U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Authorization of Aircraft and Operators for Flight in Reduced Vertical Separation Minimum (RVSM) Airspace

Date: 1/29/19 **AC No:** 91-85B
Initiated by: AFS-400 **Change:**

This advisory circular (AC) provides airworthiness and operational authorization guidance material for operators, pilots, certificate holders, and/or program managers conducting Title 14 of the Code of Federal Regulations (14 CFR) part 91, §§ 91.180 and 91.706 Reduced Vertical Separation Minimum (RVSM) operations. RVSM airspace is any airspace or route between flight level (FL) 290 and FL 410 inclusive where aircraft are separated vertically by 1,000 feet.

This AC has been updated to include guidance on eligibility and compliance for §§ 91.180 and 91.706 RVSM operations when operators seek RVSM authorization under the provisions of the new Part 91 Appendix G, Section 9, Aircraft Equipped with Automatic Dependent Surveillance – Broadcast Out.

The Federal Aviation Administration (FAA) intends to transition current authorizations, issued under part 91 appendix G, section 3, to monitor operations under the provisions of part 91 appendix G, section 9. This action reduces the operator and FAA administrative burdens associated with maintaining the part 91 appendix G, section 3 authorizations.

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CHAPTER 1. GENERAL

1.1 Purpose of This Advisory Circular (AC). This AC provides airworthiness and operational authorization guidance material for operators, pilots, certificate holders, and/or program managers conducting Title 14 of the Code of Federal Regulations (14 CFR) part 91, §§ 91.180 and 91.706 Reduced Vertical Separation Minimum (RVSM) operations. RVSM airspace is any airspace or route between flight level (FL) 290 and FL 410 inclusive where aircraft are separated vertically by 1,000 feet. The term "must" is used in this AC to indicate a mandatory requirement driven by regulation or required for a system to operate properly. The term "should" is used to indicate a recommendation. The term "operator" refers to the certificate holder, program manager, and operator/company for aircraft used in RVSM airspace for 14 CFR parts 91, 91 subpart K (part 91K), 121, 125, and 135 operations.

1.2 Audience. This AC applies to operators, pilots, certificate holders, and/or program managers under parts 91, 91K, 121, 125, and 135 conducting RVSM operations in the United States or in oceanic and remote airspace. This AC also applies to U.S.-registered operators where foreign authority has adopted International Civil Aviation Organization (ICAO) RVSM operations.

1.3 Where You Can Find This AC. You can find this AC on the Federal Aviation Administration's (FAA) website at http://www.faa.gov/regulations_policies/advisory_circulars.

1.4 What This AC Cancels. AC 91-85A, Authorization of Aircraft and Operators for Flight in Reduced Vertical Separation Minimum (RVSM) Airspace, dated July 21, 2016, is canceled.

1.5 AC Format.

- Chapter 2, Aircraft Eligibility, and Chapter 3, Knowledge and Training, apply to all operators, pilots, certificate holders, and/or program managers.
- Chapter 4, Authorizations for Operators of RVSM Aircraft Equipped with a Qualified ADS-B OUT System, applies to operators and pilots intending to operate in RVSM airspace under the provisions of part 91 appendix G, section 9.
- Chapter 5, Operators Applying for RVSM OpSpecs, MSpecs, or LOAs, applies to operators and pilots of aircraft not equipped with a qualified Automatic Dependent Surveillance-Broadcast (ADS-B) OUT system or when operating in a country requiring specific approval. Operators may also obtain this approval if the aircraft is not routinely flown in airspace where the FAA has sufficient ADS-B data to determine RVSM performance.

1.6 Airworthiness. For RVSM aircraft airworthiness requirements, see Appendix A, RVSM Airworthiness Certification.

1.7 Related Regulations. Title 14 CFR:

- Part 91, §§ 91.180 and 91.706, subpart K, and appendix G.
- Part 121.
- Part 125.
- Part 135.

1.8 Related Reading Material.

1.8.1 FAA Documents. The following documents are available at https://www.faa.gov/air_traffic/publications/:

- Aeronautical Information Manual (AIM).
- Aeronautical Information Publication (AIP).

1.8.2 ICAO Documents:

- ICAO Annex 2, Rules of the Air.
- ICAO Annex 6, Operation of Aircraft, Part I—International Commercial Air Transport—Aeroplanes and Part II—International General Aviation—Aeroplanes.
- ICAO Annex 11, Air Traffic Services.
- ICAO Doc 4444, Procedures for Air Navigation Services, Air Traffic Management.
- ICAO Doc 7030, Regional Supplementary Procedures.
- ICAO Doc 9574, Manual on a 300 m (1,000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive.

1.9 AC Feedback Form. For your convenience, the AC Feedback Form is the last page of this AC. Note any deficiencies found, clarifications needed, or suggested improvements regarding the contents of this AC on the Feedback Form.

CHAPTER 2. AIRCRAFT ELIGIBILITY

2.1 Introduction. This chapter provides guidance on how operators can determine if their aircraft is compliant and eligible for operations in RVSM airspace.

2.2 Aircraft Eligibility. An aircraft is an "RVSM-Compliant Aircraft" when:

1. The aircraft design ensures the aircraft will meet RVSM performance requirements; and
2. The aircraft has been properly maintained on an ongoing basis to conduct such operations.

2.2.1 Aircraft may be produced RVSM-compliant or brought into compliance through the application of appropriate Service Bulletins (SB), Service Letters (SL), Engineering Change Orders (EO), or Supplemental Type Certificates (STC). For airworthiness guidance, see Appendix A, RVSM Airworthiness Certification.

2.2.2 To determine eligibility for RVSM operations, the limitations section of the Airplane Flight Manual (AFM) or AFM Supplement (AFMS) should indicate the aircraft has been determined to be capable of meeting the RVSM performance requirements of 14 CFR part 91 appendix G.

Note: For operators and pilots authorized under part 91 appendix G, section 9, the aircraft may have qualified as Group or Non-Group aircraft described in Appendix A.

2.3 Configuration Control. Operators must maintain their aircraft altimetry and altitude-keeping configuration which has been shown to provide the required RVSM performance.

2.4 Maintenance. The operator is responsible for maintenance of the systems affecting RVSM performance on the aircraft. The operator must ensure that it complies with the appropriate instructions for continued airworthiness (ICA).

2.4.1 System Alteration or Design Modifications (Including Software Updates). Operators must evaluate alterations to the aircraft and identify any changes that impact altitude-keeping ability. The operator should establish that the alteration did not affect the RVSM system, or if it was affected, affirm the compliance to meet associated performance standards. When modifying an aircraft based on an approved design change, the owner of the approved design change should identify any effect on RVSM performance. Operators must determine aircraft RVSM eligibility after each alteration or modification.

2.5 RVSM Performance. Altitude-keeping performance of airplanes is a key element in ensuring safe operations in RVSM airspace. RVSM is a "performance-based" operation requiring monitoring on an ongoing basis.

2.5.1 Altitude-Keeping Performance Monitoring. RVSM aircraft must participate in altitude-keeping performance monitoring programs to ensure safe and efficient operations in RVSM airspace.

2.5.1.1 Operators and pilots conducting RVSM operations under the provisions of part 91 appendix G, section 9 must ensure their aircraft meet the RVSM altitude-keeping performance monitoring requirements as described in Chapter 4, paragraph 4.3. Under these provisions, aircraft with qualified ADS-B OUT systems will be monitored during normal operations whenever operating at RVSM altitudes where sufficient ADS-B data is available to the FAA to determine RVSM performance. All aircraft in an operator's fleet must have been monitored within the previous 24 months and found to be in compliance with the performance requirement specified in part 91 appendix G, section 9(b).

2.5.1.2 Operators conducting RVSM operations under the provision of part 91 appendix G, section 3 must meet the RVSM Minimum Monitoring Requirements (MMR) and have their aircraft monitored as specified in Appendix E, RVSM Altitude-Keeping Performance Monitoring When Operating With an RVSM OpSpec, MSpec, or LOA.

CHAPTER 3. KNOWLEDGE AND TRAINING

3.1 Pilot Knowledge. All pilots conducting operations in RVSM airspace must be proficient with the procedures and operations associated with RVSM.

3.1.1 Title 14 CFR Parts 91K, 121, 125, and 135 Operator Training. Parts 91K, 121, 125, and 135 operators should have a training program addressing the operational practices, procedures, and training items related to RVSM (e.g., initial, upgrade, or recurrent training for pilots, operational control personnel, and maintenance personnel).

Note: A separate training program is not required if RVSM training is integrated into the operator's existing training program.

3.2 Pilot Knowledge Subject Areas. The following subjects should be addressed during the initial introduction of a pilot to RVSM operations (see also Appendix B, Training Programs and Operating Practices and Procedures; Appendix C, Operations Outside of U.S.-Controlled Airspace; and Appendix D, Severe Turbulence and Mountain Wave Activity):

1. Description of RVSM airspace, including Flight Level Allocation Schemes (FLAS).
2. Flight planning for RVSM aircraft.
3. Preflight procedures.
4. Procedures before RVSM airspace entry.
5. In-flight procedures.
6. RVSM pilot air traffic control (ATC) phraseology.
7. Contingency procedures after entering RVSM airspace.
8. Postflight procedures.
9. Non-RVSM aircraft.
10. Altitude-keeping performance monitoring.
11. Minimum equipment list (MEL).
12. Traffic Alert and Collision Avoidance System (TCAS) considerations for RVSM (if TCAS-equipped).
13. RVSM oceanic operations (if applicable).
14. International operations (if applicable).
15. Severe turbulence and Mountain Wave Activity (MWA).

Note: For subsequent ground training, only the new, revised, or emphasized items need be addressed.

3.3 Pilot Currency. Pilot currency programs/training should also include RVSM elements listed in paragraph 3.2.

CHAPTER 4. AUTHORIZATIONS FOR OPERATORS OF RVSM AIRCRAFT EQUIPPED WITH A QUALIFIED ADS-B OUT SYSTEM

4.1 Introduction. This chapter discusses RVSM operations for operators and pilots seeking to conduct flight in RVSM airspace under the provisions of 14 CFR part 91 appendix G, section 9.

4.1.1 Operators and pilots seeking to operate in RVSM airspace under the provisions of part 91 appendix G, section 9 are not required to apply for authorizations. The operator or pilot needs to ensure all applicable requirements in part 91 appendix G to operate in RVSM airspace are met. The operator or pilot should:

1. Determine the aircraft is RVSM-compliant (see Chapter 2, Aircraft Eligibility);
2. Ensure pilots are knowledgeable (see Chapter 3, Knowledge and Training);
3. Ensure the aircraft meets RVSM performance and the aircraft has been height-monitored in accordance with paragraph 4.3 (see paragraph 4.3.5 when an operator is conducting the initial flight in RVSM airspace); and
4. Properly file a flight plan and understand the policies and procedures for the RVSM airspace in which the aircraft will operate.

4.2 Flight Planning. ATC uses flight planning codes to determine when to assign 1,000 ft separation in RVSM-designated airspace. See Appendix B, Training Programs and Operating Practices and Procedures, for proper flight planning procedures.

4.2.1 Non-RVSM Aircraft. If the aircraft is not eligible for RVSM operations or the flightcrew does not have knowledge of RVSM requirements, policies, and procedures sufficient for the conduct of operations in RVSM airspace, the aircraft is considered a non-RVSM aircraft.

4.3 Altitude-Keeping Performance Monitoring for RVSM Aircraft Equipped With ADS-B OUT. The goal of altitude-keeping performance monitoring is to ensure safe and efficient operations and determine aircraft compliance on an ongoing basis.

4.3.1 Altimetry System Error (ASE). Proper vertical separation in RVSM airspace relies on strict altitude-keeping performance of the aircraft. ASE is the difference between the pressure altitude displayed to the flightcrew and free stream pressure altitude. It is a key component of Total Vertical Error (TVE). This difference is not seen on the displayed altitude in the flight deck and it is not in the Altitude Reporting Mode of Secondary Radar (Mode C) or Mode Select Secondary Radar with Data Link (Mode S) reply from the aircraft transponder. Therefore, it is invisible to the pilot, to routine ATC, and to the TCAS.

4.3.2 Aircraft ICAs are designed to keep the ASE to within the limits of the error budget throughout the flight envelope. Regardless, even with attention to continuing airworthiness, there are factors that can affect the ASE significantly and can go undetected without altitude-keeping performance monitoring.

4.3.3 Aircraft equipped with qualified ADS-B OUT systems will be height-monitored during normal operations at RVSM altitudes when operating in airspace where sufficient ADS-B data is available to the FAA to determine RVSM performance.

4.3.4 For RVSM altitude-keeping performance monitoring purposes, a qualified ADS-B OUT system is one that meets the performance requirements in part 91, § 91.227.

4.3.4.1 ADS-B OUT provides the necessary aircraft information for the FAA to perform altitude-keeping performance monitoring on a continual basis during normal RVSM aircraft operations whenever the aircraft is operating at RVSM altitudes in airspace where sufficient ADS-B data is available to the FAA to determine RVSM performance. A map of that airspace can be found at https://www.faa.gov/nextgen/programs/adsb/coverageMap/.

Note: The FAA may also expand the airspace in which we collect altitude-keeping performance data via ADS-B through collaboration with other air navigation service providers (ANSP).

4.3.4.2 The ADS-B OUT equipment requirement is necessary for aircraft altitude-keeping performance monitoring, but not for aircraft altitude-keeping capability. Accordingly, an aircraft meeting RVSM altitude-keeping performance specified in part 91 appendix G, section 9, and having a current successful monitoring in accordance with paragraph 4.3.5, is authorized to operate in RVSM airspace when ADS-B OUT is temporarily inoperable.

Note: This does not relieve the operator of any other requirements regarding the use of ADS-B for the specific airspace where operations are intended.

4.3.5 The altitude-keeping performance must be monitored as follows:

4.3.5.1 The initial RVSM operation of an aircraft must be in airspace where sufficient ADS-B data will be collected for the FAA to evaluate RVSM performance. Initial RVSM operation occurs at the first RVSM flight of a new aircraft, the first RVSM flight after alterations affecting RVSM performance have been performed, or the first RVSM flight of an aircraft returned to RVSM operational status after having been removed for any reason.

1. Operators must ensure compliant performance prior to operations in RVSM airspace outside U.S.-controlled airspace (see paragraph 4.4). An operator may obtain authorization without first flying in airspace in which the FAA monitors ADS-B operations

as described in Chapter 5, Operators Applying for RVSM OpSpecs, MSpecs, or LOAs.

2. For altitude-keeping performance monitoring purposes, the FAA tracks aircraft by serial number. Transfer of ownership or the registration number of a properly maintained aircraft does not affect aircraft RVSM status under part 91 appendix G, section 9.

4.3.5.2 The aircraft's altitude-keeping performance must have been monitored within the previous 24 months in airspace the FAA can monitor the aircraft ADS-B OUT signal and found to be in RVSM compliance.

4.3.5.3 The aircraft must continue to meet the altitude-keeping performance specified in part 91 appendix G, section 9(b).

4.4 RVSM Altitude-Keeping Performance Website. U.S.-registered operators may obtain monitoring performance from the FAA altitude-keeping performance website at https://www.faa.gov/air_traffic/separation_standards/naarmo/.

4.4.1 If the operator does not meet the monitoring requirements specified in paragraph 4.3.5, the operator must file as non-RVSM aircraft until the issue is resolved. Common resolution actions include:

1. If a specific operational issue is identified as the cause of the unsatisfactory performance, conduct appropriate knowledge training and/or modification of training programs, as applicable, and obtain concurrence from the FAA Flight Standards Service prior to resuming RVSM operations;
2. If the unsatisfactory performance is attributed to an aircraft component failure, RVSM operation may be resumed after repair and return to service of the aircraft. The operator must comply with the provisions of paragraph 4.3.5 (initial RVSM operation flight); or
3. If the cause of the unsatisfactory performance cannot be attributed to an operational issue or aircraft component failure, an airworthiness evaluation of the aircraft must take place with attention to conformity of design and alterations/modifications, with discrepancies noted and repaired. Prior to resuming RVSM operations, a monitoring flight of the aircraft in normal operating configuration must be performed to ensure acceptable performance and obtain concurrence from the FAA Flight Standards Service prior to resuming RVSM operations.

4.4.2 Operators of airplanes that do not routinely operate in airspace where sufficient ADS-B data is available to the FAA to determine RVSM performance, or when a foreign country requires a specific approval, may seek an RVSM authorization via operations specification (OpSpec), management specification (MSpec), or letter of authorization (LOA) under the provisions of part 91 appendix G, section 3. (See Chapter 5.)

CHAPTER 5. OPERATORS APPLYING FOR RVSM OPSPECS, MSPECS, OR LOAs

5.1 Introduction. This chapter provides guidance on applying for RVSM authorization under the provisions of 14 CFR part 91 appendix G, section 3. Operators must obtain an operations specification (OpSpec), management specification (MSpec), or letter of authorization (LOA) for RVSM operations to operate an aircraft that is not Automatic Dependent Surveillance-Broadcast (ADS-B) OUT-equipped, or when operating in a country requiring specific approval. Operators may also obtain this approval if the aircraft is not routinely flown in airspace where the FAA has sufficient ADS-B data to determine RVSM performance.

5.1.1 Definitions. For the purposes of efficiency and consistency, when the various capitalized terms below are used in this AC, then they have the following meanings:

1. **Operator.** The person who should be the RVSM authorization applicant and holder. See paragraph 5.6 for a detailed discussion on who is and is not the correct person to be designated as an operator for the purposes of holding an RVSM authorization.
2. **RVSM-Compliant Aircraft.** An aircraft the FAA has found to comply with the requirements of part 91 appendix G, for the purposes of conducting RVSM operations. (See Chapter 2, Aircraft Eligibility.)
3. **RVSM-Knowledgeable Pilots.** Pilots who have been trained according to RVSM operating policies and/or procedures for pilots (and, if applicable, dispatchers) with sufficient knowledge for the conduct of operations in RVSM airspace. (See Chapter 3, Knowledge and Training.)
4. **RVSM-Point of Contact (POC).** A person an operator can designate in addition to the RVSM-Responsible Person to act as a contact person who has actual day-to-day knowledge of the RVSM-Compliant Aircraft operations and RVSM airworthiness status and who the FAA may contact to gather such information when the need arises.
5. **RVSM-Responsible Person.** A person(s) designated by the operator who has the legal authority to sign the RVSM authorization on behalf of the operator and who has adequate knowledge of RVSM requirements, policies, and procedures. (See paragraph 5.7.)

5.2 RVSM Authorization Elements Background. The RVSM authorization process recognizes two key elements of any RVSM authorization: an RVSM-Compliant Aircraft (see Chapter 2) and properly trained pilots who have met applicable RVSM-Knowledgeable Pilots requirements (see Chapter 3). Under the provisions of part 91 appendix G, section 3, an operator must comply with both of these elements to be authorized to operate in RVSM airspace.

