

## RVSM HEIGHT MONITORING GUIDE FOR U.S. OPERATORS

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## **Introduction.**

1. Reduced Vertical Separation Minimum (RVSM) System Performance Monitoring was implemented in conjunction with the establishment of RVSM Airspace to ensure that the implementation and continued operation of RVSM meets safety objectives.
2. Height-keeping performance of aircraft is a key element in ensuring safe operations in RVSM airspace. RVSM is a "performance based" operation requiring on-going independent monitoring to assure that the aircraft population adheres to stringent altimetry system requirements. What this means to operators is that not only are their aircraft in compliance, but also other aircraft that they will meet at the regularly used separation minimum are in compliance, assuring safe operation. An added benefit is that for operators with TCAS (ACAS II) onboard, this means that they will be assured of proper resolution maneuvers.
3. Height keeping performance of an aircraft is measured by equipment independent of the aircraft's altimetry system. The aircraft must be airborne and operating at an RVSM altitude for the performance to be measured. Currently, this requires operators to use external equipment brought on board and operated by trained technicians (GPS-based Monitoring Units (GMUs)) or have the height keeping performance of the aircraft measured by flying over ground-based measuring equipment, e.g., Aircraft Geometric Height Measuring Elements (AGHMEs) or ground-based Height Measuring Units (HMUs).
4. The guidance in this document is designed to explain how an operator holding a valid U.S. RVSM authorization can comply with the RVSM Monitoring Policy established by the Federal Aviation Administration (FAA).

**NOTE: If you wish to skip the detailed information provided in this guidance document and prefer the short version on how to get your aircraft monitored, proceed directly to the short guide in Appendix A.**

## **Who must participate in RVSM Monitoring?**

1. All aircraft operators wishing to conduct operations in RVSM designated airspace are required to participate in RVSM Monitoring.
2. Existing rule 14 CFR § 91.180 requires operations within airspace designated as Reduced Vertical Separation Minimum (RVSM) to comply with the minimum standards of appendix G of this part. 14 CFR part 91 Appendix G, Section 2 (d), (e), and (f) stipulate the requirements for altimetry system error containment. 14 CFR Part 91 Appendix G, Section 4 (b) (2) advises that no person may show, on the flight plan filed with air traffic control, an operator or aircraft as approved for RVSM operations, or operate on a route or in an area where RVSM approval is required, unless, the aircraft has been approved and complies (an ongoing commitment) with the requirements of Section 2 of this appendix.
3. 14 CFR Part 91 Appendix G, Section 3(c)(1) and (2) stipulates how the operator, in a manner prescribed by the Administrator, must provide evidence that: 1) it is capable to operate and maintain each aircraft or aircraft group for which it applies for approval to operate in RVSM airspace. Height monitoring is the only method to verify ASE within performance limits and, further, it is the manner prescribed by the Administrator. 14 CFR Part 91 Appendix G, Section 7 states the Administrator revoke or restrict an RVSM letter of authorization, if the Administrator determines that the operator is not complying, or is unable to comply, with this appendix.
4. The effective date of the currently FAA prescribed requirements for RVSM Monitoring is 18 May 2011. Operators were given until 18 November 2012 to comply.
5. To demonstrate the ability to maintain the Altimetry System Error (ASE) requirements of part 91, Appendix G, submit an RVSM height monitoring plan upon request for authorization. The elements of a monitoring plan include:
  - a) Number and identification of aircraft to be monitored in each RVSM monitoring group (see Appendix B for the definition of an RVSM monitoring group);
  - b) expected time frame for completion of monitoring requirements; and

- c) expected method for monitoring.

### **What is the minimum number of aircraft required to be monitored by each operator?**

1. U.S. Operators are required to conduct initial monitoring within six months of date of issue and must conduct monitoring every two years or within intervals of 1,000 flight hours per aircraft, whichever period is longer.
  - a) Operators are not required to complete monitoring prior to being granted operational approval.
  - b) Evidence of previous successful monitoring of an aircraft transfers to a new owner and may be used to meet the monitoring requirements.
  - c) When calculating the 1,000 hour provision of the minimum monitoring requirement the calculation of the flight time should be from the last valid monitoring date on record. Flight Log book data should be sufficient to meet this element. Operators who wish to invoke the less than 1000 flight hour provision should be prepared to provide this information to the applicable flight inspector, if requested.
2. If an operator has more than one aircraft in their fleet, they may not be required to demonstrate that every aircraft has been monitored since a statistical sampling of airframes of each type is used. To determine the minimum number of aircraft an operator must have monitored they must become familiar with the RVSM Minimum Monitoring Requirement Tables. (See Appendix B)

### **Completion of Monitoring requirement.**

1. The following methods satisfy monitoring requirements:
  - a) Entry of successful AGHME or other approved ground based monitoring system result in the U.S. RVSM Approvals Data Base.
  - b) A report of a successful monitoring supplied by an FAA approved GPS-based provider.
  - c) Evidence provided through another ICAO sponsored Regional Monitoring Agency, such as EUROCONTROL.

NOTE: It is suggested that operators make a log book entry noting the date of successful height monitoring for later reference if needed.

NOTE: Most RVSM monitoring is accomplished through use of the aircraft's Mode S address that is then translated to a registration number and associated with the records contained in the operations approval. This is the primary means used by the FAA for developing lists of approved aircraft that can be obtained online and which are forwarded to other RMA officials.

### **How do I get my aircraft monitored?**

1. There are essentially two ways to have the aircraft monitored:
  - a. An operator may choose to fly with a trained technician from an FAA approved RVSM monitoring support provider utilizing a Global Positioning System-based Monitoring Unit (GMU) onboard the aircraft; or
  - b. An operator equipped with a Mode S transponder may fly over an established ground-based height measuring system. Currently ground based systems exist in:
    - North America, Aircraft Geometric Height Monitoring Elements (AGHME); or
    - Ground-based height measuring system in Europe (HMUs); or
    - the Strumble HMU in the United Kingdom; or
    - the Setouchi, Niigata and Sendai HMU in Japan.

2. If an operator chooses to fly with an approved FAA RVSM monitoring support provider, see Appendix C for contact information.
3. If an operator wishes to fly over an AGHME constellation in North America:
  - a. An operator, with a valid RVSM authorization and mode S transponder, flight plans a route through one of the six AGHME coverage areas in North America at an RVSM altitude. The AGHMEs automatically collect height monitoring data on RVSM compliant aircraft. That data is shared with the NAARMO for entry into the RVSM Approvals Data Base.
  - b. The aircraft must fly through the optimal coverage area, straight and level, at an RVSM altitude, with its Mode S transponder operational. The longer the duration of flight through the coverage area, the better the chance is of receiving a valid monitoring. (30 minutes is recommended)

Note: RVSM aircraft equipped with **Mode C transponders** should utilize the procedures for flying with an FAA approved GMU RVSM monitoring support provider. AGHMEs **do not** have the capability to collect RVSM data from aircraft equipped with Mode C transponders.

For specific guidance on AGHMEs, see Appendix D.

For specific guidance on HMU monitoring outside North America see Appendix E.

### **How can I verify if my aircraft was monitored in the last two years?**

1. An operator that has a valid RVSM authorization and has already established a monitoring program can check the RVSM Approvals Data Base to determine if their last valid monitoring occurred within the last two years. For North American operators the data base can be accessed from the FAA RVSM Website under RVSM Documentation. The files are located under the section heading of “**US RVSM Approvals**”. The weblink for this site is:

[http://www.faa.gov/air\\_traffic/separation\\_standards/rvsm/documentation/](http://www.faa.gov/air_traffic/separation_standards/rvsm/documentation/)

### **What happens if I don't get monitored?**

1. The FAA Technical Center Separation Standards Analysis Branch monitors RVSM airspace in North America and reviews the U.S. RVSM Approvals Data Base to determine which aircraft have not met the two year monitoring requirement and notifies the applicable Flight Standards District Office FSDO, Certificate Management Office (CMO), Certificate Holding District Office (CHDO) or International Field Office (IFO) to investigate. Operators found not in compliance will be required to show reason for not meeting the monitoring requirements, including flight hour data to justify the 1000 flight hour provision if last successful monitoring exceeds a two year period. If an operator does not complete the monitoring requirements within the allotted time:
  - a. In a situation where an operator fails to meet the minimum operator requirements for monitoring within the prescribed time limits, it is the operator's responsibility to contact the FSDO, CMO, CHDO or IFO to discuss the situation and provide an updated plan for completing the monitoring requirements.
  - b. If warranted, the FSDO, CMO, CHDO or IFO may provide a letter to the operator extending the period for monitoring, not to exceed three months, to allow the operator sufficient time to complete height monitoring. During this extension the operator may continue to operate in RVSM airspace. If an operator is unable to complete monitoring requirements within the extended time period, the Inspector should coordinate action with the FAA Flight Technologies and Procedures Division (AFS-400).
  - c. Failure to complete monitoring requirements within the additional 3 months could result in termination of an operator's authorization to operate in RVSM airspace, unless the FAA determines that circumstances prevented the operator from completing the requirements.

