposes.
(v) Some aircraft manufacturers have determined that the removal and replacement of components utilizing quick disconnects and associated fittings, when properly connected, will not require a 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.

(vi) Airframe and static systems should be maintained in accordance with the airframe manufacturer's inspection standards and procedures.

(vii) 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 if needed to ensure adherence to the airframe manufacturer's RVSM tolerances. These tests and inspections should be performed as established by the airframe manufacturer. These checks should also be performed following repairs, or alterations having an effect on airframe surface and airflow.

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

(ix) Where the performance of existing equipment is demonstrated as being satisfactory for RVSM approval, it should be verified that the existing maintenance practices are also consistent with continued RVSM approval integrity. Examples of these are :

(A) Altitude alert.
(B) Automatic altitude control system.
(C) ATC altitude reporting equipment
(D) Altimetry systems.

v. Maintenance Practices for Noncompliant Aircraft. Those aircraft positively identified as exhibiting height-keeping performance errors which require investigation should not be operated in airspace where RVSM is applied until the following actions have been taken.:

(1) The failure or malfunction is confirmed and isolated by maintenance action and,
(2) Corrective action is carried out as required and verified to ensure RVSM approval integrity.

vi. Maintenance Training Rquirements. It is expected that new training requirements will be introduced by the RVSM approval processes. Areas that may need to be highlighted for initial and recurrent training of shop and line personnel are:

(1) Aircraft geometric inspection techniques.
(2) Test equipment calibration/usage techniques
(3) Any special documentation or procedures introduced by RVSM approval.

vii. Test Equipment.

(1) General. The test equipment should have the capability to demonstrate continuing complaince with all the parameters established for RVSM approval in the initial data package or as approved by the approving authority.

(2) Standards. Test equipment should be calibrated utilizing reference standards whose calibration is certified as being traceable to the national

standard. It should be calibrated at periodic intervals as agreed by the approving authority. The approved maintenance programme should encompass an effective quality control programme which includes the following:

(i) Definition of required test equipment accuracy.

(ii) Regular calibrations of test equipment traceable to a master in-house standard. Determination of calibration interval should be a function of the stability of the test equipment. The calibration interval should be established on the basis of historical data so that degradation is small in relation to the required accuracy.

(iii) Regular audits of calibration facilities both in-house and outside.

(iv) Adherence to acceptable shop and line maintenance practices.

(v) Procedures for controlling operator errors and unusual environmental conditions which may affect calibration accuracy.

RVSM APPROVAL.

The Authority will issue appropriate operations specification paragraph for AOC holder that meets the requirements of the RVSM and a Letter of Authorisation (LOA) to a general aviation operator that meets the requirements of the RVSM.