5.3 Authorization Matrix. The RVSM Authorization Matrix (or simply the "Matrix") is a tool created to assist operators and the FAA in determining the typical documentation needed for application and which RVSM authorization approval action the applicant

is seeking. (See Appendix F, Decision Matrix When Applying for an RVSM OpSpec, MSpec, or LOA.)

5.3.1 Authorization Group I. Authorization Group I applies to applicants seeking only administrative changes to an existing authorization. The following changes are considered to be administrative in nature only when all other existing RVSM elements are not changed:

1. Change in the primary business address of an RVSM-Compliant Aircraft and/or RVSM authorization holder.
2. Change in an existing RVSM operator's designated Responsible Person (or RVSM-Authorized Representative or RVSM-POC).
3. Change in the registration markings of an RVSM-Compliant Aircraft being operated by an existing RVSM authorization holder.
4. Removal of an RVSM-Compliant Aircraft from an existing RVSM authorization having multiple RVSM-Compliant Aircraft listed.

5.3.2 Authorization Group II. Authorization Group II applies to applicants seeking new RVSM authorizations based on one or more existing approved RVSM elements. This Group will normally apply to a new or proposed RVSM operator seeking the issuance of an RVSM authorization for an aircraft already an RVSM-Compliant Aircraft or where the new RVSM operator will be utilizing previously accepted RVSM-Knowledgeable Pilots requirements with respect to its operations of that specific aircraft. Examples given in the Matrix include:

1. There is a change in the legal status or identity of the business entity that is the approved RVSM operator, but the Responsible Person, RVSM-Authorized Representative, and/or RVSM-POC and each of the approved RVSM Authorization Elements are remaining the same.
2. A new proposed RVSM operator will be using an existing RVSM-Compliant Aircraft or previously accepted RVSM-Knowledgeable Pilots.
3. An existing or newly proposed approved RVSM operator seeks an RVSM authorization and will be utilizing one or more existing approved RVSM Authorization Elements.

5.3.3 Authorization Group III. Authorization Group III applies to applicants for new RVSM authorizations not based on any existing RVSM Authorization Elements. If neither Authorization Group I nor II apply, the applicant should submit sufficient evidence to show its ability to comply with each of the RVSM Authorization Elements.

5.3.4 Additional Issues When Using the Matrix. The FAA has created inspector guidance to allow for the most efficient processing of an RVSM authorization without sacrificing operational safety. While a safety inspector may rely on that guidance in issuing new or amended RVSM authorizations, applicants should understand each appropriate Flight Standards office, principal operations inspector (POI), principal avionics inspector (PAI),

principal maintenance inspector (PMI), and/or aviation safety inspector (ASI) retains the authority to conduct as much review and research with respect to any proposed RVSM-Compliant Aircraft or RVSM-Knowledgeable Pilots requirements as is warranted. This authority is to ensure safety and regulatory compliance requirements have been met. Applicants should also understand that it is the operator's responsibility to ensure documentation reflects the requirements for authorization. A positive statement by the operator detailing any changes made to previously approved programs can assist the inspector in determining the level of review necessary.

5.4 Applying for an RVSM OpSpec, MSpec, or LOA. A summary of this process is as follows:

1. The applicant identifies the appropriate FAA office to apply to. (See paragraph 5.8.1.)
2. The applicant determines if a new RVSM authorization is required, or if only an amendment to an existing RVSM authorization is required. (See paragraph 5.8.2 and Appendix F.)
3. If only an amendment to an existing RVSM authorization is required, then the applicant follows the procedures described with respect to Authorization Group I in the Matrix.
4. If the applicant determines a new RVSM authorization is required, then the applicant should first determine who the correct operator will be with respect to applying for and holding the RVSM authorization.
5. Once the appropriate operator is determined, the applicant will determine if it will be using any existing RVSM Authorization Elements, and if so, will then follow the process described in paragraph 5.8.4 with respect to Authorization Group II in the Matrix.

5.5 Providing Evidence for RVSM Authorization. An operator applying for authorization under the provisions of part 91 appendix G, section 3 must provide evidence the aircraft is RVSM-compliant and the pilots have knowledge sufficient for the conduct of operations in RVSM airspace.

5.5.1 RVSM-Compliant Aircraft. Aircraft may be produced RVSM-compliant or brought into compliance through the application of appropriate Service Bulletins (SB), Service Letters (SL), Engineering Change Orders (EO), or Supplemental Type Certificates (STC). (See Chapter 2.)

1. If the aircraft was manufactured RVSM-compliant, the date of the airworthiness certificate is usually the compliancy date. (For additional information, refer to the Airplane Flight Manual (AFM), AFM Supplement (AFMS), and/or Type Certificate Data Sheet (TCDS).)
2. If the aircraft was made RVSM-compliant through an SB, STC, or SL, or other appropriate methods, the RVSM-compliant date will be listed in the

airframe maintenance log. Include copies of the maintenance record return-to-service entry.

5.5.2 RVSM-Knowledgeable Pilots. To obtain authorization from the Administrator to conduct operations in RVSM airspace, the Administrator must find the operator to have adopted RVSM operating policies and/or procedures for pilots (and, if applicable, dispatchers) and ensure each pilot has adequate knowledge of RVSM requirements, policies, and procedures with those pilots (and, if applicable, dispatchers) being referred to in this AC as "RVSM-Knowledgeable Pilots." (See Chapter 3.)

5.5.2.1 For an applicant operating only under part 91 or 14 CFR part 125 (including part 125 Letter of Deviation Authority (A125 LODA) holders), demonstrating it has RVSM-Knowledgeable Pilots will consist of providing evidence to ensure sufficient knowledge for the conduct of operations in RVSM airspace as required by part 91 appendix G, section 3(c)(2). The following are acceptable means for the operator to show the FAA that its pilots have adequate knowledge of the RVSM operating practices and procedures:

- Title 14 CFR part 142 training center certificates without further evaluation;
- Certificates documenting completion of a course of instruction on RVSM policy and procedures; and/or
- An operator's in-house training program.

Note: The FAA, at its discretion, may evaluate a training course prior to accepting a training certificate.

5.5.2.2 For an applicant who operates under 14 CFR part 91 subpart K (part 91K), 121, or 135, in addition to meeting knowledge requirements for part 91 operators, that applicant will need to provide sufficient evidence of initial and recurring pilot training and/or testing requirements, as well as policies and procedures allowing the operator to conduct RVSM operations safely as required in part 91 appendix G, section 3(b)(2) and (3).

5.6 RVSM Applicant.

5.6.1 Who is the Correct Person to Apply for and Hold the RVSM Authorization? The person exercising operational control of the aircraft during the operation requiring an RVSM authorization is the proper person to be the applicant for that authorization. It is important to note it is the RVSM applicant's responsibility to submit a request for RVSM authorization in the name of the person having operational control of the aircraft, not the responsibility of the specific ASI to make such a determination. The following general information may be useful in assisting the RVSM applicant in determining if the appropriate party has been properly designated as the legal operator with respect to the RVSM authorization request:

5.6.1.1 For commercial and fractional ownership program operations conducted under parts 91K, 121, 125, and 135, the authorization applicant and holder should be the operating certificate holder, air carrier certificate holder, or fractional ownership program manager. The authorization will be issued in the form of an appropriate OpSpec or MSpec.

5.6.1.2 For noncommercial operations conducted under part 91 and part 125 (A125 LODA holders), the authorization applicant and legal operator should normally be one of the following persons. The authorization will be issued in the form of an appropriate LOA:

- A registered owner of the aircraft operating the aircraft incidental to its own non-air transportation business or personal activity.
- A person assuming operational control of the aircraft through a lease or use agreement for that person's operation of the aircraft incidental to that person's own non-air transportation business or personal activity.

Note: The legal operator will generally *not* be an owner trustee not operating the aircraft for its own business; a management company that has not accepted a transfer of operational control from the operator; or a holding company or bank that holds title to the aircraft solely for the purpose of leasing or transferring operational control of the aircraft to other persons.

5.6.1.3 It is both possible and common to have multiple operators for part 91, part 91K, and/or part 125/135 aircraft over a short period of time and on a non-exclusive basis (e.g., multiple dry leases for the use of any one aircraft can be in place at one time). In such instances, each individual operator is required to have an appropriate RVSM authorization issued in its own name in order for that operator to have access to RVSM airspace. For example, if an aircraft owner elects to lease the aircraft to a part 135 certificate holder for charter operations but retain operational control of the aircraft for its own part 91 flights, then the part 135 certificate holder will hold its RVSM authorization under its OpSpec for those charter operations, and the owner will simultaneously hold a separate RVSM LOA for its own part 91 operations.

5.7 Responsible Person. For part 91 RVSM applicants, the application for authorization to operate within RVSM airspace must include the designation of a Responsible Person, and may further include the designation of a separate RVSM-POC, as follows:

5.7.1 The operator should designate a person(s) who has the legal authority to sign the RVSM authorization on behalf of the operator and who has adequate knowledge of RVSM requirements, policies, and procedures. That person may be the individual person who will be the operator, or, if the operator is a legal entity, then an officer or employee of that entity, or a separate person with whom that individual person or entity has contracted

to act on behalf of the individual person or legal entity with respect to the RVSM authorization.

5.7.2 The operator should also designate a person(s) to act as a contact person who has actual day-to-day knowledge of the RVSM-Compliant Aircraft operations and RVSM airworthiness status and who the FAA may contact to gather such information when the need arises.

5.7.3 The operator may use one individual to fulfill both roles as described in paragraphs 5.7.1 and 5.7.2, or the operator may elect to designate separate persons to fulfill these roles.

5.7.4 Whoever the operator designates to fulfill the role described in paragraph 5.7.1 will be designated as the "Responsible Person," and that Responsible Person will sign LOAs, as appropriate.

5.7.5 If the operator chooses to use separate individuals, then the person fulfilling the role described in paragraph 5.7.2 will be designated as the "RVSM-POC." In such an event, the separate person designated as the RVSM-POC (i.e., someone who has not also been designated as a Responsible Person) will not have any authority to sign the RVSM authorization on behalf of the operator. Additionally, if an operator has designated a separate RVSM-POC, then that is the individual the FAA should first contact with respect to the operator's RVSM-Compliant Aircraft operations and RVSM airworthiness status.

5.7.6 In any event, the Responsible Person and/or the RVSM-POC should be a person having ongoing knowledge of the operations of the aircraft under the RVSM authorization.

5.7.7 Additionally, it generally is not appropriate to designate an "Agent for Service" with respect to RVSM authorizations being issued to part 91.

Note: Refer to LOA B046, Operations in Reduced Vertical Separation Minimum (RVSM) Airspace, for further details regarding Responsible Persons.

5.8 Considerations When Applying for an RVSM OpSpec, MSpec, or LOA.

5.8.1 Preapplication Meeting. The regulations do not require an applicant to participate in a preapplication meeting. However, an applicant may wish to request a preapplication meeting if the applicant is unfamiliar with the application process, seeks additional information with respect to RVSM authorizations, or has other questions concerning how to move forward with the application process.

5.8.1.1 An applicant who wishes to request a preapplication meeting should make initial contact with the FAA office as follows:

1. Parts 91K, 121, 125 (A125 LODA holders), and 135 operators should notify the appropriate Flight Standards office of their intent to obtain authorization for RVSM operations.

2. Part 91 operators apply for an RVSM LOA to the appropriate Flight Standards office with a service area covering the operator's primary business address. If your primary business address is not in the United States, apply to the appropriate International Field Office (IFO) at http://www.faa.gov/about/office_org/field_offices/ifo/. Once on the website, click on the service area under each office for additional information.

5.8.2 Application Requirements. Prior to making a request, determine if the procedures for Authorization Group I, Authorization Group II, or Authorization Group III should apply.

Note: In your written request to the appropriate Flight Standards office, use Appendix F, Table F-1, RVSM Decision Matrix, to identify the specific RVSM Authorization Group for your request. Include sufficient administrative information to allow the FAA inspector to make the necessary form field entries when creating the authorization document. Providing sufficient information to the appropriate Flight Standards office can assist in streamlining the application process and help prevent processing delays while the inspector waits for the needed information to be submitted.

5.8.3 General Steps for an Application Which Falls Within RVSM Authorization Group I.

5.8.3.1 Prior to making a request for service for an authorization amendment, each existing authorization holder should make a positive determination that none of the previously accepted RVSM Authorization Elements are changing.

5.8.3.2 That authorization holder should then submit a written request to the appropriate Flight Standards office that:

1. States which of the applicable administrative changes are occurring;
2. Further affirmatively states none of the previously accepted RVSM Authorization Elements forming the basis for the initial issuance of the affected RVSM authorization have changed or are changing; and
3. Requests the issuance of an amendment to the existing RVSM authorization acknowledging the administrative change being made.

5.8.3.3 The authorization holder should also provide such further information as requested by the FAA to efficiently process the request.

5.8.4 General Steps for an Application Which Falls Within RVSM Authorization Group II.

5.8.4.1 The applicant should make a positive determination the existing or new proposed RVSM operator is seeking an RVSM authorization utilizing at least one previously approved/accepted RVSM Authorization Element.

5.8.4.2 Submit a written request to the appropriate Flight Standards office that:

1. Provides complete documentation of an RVSM-compliant program, including written information evidencing the specific aircraft meets the requirements of an RVSM-Compliant Aircraft;
2. Further specifically states previously accepted RVSM-Knowledgeable Pilots requirements will be used with respect to the operation of the proposed approved RVSM aircraft in RVSM airspace, as applicable;
3. Provides such additional information as necessary to evidence compliance with new or different RVSM-Knowledgeable Pilots requirements (or to be able to gain such approvals); and
4. Asks for the issuance of an RVSM authorization applying to the operation of the aircraft by that proposed RVSM operator.

5.8.4.3 Provide such further information requested by the FAA to efficiently process the request.

5.8.5 General Steps for an Application Which Falls Within RVSM Authorization Group III.

5.8.5.1 In the event a proposed new or existing approved RVSM operator seeks the issuance of an RVSM authorization not based on any existing RVSM Authorization Element, then neither Authorization Group I nor II above will apply.

5.8.5.2 The applicant should submit a written request to the appropriate Flight Standards office with sufficient evidence to show its ability to comply with each of the RVSM Authorization Elements in paragraph 5.2, and the FAA should process the request as a new and unique request by reviewing all of the materials provided by the applicant to ensure each of the RVSM Authorization Elements have been met.

5.8.5.3 The applicant should also provide such further information requested by the FAA to efficiently process the request**.**

5.8.6 Other Items for Application.

5.8.6.1 **Minimum Equipment List (MEL).** Operators conducting operations under an MEL should include items pertinent to operating in RVSM airspace.

5.8.6.2 **Operating History.** An operating history should be included in the application, if applicable. The applicant should show any events or incidents related to poor altitude-keeping performance indicating weaknesses in training, procedures, maintenance, or the aircraft Group intended to be used.

5.8.6.3 Participation in RVSM Altitude-Keeping Performance Monitoring. See Appendix E, RVSM Altitude-Keeping Performance Monitoring When Operating With an RVSM OpSpec, MSpec, or LOA.

5.9 Applicable Forms for the RVSM Authorization Documents.

5.9.1 Parts 121, 125, and 135 Operators. Authorization for parts 121, 125, and 135 operators to operate in RVSM airspace should be granted through the issuance of an OpSpec from Part B, En Route Authorizations, Limitations, and Procedures; and Part D, Authorized Areas of En Route Operations, Limitations, and Provisions. Each aircraft for which the operator is granted authority should be listed in the OpSpecs. Authorization to conduct RVSM operations in an RVSM area of operations new to the operator should be granted by adding the Part B RVSM OpSpec number to the appropriate area of operations in OpSpec B050, Authorized Areas of En Route Operations, Limitations, and Provisions.

5.9.2 Part 129 Operators. The State of the Operator provides the operational authorization of RVSM for part 129. OpSpec A003, Aircraft Authorized for Operations to the United States, is used to confirm that the foreign air carrier has operational approval. The State of the Operator must have regulation and supporting guidance documents for the issuance of RVSM. The following are examples of guidance documents the FAA considers to be consistent with ICAO standards on RVSM:

- The current edition of this AC 91-85; and
- Joint Aviation Authority (JAA) Temporary Guidance Leaflet (TGL) No. 6, Guidance Material on the Approval of Aircraft and Operators for Flight in Airspace Above Flight Level 290 Where a 300 m (1,000 ft) Vertical Separation Minimum Is Applied.

Note: For part 129 operators, inspector guidance for OpSpec A003 is contained in FAA Order 8900.1, Volume 12, Chapter 2, Section 3, Part 129 Part A Operations Specifications.

5.9.3 Part 91K Operations. A part 91K program manager's authorization for operations in RVSM airspace should be granted through the issuance of an MSpec from Part B and Part D. Authorization for RVSM is granted by MSpec B046, Operations in Reduced Vertical Separation Minimum (RVSM) Airspace. Each aircraft for which the operator is granted authority should be listed in MSpec D092, Airplanes Authorized for Operations in Designated Reduced Vertical Separation Minimum (RVSM) Airspace. Authorization to conduct RVSM operations in an RVSM area of operations new to the operator should be granted by adding the Part B RVSM OpSpec number to the appropriate area of operations in OpSpec B050.

5.9.4 Parts 91 and 125 (A125 LODA Holder) Operators. Part 91 operators and part 125 operators holding a LODA should be issued an LOA when the initial authorization process has been completed.

Note: A LODA is a formal authorization issued by the appropriate Flight Standards office, authorizing a deviation from specified sections of part 125 and

identified in the Web-based Operations Safety System (WebOPSS) (125M database) as an A125 LODA operator.

5.9.5 LOA Exemptions. Operators issued OpSpecs are not required to obtain an LOA for those operations conducted under part 91 provided that:

1. The aircraft is operated under the operator name listed on the OpSpecs.
2. The flight is conducted in an area of operations listed in the OpSpecs.
3. The aircraft is operated under the conditions under which the OpSpecs were granted (e.g., if the operator holds part 121 or 135 OpSpecs, then the pilots used for the part 91 operation must have received part 121 or 135 training).
4. Each part 91 operation, not associated with a certificated operator, will need an LOA to operate in RVSM airspace.

5.10 Conditions Requiring the Removal of an Authorization.

Note: Examples of reasons for amendment, revocation, or restriction of RVSM authorization include, but are not limited to, the reasons listed in part 91 appendix G, section 7.

5.10.1 Altitude-Keeping Errors. The incidence of altitude-keeping errors tolerated in an RVSM environment is very small. It is incumbent upon each operator to take immediate action to rectify the conditions causing the error. The operator should also report the event to the FAA within 72 hours with initial analysis of causal factors and measures to prevent further events. The FAA should determine the requirement for followup reports. Errors which should be reported and investigated are: Total Vertical Error (TVE) equal to or greater than ±300 ft (±90 m), altimetry system error (ASE) equal to or greater than ±245 ft (±75 m), and assigned altitude deviation (AAD) equal to or greater than ±300 ft (±90 m).