### **References.**

1. 14 CFR 91.180, Operations within airspace designated as Reduced Vertical Separation Minimum airspace

2. 14 CFR Appendix G to Part 91, Operations in Reduced Vertical Separation Minimum Airspace
3. 14 CFR 91.703, Operations of civil aircraft of U.S. registry outside the United States
4. 14 CFR 91.706, Operation within airspace designed as Reduced Vertical Separation (operations outside the U.S)
5. ICAO ANNEX 6, Parts I and II (7.2.7 and 2.5.2.7 respectively), Operation of Aircraft
6. ICAO ANNEX 11, 3.3.5.1 -3.3.5.2, Air Traffic Services
7. FAA Advisory Circular 91-85( ), Authorization of Aircraft and Operators for Flight in Reduced Vertical Separation Minimum Airspace
8. FAA Order 8900.1, Flight Standards Information Management System (FSIMS), Volume 4, Chapter 1, Section 5, Paragraph 4-109H, RVSM Monitoring Programs

## SHORT GUIDE TO RVSM MONITORING

1. Determine the number of aircraft in a given fleet that need to be height monitored using the RVSM Minimum Monitoring Chart in Appendix B. Some aircraft of similar type constitute a monitoring group for fleet purposes.
2. Determine when the last successful height monitoring was recorded on the aircraft by accessing the U.S. RVSM Approvals Database by pasting the following link in your web browser:  
[http://www.faa.gov/air\\_traffic/separation\\_standards/naarmo/rvsm\\_approvals](http://www.faa.gov/air_traffic/separation_standards/naarmo/rvsm_approvals)
3. If the aircraft has been successfully height monitored within the last two years it meets the RVSM Minimum Monitoring Requirement.
4. If the aircraft has not been successfully height monitored in the last two years but has not flown more than 1000 flight hours since the last successful monitoring it meets the RVSM Minimum Monitoring Requirement.
5. If the aircraft has not been successfully height monitored in the last two years and has flown more than 1000 flight hours since the last successful monitoring the operator may not be in compliance with RVSM requirements and should contact the FSDO, CMO, CHDO or IFO as appropriate. To determine how to conduct an aircraft height monitoring:
  - a) If the aircraft is mode S transponder equipped there are two basic ways to have the aircraft height monitored:
    - (1) Fly the approved RVSM configured and authorized aircraft straight and level at an RVSM altitude through the coverage area of a ground based monitoring system, such as the AGHME system in North America or HMU system in Europe. To read more about ground based monitoring systems or go to Appendix D for the U.S. AGHME system or Appendix E for ground-based systems outside North America.
    - (2) Fly with an FAA approved RVSM monitoring support provider utilizing a Global Positioning System-based Monitoring Unit (GMU) onboard the aircraft. To read more about flying with an FAA approved RVSM monitoring support provider for onboard monitoring go to Appendix C.
  - b) AGHME Ground-based monitoring systems are not compatible with Mode C equipped aircraft. If the aircraft is mode C transponder equipped you should fly with an FAA approved GPS-based RVSM monitoring provider utilizing a GMU onboard the aircraft.
6. After flying a monitoring flight verify the height monitoring has been successfully added to the RVSM Approvals Database. Due to post processing time and quality assurance checks it can take 4-6 weeks for the Database to be updated.

## APPENDIX B

Updated: 5/25/2016

### RVSM MINIMUM MONITORING REQUIREMENTS TABLES

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#### Basic Instructions

The RVSM Minimum Monitoring Requirement (MMR) Tables (or MMR chart for short) are maintained by the ICAO Regional Monitoring Agency Coordination Group (RMACG) and reflect the current aircraft group and category listings that RVSM capable aircraft types are assigned too. These tables can be used to determine the minimum number of aircraft that an operator must have monitored.

NOTE: These tables change from time to time reflecting current performance of the aircraft group and should be consulted prior to determining the number of aircraft necessary to be monitored.

1. The following instructions will assist operators on how to use the tables in this Appendix to determine the RVSM monitoring group and category for a given fleet of aircraft.
2. Aircraft groups. Aircraft of nominally identical design and build with respect to all details that could influence the accuracy of height-keeping performance are grouped together.

**RVSM Group example from MMR Table 2:** All Gulfstream 400 and 350 series aircraft are grouped into the “GLF4” group for monitoring purposes.

| Monitoring Group | A/C ICAO | A/C Type  | A/C Series |
|------------------|----------|---|------------|
| GLF4             | GLF4     | GULFSTREAM IV (G-1159C)<br>G300<br>G350<br>G400<br>G450 | ALL SERIES |

3. Aircraft Categories. Aircraft groups are organized according to their compliance with the RVSM Minimum Aircraft System Performance Specifications (MASPS). Aircraft groups are further organized into three categories. (RVSM MMR Table 1):

- a. Category 1: Group approved data indicates compliance with RVSM MASPS.
- b. Category 2: Group approved aircraft that there is insufficient data to indicate compliance with RVSM MASPS.
- c. Category 3: Non-group approved aircraft.

4. Each Category of aircraft has different minimum monitoring requirements.
  - a. Group aircraft that fall into Category 1 require a minimum of **two airframes** from each fleet of an operator to be monitored.
  - b. Group aircraft that fall into Category 2 require that **60% of airframes** (round up if fractional) from each fleet of an operator be monitored. If an operator only has two airframes of the same group both airframes must be monitored.
  - c. Category 3, Non-group aircraft, 100% of an aircraft shall be monitored.

**APPENDIX B**

Updated: 5/25/2016

**RVSM Category example from MMR Table 1:** A G350 is in monitoring group GLF4. GLF4 is a **Category 1** aircraft. The operator of this aircraft must have **two airframes** from the total number of their GLF4 fleet monitored.