5.10.2 Error Categories. Altitude-keeping errors fall into two broad categories: 1) errors caused by malfunction of aircraft equipment, and 2) operational errors. An operator who commits an altitude-keeping error may be required to forfeit authority for RVSM operations. If a problem is identified related to one specific aircraft, then RVSM authority may be removed for the operator for that specific type.

5.10.3 Effective, Timely Response. The operator should make an effective, timely response to each altitude-keeping error report. The FAA may consider removing RVSM operational authorization if the operator response to an altitude-keeping error is not effective or timely. The FAA should also consider the operator's past performance record in determining the action to take. If an operator shows a history of operational and/or airworthiness errors, then authorization may be removed until the root causes of these errors are shown to be eliminated and RVSM programs and procedures are shown to be effective. The FAA will review each situation on a case-by-case basis.

5.10.4 Review Relevant OpSpec/MSpec/LOA Paragraphs. Operators may also consider reviewing all relevant paragraphs of their respective OpSpec, MSpec, or LOA (e.g., A001, Issuance and Applicability) for elements which may affect RVSM authorizations.

APPENDIX A. RVSM AIRWORTHINESS CERTIFICATION

CONTENTS

A.1 Introduction.

A.1.1 General. This appendix provides guidance on the aircraft airworthiness certification process for RVSM compliance. Key elements necessary to substantiate the aircraft systems performance required for RVSM certification are summarized. Differences between a Group and Non-Group aircraft certification program are presented. A comprehensive discussion of altimetry system error (ASE) and ASE variation is also provided.

Note: For additional information on obtaining RVSM airworthiness certification, contact the appropriate FAA Aircraft Certification Office (ACO) for guidance. Contact information for ACOs can be found on the FAA website at https://www.faa.gov.

A.1.2 Definitions.

1. **Air Data Sensor.** Line replaceable units (LRU) designed to detect air data characteristics (e.g., pressure and temperature) to support the air data system (ADS) of the aircraft.
2. **Air Data System (ADS).** Systems used to collect and process air data characteristics from various sensors to compute critical air data parameters (e.g., altitude, airspeed, height deviation, and temperature) for use by the pilot and other systems in the aircraft.
3. **Aircraft Group.** A Group of aircraft of nominally identical design and build with respect to all details that could influence the accuracy of altitude-keeping performance.
4. **Altimetry System Error (ASE).** The difference between the pressure altitude displayed to the flightcrew when referenced to International System of Units (SI) standard ground pressure setting (29.92 inches of mercury (inHg)/1013.25 hectopascals (hPa)) and free stream pressure altitude.
5. **Altitude-Keeping Capability.** Aircraft altitude-keeping performance expected under nominal environmental operating conditions with proper aircraft operating practices and maintenance.
6. **Altitude-Keeping Performance.** The observed performance of an aircraft with respect to adherence to a flight level (FL).
7. **Assigned Altitude Deviation (AAD).** The difference between the altitude transmitted by an Altitude Reporting Mode of Secondary Radar (Mode C) transponder and the assigned altitude/FL.
8. **Automatic Altitude Control System.** Any system designed to automatically control the aircraft to a referenced pressure altitude.
9. **Avionics Error.** 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.

10. **Basic Reduced Vertical Separation Minimum (RVSM) Envelope.** The range of Mach numbers and gross weights within the altitude ranges FL 290 to FL 410 (or maximum available altitude) where an aircraft is expected to operate most frequently.
11. **Derivative Aircraft.** Aircraft of the same model type, certified under the same type certificate (TC). The aircraft may have different exterior dimensions, such as fuselage length and wingspan, but share the same altimetry system architecture. In addition, derivative aircraft share the same SSEC at RVSM FLs. In most cases, derivative aircraft will have differing flight envelopes, so the RVSM flight envelope defined for the Group must be carefully constructed such that the performance of all models within the Group is captured.
12. **Full RVSM Envelope.** The entire range of operational Mach numbers, W/δ, and altitude values over which the aircraft is operated within RVSM airspace.
13. **Instructions for Continued Airworthiness (ICA).** Documentation giving instructions and requirements for the maintenance essential to the continued airworthiness of an aircraft.
14. **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.
15. **Reduced Vertical Separation Minimum (RVSM).** Designated airspace, typically between FL 290 and FL 410, where 1,000 ft vertical separation between aircraft is applied. This airspace is considered special qualification airspace.
16. **Residual Static Source Error (SSE).** The amount by which SSE remains undercorrected or overcorrected after application of an SSEC.
17. **Static Source Error (SSE).** The difference between the pressure sensed by the aircraft static source and the undisturbed ambient pressure.
18. **Static Source Error Correction (SSEC).** A correction applied to the altimetry system to produce minimal residual SSE.
19. **Total Vertical Error (TVE).** Vertical geometric difference between the actual pressure altitude flown by an aircraft and its assigned pressure altitude (FL).
20. **Worst-Case Avionics.** The combination of tolerance values, specified by the manufacturer for the altimetry fit into the aircraft, which gives the largest combined absolute value of avionics errors.
21. **W/δ.** Aircraft weight, W, divided by the atmospheric pressure ratio, δ.

A.1.3 An Explanation of W/δ. Throughout this appendix, there are multiple references to the performance parameter W/δ. The following discussion is provided for the benefit of readers who may not be familiar with the use of this parameter.

A.1.3.1 It would be difficult to show all of the gross weight, altitude, and speed conditions constituting the RVSM envelope(s) on a single plot. This is because most of the speed boundaries of the envelopes are a function of both altitude and gross weight. As a result, a separate chart of altitude versus Mach would be required for each aircraft gross weight. Aircraft performance engineers commonly use the following technique to solve this problem.

A.1.3.2 For most aircraft with RVSM altitude capability, the required flight envelope can be collapsed to a single chart, with good approximation, by use of the parameter W/δ (weight divided by atmospheric pressure ratio). This fact is due to the relationship between W/δ and the fundamental aerodynamic variables M and lift coefficient as shown below:

$$W/\delta = 1481.4\, C_L\, M^2\, S_{REF}$$

where δ = ambient pressure at flight altitude divided by sea level standard pressure of 29.92126 inches Hg.

W/δ = Weight over Atmospheric Pressure Ratio.

C_L = Lift Coefficient ($C_L = L/qS_{REF}$).

L = Lift (in cruise flight L is equal to W).

q = Dynamic Pressure, $q = 1481.4M^2\,\delta$.

Dynamic pressure is in the form of lbs/ft^2.

M = Mach number.

S_{REF} = Reference Wing Area in square feet.

W is the weight in pounds.

A.1.3.3 As a result, the flight envelope may be collapsed into one chart by simply plotting W/δ, rather than altitude, versus Mach number. Since δ is a fixed value for a given altitude, weight can be obtained for a given condition by simply multiplying the W/δ value by δ.

A.1.3.4 Over the RVSM altitude range, it is an accurate approximation to assume that position error is uniquely related to Mach number and W/δ for a given aircraft.

A.2 RVSM Flight Envelopes.

A.2.1 General. For the purposes of RVSM approval, the aircraft flight envelope is considered in two parts: 1) the *full* RVSM envelope, and 2) the *basic* RVSM envelope. The basic RVSM envelope is the part of the flight envelope where aircraft operate the majority

of time. The full RVSM envelope is the entire range of operational Mach numbers, W/δ, and altitude values over which the aircraft is operated within RVSM airspace. In general, the full RVSM envelope comprises parts of the flight envelope where the aircraft operates less frequently and where a larger ASE tolerance is allowed.

A.2.2 Full RVSM Envelope. The full RVSM envelope will comprise the entire range of operational Mach numbers, W/δ, and altitude values over which the aircraft can operate within RVSM airspace. Table A-1 establishes the parameters to consider.

Table A-1. Full RVSM Envelope Boundaries

	Lower Boundary Is Defined By:	**Upper Boundary Is Defined By:**
Altitude	Flight Level (FL) 290	The lower of the following: • FL 410 • Airplane maximum certified altitude • Altitude limited by: cruise thrust; buffet; other aircraft flight limitations
Mach or Speed	The lower of the following: • Maximum endurance (holding) speed • Maneuver speed	The lower of the following: • M_{MO}/V_{MO} (maximum operating limit speed (Mach/velocity)) • Speed limited by: cruise thrust; buffet; other aircraft flight limitations
Gross Weight	The lowest gross weight compatible with operation in RVSM airspace	The highest gross weight compatible with operation in RVSM airspace

A.2.3 Basic RVSM Envelope. The boundaries for the basic RVSM envelope are the same as those for the full RVSM envelope except in regard to the upper Mach boundary.

A.2.3.1 For the basic RVSM envelope, the upper Mach boundary may be limited to a range of airspeeds over which the aircraft Group can reasonably expect to operate most frequently. The manufacturer or design organization should define this boundary for each aircraft Group. It may be defined as equal to the upper Mach/airspeed boundary defined for the full RVSM envelope or a specified lower value. This lower value should not be less than the Long Range Cruise (LRC) Mach number plus 0.04 Mach unless limited by available cruise thrust, buffet, or other aircraft flight limitations.

A.2.3.2 The LRC Mach number is the Mach for 99 percent of best fuel mileage at the particular W/δ under consideration.

A.3 Group and Non-Group Aircraft.

A.3.1 Group Aircraft. Aircraft comprising a Group must be of nominally identical design and build with respect to all details that could influence the accuracy of the altitude-keeping performance. The following conditions should be met:

1. Aircraft should be approved by the same TC, TC amendment, or Supplemental Type Certificate (STC), as applicable.
2. For derivative aircraft, it may be possible to use the database from the parent configuration to minimize the amount of additional data required to show compliance. The extent of additional data required will depend on the nature of the changes between the parent aircraft and the derivative aircraft.
3. The static system of each aircraft should be installed in a nominally identical manner and position. The same SSEC should be incorporated in all aircraft of the Group.
4. The avionics units installed on each aircraft to meet the minimum RVSM equipment requirements (see paragraph A.4) should be manufactured to the manufacturer's same specification, and have the same equipment part number and software part number (or version and revision).

   Note: Aircraft which have avionics units which are of a different manufacturer or equipment part number, software part number (or version and revision) may be considered part of the Group if the applicant demonstrates to the appropriate FAA office this standard of avionic equipment provides identical or better system performance.

5. The airframe manufacturer or design organization produced or provided the RVSM data package.

A.3.2 Non-Group Aircraft. If an airframe does not meet the conditions of paragraph A.3.1 to qualify as a member of a Group or is presented as an individual airframe for approval, then it must be considered as a Non-Group aircraft for the purposes of RVSM approval.

A.4 Aircraft Systems—Group and Non-Group Aircraft.

A.4.1 Equipment for RVSM Operations. The minimum equipment fit should be as presented below. Additional examples of aircraft systems found on older, "legacy" airframes are presented in paragraph A.6.

A.4.1.1 Two Independent Altitude Measurement Systems. Each system should be comprised and configured with the following elements:

A.4.1.1.1 Static Sources. Cross-coupled static source/system, provided with ice protection if located in areas subject to ice accretion.

A.4.1.1.2 Altitude Display. Equipment for measuring static pressure sensed by the static source, converting it to pressure altitude, and displaying the pressure altitude to the flightcrew.

A.4.1.1.3 Altitude Reporting. Equipment for providing a digitally coded signal corresponding to the displayed pressure altitude, for automatic altitude reporting purposes. The pressure altitude from which the signal is derived must meet the requirements of paragraphs A.5.2.1 and A.5.2.2, or paragraph A.5.3.2, as appropriate.

A.4.1.1.4 Altimetry System Components. The altimetry system should comprise all those elements involved in the process of sampling free stream static pressure and converting it to a pressure altitude output. The elements of the altimetry system fall into two main groups:

- Airframe plus static sources (pitot-static probe/static port), including the area around the static sources in the system design that must be maintained.
- Avionics and/or instruments.

A.4.1.1.5 Altimetry System Accuracy. The total altimetry system accuracy should satisfy the requirements of paragraphs A.5.2.1 and A.5.2.2, or paragraph A.5.3.2, as appropriate.

A.4.1.1.6 SSEC. If the design and characteristics of the aircraft and altimetry system are such that the standards of paragraphs A.5.2.1 and A.5.2.2, or paragraph A.5.3.2, are not satisfied by the location and geometry of the static sources alone, then suitable SSEC should be applied automatically within the avionic part of the altimetry system. The design aim for SSEC, whether aerodynamic/geometric or avionic, should be to produce a minimum residual SSE, but in all cases it should lead to satisfaction of the standards of paragraphs A.5.2.1 and A.5.2.2, or paragraph A.5.3.2, as appropriate.

A.4.1.1.7 Output to the Automatic Altitude Control and Altitude Alert Systems. Thealtimetry system equipment fit should provide reference signals for automatic altitude control and alerting at selected altitude. These signals should be derived from an altitude measurement system meeting the full requirements of this appendix. The output may be used either directly or combined with other sensor signals. If SSEC is necessary to satisfy the

requirements of paragraphs A.5.2.1 and A.5.2.2, or paragraph A.5.3.2, then an equivalent SSEC must be applied to the altitude control output. The output may be an altitude deviation signal, relative to the selected altitude, or a suitable absolute altitude output. Whatever the system architecture and SSEC system, the difference between the output to the altitude control system and the altitude displayed must be minimal.

A.4.1.1.8 System Safety Analysis. During the RVSM approval process, it must be verified analytically that the predicted rate of occurrence of undetected altimetry system failures does not exceed 1 x 10^{-5} per flight-hour. All failures and failure combinations whose occurrence would not be evident from cross-flight deck checks, and which would lead to altitude measurement/display errors outside the specified limits, need to be assessed against this budget. No other failures or failure combinations need to be considered.

A.4.1.1.9 ADSs and Configurations with Multiple Static Source Inputs. Many aircraft are produced with ADSs making use of three or more static source inputs, and/or three or more air-data computers (ADC). Such systems (often referred to as "triplex" systems or "voting" schemes) are designed with integrated algorithms that monitor and compare the pressures sensed at the static sources. Sources providing "good" pressure values are used in the calculation of corrected altitude. Such configurations are acceptable provided at least two ADSs meet the requirements of paragraphs A.4.1.1.1 through A.4.1.1.8. Upon failure of one ADS, a second system must remain fully functional in compliance with the requirements of paragraphs A.4.1.1.1 through A.4.1.1.8.

A.4.1.2 One Secondary Surveillance Radar (SSR) Altitude Reporting Transponder. Any transponder meeting or exceeding the requirements of Technical Standard Order (TSO)-C74, Air Traffic Control Radar Beacon System (ATCRBS) Airborne Equipment, or TSO-C112, Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment, as applicable, in accordance with the operational regulations under which the airplane is approved. An aircraft may be equipped with one or more transponders. If only one is fitted, it should have the capability for switching to obtain input from either altitude measurement system.

A.4.1.3 An Altitude Alert System. The altitude alert system should be capable of operation from either of the two required independent altitude measurement systems. The altitude alert system may be comprised of one or more LRUs, or it may be an integral part of a flight management system (FMS) or flight management computer (FMC). The altitude deviation warning system should signal an alert when the altitude displayed to the flightcrew deviates from selected altitude by more than a nominal value.

1. For aircraft for which application for TC or major change in type design is on or before April 9, 1997, the nominal value must not be greater than ±300 ft (±90 m).
2. For aircraft for which application for TC or major change in type design (e.g., STC) is made after April 9, 1997, the nominal value should not be greater than ±200 ft (±60 m). The overall equipment tolerance in implementing these nominal threshold values should not exceed ±50 ft (±15 m).

A.4.1.4 An Automatic Altitude Control System. The automatic altitude control system is generally comprised of an autopilot with altitude hold mode. The automatic altitude control system should be capable of operation from either of the two required independent altitude measurement systems. Paragraph A.6 presents additional options for automatic altitude control configurations found on older, "legacy" aircraft.

1. As a minimum, a single automatic altitude control system should be installed which is capable of controlling aircraft height within a tolerance band of ±65 ft (±20 m) about the acquired altitude when the aircraft is operated in straight and level flight under nonturbulent, nongust conditions.
   a. Aircraft types for which application for TC is on or before April 9, 1997, which are equipped with an automatic altitude control system with FMS/performance management system inputs allowing variations up to ±130 ft (±40 m) under nonturbulent, nongust conditions do not require retrofit or design alteration.
   b. If specific tuning is needed for a "legacy" autopilot to meet performance standards in RVSM airspace, this gain scheduling or tuning must not negatively impact the way the autopilot performs in other phases of flight and at non-RVSM altitudes. For example, it is common for older systems to be tuned to meet RVSM tolerance, only to realize they no longer have acceptable vertical performance on a coupled approach.
2. Where an altitude select/acquire function is provided, the altitude select/acquire control panel must be configured such that an error of no more than ±25 ft (±8 m) exists between the display selected by the flightcrew and the corresponding output to the control system.

A.5 Altimetry System Performance.

A.5.1 General. The statistical performance statements of International Civil Aviation Organization (ICAO) Doc 9574, Manual on a 300 m (1,000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive, for a population of aircraft are translated into airworthiness standards by assessment of the characteristics of ASE and

altitude control. The following standards differ in some respects from that document, but they are consistent with the requirements of RVSM and in accordance with 14 CFR part 91 appendix G, section 2.

A.5.2 Group Approval.

A.5.2.1 The requirements in the *basic RVSM envelope* are as follows:

1. At the point in the basic RVSM envelope where the mean for ASE (ASE_{mean}) reaches its largest absolute value, the absolute value should not exceed 80 ft (25 m).
2. At the point in the basic RVSM envelope where ASE_{mean} plus three standard deviations (ASE3 SD) reaches its largest absolute value, the absolute value should not exceed 200 ft (60 m).

A.5.2.2 The requirements in the *full RVSM envelope* are as follows:

1. At the point in the full RVSM envelope where ASE_{mean} reaches its largest absolute value, the absolute value should not exceed 120 ft (37 m).
2. At the point in the full RVSM envelope where ASE_{mean} plus ASE3 SD reaches its largest absolute value, the absolute value should not exceed 245 ft (75 m).
3. If necessary, for the purpose of achieving RVSM approval for an aircraft Group, an operating restriction may be established to restrict aircraft from conducting RVSM operations in areas of the full RVSM envelope where the absolute value of ASE_{mean} exceeds 120 ft (37 m) and/or the absolute value of ASE_{mean} plus ASE3 SD exceed 245 ft (75 m). When such a restriction is established, identify it in the data package and document it in appropriate aircraft operating manuals; however, visual or aural warning/indication systems should not be required to be installed on the aircraft.

A.5.2.3 Aircraft types for which application for TC or major change in type design is made after April 9, 1997, should meet the criteria established for the basic envelope in the full RVSM envelope. The FAA will consider factors providing an equivalent level of safety in the application of this criteria as stated in 14 CFR part 21, § 21.21(b)(1).

A.5.3 Non-Group Approval.

A.5.3.1 The standards of paragraphs A.5.2.1, A.5.2.2, and A.5.2.3 cannot be applied to Non-Group aircraft approval because there can be no Group data with which to develop airframe-to-airframe variability. Therefore, a single ASE value has been established that controls the simple sum of the ASEs. In order to control

the overall population distribution, this limit has been set at a value less than that for Group approval.

A.5.3.2 The standard for aircraft submitted for approval as Non-Group aircraft, as defined in paragraph A.3.2, is as follows:

1. For all conditions in the *basic RVSM envelope*:

   $|Residual\ SSE + worst\text{-}case\ avionics| \leq 160\ ft\ (50\ m)$

2. For all conditions in the *full RVSM envelope*:

   $|Residual\ SSE + worst\text{-}case\ avionics| \leq 200\ ft\ (60\ m)$

3. "Worst-case avionics" means that combination of tolerance values, specified by the manufacturer for the altimetry fit into the aircraft, which gives the largest combined absolute value of avionics errors. For most systems, this may not be a fixed value over time.

A.5.3.3 An operating restriction may be established to restrict the Non-Group aircraft from conducting RVSM operations in areas of the full RVSM envelope where the requirements of paragraph A.5.3.2 cannot be met.

A.5.3.4 The ASE airworthiness standards in paragraphs A.5.2 and A.5.3 should not be confused with the ASE values stated in the altitude-keeping paragraph 4.3. Paragraphs A.5.2 and A.5.3 represent the ASE performance specification for RVSM airframe airworthiness certification, which is a key element of the RVSM airplane airworthiness certification process. Paragraph 4.3 presents performance criteria specified for the RVSM height-monitoring program, which is an element of the operational quality assurance process. The monitoring program is independent of the airworthiness certification program.

A.6 Aircraft System Configurations: Older "Legacy" Airframes.

A.6.1 Background. This paragraph provides additional guidance regarding configurations found on older model airplanes (also known as "legacy" airplanes (e.g., B707, DC-8, older business jets, and turboprop aircraft)) for which RVSM approval is sought.

A.6.2 Single Autopilot Installation. Paragraph A.4.1.1.7 states the ADS should provide reference signals for automatic control and alerting at selected altitude. These signals should preferably be derived from an altitude measurement system meeting the full requirements of this appendix. In addition, paragraph A.4.1.1.7 states the altimetry system must provide an output which can be used by an automatic altitude control system to control the aircraft at a commanded altitude. The output may be used either directly or combined with other sensor signals. The altitude control output may be an altitude deviation signal, relative to the selected altitude, or a suitable absolute altitude output.

A.6.2.1 A distinction can be made between signals derived from an ADC and signals derived from an altitude measurement system. Paragraph A.4.1.1.7 does not mandate the need for dual ADC inputs to the automatic altitude control system.

A.6.2.2 Several airplane model types are equipped with a single autopilot installation. In many cases, the autopilot is only capable of receiving altitude hold inputs from a single source. It has been further noted retrofitting of these autopilot installations to receive altitude hold input from additional sources (e.g., another ADC) may yield one or more of the following problems:

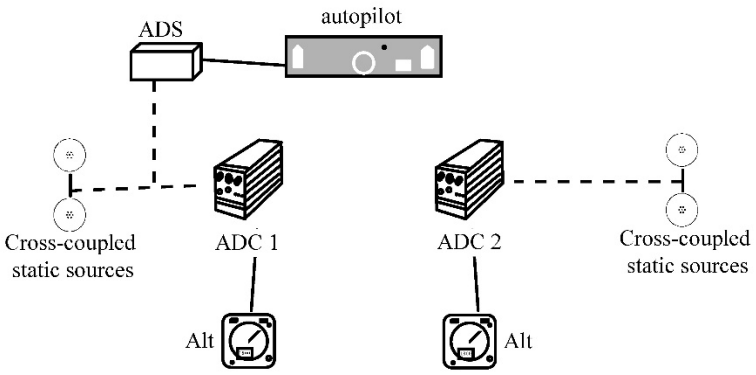
1. The retrofit costs are a significant percentage of the total worth of the airframe.
2. The retrofit is not possible without replacement of the autopilot.
3. The retrofit increases ADS complexity, which in turn increases the scenarios and rates of failure.
4. Upgraded avionics (i.e., ADCs) are not available, or the vendors will not support retrofits.

A.6.2.3 There are two common avionics configurations that may meet RVSM requirements, but do not have dual ADC input to the autopilot. A general description and possible means of compliance are given below. They are:

1. Figure A-1, Example of Air Data System/Autopilot Configuration.
2. Figure A-2, Single Air-Data Computer Configuration for Autopilot Input.

A.6.2.4 Figure A-1 is a typical configuration for an aircraft using an independent source for altitude hold input to the autopilot.

Figure A-1. Example of Air Data System/Autopilot Configuration



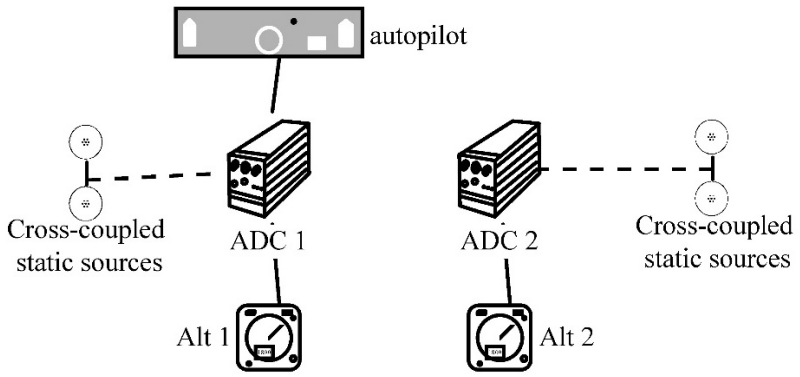
A.6.2.4.1 The air data sensor is a single LRU activated in altitude hold mode when the pilot presses an ALT HOLD button, after reaching the desired cruise FL. It is not tied to either ADC or other components comprising the ADS. The air data sensor provides ΔH information to the autopilot so the airplane can maintain the desired altitude. In some configurations, the pilot further provides FL information to the autopilot by manually selecting the displayed altitude (either pilot's or copilot's).

A.6.2.4.2 Airplanes equipped with the avionics configuration shown in Figure A-1 may show compliance as follows:

1. The airplane must maintain altitude to within ±65 ft of the acquired altitude as required by item 1 under paragraph A.4.1.4. For RVSM compliance, the ΔH signal must be accurate enough such that the airplane maintains the required ±65 ft altitude deviation specification. This may be substantiated with flight test data and/or manufacturer's specification data.
2. The altitude alerter should function if the air data sensor/ADC fails. If the altitude alert function is not operational, altitude hold performance must be monitored manually.
3. The air data sensor should be compensated such that an airspeed change at a cruise FL is not interpreted by the system as change in altitude, causing altitude hold deviation in excess of ±65 ft.
4. The altimetry systems meet the RVSM accuracy requirements specified in paragraphs A.5.2.1 and A.5.2.2, or paragraph A.5.3.2, as appropriate.
5. All other requirements set forth in this AC, as appropriate, are satisfied.

A.6.2.5 Single ADC input to the autopilot: On a large number of older airplane models, the avionics configuration is such that one ADC provides altitude hold information to the autopilot (see Figure A-2). In most models, a second ADC is also present, or provisions exist so a second can be installed.

Figure A-2. Single Air-Data Computer Configuration for Autopilot Input



A.6.2.5.1 Airplanes equipped with the avionics configuration shown in Figure A-2 may show compliance as follows:

1. The airplane must maintain altitude to within ±65 ft of the acquired altitude required by item 1 under paragraph A.4.1.4. This may be substantiated with flight test data or manufacturer's specification data.
2. The altitude alerter should function if either ADS or ADC fails. If the altitude alert function is not operational, altitude hold performance must be monitored manually.
3. If ADC 1 fails, the airplane must be controlled manually until air traffic control (ATC) contingency procedures are executed. Annunciation should be provided if the pilot deviates ±300 ft from desired altitude. This annunciation must be provided automatically by the altitude alert system. If the altitude alert system is not functioning, altitude hold performance must be monitored manually.
4. The altimetry systems meet the RVSM accuracy requirements specified in paragraphs A.5.2.1 and A.5.2.2, or paragraph A.5.3.2, as appropriate.
5. All other requirements in this AC, as appropriate, are satisfied.

A.6.3 Operational Restrictions. Applicants should be aware operational restrictions and/or changes may also be required for aircraft with avionics configurations shown in Figures A-1 and A-2, to meet all RVSM requirements.

A.7 Altimetry System Performance Substantiation.

A.7.1 Flight Testing: Group and Non-Group Aircraft.

A.7.1.1 Where precision flight calibrations are used to quantify or verify altimetry system performance, they may be accomplished by any of the following methods. Flight calibrations should only be performed once appropriate ground checks have been completed, and the certifying authority should agree to the number of flight test conditions. Uncertainties in application of the method must be assessed and taken into account in the data package.

1. Precision tracking radar in conjunction with pressure calibration of the atmosphere at test altitude.
2. Trailing cone.
3. Pacer aircraft. The pacer aircraft must have been directly calibrated to a known standard. It is not acceptable to calibrate a pacer aircraft by another pacer aircraft.
4. Any other method acceptable to the FAA or approving authority.

Note: Data acquired using elements from the RVSM monitoring program, such as a ground-based height monitoring unit (HMU) or Aircraft Geometric Height Measurement Element (AGHME), or a portable Global Positioning System (GPS)-based monitoring unit (GMU), is not acceptable for substantiating the ASE performance specified in paragraphs A.5.2 and A.5.3.

A.7.1.2 ASE will generally vary with flight condition. The data package should provide coverage of the RVSM envelope sufficient to define the largest errors in the basic and full RVSM envelopes. Note that, in the case of Group approval, the worst flight condition may be different for each of the requirements of paragraphs A.5.2.1 and A.5.2.2, and each should be evaluated. Similarly, for Non-Group approval, the worst flight condition may be different for each of the requirements of paragraph A.5.3.2 and each should be evaluated.

A.7.2 ASE Variability. In order to evaluate a system against the ASE performance statements established by the Review of the General Concept of Separation Panel (RGCSP) (see Appendix D), it is necessary to quantify the mean and three SD values for ASE, expressed as ASE_{mean} and ASE3 SD. In order to do this, it is necessary to account for the different ways in which variations in ASE can arise. The factors affecting ASE are as follows and should be considered in the ASE evaluation:

1. Unit-to-unit variability of avionics.
2. Effect of environmental operating conditions on avionics.
3. Effect of transducer and/or avionics component error drift over time.

4. Effect of flight operating condition on SSE.
5. Airframe-to-airframe variability of SSE, including the following:
   - Skin waviness, skin splices/joints, access panels, and radome fit/fair.
   - Pitot-static probe variation. This includes manufacturing variation, installation variation, and probe degradation (erosion/corrosion) over time.
   - Static port variation (for aircraft configured with static sources flush to the skin surface). Sources of variation include port step-height, degradation, and static port condition.
   - SmartProbes© (integrated ADC/pitot-static probe). Smart probes are sensitive to installation variation. They are also capable of complex SSEC algorithms that are a function of several variables, all of which may be affected by probe condition and installation.

A.7.2.1 Assessment of ASE, whether based on measured or predicted data, must include the factors listed above in items 1 through 5. The effect of item 4 as a variable can be eliminated by evaluating ASE at the most adverse flight condition in an RVSM flight envelope.

A.7.2.2 This document does not specify separate limits for the various error sources contributing to the mean and variable components of ASE as long as the overall ASE accuracy requirements of paragraph A.5.2 or A.5.3 are met. For example, in the case of Group approval, the smaller the mean of the Group and the more stringent the avionics standard, the larger the available allowance for SSE variations. In all cases, present the tradeoff adopted in the data package in the form of an error budget including all significant error sources.

A.8 Altimetry System Component Error Budget.

A.8.1 General. The ASE budget demonstrates the allocation of tolerances among the various parts of the altimetry system is, for the particular data package, consistent with the overall statistical ASE requirements. These individual tolerances within the ASE budget represent the maximum error levels for each of the ADS components contributing to ASE. These error levels form the basis of the maintenance procedures used to substantiate the RVSM airworthiness compliance status of Group or Non-Group aircraft. The component error evaluation should be assessed at the worst flight condition in the basic and full envelope.

A.8.2 ASE Components.

A.8.2.1 **General.** Figure A-3, Altimetry System Error and Its Components, shows the breakdown of total ASE into its main components, with each error block representing the error associated with one of the functions needed to generate a display of pressure altitude. This breakdown encompasses all ASEs that can

occur, although different system architectures may combine the components in slightly different ways.

A.8.2.1.1 The "Actual Pressure Altitude" is the pressure altitude corresponding to the undisturbed ambient pressure.

A.8.2.1.2 "Static Source Error" is the difference between the undisturbed ambient pressure and the pressure within the static port at the input end of the static pressure line.

A.8.2.1.3 "Static Line Error" is any difference in pressure along the length of the line.

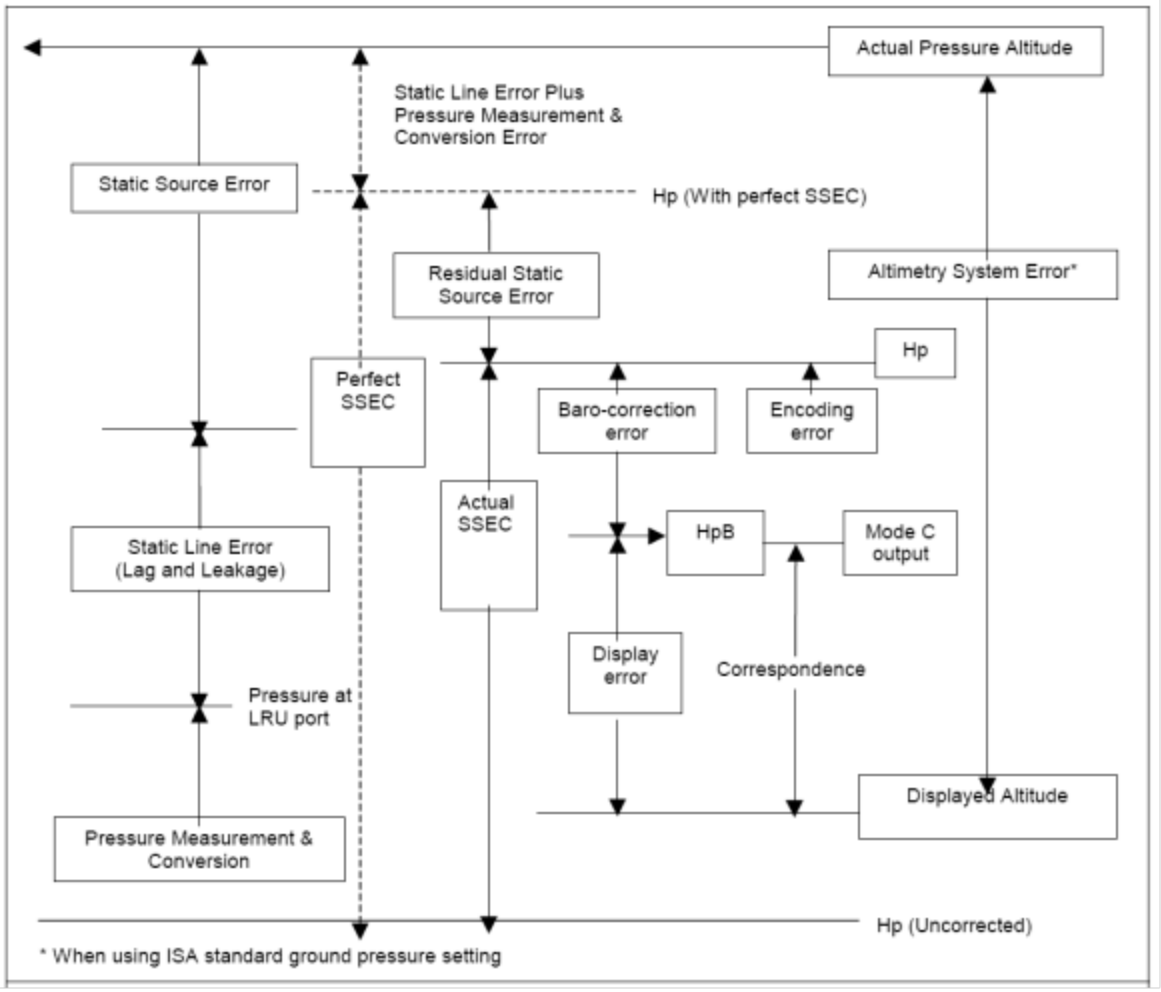
A.8.2.1.4 "Pressure Measurement & Conversion" is the error associated with the processes of transducing the pneumatic input seen by the avionics and converting the resulting pressure signal into altitude. As drawn, Figure A-3 represents a self-sensing altimeter system in which the pressure measurement and altitude conversion functions would not normally be separable. In an ADC system, the two functions would be separate and SSEC would probably then be applied before pressure altitude (Hp) was calculated.

A.8.2.1.5 "Perfect SSEC" would be that correction which compensated exactly for the SSE actually present at any time. If such a correction could be applied, then the resulting value of Hp calculated by the system would differ from the actual altitude only by the static line error plus the pressure measurement and conversion error. In general, this cannot be achieved, so although the "Actual SSEC" can be expected to reduce the effect of SSE, it will do so imperfectly.

A.8.2.1.6 "Residual Static Source Error" is applicable only in systems applying an avionic SSEC. It is the difference between the SSE and the correction actually applied. The corrected value of Hp will therefore differ from actual pressure altitude by the sum of static line error, pressure measurement and conversion error, and residual SSE.

A.8.2.1.7 The baro-correction error and the display error occur between Hp and the displayed altitude. Figure A-3 represents their sequence for a self-sensing altimeter system. ADC systems can implement baro-correction in a number of ways that would slightly modify this part of the block diagram, but the errors would still be associated with either the baro-correction function or the display function. The only exception is those systems that can be switched to operate the display directly from the Hp signal. These systems can eliminate baro-correction error where standard ground pressure setting is used, as in RVSM operations.

Figure A-3. Altimetry System Error and Its Components



A.8.2.2 SSE Components. The component parts of SSE are presented in Table A-2, Static Source Error, with the factors controlling their magnitude.

A.8.2.2.1 The reference SSE is the best estimate of actual SSE, for a single aircraft or an aircraft Group, obtained from flight calibration measurements. It is variable with operating condition, characteristically reducing to a family of W/δ curves that are functions of Mach. It includes the effect of any aerodynamic compensation incorporated in the design, and once it has been determined, the reference SSE is fixed for the single aircraft or Group, although it may be revised if substantiated with subsequent data.