| CATEGORY | AIRCRAFT GROUP  | MINIMUM OPERATOR MONITORING FOR EACH AIRCRAFT GROUP  | MINIMUM OPERATOR MONITORING FOR EACH AIRCRAFT GROUP                 |
|----------|---|--|---|
| <b>1</b> | GROUP APPROVED: DATA INDICATES COMPLIANCE WITH THE RVSM MASPS | A124, A300, A306, A310-GE, A310-PW, A318, A320, A330, A340, A345, A346, A350, A380, A388, A390, A395, A396, A398, A399, A39X, A39Y, A39Z, A39AA, A39AB, A39AC, A39AD, A39AE, A39AF, A39AG, A39AH, A39AI, A39AJ, A39AK, A39AL, A39AM, A39AN, A39AO, A39AP, A39AQ, A39AR, A39AS, A39AT, A39AU, A39AV, A39AW, A39AX, A39AY, A39AZ, A39BA, A39BB, A39BC, A39BD, A39BE, A39BF, A39BG, A39BH, A39BI, A39BJ, A39BK, A39BL, A39BM, A39BN, A39BO, A39BP, A39BQ, A39BR, A39BS, A39BT, A39BU, A39BV, A39BW, A39BX, A39BY, A39BZ, A39CA, A39CB, A39CC, A39CD, A39CE, A39CF, A39CG, A39CH, A39CI, A39CJ, A39CK, A39CL, A39CM, A39CN, A39CO, A39CP, A39CQ, A39CR, A39CS, A39CT, A39CU, A39CV, A39CW, A39CX, A39CY, A39CZ, A39DA, A39DB, A39DC, A39DD, A39DE, A39DF, A39DG, A39DH, A39DI, A39DJ, A39DK, A39DL, A39DM, A39DN, A39DO, A39DP, A39DQ, A39DR, A39DS, A39DT, A39DU, A39DV, A39DW, A39DX, A39DY, A39DZ, A39EA, A39EB, A39EC, A39ED, A39EE, A39EF, A39EG, A39EH, A39EI, A39EJ, A39EK, A39EL, A39EM, A39EN, A39EO, A39EP, A39EQ, A39ER, A39ES, A39ET, A39EU, A39EV, A39EW, A39EX, A39EY, A39EZ, A39FA, A39FB, A39FC, A39FD, A39FE, A39FF, A39FG, A39FH, A39FI, A39FJ, A39FK, A39FL, A39FM, A39FN, A39FO, A39FP, A39FQ, A39FR, A39FS, A39FT, A39FU, A39FV, A39FW, A39FX, A39FY, A39FZ, A39GA, A39GB, A39GC, A39GD, A39GE, A39GF, A39GG, A39GH, A39GI, A39GJ, A39GK, A39GL, A39GM, A39GN, A39GO, A39GP, A39GQ, A39GR, A39GS, A39GT, A39GU, A39GV, A39GW, A39GX, A39GY, A39GZ, A39HA, A39HB, A39HC, A39HD, A39HE, A39HF, A39HG, A39HH, A39HI, A39HJ, A39HK, A39HL, A39HM, A39HN, A39HO, A39HP, A39HQ, A39HR, A39HS, A39HT, A39HU, A39HV, A39HW, A39HX, A39HY, A39HZ, A39IA, A39IB, A39IC, A39ID, A39IE, A39IF, A39IG, A39IH, A39IJ, A39IK, A39IL, A39IM, A39IN, A39IO, A39IP, A39IQ, A39IR, A39IS, A39IT, A39IU, A39IV, A39IW, A39IX, A39IY, A39IZ, A39JA, A39JB, A39JC, A39JD, A39JE, A39JF, A39JG, A39JH, A39JI, A39JJ, A39JK, A39JL, A39JM, A39JN, A39JO, A39JP, A39JQ, A39JR, A39JS, A39JT, A39JU, A39JV, A39JW, A39JX, A39JY, A39JZ, A39KA, A39KB, A39KC, A39KD, A39KE, A39KF, A39KG, A39KH, A39KI, A39KJ, A39KK, A39KL, A39KM, A39KN, A39KO, A39KP, A39KQ, A39KR, A39KS, A39KT, A39KU, A39KV, A39KW, A39KX, A39KY, A39KZ, A39LA, A39LB, A39LC, A39LD, A39LE, A39LF, A39LG, A39LH, A39LI, A39LJ, A39LK, A39LL, A39LM, A39LN, A39LO, A39LP, A39LQ, A39LR, A39LS, A39LT, A39LU, A39LV, A39LW, A39LX, A39LY, A39LZ, A39MA, A39MB, A39MC, A39MD, A39ME, A39MF, A39MG, A39MH, A39MI, A39MJ, A39MK, A39ML, A39MN, A39MO, A39MP, A39MQ, A39MR, A39MS, A39MT, A39MU, A39MV, A39MW, A39MX, A39MY, A39MZ, A39NA, A39NB, A39NC, A39ND, A39NE, A39NF, A39NG, A39NH, A39NI, A39NJ, A39NK, A39NL, A39NM, A39NN, A39NO, A39NP, A39NQ, A39NR, A39NS, A39NT, A39NU, A39NV, A39NW, A39NX, A39NY, A39NZ, A39OA, A39OB, A39OC, A39OD, A39OE, A39OF, A39OG, A39OH, A39OI, A39OJ, A39OK, A39OL, A39OM, A39ON, A39OO, A39OP, A39OQ, A39OR, A39OS, A39OT, A39OU, A39OV, A39OW, A39OX, A39OY, A39OZ, A39PA, A39PB, A39PC, A39PD, A39PE, A39PF, A39PG, A39PH, A39PI, A39PJ, A39PK, A39PL, A39PM, A39PN, A39PO, A39PP, A39PQ, A39PR, A39PS, A39PT, A39PU, A39PV, A39PW, A39PX, A39PY, A39PZ, A39QA, A39QB, A39QC, A39QD, A39QE, A39QF, A39QG, A39QH, A39QI, A39QJ, A39QK, A39QL, A39QM, A39QN, A39QO, A39QP, A39QQ, A39QR, A39QS, A39QT, A39QU, A39QV, A39QW, A39QX, A39QY, A39QZ, A39RA, A39RB, A39RC, A39RD, A39RE, A39RF, A39RG, A39RH, A39RI, A39RJ, A39RK, A39RL, A39RM, A39RN, A39RO, A39RP, A39RQ, A39RR, A39RS, A39RT, A39RU, A39RV, A39RW, A39RX, A39RY, A39RZ, A39SA, A39SB, A39SC, A39SD, A39SE, A39SF, A39SG, A39SH, A39SI, A39SJ, A39SK, A39SL, A39SM, A39SN, A39SO, A39SP, A39SQ, A39SR, A39SS, A39ST, A39SU, A39SV, A39SW, A39SX, A39SY, A39SZ, A39TA, A39TB, A39TC, A39TD, A39TE, A39TF, A39TG, A39TH, A39TI, A39TJ, A39TK, A39TL, A39TM, A39TN, A39TO, A39TP, A39TQ, A39TR, A39TS, A39TT, A39TU, A39TV, A39TW, A39TX, A39TY, A39TZ, A39UA, A39UB, A39UC, A39UD, A39UE, A39UF, A39UG, A39UH, A39UI, A39UJ, A39UK, A39UL, A39UM, A39UN, A39UO, A39UP, A39UQ, A39UR, A39US, A39UT, A39UU, A39UV, A39UW, A39UX, A39UY, A39UZ, A39VA, A39VB, A39VC, A39VD, A39VE, A39VF, A39VG, A39VH, A39VI, A39VJ, A39VK, A39VL, A39VM, A39VN, A39VO, A39VP, A39VQ, A39VR, A39VS, A39VT, A39VU, A39VV, A39VW, A39VX, A39VY, A39VZ, A39WA, A39WB, A39WC, A39WD, A39WE, A39WF, A39WG, A39WH, A39WI, A39WJ, A39WK, A39WL, A39WM, A39WN, A39WO, A39WP, A39WQ, A39WR, A39WS, A39WT, A39WU, A39WV, A39WW, A39WX, A39WY, A39WZ, A39XA, A39XB, A39XC, A39XD, A39XE, A39XF, A39XG, A39XH, A39XI, A39XJ, A39XK, A39XL, A39XM, A39XN, A39XO, A39XP, A39XQ, A39XR, A39XS, A39XT, A39XU, A39XV, A39XW, A39XX, A39XY, A39XZ, A39YA, A39YB, A39YC, A39YD, A39YE, A39YF, A39YG, A39YH, A39YI, A39YJ, A39YK, A39YL, A39YM, A39YN, A39YO, A39YP, A39YQ, A39YR, A39YS, A39YT, A39YU, A39YV, A39YW, A39YX, A39YY, A39YZ, A39ZA, A39ZB, A39ZC, A39ZD, A39ZE, A39ZF, A39ZG, A39ZH, A39ZI, A39ZJ, A39ZK, A39ZL, A39ZM, A39ZN, A39ZO, A39ZP, A39ZQ, A39ZR, A39ZS, A39ZT, A39ZU, A39ZV, A39ZW, A39ZX, A39ZY, A39ZZ | <b>Two airframes from each fleet of an operator to be monitored</b> |

5. In summary to determine the number of aircraft an operator must have monitored:
- Determine the aircraft “Group” that each of an operator’s type and series of aircraft belongs from Table 2 of the RVSM MMR Tables; and
  - Determine the “Category” for each aircraft group from Table 1 of the RVSM MMR Tables; and
  - The number of airframes an operator has for each “Group” will provide the basis for the minimum number of airframes to be monitored from Categories in Table 1 of the RVSM MMR Chart. Using the “Category” multiply the minimum number required (from column 4 of Table 1) x the number of aircraft in each “Group” (round up if fractional).
  - Example. An operator has five (5) G-550’s. Since the G-550 belongs to the GLF5 monitoring group and that aircraft group is in Category 1, only two airframes from this operator’s fleet need to be monitored.

If the operator also has three (3) C-550s, since the Citations (C550 Group) is in Category 2, 60% of these airframes must be monitored, (3 x .60 = 1.8) rounding up the operator would also have to have two of these airframes monitored.

**RVSM MINIMUM MONITORING REQUIREMENTS:  
As of: 20 May 2016**

1. UPDATE OF MONITORING REQUIREMENTS TABLE AND WEBSITE. As significant data is obtained, monitoring requirements for specific aircraft types may change.
2. INITIAL MONITORING. All operators that operate or intend to operate in airspace where RVSM is applied are required to participate in the RVSM monitoring program. Table 1 establishes requirements for initial monitoring associated with the RVSM approval process. In their application to the appropriate State authority for RVSM approval, operators must show a plan for meeting the applicable initial monitoring requirements.
3. AIRCRAFT STATUS FOR MONITORING. Aircraft engineering work that is required for the aircraft to receive RVSM airworthiness approval must be completed prior to the aircraft being monitored.
4. APPLICABILITY OF MONITORING FROM OTHER REGIONS. Monitoring data obtained in conjunction with RVSM monitoring programs from other regions may be used to meet regional monitoring requirements.
5. MONITORING PRIOR TO THE ISSUE OF RVSM OPERATIONAL APPROVAL IS NOT A REQUIREMENT. Operators should submit monitoring plans to the responsible CHDO that show how they intend to meet the requirements specified in Table 1. Monitoring will be carried out in accordance with this table.
6. AIRCRAFT GROUPS NOT LISTED IN TABLE 1. Contact the RMA for clarification if an aircraft group is not listed in Table 1 or for clarification of other monitoring related issues. An aircraft group not listed in Table 1 will probably be subject to Category 2 monitoring requirements.
7. TABLE OF MONITORING GROUPS. Table 2 shows the aircraft types and series that are grouped together for operator monitoring purposes.
8. TABLE OF NON-GROUP AIRCRAFT: Table 3 shows the aircraft types and series that are Non-Group aircraft (i.e., Not certified under group approval requirements) for monitoring purposes.
9. TRAILING CONE DATA. Altimetry System Error estimations developed using Trailing Cone data collected during RVSM certification flights can be used to fulfill monitoring requirements. It must be documented, however, that aircraft RVSM systems were in the approved RVSM configuration for the flight.
10. 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 operational approval and has completed monitoring requirements for the type in accordance with the attached table, the new airframes are not required to be monitored. If an operator adds new RVSM compliant airframes of an aircraft type for which it has NOT previously received RVSM operational approval, then the operator should complete monitoring in accordance with the attached table.
11. FOLLOW-ON MONITORING. Monitoring is an on-going program that will continue after the RVSM approval process. Long term minimum monitoring requirements are established in the Annex 6 to the Convention on International Civil Aviation. On a regional basis, a programme shall be instituted for monitoring the height-keeping performance of aircraft operating in RVSM airspace in order to ensure that continued application of this vertical separation minimum meets regional safety objectives.