A.8.2.2.2 The test techniques used to derive the reference SSE will have some measurement uncertainty associated with them, even though known instrumentation errors will normally be eliminated from the data. For trailing-cone measurements, the uncertainty arises from limitations on pressure measurement accuracy, calibration of the trailing-cone installation,

and variability in installations where more than one is used. Once the reference SSE has been determined, the actual measurement error is fixed, but as it is unknown, it can only be handled within the ASE budget as an estimated uncertainty.

A.8.2.2.3 The airframe variability and pitot-static probe/static port variability components arise from differences between the individual airframe and pitot-static probe/static port, and the example(s) of airframe and probe/port used to derive the reference SSE.

A.8.2.3 Residual SSE.

A.8.2.3.1 Figure A-3 presents the components and factors. Residual SSE consists of those error components that make actual SSE different from the reference value (components 2), 3), and 4) from Table A-2), plus the amount by which the actual SSEC differs from the value that would correct the reference value exactly (components 2)a), 2)b), and 2)c) from Table A-3, Residual Static Source Error (Aircraft with Avionic Static Source Error Correction)).

A.8.2.3.2 There will generally be a difference between the SSEC that would exactly compensate the reference SSE, and the SSEC that the avionics is designed to apply. This arises from practical avionics design limitations. The resulting Table A-3 error component 2)a) will therefore be fixed, for a particular flight condition, for the single aircraft or Group. Additional variable errors 2)b) and 2)c) arise from those factors causing a particular set of avionics to apply an actual SSEC that differs from its design value.

A.8.2.3.3 The relationship between perfect SSEC, reference SSEC, design SSEC, and actual SSEC is illustrated in Figure A-4, Static Source Error/Static Source Error Correction Relationships for Altimetry System Error Where Static Line, Pressure Measurement, and Conversion Errors Are Zero, for the case where static line errors and pressure measurements and conversion errors are taken as zero.

A.8.2.3.4 Account for factors creating variability of SSE relative to the reference characteristic in two ways: first, as noted for the SSE itself in Table A-2, and second, for its effect on the application of SSEC as in factor 2)a)i) of Table A-3. Similarly, account for the static pressure measurement error in two separate ways: the main effect will be via the “pressure measurement and conversion,” but a secondary effect will be via factor 2)a)ii) of Table A-3.

Table A-2. Static Source Error

(Cause: Aerodynamic Disturbance to Free-Stream Conditions)

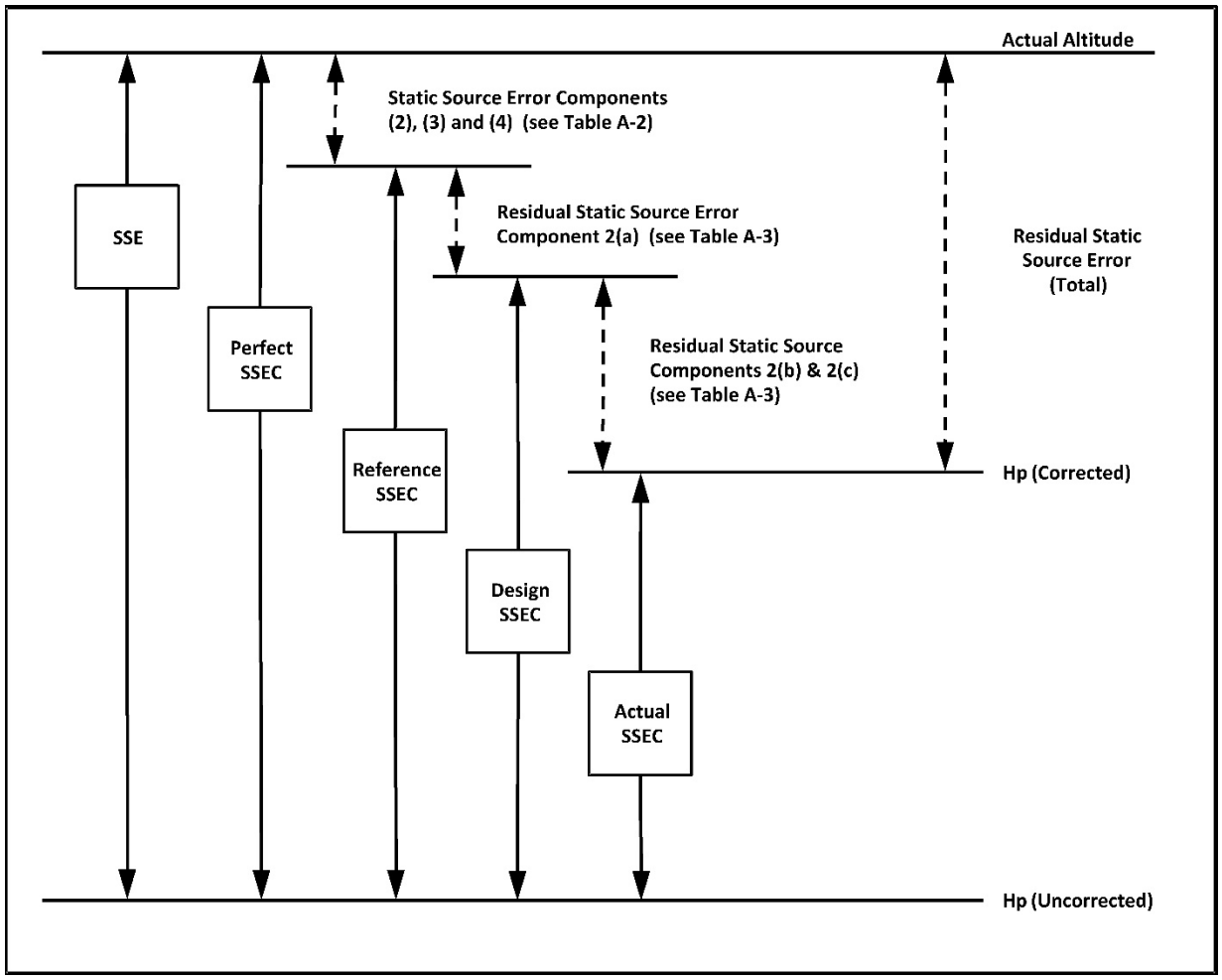
Factors	Error Components
Airframe Effects Operating Condition (M, Hp, ∝, β)* Geometry: Shape of airframe Location of static sources Variations of surface contour near the sources Variations in fit of nearby doors, skin panels, or other items Probe/Port Effects Operating Condition (M, Hp, ∝, β)* Geometry: Shape of probe/port Manufacturing variations Installation variations *M Mach, speed; Hp pressure altitude; ∝ angle of attack (AOA); β yaw (sideslip).	1) Reference SSE values from flight calibration measurements. 2) Uncertainty of flight calibration measurements. 3) Airframe-to-airframe variability. 4) Probe/port-to-probe/port variability.

Table A-3. Residual Static Source Error (Aircraft with Avionic Static Source Error Correction)

(Cause: Difference Between the Static Source Error Correction Actually Applied and the Actual Static Source Error)

Factors	Error Components
1) As for SSE. **PLUS** 2) Source of input data for SSEC function: a) Where SSEC is a function of Mach: i) PS sensing: difference in SSEC from reference SSE. ii) PS measurement: pressure transduction error. iii) PT errors: mainly pressure transduction error. b) Where SSEC is a function of angle of attack (AOA): i) Geometric effects on alpha: • Sensor tolerances. • Installation tolerances. • Local surface variations. ii) Measurement error: • Angle transducer accuracy. 3) Implementation of SSEC function: a) Calculation of SSEC from input data. b) Combination of SSEC with uncorrected height.	1) Static Source Error Components 2), 3), and 4) from Table A-2. **PLUS** 2a) Approximation in fitting design SSEC to flight calibration reference SSE. 2b) Effect of production variability (sensors and avionics) on achieving design SSEC. 2c) Effect of operating environment (sensors and avionics) on achieving design SSEC.

Figure A-4. Static Source Error/Static Source Error Correction Relationships for Altimetry System Error Where Static Line, Pressure Measurement, and Conversion Errors Are Zero



A.8.2.3.5 Static line errors arise from leaks and pneumatic lags. In level cruise, these can be made negligible for a system correctly designed and correctly installed.

A.8.2.3.6 Pressure measurement and conversion error:

1. The functional elements are static pressure transduction (which may be mechanical, electromechanical, or solid-state) and the conversion of pressure signal to pressure altitude. The error components are:
   - Calibration uncertainty;
   - Nominal design performance;
   - Unit-to-unit manufacturing variations; and
   - Effect of operating environment.

2. The equipment specification usually covers the combined effect of the error components. If the value of pressure measurements and conversion error used in the error budget is the worst-case specification value, then it is not necessary to assess the above components separately. However, calibration uncertainty, nominal design performance, and effect of operating environment can all contribute to bias errors within the equipment tolerance. Therefore, if it is desired to take statistical account of the likely spread of errors within the tolerance band, it will be necessary to assess their likely interaction for the particular hardware design under consideration.
3. It is particularly important to ensure the specified environmental performance is adequate for the intended application.

A.8.2.3.7 Baro-setting error is defined as the difference between the value displayed and the value applied within the system. For RVSM operation, the value displayed should always be International Standard Atmosphere (ISA) standard ground pressure, but setting mistakes, although part of TVE, are not components of ASE.

1. The components of the baro-setting error are:
   - Resolution of setting knob/display ("Setability");
   - Transduction of displayed value; and
   - Application of transduced value.
2. The applicability of these factors and the way they combine depends on the particular system architecture.
3. For systems in which the display is remote from the pressure measurement function there may be elements of the transduction and/or application or transduced value error components arising from the need to transmit and receive the setting between the two locations.

A.8.2.3.8 Imperfect conversion from altitude signal to display causes display error. The components are:

- Conversion of display input signal;
- Graticule/format accuracy; and
- Readability.

Note: In self-sensing altimeters, the first of these would normally be separate from the pressure measurement and conversion error.

A.8.3 ASE Component Error Budget: Group Approval. Where approval is sought for an aircraft Group, the data package must be sufficient to show the requirements of paragraphs A.5.1 and A.5.2 are met. Because of the statistical nature of these requirements, the content of the data package may vary considerably from Group to Group. Paragraph A.8 should serve as a guide to properly account for ASE sources.

A.8.3.1 Establish the mean and airframe-to-airframe variability of ASE based on precision flight test calibration of a number of aircraft. Where analytical methods are available, it may be possible to enhance the flight test database and to track subsequent change in the mean and variability based on geometric inspections and bench tests or any other method acceptable to the approving authority. In the case of derivative aircraft, it may be possible to utilize data from the parent as part of the database (e.g., a fuselage stretch where the only difference in ASE_{mean} between Groups could be reliably accounted for by analytical means).

A.8.3.2 All avionics equipment contributing to ASE must be identified by function and part number. The applicant must demonstrate the avionics equipment can meet the requirements established according to the error budget when operating the equipment in the environmental conditions expected to be met during RVSM operations.

A.8.3.3 Assess the aircraft-to-aircraft variability of each error source. The error assessment may take various forms as appropriate to the nature and magnitude of the source and the type of data available. For example, for some error sources (especially small ones) it may be acceptable to use specification values to represent 3 SD. For other error sources (especially larger ones), a more comprehensive assessment may be required; this is especially true for airframe error sources where "specification" values of ASE contribution may not have been previously established.

A.8.3.4 In many cases, one or more of the major ASE sources will be aerodynamic in nature (such as variations in the aircraft surface contour near the static pressure source). If evaluation of these errors is based on geometric measurements, substantiation should be provided that the methodology used is adequate to ensure compliance. (See Figure A-6, Compliance Demonstration Ground-To-Flight Test Correlation Process Example.)

A.8.3.5 In showing compliance with the overall requirements, combine the component error sources in an appropriate manner. In most cases, this will involve the algebraic summation of the mean components of the errors, root sum square (RSS) combination of the variable components of the errors, and summation of the RSS value with the absolute value of the overall mean. *Be sure the RSS combines only variable component error sources independent of each other.*

A.8.3.6 The methodology described above for Group approval is statistical in nature. This is the result of the statistical nature of the risk analysis and previous statistical statements made when developing RVSM. In the context of a statistical method, a statement that, "Each individual aircraft in the Group must be built to have ASE contained within ±200 ft," does not mean every airframe should be calibrated with a trailing cone or equivalent to demonstrate ASE is within 200 ft. Such an interpretation would be unduly onerous. However, if any aircraft is identified as having an error exceeding ±200 ft, then it should receive corrective action.

A.8.4 ASE Component Error Budget: Non-Group Approval. Where an aircraft is submitted for approval as a Non-Group aircraft, the data should be sufficient to show the requirements of paragraph A.5.3.2 are met. The data package should specify how the ASE budget has been allocated between residual SSE and avionics error. The operator and the FAA should agree on what data will satisfy approval requirements. The following data should be acquired and presented:

1. Calibration of the avionics used in the flight test as required establishing actual avionics errors contributing to ASE. Since the purpose of the flight test is to determine the residual SSE, specially calibrated altimetry equipment may be used.
2. All avionics equipment contributing to ASE must be identified by function and part number. The applicant must demonstrate the avionics equipment can meet the requirements established according to the error budget when operating the equipment in the environmental conditions expected during RVSM operations.
3. Specifications for the installed altimetry avionics equipment indicating the largest allowable errors must be presented. The error sources shown in items 1 through 5 under paragraph A.7.2 are necessary elements of the altimetry system component error budget for a Non-Group aircraft.

A.9 Establishing and Monitoring SSEs.

A.9.1 General. Paragraph A.8.3.4 requires the methodology used to establish the SSE be substantiated. Further, maintenance procedures must be established to ensure conformity of both newly manufactured airplanes and those with in-service history. There may be many ways of satisfying these requirements; two examples are included below.

A.9.1.1 **Example 1: Group Aircraft.** One process for showing compliance with RVSM requirements is shown in Figure A-5, Process for Showing Initial and Continued Compliance of Airframe Static Pressure System. Figure A-5 illustrates flight test calibrations and geometric inspections will be performed on a given number of aircraft. The flight calibrations and inspections will continue until a correlation between the two is established. Geometric tolerances and SSEC will be established to satisfy RVSM requirements. For aircraft being manufactured, every Nth aircraft will be inspected in detail and

every Mth aircraft will be flight test calibrated, where N and M are determined by the manufacturer and agreed to by the approving authority. The data generated by N inspections and M flight calibrations must be used to track the mean and 3 SD values to ensure continued compliance of the model with the requirements of paragraphs A.5.2.1 and A.5.2.2. As additional data are acquired, they should be reviewed to determine if it is appropriate to change the values of N and M as indicated by the quality of the results obtained.

A.9.1.1.1 There are various ways in which the flight test and inspection data might be used to establish the correlation. The example shown in Figure A-6 is a process in which each of the error sources for several airplanes is evaluated based on bench tests, inspections, and analysis. Correlation between these evaluations and the actual flight test results would be used to substantiate the method. A highly favorable correlation may be used to augment flight test data, and if appropriate, mitigate the need to conduct periodic flight tests (every Mth aircraft) as presented in paragraph A.9.1.1 above.

A.9.1.1.2 The method illustrated in Figures A-5 and A-6 is appropriate for new models since it does not rely on any preexisting database for the Group.

A.9.1.2 **Example 2: Group Aircraft.** Figure A-7, Process for Showing Initial and Continued Compliance of Airframe Static Pressure Systems for In-Service and New Model Aircraft, illustrates flight test calibrations should be performed on a given number of aircraft and consistency rules for air data information between all concerned systems verified. Geometric tolerances and SSEC should be established to satisfy the requirements. A correlation should be established between the design tolerances and the consistency rules. For aircraft being manufactured, air data information for all aircraft should be checked in terms of consistency in cruise conditions and every Mth aircraft should be calibrated, where M is determined by the manufacturer and agreed to by the approving authority. The data generated by the M flight calibrations should be used to track the mean and 3 SD values to ensure continued compliance of the Group with the requirements of paragraphs A.5.2.1 and A.5.2.2.

A.9.1.3 **Non-Group Aircraft.** Where airworthiness approval has been based on flight tests, the continuing integrity and accuracy of the altimetry system must be demonstrated by periodic ground and flight tests of the aircraft and its altimetry system at periods to be agreed with the approving authority. However, exemption from flight test requirements may be granted if the applicant can adequately demonstrate the relationship between any subsequent airframe/system degradation and its effects on altimetry system accuracy is understood and adequately compensated/corrected for.