**Table 1: MONITORING REQUIREMENTS TABLE (Civilian)**

| <b>MONITORING IS REQUIRED IN ACCORDANCE WITH THIS TABLE</b>                       |  |  |  |
|---|--|--|--|
| MONITORING PRIOR TO THE ISSUE OF RVSM APPROVAL IS <b><u>NOT</u></b> A REQUIREMENT |  |  |  |
| <b>CATEGORY</b>   | <b>GROUP DESCRIPTOR</b>  | <b>MINIMUM MONITORING REQUIREMENTS</b>   |  |
| <b>1</b>  | GROUP APPROVED:<br>DATA INDICATES COMPLIANCE WITH THE RVSM MASPS | A124, A30B, A306, A310-GE, A310-PW, A318, A320, A330, A340, A345, A346, A380, A3ST, AVRO, B712, B727, B737C, B737CL, B737NX, B747CL, B74S, B744-5, B744-10, B752, B753, B764, B767, B772, B773, BD100, BE40, C25A, C25B, C510, C525, C560, C56X, C650, C680, C750, CARJ, CL600, CL604, CL605, CRJ7, CRJ9, DC10, E135-145, E170-190, E50P, E55P, F100, F900, FA7X, GALX, GLEX, GLF4, GLF5, H25B-800, J328, LJ40, LJ45, LJ60, MD10, MD11, MD80, MD90, PC12, PRM1, T154   | Operators of aircraft types contained in this category shall have a minimum of 2 airframes monitored every 2 years or 1,000 flight hours, whichever is longer calculated from the date of the last successful height monitoring. Operators with fleets consisting of aircraft from more than one Monitoring Group shall meet this requirement for each group in the fleet. In the event that an operator has a single airframe from a Group, then that aircraft shall be monitored every 2 years or 1,000 flight hours, whichever is longer calculated from the date of the last successful height monitoring. |
| <b>2</b>  | GROUP APPROVED:<br>INSUFFICIENT DATA ON APPROVED AIRCRAFT        | Other group aircraft other than those listed above including:<br>A148, A158, A350, AC90, AC95, AJ27, AN72, ASTR, ASTR-SPX, B701, B703, B731, B732, B744-LCF, B748, B787, BCS1, BD700, BE20, BE30, C25C, C441, C500, C550-B, C550-II, C550-SII, CRJ10, D328, DC85, DC86-87, DC91, DC93, DC94 DC95, E120, E45X, EA50, E545-550, F2TH, F70, FA10, FA20, FA50, G150, G280, GLF2, GLF2B, GLF3, GLF6, H25B-700, H25B-750, H25C, HA4T, HDJT, IL62, IL76, IL86, IL96, L101, L29B-2, L29B-731, LJ23, LJ24, LJ25, LJ28, LJ31, LJ35-36, LJ55, MU30, PC24, P180, PAY4, SB20, SBR1, SBR2, SU95, T134, T204, T334, TBM, WW24, YK42 | Operators of aircraft types contained in this category shall have a minimum of 60% of airframes monitored every 2 years or 1,000 flight hours, whichever is longer calculated from the date of the last successful height monitoring. (the number of airframes to be monitored shall be rounded up to the nearest whole integer). Operators with fleets consisting of aircraft from more than one Monitoring Group shall meet this requirement for each Group in the fleet.  |
| <b>3</b>  | NON-GROUP  | Aircraft types for which no generic compliance method exists:<br>A225, AN12, AN26, B190, B462, B463, B74S-SOFIA, BA11, BE9L, GSPN, H25A, L29A, PAY3, R721, R722, SJ30, STAR  | Operators of aircraft types contained in this category shall have 100% of airframes monitored every 2 years or 1,000 flight hours., whichever is longer calculated from the date of the last successful height monitoring  |

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**Table 2: MONITORING GROUPS FOR AIRCRAFT CERTIFIED UNDER GROUP APPROVAL REQUIREMENTS**

| <b>Monitoring Group</b> | <b>A/C ICAO</b>      | <b>Manufacturer Type</b>                            | <b>Additional Defining Criteria</b> |
|-------------------------|----------------------|---|-------------------------------------|
| A124                    | A124                 | AN-124 RUSLAN                                       |                                     |
| A148                    | A148                 | AN-148  |                                     |
| A158                    | A158                 | AN-158  |                                     |
| A30B                    | A30B                 | A300  |                                     |
| A306                    | A306                 | A300  |                                     |
| A310-GE                 | A310                 | A310  | Series: 200, 200F, 300, 300F        |
| A310-PW                 | A310                 | A310  | Series: 220, 220F, 320, 320F        |
| A318                    | A318                 | A318  |                                     |
| A320                    | A319<br>A320<br>A321 | A319<br>A320<br>A321                                |                                     |
| A330                    | A332<br>A333         | A330<br>A330  |                                     |
| A340                    | A342<br>A343         | A340<br>A340  |                                     |
| A345                    | A345                 | A340  |                                     |
| A346                    | A346                 | A340  |                                     |
| A350                    | A359<br>A358         | AIRBUS 350-900<br>AIRBUS 350-800                    |                                     |
| A380                    | A388                 | A380  |                                     |
| A3ST                    | A3ST                 | A300  |                                     |
| AC90                    | AC90                 | COMMANDER 690<br>COMMANDER 840<br>COMMANDER 900     |                                     |
| AC95                    | AC95                 | AERO COMMANDER 695                                  |                                     |
| AJ27                    | AJ27                 | COMAC ARJ-21-700                                    |                                     |
| AN72                    | AN72                 | ANTONOV AN-72<br>ANTONOV AN-74                      |                                     |
| ASTR                    | ASTR                 | 1125 ASTRA  | S/n 1-78, except 73                 |
| ASTR-SPX                | ASTR                 | 1125 ASTR SPX,<br>G100                              | S/n 73, 79-145<br>S/n > 145         |
| AVRO                    | RJ1H<br>RJ70<br>RJ85 | RJ100 Avroliner<br>RJ70 Avroliner<br>RJ85 Avroliner |                                     |
| B701                    | B701                 | B707  |                                     |
| B703                    | B703                 | B707  | Series 320, 320B, 320C              |
| B712                    | B712                 | B717  |                                     |
| B727                    | B721<br>B722         | B727<br>B727  |                                     |
| B731                    | B731                 | B737  |                                     |
| B732                    | B732                 | B737  |                                     |

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| <b>Monitoring Group</b> | <b>A/C ICAO</b>      | <b>Manufacturer Type</b>         | <b>Additional Defining Criteria</b> |
|-------------------------|----------------------|----------------------------------|-------------------------------------|
| B737CL                  | B733<br>B734<br>B735 | B737-300<br>B737-400<br>B737-500 |                                     |
| B737NX                  | B736                 | B737-600                         |                                     |
|                         | B737                 | B737-700                         | Series: 700, BBJ only               |
|                         | B738<br>B739         | B737-800<br>B737-900             |                                     |
| B737C                   | B737                 | B737-700                         | Series: 700C                        |
| B747CL                  | B741<br>B742<br>B743 | B747-100<br>B747-200<br>B747-300 |                                     |
| B74S                    | B74S<br>B74R         | B747SP<br>B747SR                 |                                     |
| B744-5                  | B744<br>B74D         | B747-400                         | 5 inch Probes up to SN 25350        |
| B744-10                 | B744<br>B74D         | B747-400                         | 10 inch Probes from SN 25351        |
| B744-LCF                | BLCF                 | B747-400                         |                                     |
| B748                    | B748                 | B747-800                         |                                     |
| B752                    | B752                 | B757-200                         |                                     |
| B753                    | B753                 | B757-300                         |                                     |
| B767                    | B762                 | B767-200                         |                                     |
|                         | B763                 | B767-300                         |                                     |
| B764                    | B764                 | B767-400                         |                                     |
| B772                    | B772                 | B777-200                         |                                     |
|                         | B77L                 | B777-F                           |                                     |
|                         | B77L                 | B777-200LR                       |                                     |
| B773                    | B773                 | B777-300                         |                                     |
|                         | B77W                 | B777-300ER                       |                                     |
| B787                    | B788                 | B787-8                           |                                     |
|                         | B789                 | B787-9                           |                                     |
| BCS1                    | BCS1                 | BOMBARDIER 500 C SERIES CS100    |                                     |
|                         | BCS3                 | BOMBARDIER 500 C SERIES CS300    |                                     |
| BD100                   | CL30                 | CHALLENGER 300                   |                                     |
|                         | CL35                 | CHALLENGER 350                   | Begins at s/n 20501                 |
| BD700                   | GL5T                 | GLOBAL 5000                      |                                     |
| BE20                    | BE20                 | 200 KINGAIR                      |                                     |
| BE30                    | BE30                 | B300 SUPER KINGAIR               |                                     |
|                         | B350                 | B300 SUPER KINGAIR 350           |                                     |
| BE40                    |                      | BEECHJET 400                     |                                     |
|                         |                      | BEECHJET 400A                    |                                     |
|                         |                      | BEECHJET 400XP                   |                                     |
|                         |                      | HAWKER 400XP                     |                                     |
| C441                    | C441                 | CONQUEST II                      |                                     |

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| <b>Monitoring Group</b> | <b>A/C ICAO</b>              | <b>Manufacturer Type</b>  | <b>Additional Defining Criteria</b>         |
|-------------------------|------------------------------|---|---|
| C500                    | C500<br>C500<br>C501         | 500 CITATION<br>500 CITATION I<br>501 CITATION I SINGLE PILOT           |   |
| C510                    | C510                         | MUSTANG   |   |
| C525                    | C525                         | 525 CITATIONJET<br>525 CITATIONJET 1<br>525 CITATIONJET PLUS<br>C525-M2 |   |
| C25A                    | C25A                         | 525A CITATIONJET II   |   |
| C25B                    | C25B                         | CITATIONJET III<br>525B CITATIONJET III                                 |   |
| C25C                    | C25C                         | 525C CITATIONJET IV   |   |
| C550-B                  | C550                         | 550 CITATION BRAVO  | s/n 550-0801 and on                         |
| C550-II                 | C550<br>C551                 | 550 CITATION II<br>551 CITATION II SINGLE PILOT                         | s/n 550-0001 to 550-0800                    |
| C550-SII                | C550                         | S550 CITATION SUPER II  | s/n starts with "S"                         |
| C560                    | C560                         | 560 CITATION V<br>560 CITATION V ULTRA<br>560 CITATION V ENCORE         |   |
| C56X                    | C56X                         | 560 CITATION EXCEL<br>560 CITATION XLS                                  |   |
| C650                    | C650                         | 650 CITATION III<br>650 CITATION VI<br>650 CITATION VII                 |   |
| C680                    | C680                         | 680 CITATION SOVEREIGN<br>680-A LATITUDE                                | "A" in s/n                                  |
| C750                    | C750                         | 750 CITATION X  |   |
| CARJ                    | CRJ1<br>CRJ2<br>CRJ2<br>CRJ2 | CRJ-100<br>CRJ-200<br>CHALLENGER 800<br>CHALLENGER 850                  |   |
| CRJ7                    | CRJ7                         | CRJ-700   |   |
| CRJ9                    | CRJ9                         | CRJ-900   |   |
| CRJ10                   | CRJX                         | CRJ-1000  |   |
| CL600                   | CL60                         | CL-600<br>CL-601  | S/n < 5000                                  |
| CL604                   | CL60                         | CL-604<br>CL-601-3A<br>CL-601-3R  | 5000 < S/n < 5700<br>5001-5134<br>5135-5300 |
| CL605                   | CL60                         | CL-605  | S/n > 5700                                  |

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| <b>Monitoring Group</b> | <b>A/C ICAO</b>                      | <b>Manufacturer Type</b>   | <b>Additional Defining Criteria</b> |
|-------------------------|--------------------------------------|--|-------------------------------------|
| DC10                    | DC10                                 | DC-10  |                                     |
| D328                    | D328                                 | 328 TURBOPROP  |                                     |
| DC85                    | DC85                                 | DC-8   |                                     |
| DC86-87                 | DC86<br>DC87                         | DC-8<br>DC-8   |                                     |
| DC91                    | DC91                                 | DC-9   |                                     |
| DC93                    | DC93                                 | DC-9   |                                     |
| DC94                    | DC94                                 | DC-9   |                                     |
| DC95                    | DC95                                 | DC-9   |                                     |
| E120                    | E120                                 | EMB-120 Brasilia   |                                     |
| E135-145                | E135<br>E145<br>E35L                 | EMB-135<br>EMB-145<br>EMB-135BJ Legacy 600/650                       |                                     |
| E45X                    | E45X                                 | EMB-145 XR   |                                     |
| E170-190                | E170<br>E170<br>E75S<br>E190<br>E190 | EMB-170<br>EMB-175<br>ERJ-170-200 (short wing)<br>EMB-190<br>EMB-195 |                                     |
| E50P                    | E50P                                 | PHENOM 100   |                                     |
| E545-550                | E545<br>E550                         | EMB-545 Legacy 450<br>EMB-550 Legacy 500                             |                                     |
| E55P                    | E55P                                 | PHENOM 300   |                                     |
| EA50                    | EA50                                 | ECLIPSE  |                                     |
| F100                    | F100                                 | FOKKER 100   |                                     |
| F2TH                    | F2TH                                 | FALCON 2000<br>FALCON 2000-EX<br>FALSON 2000LX                       |                                     |
| F70                     | F70                                  | FOKKER 70  |                                     |
| F900                    | F900                                 | FALCON 900<br>FALCON 900DX<br>FALCON 900EX<br>FALCON 900LX           |                                     |

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| <b>Monitoring Group</b> | <b>A/C ICAO</b> | <b>Manufacturer Type</b>  | <b>Additional Defining Criteria</b> |
|-------------------------|-----------------|---|-------------------------------------|
| FA10                    | FA10            | FALCON 10   |                                     |
| FA20                    | FA20            | FALCON 20<br>FALCON 200   |                                     |
| FA50                    | FA50            | FALCON 50<br>FALCON 50EX  |                                     |
| FA7X                    | FA7X<br>FA8X    | FALCON 7X<br>FALCON 8X  |                                     |
| G150                    | G150            | G150  |                                     |
| G280                    | G250<br>G280    | G250<br>G280  |                                     |
| GALX                    | GALX            | 1126 GALAXY<br>G200   |                                     |
| GLEX                    | GLEX            | BD-700 GLOBAL EXPRESS   |                                     |
| GLF2                    | GLF2            | GULFSTREAM II (G-1159)  |                                     |
| GLF2B                   | GLF2            | GULFSTREAM IIB (G-1159B)  |                                     |
| GLF3                    | GLF3            | GULFSTREAM III (G-1159A)  |                                     |
| GLF4                    | GLF4            | GULFSTREAM IV (G-1159C)<br>G300<br>G350<br>G400<br>G450   |                                     |
| GLF5                    | GLF5            | GULFSTREAM V (G-1159D)<br>G500<br>G550  |                                     |
| GLF6                    | GLF6            | G650  |                                     |
| H25B-700                | H25B            | BAE 125 / HS125   | Series: 700A, 700B                  |
| H25B-750                | H25B            | HAWKER 750  |                                     |
| H25B-800                | H25B            | BAE 125 / HS125<br>HAWKER 800XP<br>HAWKER 800XPI<br>HAWKER 800<br>HAWKER 850XP<br>HAWKER 900XP<br>HAWKER 950XP HAWKER 900XP<br>HAWKER 950XP | Series: 800A, 800B                  |
| H25C                    | H25C            | HAWKER 1000   |                                     |
| HA4T                    | HA4T            | HAWKER 4000   |                                     |

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| <b>Monitoring Group</b> | <b>A/C ICAO</b>                      | <b>Manufacturer Type</b>                  | <b>Additional Defining Criteria</b> |
|-------------------------|--------------------------------------|---|-------------------------------------|
| HDJT                    | HDJT                                 | HONDAJET HA-420                           |                                     |
| IL62                    | IL62                                 | ILYUSHIN-62                               |                                     |
| IL76                    | IL76                                 | ILYUSHIN-76                               |                                     |
| IL86                    | IL86                                 | ILYUSHIN-86                               |                                     |
| IL96                    | IL96                                 | ILYUSHIN-96                               |                                     |
| J328                    | J328                                 | 328JET                                    |                                     |
| L101                    | L101                                 | L-1011 TRISTAR                            |                                     |
| L29B-2                  | L29B                                 | L-1329 JETSTAR II                         |                                     |
| L29B-731                | L29B                                 | L-1329 JETSTAR 731                        |                                     |
| LJ23                    | LJ23                                 | LEARJET 23                                |                                     |
| LJ24                    | LJ24                                 | LEARJET 24                                |                                     |
| LJ25                    | LJ25                                 | LEARJET 25                                |                                     |
| LJ28                    | LJ28                                 | LEARJET 28<br>LEARJET 29                  |                                     |
| LJ31                    | LJ31                                 | LEARJET 31                                |                                     |
| LJ35-36                 | LJ35                                 | LEARJET 35<br>LEARJET 36                  |                                     |
| LJ40                    | LJ40<br>LJ70                         | LEARJET 40<br>LEARJET 70                  |                                     |
| LJ45                    | LJ45<br>LJ75                         | LEARJET 45<br>LEARJET 75                  |                                     |
| LJ55                    | LJ55                                 | LEARJET 55                                |                                     |
| LJ60                    | LJ60                                 | LEARJET 60                                |                                     |
| MD10                    | MD10                                 | MD-10                                     |                                     |
| MD11                    | MD11                                 | MD-11                                     |                                     |
| MD80                    | MD81<br>MD82<br>MD83<br>MD87<br>MD88 | MD-80<br>MD-80<br>MD-80<br>MD-80<br>MD-80 |                                     |

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| <b>Monitoring Group</b> | <b>A/C ICAO</b>      | <b>Manufacturer Type</b>                        | <b>Additional Defining Criteria</b>    |
|-------------------------|----------------------|---|--|
| MD90                    | MD90                 | MD-90   |  |
| MU30                    | MU30                 | MU-300 DIAMOND                                  |  |
| P180                    | P180                 | P-180 AVANTI<br>P-180 AVANTI II                 |  |
| PAY4                    | PAY4                 | PA-42 Cheyenne 400                              | Series: 1000 CHEYENNE                  |
| PC12                    | PC12                 | Pilatus PC-12                                   |  |
| PC24                    | PC24                 | Pilatus PC-24                                   |  |
| PRM1                    | PRM1                 | PREMIER 1                                       |  |
| SB20                    | SB20                 | SAAB 2000                                       |  |
| SBR1                    | SBR1                 | SABRELINER 40<br>SABRELINER 60<br>SABRELINER 65 |  |
| SBR2                    | SBR2                 | SABRELINER 80                                   |  |
| SU95                    | SU95                 | SUKHOI SUPERJET 100-95                          |  |
| T134                    | T134                 | TU-134  |  |
| T154                    | T154                 | TU-154  |  |
| T204                    | T204                 | TU-204<br>TU-214<br>TU-224<br>TU-234            |  |
| T334                    | T334                 | TU-334  |  |
| TBM                     | TBM7<br>TBM8<br>TBM9 | TBM-700<br>TBM-850<br>TBM-900                   | TBM8 with winglets, begins at s/n 1000 |
| WW24                    | WW24                 | 1124 WESTWIND                                   |  |
| YK42                    | YK42                 | Yakovlev YAK-42<br>Yakovlev YAK-40              |  |