Figure A-5. Process for Showing Initial and Continued Compliance of Airframe Static Pressure System

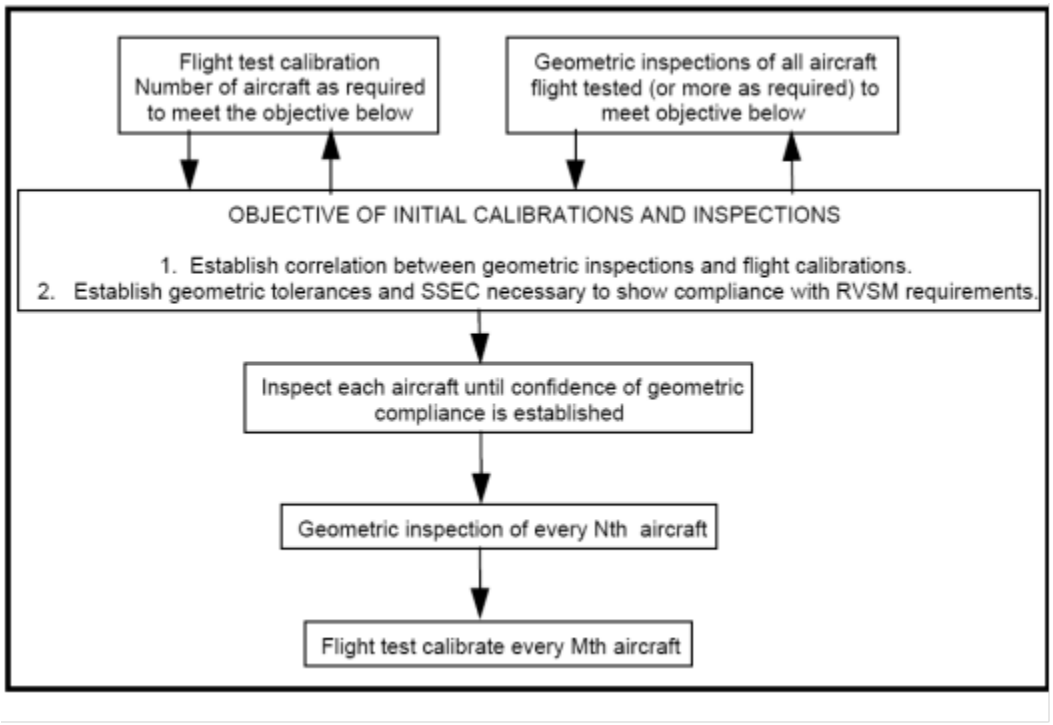


Figure A-6. Compliance Demonstration Ground-To-Flight Test Correlation Process Example

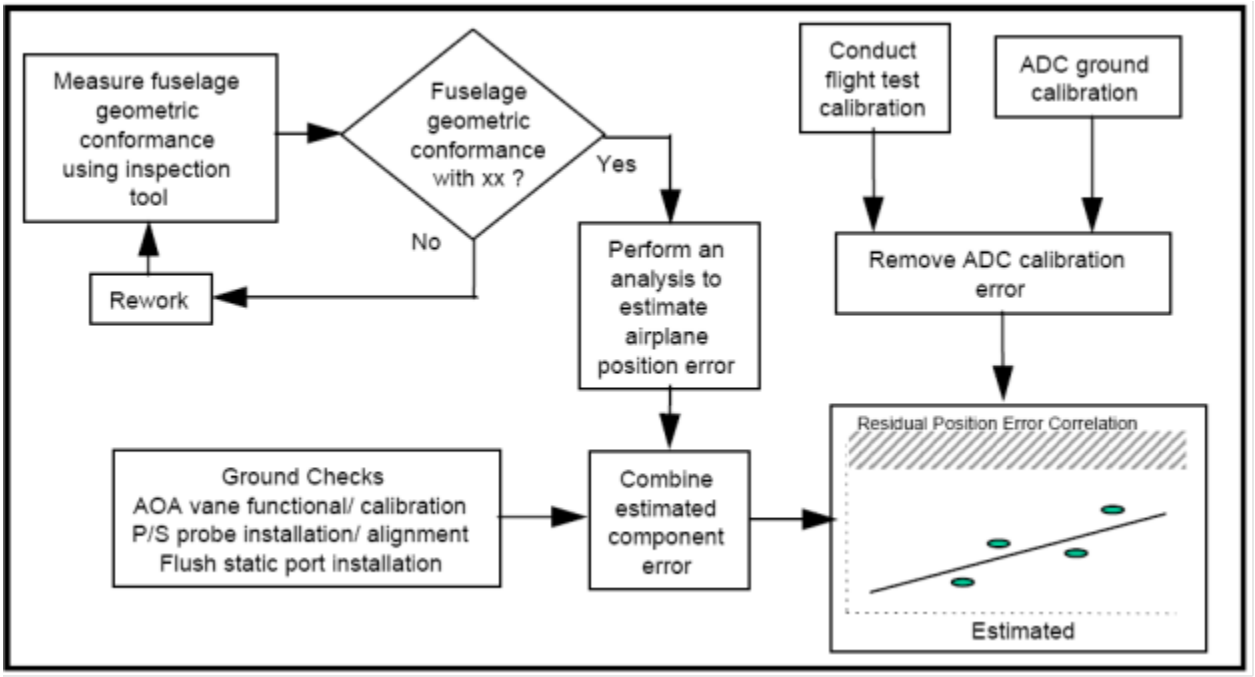
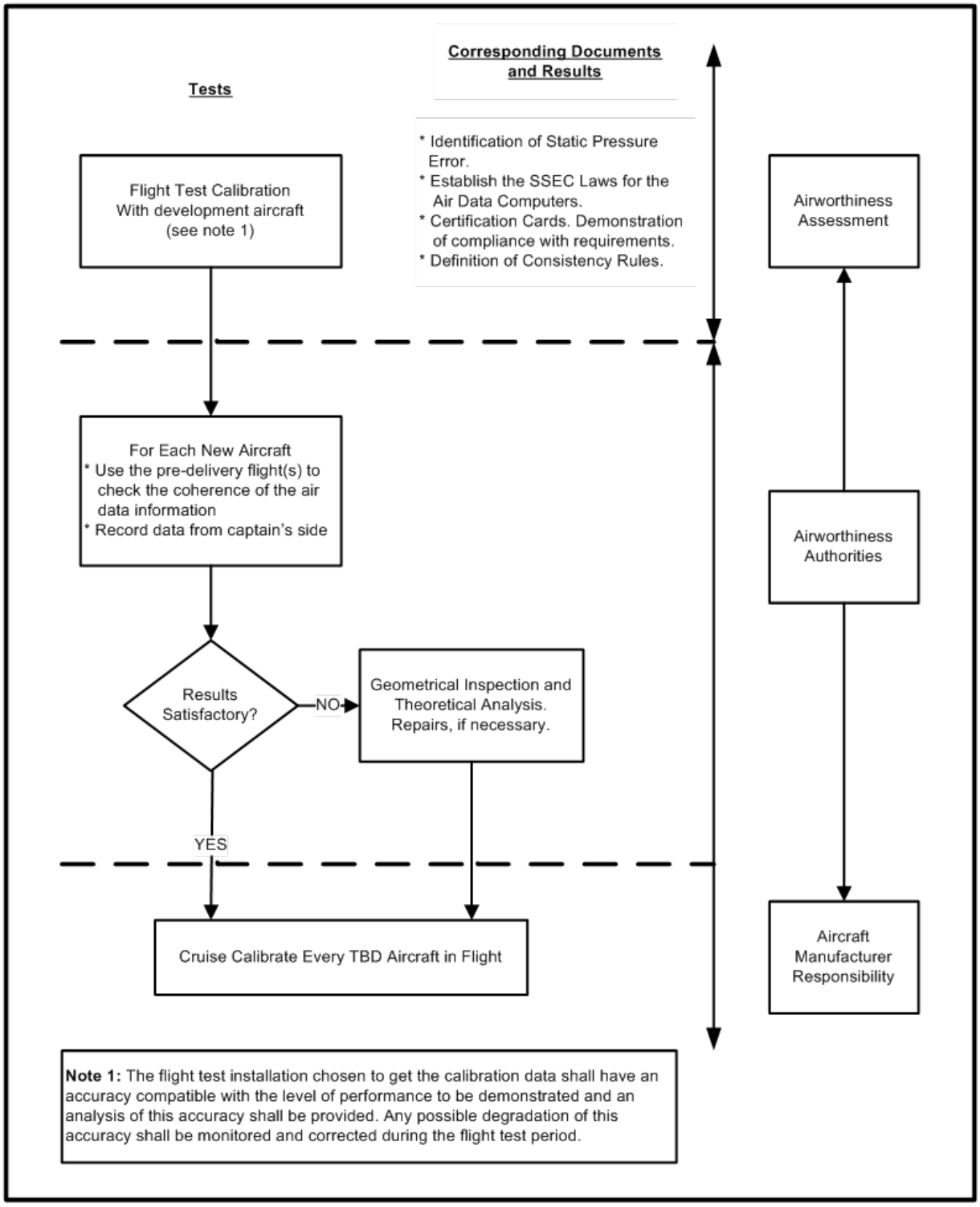


Figure A-7. Process for Showing Initial and Continued Compliance of Airframe Static Pressure Systems for In-Service and New Model Aircraft



A.10 Maintenance Requirements.

A.10.1 General. The data package must include a definition of the procedures, inspections/tests, and limits used to ensure all aircraft approved against the data package "conform to type design." All future approvals, whether of new build or in-service aircraft, must also meet the error budget allowances developed according to paragraph A.8. The tolerances will be established by the data package and include a methodology allowing for tracking the mean and SD for new build aircraft.

A.10.1.1 Define compliance requirements and test procedures for each potential source of ASE. Ensure the error sources remain as allocated in the ASE budget. Provide guidance for corrective action in the event of equipment, test, and/or inspection failure. Typical RVSM-specific maintenance procedures include the following:

1. Verification of avionics component part numbers.
2. ADS Ground Test. This is a direct assessment of altimetry system component errors and correct application of the SSEC.
3. Assessment/measurement of the skin surrounding the static sources (e.g., skin waviness, skin splices/joints, access panels, radome fit/fair, and damage).
4. Inspection of the pitot-static probe or static port (e.g., erosion, corrosion, damage, static port orifice degradation, static port step-height, excessive or non-homogenous paint).
5. SmartProbe©. Inspection for corrosion, erosion, damage, and degradation.

A.10.1.2 RVSM-specific maintenance requirements may be necessary to ensure the automatic altitude control and altitude alerting systems meet the requirements of paragraphs A.4.1.3 and A.4.1.4. The data package should provide data to substantiate these requirements, if needed.

A.10.1.3 Where an operating restriction has been adopted (paragraphs A.5.2.2 or A.5.3.3, as appropriate), the data package should contain the data and information necessary to document and establish that restriction. The Airplane Flight Manual (AFM), Pilot Operating Manual (POM), or an RVSM-specific flight manual supplement must be revised/created as necessary to reflect this restriction.

A.10.1.4 Any variation/modification from the initial installation affecting RVSM approval should be approved by the airframe manufacturer or approved design organization and allowed by the FAA to show RVSM compliance has not been compromised.

1. ADS modifications. Changes to the components comprising an RVSM-compliant ADS cannot be effectively evaluated without the development of a revised ASE budget. Such modifications must be approved by the airframe manufacturer or approved design organization.
2. Automatic altitude control and altitude alert system modifications. Changes to components comprising an RVSM-compliant automatic altitude control or altitude alert system should be evaluated by the airframe manufacturer or approved design organization.
3. Altitude reporting. As stated in paragraph A.4.1.2, any transponder meeting or exceeding the requirements of TSO-C74( ) or TSO-C112( ), as applicable, in accordance with the operational regulations under which the airplane is approved.
4. Airframe modifications. Over time, a RVSM-approved aircraft may become a candidate for airframe modifications, such as installation of large antennas, radomes, fairings, equipment lockers, winglets, etc. Any modification changing the exterior contour of the aircraft, or potentially impacting the ADS static sources and/or pneumatic configuration, aircraft weight, and/or performance in any manner, must be evaluated by the manufacturer or design organization to ascertain the RVSM compliance status.

A.10.2 Continued Airworthiness Documentation.

A.10.2.1 Aircraft manufacturers. Review and update the following items, as appropriate, to include the effects of RVSM implementation:

1. The Structural Repair Manual (SRM), with special attention to the areas around the static source, angle of attack (AOA) sensors, and doors if their rigging can affect airflow around the previously mentioned sensors.
2. The Master Minimum Equipment List (MMEL).

A.10.2.2 Design organizations. The RVSM airworthiness approval will generally take the form of an RVSM-specific STC. The STC should contain the following:

1. RVSM-specific maintenance instructions for initial and continued airworthiness. These maintenance instructions should include procedures ensuring all sources of ASE and aircraft systems performance degradation can be assessed and controlled. Paragraphs A.10.1.1, A.10.1.2, and A.10.1.4 summarize key elements of RVSM-specific maintenance procedures.

2. An Airplane Flight Manual Supplement (AFMS). The AFMS should summarize any RVSM-specific performance, configuration, and/or operational considerations (see paragraph A.10.1.3) specific to RVSM performance.

A.10.2.3 The data package should include the required periodicity of the maintenance procedures presented in paragraph A.10.1.1 and A.10.1.2, to ensure continued airworthiness compliance with RVSM requirements.

A.10.2.4 The data package should include descriptions of any special procedures not covered in paragraph A.10.1, but may be needed to ensure continued compliance with RVSM requirements.

A.10.2.5 To the extent possible, define in-flight defect reporting procedures to facilitate identification of ASE sources. Such procedures could cover acceptable differences between primary and alternate static sources, and others as appropriate.

A.11 RVSM Airworthiness Approval.

A.11.1 General. Obtaining RVSM airworthiness approval is a two-step process. First, the manufacturer or design organization develops the data package for airworthiness approval and submits the package to the appropriate ACO. Once the ACO approves the data package, the operator applies the procedures defined in the package to obtain authorization from the appropriate Flight Standards office to use its aircraft to conduct flight in RVSM airspace. The initial airworthiness review process must consider continued airworthiness requirements. This paragraph summarizes the requirements of the RVSM airworthiness approval data package, and presents a means of compliance for a Group or Non-Group aircraft. All aircraft must meet the equipment, configuration, and performance requirements of paragraph A.4, and the altimetry system performance requirements of paragraph A.5.

A.11.2 Contents of the Data Package. As a minimum, the data package should consist of the following items:

1. A definition of the flight envelope(s) applicable to the subject aircraft. (See paragraph A.2.)
2. A definition of the Group or Non-Group aircraft to which the data package applies. (See paragraph A.3.)
3. The data needed to show compliance with the requirements of paragraphs A.4 and A.5. This data will include most elements presented in paragraphs A.7 through A.9, as appropriate. Older, “legacy” airframes may require guidance presented in paragraph A.6.

4. The engineering data and compliance procedures required to:
   - Validate all aircraft submitted for airworthiness approval meet RVSM requirements; and
   - Validate continued in-service RVSM approval integrity of the Group or Non-Group aircraft.

A.11.2.1 Data Package Approval. All necessary data should be submitted to the appropriate ACO for action. The operator will be required to implement the procedures for initial and continued airframe airworthiness compliance, as presented in the approved data package, to demonstrate the aircraft is in compliance with RVSM performance standards.

APPENDIX B. TRAINING PROGRAMS AND OPERATING PRACTICES AND PROCEDURES

B.1 Introduction. Items listed in this appendix should be standardized and incorporated into training programs and operating practices and procedures. Certain items may already be adequately standardized in existing operator programs and procedures. New technologies may also eliminate the need for certain crew actions. If this is the case, then the intent of this guidance can be considered to be met.

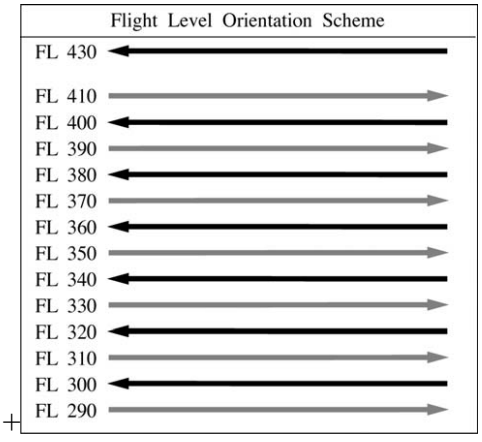
Note: This AC was written for use by a wide variety of operator types (e.g., 14 CFR parts 91, 91K, 121, 125, 129, and 135 operators); therefore, certain items are included for purposes of clarity and completeness.

B.2 RVSM General.

B.2.1 RVSM Description. RVSM airspace was designed to allow 1,000 ft vertical separation between aircraft operating at flight levels (FL) at or above FL 290. At 0901 universal coordinated time (UTC) on January 20, 2005, the FAA implemented RVSM between FL 290−410 (inclusive) in the following airspace: the airspace of the lower 48 states of the United States, Alaska, Atlantic, and Gulf of America High Offshore Airspace, and the San Juan flight information region (FIR). On the same time and date, RVSM was also introduced into the adjoining airspace of Canada and Mexico to provide a seamless environment for aircraft traversing those borders. In addition, RVSM was implemented on the same date in the Caribbean and South American regions.

B.2.1.1 In the domestic United States, Alaska, offshore airspace, and the San Juan FIR RVSM airspace, altitude assignments for direction of flight follow a scheme of odd altitude assignment for magnetic courses 000−179 degrees and even altitudes for magnetic courses 180−359 degrees for flights up to and including FL 410, as indicated in Figure B-1.

Figure B-1. Flight Level Orientation Scheme



Note: Odd flight levels (FL): magnetic course 000−179 degrees. Even FLs: magnetic course 180−359 degrees.

B.3 Operating Policies and Procedures in U.S.-Controlled RVSM Airspace. Operators and pilots should reference the U.S. Aeronautical Information Manual (AIM), Chapter 4, Section 6, Operational Policy/Procedures for Reduced Vertical Separation Minimum (RVSM) in the Domestic U.S., Alaska, Offshore Airspace and the San Juan FIR, and the U.S. Aeronautical Information Publication (AIP), En Route Section 7, Oceanic Operations, as applicable, prior to conducting RVSM operations in U.S.-controlled RVSM airspace.

B.3.1 Flight Planning. During flight planning, the flightcrew and dispatchers, if applicable, should pay particular attention to conditions which may affect operation in RVSM airspace. These include, but may not be limited to:

1. Verifying the aircraft and operator meet RVSM requirements.
2. Annotating the flight plan to be filed with the Air Traffic Service Provider (ATSP) to show compliance for RVSM operations. The International Civil Aviation Organization (ICAO) flight plan, FAA Form 7233-4, Pre-Flight Pilot Checklist and International Flight Plan, Item 10, Equipment, should be annotated with the letter W for filing in RVSM airspace.
   - When using FAA Form 7233-4, operators should ensure that the aircraft's registration number (Reg/) is listed in Item 18 (Other Information), if different than that listed in Item 7 (Aircraft Identification).
   - For exceptions to the use of FAA Form 7233-4, refer to the FAA AIM, Chapter 5, Air Traffic Procedures, for the proper flight codes.

     Note: An aircraft or operator not meeting the requirements for RVSM operations including an aircraft without operable RVSM equipment is referred to as non-RVSM. If either the flightcrew or aircraft do not meet the requirements for RVSM, the operator or dispatcher will not file the RVSM equipment code in the flight plan and follow the procedures for a non-RVSM status, including the appropriate pilot-air traffic control (ATC) phraseology in Table B-1, RVSM Phraseology.
3. Reported and forecast weather conditions on the route of flight.
4. Minimum equipment requirements pertaining to altitude-keeping systems.
5. Traffic Alert and Collision Avoidance System (TCAS) equipage. TCAS equipage requirements are contained in part 121, § 121.356; part 125, § 125.224; part 129, § 129.18; and part 135, § 135.180. Part 91 appendix G does not contain TCAS equipage requirements specific to RVSM; however, part 91 appendix G does require that aircraft equipped with TCAS II and flown in RVSM airspace be modified to incorporate TCAS II Version 7.0 or a later version.
6. If required for the specific aircraft Group, accounting for any aircraft operating restrictions related to RVSM airworthiness approval. (See Appendix A, RVSM Airworthiness Certification, paragraph A.10.1.3.)

B.3.2 Preflight Procedures. Accomplish the following actions during preflight:

1. Review maintenance logs and forms to ascertain the condition of equipment required for flight in the RVSM airspace. Ensure maintenance action has been taken to correct defects to required equipment.
2. During the external inspection of aircraft, pay particular attention to the condition of static sources, the condition of the fuselage skin near each static source, and any other component affecting altimetry system accuracy. (A qualified and authorized person other than the pilot (e.g., a Flight Engineer (FE) or maintenance personnel) may perform this check.)
3. Before takeoff:
   - The aircraft altimeters should be set to the barometric pressure for local altimeter setting (QNH) and should display a known elevation (e.g., field elevation) within the limits specified in aircraft operating manuals. The difference between the known elevation and the elevation displayed on the altimeters should not exceed 75 ft.
   - The two primary altimeters should also agree within limits specified by the aircraft operating manual/Airplane Flight Manual (AFM), as applicable. An alternative procedure using atmospheric pressure at aerodrome elevation (QFE) may also be used.

   Note: Both checks should be an emphasis item for training materials.
4. Equipment required for flight in RVSM airspace should be operational, and indications of malfunction should be resolved.

B.3.3 Procedures Before RVSM Airspace Entry. If any of the required equipment fails prior to the aircraft entering RVSM airspace, the pilot should request a new clearance to avoid flight in this airspace. The following equipment must be operating normally at entry into RVSM airspace:

1. Two primary altitude measurement systems.
2. One automatic altitude control system.
3. One altitude alerting device.

Note: The operator or pilot should ascertain the requirement for an operational transponder and TCAS in each RVSM area where operations are intended.

B.3.4 In-Flight Procedures. Incorporate the following policies into flightcrew training and procedures, as applicable:

1. Flightcrews should comply with aircraft operating restrictions (if required for the specific aircraft Group) related to RVSM airworthiness approval. (See paragraph A.10.1.3.)

2. Place emphasis on promptly setting the sub-scale on all primary and standby altimeters to 29.92 inches of mercury (inHg)/1013.25 hectopascals (hPa) when climbing through the transition altitude and rechecking for proper altimeter setting when reaching the initial cleared flight level (CFL).
3. In level cruise, it is essential the aircraft is flown at the CFL. This requires particular care is taken to ensure ATC clearances are fully understood and followed. Except in contingency or emergency situations, the aircraft should not intentionally depart from CFL without a positive clearance from ATC.
4. During cleared transition between FLs, the aircraft should not be allowed to overshoot or undershoot the CFL by more than 150 ft (45 m).

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

5. An automatic altitude control system must be operative and engaged during level cruise, except when circumstances such as the need to retrim 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.
6. The altitude alerting system must be operational.
7. At cruise FL, the two primary altimeters should agree within 200 ft (60 m) or a lesser value if specified in the aircraft operating manual. (Failure to meet this condition will require that the altimetry system be reported as defective and notified to ATC.) Note the difference between the primary and standby altimeters for use in contingency situations.
8. At intervals of approximately 1 hour, make cross-checks between the primary altimeters and the standby altimeter.
   a. The normal pilot scan of flight deck instruments should suffice for altimeter cross-checking on most flights.
   b. When operating in surveillance airspace (Radar/Automatic Dependent Surveillance-Broadcast (ADS-B)), the initial altimeter cross-check should be performed after level-off.
   c. In oceanic and remote continental (procedural) airspace, a cross-check should be performed and recorded in the vicinity of the point where oceanic and remote continental navigation begins (e.g., on coast out). The readings of the primary and standby altimeters should be recorded and available for use in contingency situations.
   d. Some aircraft have automatic comparators that compare the two primary altimetry systems. The comparators include a monitoring, warning, and fault function. The faults may be recorded automatically by the system, but a record of the differences in the primary altimetry systems may not be easily derived.

Note: In oceanic and remote continental (procedural) airspace, even if the aircraft is equipped with automatic comparators, the crew should be recording the altimeter cross-checks for use in a contingency situation.

9. Normally, the altimetry system being used to control the aircraft should be selected to provide the input to the altitude-reporting transponder transmitting information to ATC.
10. If ATC notifies the pilot of an assigned altitude deviation (AAD) error equal to or exceeding 300 ft (90 m), then the pilot should take action to return to CFL as quickly as possible.

B.3.5 Pilot Controller Phraseology for RVSM Operations. See Table B-1.

Table B-1. RVSM Phraseology

Message	Phraseology
For a controller to ascertain the RVSM approval status of an aircraft:	(call sign) Confirm RVSM approved.
Pilot indication that flight is RVSM approved.	Affirm RVSM.
Pilot report of lack of RVSM approval (non-RVSM status). Pilot will report non-RVSM status, as follows: a. On the initial call on any frequency in the RVSM airspace; b. In all requests for flight level (FL) changes pertaining to FLs within the RVSM airspace; c. In all read backs to FL clearances pertaining to FLs within the RVSM airspace; and d. In read back of FL clearances involving climb and descent through RVSM airspace (FL 290−410).	Negative RVSM (supplementary information, e.g., "Certification flight").
Pilot report of one of the following after entry into RVSM airspace: all primary altimeters, automatic altitude control systems, or altitude alerters have failed. (Refer to AIM Paragraph 4-6-9, Contingency Actions: Weather Encounters and Aircraft System Failures that Occur After Entry into RVSM Airspace.) ***NOTE:*** *This phrase is to be used to convey both the initial indication of RVSM aircraft system failure and on initial contact on all frequencies in RVSM airspace until the problem ceases to exist or the aircraft has exited RVSM airspace.*	Unable RVSM due equipment.
ATC denial of clearance into RVSM airspace.	Unable issue clearance into RVSM airspace, maintain FL.
*Pilot reporting inability to maintain cleared flight level (CFL) due to weather encounter. (Refer to AIM paragraph 4-6-9.)	*Unable RVSM due (state reason) (e.g., turbulence, mountain wave).
ATC requesting pilot to confirm that an aircraft has regained RVSM-approved status or a pilot is ready to resume RVSM.	Confirm able to resume RVSM.
Pilot ready to resume RVSM after aircraft system or weather contingency.	Ready to resume RVSM.

B.3.6 Contingency Procedures After Entering RVSM Airspace. The flightcrew, after realizing that they no longer can comply with RVSM requirements (aircraft system failure, weather, lost com, etc.), must request a new clearance from the controller/radio operator as soon as the situation allows. If a new clearance is not available or the nature of the emergency requires rapid action, the pilot should notify ATC of their action and contingency procedures. Operators should refer to the RVSM section of the AIM when experiencing abnormal situations and implementing contingency procedures. It is also the responsibility of the crew to notify ATC when the implementation of the contingency procedures is no longer required.

Table B-2. Contingency Actions: Weather Encounters and Aircraft System Failures That Occur After Entry into RVSM Airspace

Initial Pilot Actions in Contingency Situations
Initial pilot actions when unable to maintain flight level (FL) or unsure of aircraft altitude-keeping capability: • Notify ATC and request assistance as detailed below. • Maintain CFL, to the extent possible, while evaluating the situation. • Watch for conflicting traffic both visually and by reference to TCAS, if equipped. • Alert nearby aircraft by illuminating exterior lights (commensurate with aircraft limitations).

Severe Turbulence and/or Mountain Wave Activity (MWA) Induced Altitude Deviations of Approximately 200 Feet or Greater	
Pilot will: • When experiencing severe turbulence and/or MWA induced altitude deviations of approximately 200 ft or greater, pilot will contact ATC and state "Unable RVSM due [state reason]" (e.g., turbulence, mountain wave). • If not issued by the controller, request vector clear of traffic at adjacent FLs. • If desired, request FL change or reroute. • Report location and magnitude of turbulence or MWA to ATC.	**Controller will:** • Vector aircraft to avoid merging target with traffic at adjacent FLs, traffic permitting. • Advise pilot of conflicting traffic. • Issue FL change or reroute, traffic permitting. • Issue Pilot Weather Report (PIREP) to other aircraft.

MWA Encounters – General	
Pilot actions: • Contact ATC and report experiencing MWA. • If so desired, pilot may request an FL change or reroute. • Report location and magnitude of MWA to ATC. See Appendix D, Severe Turbulence and Mountain Wave Activity.	**Controller actions:** • Advise pilot of conflicting traffic at adjacent FL. • If pilot requests, vector aircraft to avoid merging target with traffic at adjacent RVSM FLs, traffic permitting. • Issue FL change or reroute, traffic permitting. • Issue PIREP to other aircraft.
NOTE: *MWA encounters do not necessarily result in altitude deviations on the order of 200 ft. The guidance below is intended to address less significant MWA encounters.*	

Wake Turbulence Encounters	
Pilot should: • Contact ATC and request vector, FL change, or, if capable, a lateral offset. See Appendix D.	**Controller should:** • Provide 2,000 ft vertical separation or appropriate horizontal separation. • Clear aircraft out of RVSM airspace unless operational situation dictates otherwise.

"Unable RVSM Due Equipment" Failure of Automatic Altitude Control System, Altitude Alerter, or All Primary Altimeters	
Pilot will: • Contact ATC and state "Unable RVSM due equipment." • Request clearance out of RVSM airspace unless operational situation dictates otherwise.	**Controller will:** • Provide 2,000 ft vertical separation or appropriate horizontal separation. • Clear aircraft out of RVSM airspace unless operational situation dictates otherwise.

One Primary Altimeter Remains Operational	
Pilot will: • Cross-check standby altimeter. • Notify ATC of operation with single primary altimeter. • If unable to confirm primary altimeter accuracy, follow actions for failure of all primary altimeters.	**Controller will:** • Acknowledge operation with single primary altimeter.

Transponder Failure	
Pilot will: • Contact ATC and request authority to continue to operate at CFL. • Comply with revised ATC clearance, if issued. ***NOTE:*** *Part 91, § 91.215, ATC Transponder and Altitude Reporting Equipment and Use, regulates operation with the transponder inoperative.*	**Controller will:** • Consider request to continue to operate at CFL. • Issue revised clearance, if necessary.

Note 1: For an expanded description and explanation of severe turbulence and MWA, see Appendix D.

Note 2: Transponder or TCAS Failure: In airspace not controlled by the United States, the provider States will determine the specific actions operators should take in the event of transponder or TCAS failure while operating in RVSM airspace.

B.3.7 Postflight. In making maintenance logbook entries against malfunctions in altitude-keeping systems, the pilot should provide sufficient detail to enable maintenance to effectively troubleshoot and repair the system. The pilot should detail the actual defect and the crew action taken to try to isolate and rectify the fault. Note the following information when appropriate:

1. Primary and standby altimeter reading.
2. Altitude selector setting.

3. Subscale setting on altimeter.
4. Autopilot used to control the airplane and any differences when the alternate system was selected.
5. Differences in altimeter readings if alternate static ports selected.
6. Use of air-data computer (ADC) selector for fault diagnosis procedure.
7. Transponder selected to provide altitude information to ATC and any difference if alternate transponder or altitude source is manually selected.

B.4 Accommodation of Non-RVSM Aircraft. Operators must be authorized and aircraft must be compliant to fly in designated RVSM airspace with limited exceptions. An operator not authorized for RVSM operations or an operator/aircraft without operable RVSM equipment is referred to as non-RVSM. The operator or dispatcher must not file the RVSM equipment code in the flight plan. The pilot of a non-RVSM aircraft must inform the controller of the lack of RVSM approval in accordance with the direction provided in Table B-1.

B.4.1 The procedures for accommodation of non-RVSM aircraft in RVSM airspace for operations in the domestic United States, Alaska, offshore airspace, and the San Juan FIR are contained in the FAA AIM, Paragraph 4-6-10, Procedures for Accommodation of Non-RVSM Aircraft. For operations within oceanic airspace, refer to the U.S. AIP, En Route Section 7.

B.4.2 Specific categories of non-RVSM aircraft may be accommodated. Subject to FAA approval and clearance, the following categories of non-RVSM aircraft may operate in domestic U.S. RVSM airspace provided they have an operational transponder.

1. Department of Defense (DOD) aircraft.
2. Active air ambulance flights utilizing the “MEDEVAC” call sign.
3. Aircraft capable of climbing/descending through RVSM FLs without level-off.

B.4.3 In addition to those aircraft identified in paragraph B.4.2 above, in oceanic and offshore airspace controlled by the United States, the following non-RVSM aircraft may be accommodated on a workload permitting basis with prior coordination:

1. Aircraft being initially delivered to the State of Registry or State of the Operator; and
2. Aircraft that was formerly RVSM-compliant but has experienced equipment failure being flown to a maintenance facility.

B.5 Minimum Equipment List (MEL). Operators conducting operations under an MEL adopted from the Master Minimum Equipment List (MMEL) should include items pertinent to operating in RVSM airspace.

B.6 Oceanic Operations. In general, RVSM procedures in oceanic airspace are no different from those in domestic airspace. However, some regional differences apply. Operators should be cognizant of differences for the area in which they are intending to operate.

Note: ICAO Doc 7030, Regional Supplementary Procedures, provides differences for individual regions of the world.

B.6.1 Strategic Lateral Offset Procedures (SLOP). SLOP are approved oceanic procedures allowing aircraft to fly on a parallel track to the right of the centerline relative to the direction of flight to mitigate the lateral overlap probability due to increased navigation accuracy and wake turbulence encounters. Unless specified in the separation standard, an aircraft's use of these procedures does not affect the application of prescribed separation standards. Implementation of SLOP must be coordinated among the States involved. Procedures for the conduct of SLOP are contained in ICAO Doc 4444, Procedures for Air Navigation Services, Air Traffic Management, Chapter 16.5, Strategic Lateral Offset Procedures (SLOP).

Note: In domestic U.S. airspace, pilots must request clearance to fly a lateral offset. Strategic lateral offsets flown in oceanic airspace do not apply. (Refer to FAA AIM Paragraph 4-6-7, Guidance on Wake Turbulence.)

B.6.2 Special Procedures for In-Flight Contingencies in Oceanic Airspace. Special procedures, including weather deviation procedures, can be found in ICAO Doc 4444, Chapter 15, Procedures Related to Emergencies, Communication Failure and Contingencies.

APPENDIX C. OPERATIONS OUTSIDE OF U.S.-CONTROLLED AIRSPACE

C.1 Introduction. RVSM was initially implemented in North Atlantic minimum navigation performance specifications (MNPS) airspace in March 1997 (MNPS airspace was later renamed North Atlantic High Level Airspace (NAT HLA)). Since then, RVSM operations have been implemented worldwide. Operators should expect to have to comply with RVSM procedures whenever operating at FL 290 to FL 410 inclusive.

C.2 ICAO Doc 9574, Manual on a 300 m (1,000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive. RVSM guidance to State authorities can be found in ICAO Doc 9574. The operating procedures specified in Appendix B, Training Programs and Operating Practices and Procedures, are consistent with this guidance.

C.3 ICAO Doc 7030, Regional Supplementary Procedures, and State-Specific Guidance. While States make every effort to harmonize RVSM implementations, there are differences that are highlighted in State guidance.

C.3.1 Operators are responsible for knowing the RVSM procedures in the areas of intended operation. Operators starting RVSM operation in an RVSM area of operation new to them should ensure their RVSM programs incorporate RVSM policy and procedures unique to the new area of operations.

C.3.2 Operators should review ICAO Doc 7030 and State AIPs prior to starting RVSM operations in an area new to the operator.

C.4 RVSM Metric FLs, China and Mongolia.

C.4.1 China RVSM. Metric RVSM was implemented in the Shenyang, Beijing, Shanghai, Guangzhou, Kunming, Wuhan, Lanzhou, and Urumqi FIRs and Sector AR01 (Island airspace) of the Sanya control area (CTA) between 8,900 meters (m) (FL 291) and 12,500 m (FL 411) inclusive. The airspace between 8,900 m (FL 291) and 12,500 m (FL 411) is defined as RVSM airspace. China RVSM airspace is exclusive RVSM airspace; aircraft that are not RVSM-compliant may not operate into China RVSM airspace between 8,900 m (FL 291) and 12,500 m (FL 411).

- ATC will issue the FL clearance in meters, but the aircraft shall be flown using the FL in feet. The China RVSM FLAS and specific RVSM procedures can be found in the State AIP.
- Operators must review the State AIP prior to operating in these areas.

Note: Operators can find RVSM-related documents, including the RVSM Aeronautical Information Circular (AIC) Nr. 06/07, Policy and Procedures of RVSM in China Airspace, at http://www.chinarma.cn/documenten/index.jhtml.

C.4.2 Mongolia RVSM. Metric RVSM was implemented in the Ulaanbaatar FIR between 8,900 m (29,100 ft) and 12,500 m (41,100 ft) inclusive. The airspace between 8,900 m (29,100 ft) and 12,500 m (41,100 ft) is defined as RVSM airspace. Mongolia RVSM

airspace is exclusive RVSM airspace, and aircraft that are not RVSM-compliant may not operate into Mongolia RVSM airspace between 8,900 m (29,100 ft) and 12,500 m (41,100 ft).

C.4.2.1 ATC will issue the FL clearance in meters, but the aircraft shall be flown using the FL in feet. The Mongolia RVSM FLAS and specific RVSM procedures can be found in the Civil Aviation Authority (CAA) of Mongolia AIC 03/11, Policy and Procedures of Reduced Vertical Separation Minimum (RVSM) in the Airspace of Mongolia.

Note: Operators can find the AIC on the FAA RVSM documentation web page at https://www.faa.gov/air_traffic/separation_standards/rvsm/documentation/.

C.5 U.S.-Registered Operators Based Outside of U.S.-Controlled Airspace.

C.5.1 U.S.-registered operators that are based or routinely operate in airspace not controlled by the United States must be cognizant of the RVSM policies and procedures in the areas of intended operation.

C.5.1.1 Operators wishing to operate under the provisions of 14 CFR part 91 appendix G, section 9 must meet all of the requirements, including RVSM altitude-keeping performance standards as specified in part 91 appendix G, section 9(b), prior to conducting RVSM operations outside of U.S.-controlled airspace.

C.5.1.2 The aircraft's altitude-keeping performance must have been monitored within the previous 24 months in airspace the FAA can monitor the aircraft ADS-B OUT signal and found to be in compliance. A map of FAA ADS-B monitored airspace can be found at https://www.faa.gov/nextgen/programs/adsb/coverageMap/.

Note: The FAA may also expand the airspace in which we collect altitude-keeping performance data via ADS-B through collaboration with other ANSPs.

C.5.1.3 U.S.-registered operators may obtain monitoring performance from the FAA altitude-keeping performance website at https://www.faa.gov/air_traffic/separation_standards/naarmo/.

C.5.2 Operators of airplanes that do not routinely operate in airspace where sufficient ADS-B data is available to the FAA to determine RVSM performance, or when a foreign country requires a specific approval, may seek an RVSM authorization via OpSpec, MSpec, or LOA under the provisions of part 91 appendix G, section 3. (See Chapter 5, Operators Applying for RVSM OpSpecs, MSpecs, or LOAs.)

APPENDIX D. SEVERE TURBULENCE AND MOUNTAIN WAVE ACTIVITY

D.1 Introduction/Explanation. The information and practices in this paragraph are provided to emphasize to pilots the importance of taking appropriate action in RVSM airspace when aircraft experience severe turbulence and/or Mountain Wave Activity (MWA) that is of sufficient magnitude to significantly affect altitude-keeping.