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**Table 3: Non-GROUP AIRCRAFT (i.e., Not certified under group approval requirements) (Civilian)**

| <b>Non-Group Descriptor</b> | <b>A/C ICAO</b> | <b>Manufacturer Type</b>        | <b>Additional Defining Criteria</b> |
|-----------------------------|-----------------|---------------------------------|-------------------------------------|
| A225                        | A225            | ANTONOV AN-225                  | Non-Group                           |
| AN12                        | AN12            | ANTONOV AN-12                   | Non-Group                           |
| AN26                        | AN26            | ANTONOV AN-26                   | Non-Group                           |
| B190                        | B190            | BEECH 1900                      | Non-Group                           |
| B462                        | B462            | BAe-146-200                     | Non-Group                           |
| B463                        | B463            | BAe-146-300                     | Non-Group                           |
| B74S-SOFIA                  | B74S            | NASA B74SP with Sofia telescope | Non-Group:<br>N747NA (s/n<br>21441) |
| BA11                        | BA11            | BAC-111                         | Non-Group                           |
| BE9L                        |                 |                                 | Non-Group                           |
| GSPN                        | GSPN            | GROB G-180 SPn Utility Jet      | Non-Group                           |
| H25A                        | H25A            | HS125-400, -600                 | Non-Group                           |
| L29A                        | L29A            | L-1329 JETSTAR 6/8              | Non-Group                           |
| PAY3                        | PAY3            | PIPER Cheyenne 3                | Non-Group                           |
| R721                        | R721            | B-727-100: Re-engined           | Non-Group                           |
| R722                        | R722            | B-727-200: Re-engined           | Non-Group                           |
| SJ30                        | SJ30            | SWEARINGEN SJ-30                | Non-Group                           |
| STAR                        | STAR            | BEECH 2000 STARSHIP             | Non-Group                           |

## APPENDIX C

Updated: 5/25/2016

### GPS-BASED MONITORING SYSTEM/UNIT (GMS/GMU) PROCEDURES

1. The NAARMO is responsible for all aircraft height monitoring activity for North American RVSM operations (Domestic U.S., Southern Canadian Domestic, and Mexico) and administers the GMS/GMU height-monitoring program. Both CSSI, Inc. and ARINC are approved GMS/GMU support contractors and assist the NAARMO with administering the monitoring program.

#### **Global Positioning System-based Monitoring System (GMS) Description**

2. The GMS is composed of the equipment and procedures to collect and process three required data elements: 1) GPS data; 2) pressure altitude or Mode C data; and 3) meteorological data. The GPS-based Monitoring Unit (GMU) is used to collect the GPS data during the monitoring flight. The NAARMO will use information to coordinate the collection of pressure altitude or Mode C data (or an approved substitute) from ATC facilities.

#### **GMS/GMU Contacts:**

U.S. GMS Coordinator at FAA Technical Center,

Phone: +1 609-485-5102  
Fax: +1 609-485-5078  
Email: [rvsm@faa.gov](mailto:rvsm@faa.gov)

CSSI Inc. FAA approved GMS RVSM Monitoring Support Provider:

Phone: +1 866-468-8111 or +1 202-554-1050  
Fax: +1 202-863-2398  
Email: [monitor@cssiinc.com](mailto:monitor@cssiinc.com)

ARINC FAA approved GMU RVSM Support Provider:

Phone: +1 410-266-4707  
Fax: +1 410-573-3007  
Email: [rvsmops@arinc.com](mailto:rvsmops@arinc.com)

#### **GMS/GMU Monitoring Flights**

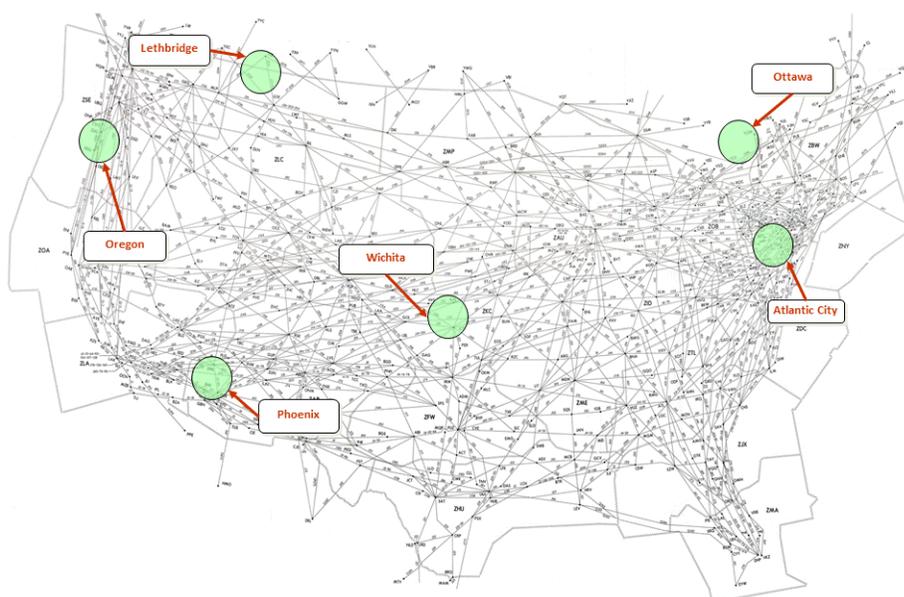
3. Height monitoring can be conducted on scheduled flights, ferry flights, or monitoring-specific flights. To ensure collection of sufficient position data the aircraft must fly straight and level at any altitude from flight level (FL) 290 to 410 (inclusive) for at least thirty minutes in duration. Monitoring flights do not need to be conducted in North American airspace; however, monitoring should be conducted in areas where Mode-C radar data can be retrieved by the FAA Technical Center staff in a timely manner.

4. For more information on GMS/GMU monitoring visit the NAARMO web site at:

[https://www.faa.gov/air\\_traffic/separation\\_standards/naarmo/monitoring\\_methods/](https://www.faa.gov/air_traffic/separation_standards/naarmo/monitoring_methods/)

## AIRCRAFT GEOMETRIC HEIGHT MEASUREMENT ELEMENT (AGHME) GROUND-BASED MONITORING SYSTEM

1. The North American Approvals Registry and Monitoring Organization (NAARMO) has developed the AGHME system to monitor all aircraft passing through its coverage volume, with the primary aim of supporting estimation of height-keeping performance parameters for the bulk of operations in North American RVSM airspace. The AGHME system does not require that any special monitoring devices be installed on an aircraft in order for it to be monitored. It is necessary, however, that the aircraft have an operational Mode S transponder.
2. All AGHME systems are functionally identical. Hence, an operator wishing to use an AGHME constellation to satisfy monitoring requirements should follow the guidance provided under the “AGHME Monitoring Procedures” link below. This will suffice at any AGHME constellation location.
3. AGHME constellations will be located at six sites in the United States and Canada. The link in paragraph 4 provides information about these locations, and associated availability dates.



### Basic AGHME Procedures

1. Ensure the aircraft is in RVSM approved configuration. Mode S transponder is operational.
  2. Ensure the operator is authorized for RVSM operation from the relevant State RVSM approving official.
  3. Choose an AGHME constellation for monitoring (see the “AGHME Locations” section for choices).
  4. If your aircraft is not currently listed in the Approvals Data Base, complete the “US Operator Application for RVSM Monitoring”. Email the form to “naarmo@faa.gov” with “AGHME Monitoring Application” and the aircraft registration number in the subject line or fax it to +1(609) 485-5078. (See form-1 at the end of this document)
  5. Flight plan a route through the AGHME coverage area, at a flight level between 290 and 410, inclusive. The “Optimal Coverage Area” link shows a depiction of the coverage area superimposed on a route chart.
  6. Ensure that the flight plan provides for straight level-flight operation through the AGHME coverage area.
  7. Prior to departure, verify the operating status of appropriate AGHME monitoring constellation on the “AGHME Locations” link
4. For detailed information on AGHME locations and procedures, please access the AGHME Main Page at: [http://www.faa.gov/air\\_traffic/separation\\_standards/aghme/](http://www.faa.gov/air_traffic/separation_standards/aghme/)

## GROUND-BASED HEIGHT MONITORING OUTSIDE NORTH AMERICA

**U.S. Operators requesting monitoring results from Regional Monitoring Agencies (RMAs) other than North American Approvals Registry and Monitoring Organization (NAARMO)**

1. RVSM is a globally coordinated program. An operator that holds a valid RVSM authorization can fly in any region's RVSM airspace without additional RVSM approvals needed. Additionally, the RVSM Monitoring Program is globally coordinated. However, the implementation of monitoring requirements and collection of monitoring data is implemented on a regional basis.
2. Monitoring data obtained to fulfill the monitoring requirements for one region can be used to fulfill the monitoring requirements for another region. Regional Monitoring Agencies coordinate with each other to exchange database information on monitoring results.
3. A U.S. Operator that wants to access monitoring results from a RMA other than NAARMO should request the results by contacting NAARMO via email at: [NAARMO@faa.gov](mailto:NAARMO@faa.gov).

**Ground-based Height Monitoring Units (HMU) in Europe**

1. The HMU is a passive ground based system that measures aircraft height keeping over an approximately circular area. Each system consists of a set of ground stations arranged as a central site with four additional receivers arranged in a square. Each site receives aircraft SSR replies (Modes A, C and S) from which the 3D position of the aircraft is derived. Using meteorological information and the Mode C/S height data the altimetry system error is calculated. HMUs are operating at the following locations:
  - a) Linz in Austria [centre 48°12'N, 014°18'E];
  - b) Nattenheim in Germany [centre 49°57'N, 006°28'E]; and
  - c) Geneva in Switzerland [centre 46°22'N, 005°56'E].
2. Air Traffic Service route segments within HMU coverage can be determined by considering a circle with 45 NM radius around the center coordinates given above. Up-to-date information can be obtained from the RMA.
3. For information on European HMU Monitoring see the European Regional Monitoring Agency (RMA) web site at: <http://www.eurocontrol.int/eur-rma>

**Strumble Ground-based Height Monitoring Units (HMU) for the North Atlantic**

1. In the North Atlantic Region, monitoring can be completed by overflying ground-based Height Monitoring Units (HMUs) or utilizing the portable, airborne GPS-based Monitoring System (GMS).
2. An HMU is located near the Strumble (STU) VOR below the centreline of UL9. The horizontal coverage areas for the Strumble HMU is a 13.8 nm radius circle centered on position N51° 56' 00'' W004° 40' 00''. In the vertical dimension, the coverage is from FL 290 to FL 410 inclusive. The site is unmanned and designed to operate continuously.

3. To obtain additional information or ascertain the result of the overflight operators may fax a request to the NAT Central Monitoring Agency (CMA) on +44 (\*0) 1292 692754. (0 not required from U.S. locations) or via e-mail to [natcma@nats.co.uk](mailto:natcma@nats.co.uk). Any request for information regarding the result of monitoring will be more speedily dealt with if the Mode S or Mode A codes and approximate time of overflight are included in the enquiry.

### **Ground-based Height Monitoring Units (HMU) in Japan**

1. Japan has implemented the 3 HMUs, the Setouchi HMU, the Niigata HMU and the Sendai HMU. The HMU systems have one central and 4 outer receiving stations. The outer receiving stations are ideally installed to form a square of some 30 NM. The HMU measures geometric height of an aircraft using the multi-lateration principle. multi-lateration obtains three-dimensional positions calculated from the time difference of arrival (TDOA) of signals at each receiving stations from the transponder of an aircraft in flight. At least 4 receiving stations are required, and the fifth improves omni-directional coverage, accuracy and system redundancy.

2. The Setouchi HMU is located around the SHODO VOR/DME Site [center 34° 30'N, 134° 16'E]

The Niigata HMU is located [center 37° 58'N, 138° 52'E]

The Sendai HMU is located [center 38° 09'N, 140° 39'E]

3. Additional information about the HMUs in Japan can be found on the Japan Airspace Safety Monitoring Agency (JASMA) web site at: <http://www.jasma.jp/height-monitoring.html>

## FREQUENTLY ASKED QUESTIONS (FAQ's) ON MONITORING

**Note:** these FAQ's are not in alphabetical order.

**1. FAQ: Documents and Guidance. Where can documents explaining monitoring systems, operator requirements and procedures be found?**

**All** of the documents referred to in this list of Monitoring FAQ's are posted on the RVSM Documentation Webpage in the "Monitoring Requirements and Procedures" section.

**Requirements.** Operators that have been issued an U.S. RVSM authorization will be required to conduct initial monitoring within six months of date of issue and must conduct monitoring every two years or within intervals of 1,000 flight hours per aircraft, whichever period is longer, in accordance with the aircraft categories as presented in the current version of the (North American) RVSM Minimum Monitoring Requirements chart. The RVSM Minimum Monitoring Chart is coordinated with the North American Approvals Registry and Monitoring Organization (NAARMO) and updated periodically to reflect changes in aircraft data. The RVSM Minimum Monitoring Requirements Chart will be posted to the FAA RVSM Webpage in documentation section "Monitoring Requirements/Procedures".

**Note: Regarding the initial monitoring within 6 months see question 2. below.**

**2. FAQ: Previous monitoring results relating to transfer of ownership .** If an aircraft has been successfully monitored previously and a new owner can demonstrate that the aircraft has been continuously maintained in standard airworthiness condition and the approved maintenance program is current, the previous monitoring can be used to meet the RVSM monitoring requirements. The time frames associated with the RVSM monitoring policy apply.

**Example 1.** If an operator purchases an aircraft and requires issuance of a new RVSM authorization and can demonstrate that the aircraft has a previous successful monitoring and meets the airworthiness and monitoring requirements above he has the remaining balance of the monitoring time to have the aircraft monitored (e.g., 2 years or 1000 flight hours, whichever is longer from the last successful monitoring.)

**Example 2.:** If an operator requires issuance of a new authorization and the aircraft has not been monitored (or can't be shown to have been monitored) within the previous 2 years or 1000 flight hours, whichever is longer, he has 6 months to get it monitored.

**3. FAQ: Monitoring Objectives. What are the objectives of monitoring?**

Monitoring objectives are to identify individual aircraft that are not performing to RVSM standards, identify any adverse altitude-keeping trends for individual aircraft types and provide data for use in safety analysis.

**4. FAQ: Required Operator Participation. Are operators required to participate in the monitoring program? What are the regulatory requirements?**

With reference to the assertion that there is no regulatory requirement for height monitoring, operators should review 14 CFR Part 91.180 and 14 CFR Part 91 Appendix G,

The following requirements in the regulations are met by height monitoring.

a) 14 CFR Part 91.180 - Operations within airspace designated as Reduced Vertical Separation Minimum airspace. (a) Except as provided in paragraph (b) of this section, no person may operate a civil aircraft in airspace designated as Reduced Vertical Separation Minimum (RVSM) airspace unless: (1) The operator and the operator's aircraft comply with the minimum standards of **appendix G of this part**; and (2) The operator is authorized by the Administrator or the country of registry to conduct such operations. (b) The Administrator may authorize a deviation from the requirements of this section

b) 14 CFR Part 91 Appendix G, Section 2 (d), (e) and (f) stipulates the requirements for altimetry system error containment and that , "...the Administrator must find that the altimetry system error (ASE) is contained as follows:..."

*(Ed. comment: Height monitoring is the only method to detect aircraft with ASE that is not contained within requirements.)*

c) 14 CFR Part 91 Appendix G, Section 4 (b) (2) advises that, "No person may show, on the flight plan filed with air traffic control, an operator or aircraft as approved for RVSM operations, or operate on a route or in an area where RVSM approval is required, unless, "...The aircraft has been approved and complies *(Ed. comment: Word is underlined to emphasize an ongoing commitment)* with the requirements of Section 2 of this appendix." *(Ed. comment: Compliance with the performance requirements in Section 2 can only be verified through height monitoring and is ongoing)*

d) 14 CFR Part 91 Appendix G, Section 3(c)(1) and (2) stipulates how the operator "In a manner prescribed by the Administrator, must provide evidence that: 1) it is capable to operate and maintain each aircraft or aircraft group for which it applies for approval to operate in RVSM airspace..." *(Ed. comment: Height monitoring is the only method to verify ASE within performance limits and, further, it is the manner prescribed by the Administrator.)*

e) 14 CFR Part 91 Appendix G, Section 6(b) advises that, "Each operator shall report to the Administrator each event in which the operator's aircraft has exhibited the following altitude-keeping performance: ...

(b) Altimetry system error of 245 feet or more;..."

*(Ed. Comment: ASE containment can only be verified by height monitoring.)*

f) 14 CFR Part 91 Appendix G, Section 7. Removal or Amendment of Authority provides for Administrator action if "...the operator is not complying, or is unable to comply with this appendix or subpart H..."

Height keeping is required by the Federal Aeronautical Regulations and implemented in accordance with FAA policy.

**5. FAQ: RVSM Letters of Authorization (LOA) or Operations Specification (OpSpec) and Monitoring. Am I required to complete my monitoring requirements prior to obtaining RVSM authority (i.e., a Letter of Authorization or Operations Specifications, as appropriate)?**

No. See the Minimum Monitoring Requirements charts. For DRVSM, you must complete your monitoring requirements not later than 6 months after you receive RVSM authority **or** 6 months after the start of DRVSM (Domestic U.S.RVSM) operations, whichever occurs later. In other areas of operation, you have up to 6 months after obtain RVSM authority to complete your monitoring requirements.

**6. FAQ: Number of Aircraft to be Monitored. How many aircraft from an operator's fleet are required to be monitored?**

In general, operators are only required to have a portion of their fleets monitored. Monitoring requirements are published in the North American Minimum Monitoring Requirements Charts posted under “Monitoring Requirements and Procedures”.

**7. FAQ: Monitoring Groups. What are monitoring groups and where are they listed?**

Monitoring groups are listed on the Minimum Monitoring Requirements charts. For monitoring purposes, aircraft types can be placed in a single monitoring group. For example, the A319, A320 and A321 are categorized as a single monitoring group.

**8. FAQ: GMU (GPS-based Monitoring Unit) FAQ’s and Information. Where can I find FAQ’s and information on scheduling GMU monitoring?**

See monitoring procedures for U.S. Operators under the “Monitoring Requirements/Procedures” section of the FAA RVSM webpage.

**9. FAQ: 1000-hour Requirement.** If I fly my RVSM approved aircraft less than 1000 flight hours in 2 years. Am I required to have it monitored within a 2-year period.

No. The policy states that aircraft will be monitored every two years or 1000 flight hours, whichever is longer. However, if your aircraft has not had a valid monitoring in the last 2 years you may be contacted by your local Flight Standards District Office (FSDO) or Certificate Management Office (CMO) and asked to provide data that shows you have flown less than 1000 hours from the last successful monitoring.

**The 1000 flight hour time limit clock starts on the date of the last successful monitoring.**

NOTE: The 2-year time limit clock also starts on the date of the last successful monitoring.

**10. FAQ: MMR Chart. If I purchase an aircraft of the same model and type series, for which I already hold a valid RVSM authorization, does it have to be monitored?**

It depends. NOTE 9 of the RVSM MMR Chart states: If an operator adds new RVSM compliant airframes of a type for which it already has RVSM operational approval and has completed monitoring requirements for the type in accordance with the attached table, the new airframes are not required to be monitored. If an operator adds new RVSM compliant airframes of an aircraft type for which it has NOT previously received RVSM operational approval, then the operator should complete monitoring in accordance with the attached table.

Example 1. You own a fleet of three Gulfstream 5’s (GLF5) that have a valid monitoring in the last two years. You purchase of a fourth Gulfstream 5, it would not require monitoring because you already meet the minimum requirement of two airframes. A GLF5 is a group approved aircraft in category 1. This is specified in Table 1 of the Minimum Monitoring Chart.

Example 2.

You own a fleet of three Gulfstream 3’s (GLF3) and 2 of the aircraft have a valid monitoring in the last two years. You purchase two more GLF3’s, At least one would require monitoring to meet the 60% requirement (3-aircraft) within 6 months. A GLF3 is a group approved aircraft in category 2. This is specified in Table 1 of the Minimum Monitoring Chart.

Note: airframes must be RVSM compliant upon delivery

**11. FAQ: MMR Chart. I just purchased a fleet of 4 Boeing 767's and applied for an U.S. RVSM operational authorization. How many must be monitored and when?**

In accordance with FAA Policy and Note 2 of the RVSM MMR CHART, operators must show a plan for meeting applicable monitoring requirements. Initial monitoring of two airframes (for MMR chart category 1) should be completed as soon as possible but not later than 6 months after the issue of RVSM operational authority. A minimum of two airframes (MMR chart category 1) shall have a valid monitoring every two years or 1000 flight hours whichever period is longer.

**12. FAQ: Determination of Monitoring. How will the FAA know if the aircraft has been monitored on time?**

The FAA will periodically review its database of all RVSM aircraft monitoring to determine which aircraft have not met the two (2) year monitoring requirement and notify the applicable FSDO/CMO/CHDO, etc. to investigate.

**13. FAQ: RVSM Monitoring and Maintenance Programs. Does the maintenance program have to be reissued to address the minimum monitoring requirements?**

No, RVSM aircraft monitoring is a component of RVSM system quality control not continued airworthiness. As such, the monitoring requirements are operational in nature and do not need to be described in the maintenance program. The approved maintenance program is required to provide for continued airworthiness of the aircraft without periodic monitoring.

**14. FAQ: RVSM Monitoring Time Limits. When does the 2 year or the 1000 hour time limit begin?**

See Question #9

**15. FAQ: RVSM Proof of Monitoring. What is an acceptable method to advise FSDO/CMO/CHDO that timely, successful monitoring has been completed.**

Notification of a successful monitoring can be made in several ways:

- A report of successful monitoring supplied by an FAA approved GMS RVSM monitoring provider, e.g., CSSI Inc., ARINC
- The entry of successful Aircraft Geometric Height Measurement Element (AGHME) monitoring on the NAARMO AGHME webpage.
- Evidence of successful monitoring by another Regional Monitoring Agency, such as EUROCONTROL or the UK NATS Central Monitoring Agency in accordance with the directions available on the FAA RVSM Documentation webpage.

Note (1): If you conducted a monitoring flight and your aircraft is not listed in the RVSM Approvals database this is not necessarily an indication that the aircraft has not been successfully monitored. Please contact NAARMO if this occurs.

Note (2): Operators should be aware that the AGHME web page is only updated once a month, typically around the 15<sup>th</sup>. Also, it takes approximately 30 days for an AGHME measurement to be processed and posted to the approvals data base.

**16. FAQ: Application for Monitoring. For the new two year requirement, do I have to fill out an "Application for Monitoring" if I already have an established RVSM monitoring program.**

No, the application for monitoring is designed for an operator requesting an initial RVSM authorization. An operator that has a valid RVSM authorization and has already established a monitoring program can check the RVSM Approvals Data Base to determine when their last valid monitoring was recorded. For North American Operators the data base can be accessed from the FAA RVSM Website under RVSM Documentation. The files are located under the section heading of “**US RVSM Approvals**”. The weblink for this site is:

[http://www.faa.gov/air\\_traffic/separation\\_standards/rvsm/documentation/](http://www.faa.gov/air_traffic/separation_standards/rvsm/documentation/)

**17. FAQ: Previous monitoring results relating to transfer of ownership .** If an aircraft has been successfully monitored previously and a new owner can demonstrate that the aircraft has been continuously maintained in standard airworthiness condition and the approved maintenance program is current, the previous monitoring can be used to meet the RVSM monitoring requirements. The time frames associated with the RVSM monitoring policy apply.

**Example 1.** If an operator purchases an aircraft and requires issuance of a new RVSM authorization and can demonstrate that the aircraft has a previous successful monitoring and meets the airworthiness and monitoring requirements above he has the remaining balance of the monitoring time to have the aircraft monitored (e.g., 2 years or 1000 flight hours, whichever is longer from the last successful monitoring.)

**Example 2.:** If an operator requires issuance of a new authorization and the aircraft has not been monitored (or can't be shown to have been monitored) within the previous 2 years or 1000 flight hours, whichever is longer, he has 6 months to get it monitored.

**18. FAQ: Use of Electronic Media for RVSM Documentation.** It is acceptable to maintain RVSM documentation carried onboard the aircraft via electronic media (e.g., IPAD, Electronic Flight Bag). However, copies of RVSM Authorizations may continue to be carried onboard at all times in paper format for backup purposes (note: any backup copies carried must reflect current electronic authorizations). For operators AC 120-76B provides an acceptable method of compliance for the certification, airworthiness, and the operational approval of both portable and installed Electronic Flight Bag (EFB) aircraft computing devices. Many of the RVSM documents, including the RVSM maintenance manual, are considered “Type A” documents and the use of an electronic device for these items requires Principal Inspector (PI) approval (see the AC for guidance). Note: For part 91 operators other than 91K, the use of an EFB in lieu of paper is the decision of the aircraft operator and/or the pilot in command. AC 91-78 and AC 120-76B contain guidance on replacing paper products with an EFB.

RVSM MONITORING POINTS OF CONTACT

**Scheduling GPS-based Monitoring System/Unit Flights:**

CSSI Inc., FAA RVSM GMS Monitoring Support Contractor:

Phone: +1 866-468-8111 or +1 202-554-1050  
Fax: +1 202-863-2398  
Email: [monitor@cssiinc.com](mailto:monitor@cssiinc.com)

ARINC, FAA RVSM Monitoring GMU Support Contractor:

Phone: +1 410-266-4707  
Fax: +1 410-573-3007  
Email: [rvsmops@arinc.com](mailto:rvsmops@arinc.com)

**RVSM Monitoring Programs, Approvals Data Base and Support Questions:**

| <u>Name</u>  | <u>Title</u>                 | <u>Phone</u>      | <u>Email</u>             |
|--------------|------------------------------|-------------------|--------------------------|
| Steve Smoot  | FAA RVSM Support, RA.        | +1 (202) 267-8855 | steve.ctr.smoot@faa.gov  |
| Tracy Sivley | FAA RVSM Support, CSSI, Inc. | +1 (609) 485-7371 | tracy.ctr.sivley@faa.gov |

**FAA RVSM Monitoring Program Leads:**

| <u>Name</u>    | <u>Title</u>               | <u>Phone</u>      | <u>Email</u>           |
|----------------|----------------------------|-------------------|------------------------|
| Madison Walton | FAA Headquarters (AFS-470) | +1 (202) 267-8850 | madison.walton@faa.gov |
| Wayne Smoot    | FAA Tech Center (ANG-E61)  | +1 (609) 485-5475 | wayne.smoot@faa.gov    |

**U.S. OPERATOR APPLICATION FOR RVSM MONITORING**

Updated: 5/25/2016

Instructions

1. If your aircraft **is not currently listed** in the Approvals Data Base, fax the completed form to +1(609) 485-5078 or email to [naarmo@faa.gov](mailto:naarmo@faa.gov)

Operator Name: \_\_\_\_\_  
Operator's 3-letter  
ICAO Identifier: \_\_\_\_\_

*(For International General Aviation Operators (IGA), enter IGA. If no ICAO identifier assigned, enter "None")*

**Operator Primary Point of Contact**

Name: \_\_\_\_\_ Title: \_\_\_\_\_  
Telephone Number: \_\_\_\_\_ Fax Number: \_\_\_\_\_  
Email Address: \_\_\_\_\_

**Operator Secondary Point of Contact**

Name: \_\_\_\_\_ Title: \_\_\_\_\_  
Telephone Number: \_\_\_\_\_ Fax Number: \_\_\_\_\_  
Email Address: \_\_\_\_\_

**Responsible Flight Standards Office (FSDO or CMO) Point of Contact**

Name: \_\_\_\_\_ Title: \_\_\_\_\_  
Address: \_\_\_\_\_  
Telephone Number: \_\_\_\_\_ Fax Number: \_\_\_\_\_  
Email Address: \_\_\_\_\_

**REGION WHERE RVSM OPERATIONS WILL BE CONDUCTED:**

(Check all that apply)

- North America     Pacific     North Atlantic     Caribbean/ South American     European     Asia     Other
- (Please Specify)