1. Severe turbulence causes large, abrupt changes in altitude and/or attitude usually accompanied by large variations in indicated airspeed. Aircraft may be momentarily out of control. Encounters with severe turbulence must be remedied immediately in any phase of flight. Severe turbulence may be associated with MWA.
2. Also refer to the FAA AIM, Chapter 4, Section 6, Operational Policy/Procedures for Reduced Vertical Separation Minimum (RVSM) in the Domestic U.S., Alaska, Offshore Airspace and the San Juan FIR.

D.1.1 MWA. Significant MWA occurs both below and above the floor of RVSM airspace, FL 290. MWA often occurs in western states in the vicinity of mountain ranges. It may occur when strong winds blow perpendicular to mountain ranges resulting in up and down or wave motions in the atmosphere. Wave action can produce altitude excursions and airspeed fluctuations accompanied by only light turbulence. With sufficient amplitude, however, wave action can induce altitude and airspeed fluctuations accompanied by severe turbulence. MWA is difficult to forecast and can be highly localized and short-lived.

D.1.1.1 Wave Activity Is Not Necessarily Limited to the Vicinity of Mountain Ranges. Pilots experiencing wave activity anywhere that significantly affects altitude-keeping can follow the guidance provided below.

D.1.1.2 In-Flight MWA Indicators (Including Turbulence). Indicators that the aircraft is being subjected to MWA are:

- Altitude excursions and/or airspeed fluctuations with or without associated turbulence.
- Pitch and trim changes required to maintain altitude with accompanying airspeed fluctuations.
- Light to severe turbulence, depending on the magnitude of the MWA.

D.1.2 Application of Merging Target Procedures.

D.1.2.1 Explanation of Merging Target Procedures. ATC will use “merging target procedures” to mitigate the effects of both severe turbulence and MWA. En route controllers will advise pilots of potential traffic that they perceive may fly directly above or below his or her aircraft at minimum vertical separation. In response, pilots are given the option of requesting a radar vector

to ensure their radar target will not merge or overlap with the traffic's radar target.

D.1.2.2 Priority. The provision of "merging target procedures" to mitigate the effects of severe turbulence and/or MWA is not optional for the controller, but rather is a priority responsibility. Pilot requests for vectors for traffic avoidance when encountering MWA or pilot reports of "Unable RVSM due turbulence or MWA" are considered first priority aircraft separation and sequencing responsibilities. The controller's first priority is to separate aircraft and issue safety alerts.

D.1.2.3 Explanation of the Term "Traffic Permitting." The contingency actions for MWA and severe turbulence detailed in this appendix state that the controller will "vector aircraft to avoid merging targets with traffic at adjacent FLs, traffic permitting." The term "traffic permitting" is not intended to imply that merging target procedures are not a priority duty. The term is intended to recognize there are circumstances when the controller is required to perform more than one action and must "exercise their best judgment based on the facts and circumstances known to them" to prioritize their actions. Further direction given is: "That action which is most critical from a safety standpoint is performed first."

D.1.3 TCAS Sensitivity. For both MWA and severe turbulence encounters in RVSM airspace, an additional concern is the sensitivity of collision avoidance systems when one or both aircraft operating in close proximity receive TCAS advisories in response to disruptions in altitude hold capability.

D.1.4 Preflight Tools. Sources of observed and forecast information that can help the pilot ascertain the possibility of MWA or severe turbulence are Forecast Winds and Temperatures Aloft (FD), Area Forecast (FA), Graphical Turbulence Guidance (GTG), significant meteorological information (SIGMET) and Pilot Weather Reports (PIREP).

D.1.5 Pilot Actions When Encountering Weather (e.g., Severe Turbulence or MWA).

D.1.5.1 Weather Encounters Inducing Altitude Deviations of Approximately 200 Feet. When the pilot experiences weather-induced altitude deviations of approximately 200 ft, the pilot will contact ATC and state "Unable RVSM due [state reason]" (e.g., turbulence, MWA).

D.1.5.2 Severe Turbulence (Including That Associated With MWA). When pilots encounter severe turbulence, they should contact ATC and report the situation. Until the pilot reports clear of severe turbulence, the controller will apply merging target vectors to one or both passing aircraft to prevent their targets from merging.

Example: *"Yankee 123, FL 310, unable RVSM due severe turbulence."*

"Yankee 123, fly heading 290; traffic twelve o'clock, 10 miles, opposite direction; eastbound MD-80 at FL 320" (or the controller may issue a vector to the MD-80 traffic to avoid Yankee 123).

D.1.5.3 **MWA.** When pilots encounter MWA, they should contact ATC and report the magnitude and location of the wave activity. When a controller makes a merging targets traffic call, the pilot may request a vector to avoid flying directly over or under the traffic. In situations where the pilot is experiencing altitude deviations of 200 ft or greater, the pilot will request a vector to avoid traffic. Until the pilot reports clear of MWA, the controller will apply merging target vectors to one or both passing aircraft to prevent their targets from merging.

Example: *"Yankee 123, FL 310, unable RVSM due mountain wave."*

"Yankee 123, fly heading 290; traffic twelve o'clock, 10 miles, opposite direction; eastbound MD-80 at FL 320" (or the controller may issue a vector to the MD-80 traffic to avoid Yankee 123).

D.1.5.4 **FL Change or Reroute.** To leave airspace where MWA or severe turbulence is being encountered, the pilot may request an FL change and/or reroute, if necessary.

D.2 Wake Turbulence.

D.2.1 Background.

D.2.1.1 Pilots should be aware of the potential for wake turbulence encounters in RVSM airspace. Experience gained since 1997 has shown that such encounters in RVSM airspace are generally moderate or less in magnitude.

D.2.1.2 Prior to Domestic RVSM (DRVSM) implementation, the FAA established provisions for pilots to report wake turbulence events in RVSM airspace using the National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS). A "Safety Reporting" section established on the FAA RVSM Documentation web page provides contacts, forms, and reporting procedures.

D.2.1.3 To date, wake turbulence has not been reported as a significant factor in DRVSM operations. European authorities also found that reports of wake turbulence encounters did not increase significantly after RVSM implementation (eight versus seven reports in a 10-month period). In addition, they found that reported wake turbulence was generally similar to moderate clear air turbulence.

D.2.2 Pilot Action to Mitigate Wake Turbulence Encounters.

1. Pilots should be alert for wake turbulence when operating:
   a. In the vicinity of aircraft climbing or descending through their altitude.
   b. Approximately 10−30 miles after passing 1,000 ft below opposite-direction traffic.
   c. Approximately 10−30 miles behind and 1,000 ft below same-direction traffic.
2. Pilots encountering or anticipating wake turbulence in DRVSM airspace have the option of requesting a vector, FL change, or, if capable, a lateral offset.

Note 1: Offsets of approximately a wingspan upwind generally can move the aircraft out of the immediate vicinity of another aircraft's wake vortex.

Note 2: In domestic U.S. airspace, pilots must request clearance to fly a lateral offset. Strategic lateral offsets flown in oceanic airspace do not apply.

D.3 Pilot/Controller Phraseology. See Appendix B, Training Programs and Operating Practices and Procedures, Table B-1, RVSM Phraseology, for a table of pilot/controller phraseology.

D.4 Contingency Actions. See Appendix B, Table B-2, Contingency Actions: Weather Encounters and Aircraft System Failures That Occur After Entry into RVSM Airspace, for a table of contingency actions.

APPENDIX E. RVSM ALTITUDE-KEEPING PERFORMANCE MONITORING WHEN OPERATING WITH AN RVSM OPSPEC, MSPEC, OR LOA

E.1 Introduction. This appendix explains how an operator can meet the requirements for altitude-keeping performance monitoring when operating under the provisions of 14 CFR part 91 appendix G, section 3 when issued an OpSpec, MSpec, or LOA.

Note: If the operator's aircraft is equipped with a qualified ADS-B OUT system and wishes to conduct operations under the provisions of part 91 appendix G, section 9, see Chapter 4, Authorizations for Operators of RVSM Aircraft Equipped With a Qualified ADS-B OUT System.

E.1.1 All Operators Wishing to Conduct Operations in RVSM-Designated Airspace Are Required to Participate in RVSM Height-Monitoring.

E.1.1.1 Part 91 appendix G, section 3 stipulates how the operator, in a manner prescribed by the Administrator, must provide evidence that "[i]t 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 method prescribed to verify ASE remains within required performance limits.

E.1.2 When Do I Have to Get My Airplanes Monitored? U.S.-registered operators are required to conduct initial height-monitoring within 6 months of the authorization date of issue and must conduct height-monitoring every 2 years, or within intervals of 1,000 flight-hours, whichever period is longer.

1. Monitoring is not required prior to being granted operational approval.
2. Evidence of previous successful monitoring of an airplane may be used to meet the monitoring requirements.
3. When calculating the 1,000-hour provision of the Minimum Monitoring Requirement (MMR), the calculation of the flight time should be from the last satisfactory height-monitoring date on record.

E.1.3 How Many Airplanes Need to Be Monitored?

1. An operator with multiple airplanes may not need to have all airplanes monitored. For height-monitoring, only a sampling of airframes of each airplane type need to be monitored.
2. To determine the number of airframes each operator is required to have monitored, use the RVSM Minimum Monitoring Requirement (MMR) chart. (Refer to the RVSM Documentation web page at https://www.faa.gov/air_traffic/separation_standards/rvsm/documentation/.)

Note: An operator that is unable to meet the minimum height-monitoring requirements within the specified timeframe should contact the appropriate Flight Standards office prior to exceeding the specified timeframe.

E.1.4 How Do I Get My Airplanes Monitored?

1. An operator may choose to fly with a trained technician from an FAA-approved RVSM monitoring support provider utilizing a GMU on board the airplanes.
2. An operator may fly an airplane through an established ground-based height-measuring system. Currently, ground-based systems exist in:
   - North America, AGHME (requires Mode S equipment); or approved ground-based height-measuring systems in other regions (e.g., Europe or Japan).
   - An RVSM-authorized aircraft equipped and operating with ADS-B OUT avionics meeting the performance requirements of part 91, § 91.227 at an RVSM altitude where ADS-B height-monitoring is provided.

E.1.5 How Can I Verify If My Airplanes Were Monitored in the Last 2 Years?

1. An operator that has a valid RVSM authorization can check the RVSM Approvals database to determine if their last valid monitoring occurred within the last 2 years.
2. The following methods satisfy monitoring requirements:
   - Entry of successful AGHME or other approved ground-based monitoring system result in the U.S. RVSM Approvals database.
   - A report of a successful monitoring supplied by an FAA-approved, GPS-based provider.
   - Evidence provided through another ICAO-sponsored regional monitoring agency, such as EUROCONTROL.

Note: For North American operators, the database can be accessed from the FAA RVSM website under the RVSM Documentation section or on the FAA's North American Approvals Registry and Monitoring Organization (NAARMO) website at https://www.faa.gov/air_traffic/separation_standards/naarmo/rvsm_approvals/.

E.1.6 RVSM Height-Monitoring Plan. Operators, upon application, should submit a monitoring plan including:

- Number and identification (registration number/serial number) of airplanes to be monitored.
- Expected timeframe for completion of monitoring requirements.
- Expected method for monitoring.

APPENDIX F. DECISION MATRIX WHEN APPLYING FOR AN RVSM OPSPEC, MSPEC, OR LOA

F.1 Introduction. The RVSM Authorization Matrix (or simply the "Matrix") is a tool created to assist operators and the FAA in determining the typical documentation needed for application and which RVSM Authorization Elements approval action the applicant is seeking.

Table F-1. RVSM Decision Matrix

RVSM DECISION MATRIX	
AUTHORIZATION GROUP I: **RVSM AUTHORIZATION AMENDMENTS** • The following changes are considered to be administrative in nature only. • This Group *only* applies in circumstances where a previously authorized RVSM operator and each of the previously accepted RVSM Authorization Elements *are remaining the same*.	
I.	**A. Examples of Requested Action/Nature of Change**
	1. Change in the primary business address of an RVSM-Compliant Aircraft and/or RVSM authorization holder. 2. Change in an existing RVSM operator's designated Responsible Person (or RVSM-Authorized Representative or RVSM-Point of Contact (POC)). 3. Change in the registration markings of an RVSM-Compliant Aircraft being operated by an existing RVSM authorization holder. 4. Removal of wording describing use of an RVSM-Approved Maintenance Program for operators otherwise not having a requirement for an approved maintenance program. 5. Removal of an RVSM-Compliant Aircraft from an existing RVSM authorization that has multiple RVSM-Compliant Aircraft listed.

I.	B. Applicable Steps and Information Required From RVSM Authorization Holder
	1. Prior to making a request for service for an authorization amendment, each existing authorization holder should make a positive determination as to which portions of the previously accepted RVSM Authorization Elements the authorization holder is requesting to change. 2. That authorization holder should then submit a written request to the appropriate Flight Standards office that: a. States which of the applicable administrative changes are occurring; b. Further affirmatively states that none of the previously accepted RVSM Authorization Elements that formed the basis for the initial issuance of the affected RVSM authorization have changed or are changing; and c. Requests the issuance of an amendment to the existing RVSM authorization that acknowledges the administrative change being made. 3. If the nature of the requested amendment is to change the primary business address from one service area to another, he or she must notify, in writing, the losing (previously responsible) FAA office of the new physical location and mailing address within 30 calendar-days following relocation. The losing office must request that the Web-based Operations Safety System (WebOPSS) Help Desk move the operator's database to the appropriate receiving FAA office. The losing office must also notify the receiving office of the change. The receiving office should then update and reissue the operator's A001 template to reflect the new address, and the receiving office becomes the appropriate Flight Standards office for processing new letters of authorization (LOA) for that operator. 4. The authorization holder should also provide such further information as requested by the FAA to efficiently process the request.
I.	**C. Applicable Procedures to Be Followed by the Appropriate Flight Standards Office**
	1. Review the request and supporting documentation received from the RVSM authorization applicant to determine if it appears that an amended RVSM authorization is warranted. 2. Reissue the amended RVSM authorization that is identical to the initial RVSM authorization in all respects other than reflecting the new amended information. 3. If the nature of the requested amendment is to change the primary business address from one service area to another, see the additional applicable guidance in FAA Order 8900.1, Volume 3, Chapter 2, Section 2, Responsibility for Part 91 Letters of Authorization (LOA). 4. If an existing RVSM authorization holder has made a written affirmation that none of the underlying previously accepted RVSM Authorization Elements have changed or will change, and there is no other information provided to the FAA raising any questions or concerns with respect to the ongoing validity or applicability of those RVSM Authorization Elements, then, subject to paragraph 5.3.4 of this AC, the appropriate Flight Standards office should issue the requested amendment without further inspections being required.

AUTHORIZATION GROUP II:

RVSM AUTHORIZATION BASED ON ONE OR MORE EXISTING APPROVED RVSM AUTHORIZATION ELEMENTS

- The following RVSM authorizations are new authorizations.
- This Group will normally apply to a new or proposed RVSM operator that is seeking the issuance of an RVSM authorization for an aircraft that is already an RVSM-Compliant Aircraft and/or previously accepted RVSM-Knowledgeable Pilots requirements with respect to its operations of that specific aircraft.

II.	A. Examples of Requested Action/Nature of Change

1. There is a change in the legal status or identity of the business entity that is the Approved RVSM operator, but the Responsible Person, RVSM-Authorized Representative, and/or RVSM-POC and each of the Approved RVSM Authorization Elements are remaining the same.
   a. One example of this situation may occur where an operator is converted from an S corporation to a limited liability company under applicable state law, but no other changes are occurring.
   b. Another example may occur where the ownership and operation of an aircraft is transferred from one company to a legal affiliate, but there are no other changes occurring.
2. A new proposed RVSM operator will be using an existing RVSM-Compliant Aircraft and/or previously accepted RVSM-Knowledgeable Pilots requirements. Examples of this type of situation may include:
   a. An operator takes delivery of a newly manufactured aircraft that is type-certified as RVSM-compliant.
   b. An Approved RVSM Aircraft is being operated under an RVSM authorization issued to a Title 14 of the Code of Federal Regulations (14 CFR) part 135 air carrier, and the underlying owner or a separate lessee will occasionally use that specific aircraft and/or the same RVSM-Knowledgeable Pilots requirements.
   c. A group of underlying owners or lessees use an RVSM-Compliant Aircraft, each maintaining their own operational control of that aircraft pursuant to a dry lease and/or the same RVSM-Knowledgeable Pilots requirements.
3. An existing or newly proposed Approved RVSM operator seeks an RVSM authorization and will be utilizing one or more existing Approved RVSM Authorization Elements.
   a. An example may be where an existing RVSM operator seeks to add a new proposed RVSM-Compliant Aircraft to an existing RVSM authorization where that operator will continue to use previously accepted RVSM-Knowledgeable Pilots requirements.

II.	**B. Applicable Steps and Information Required From RVSM Authorization Applicant**
	1. Make a positive determination that the existing or newly proposed RVSM operator is seeking an RVSM authorization that will utilize at least one previously Approved RVSM Authorization Element (i.e., an existing RVSM-Compliant Aircraft and/or RVSM-Knowledgeable Pilots requirements). 2. Submit a written request to the appropriate Flight Standards office that: a. Provides complete documentation of an RVSM compliance program, including written information evidencing that the specific aircraft meets the requirements of an RVSM-Compliant Aircraft; b. Further specifically states that previously accepted RVSM-Knowledgeable Pilots requirements will be used with respect to the operation of the proposed Approved RVSM Aircraft in RVSM airspace, as applicable; c. Provides such additional information as necessary to evidence compliance with new or different RVSM-Knowledgeable Pilots requirements (or to be able to gain such approvals); and d. Asks for the issuance of an RVSM authorization that applies to the operation of the aircraft by that proposed RVSM operator. 3. Provide such further information requested by the FAA to efficiently process the request.
II.	**C. Applicable Procedures to Be Followed by the Appropriate Flight Standards Office**
	1. Review the request and supporting documentation received from the RVSM authorization applicant to determine if it appears that the requested RVSM authorization is warranted. 2. To the extent the RVSM applicant has provided written documentation evidencing that the operator will be using a previously accepted RVSM Authorization Element, and accept that RVSM Authorization Element as a valid basis for the issuance of the new RVSM authorization, and to the extent the applicant has presented a proposed RVSM Authorization Element that has not been previously reviewed and accepted, conduct such additional review and research with respect to that RVSM Authorization Element only as is required to issue the new RVSM authorization. 3. If an RVSM applicant has made a written affirmation that one or more of the underlying previously accepted RVSM Authorization Elements have not changed or will not change, there is no other information provided to the FAA raising any questions or concerns with respect to the ongoing validity or applicability of those RVSM Authorization Elements, and the applicant has otherwise presented sufficient evidence of compliance with the requirements of the remaining RVSM Authorization Elements, then, subject to paragraph 5.3.4, the appropriate Flight Standards office should issue the requested amendment without further inspections being required.

AUTHORIZATION GROUP III:

RVSM AUTHORIZATION NOT BASED ON ONE OR MORE EXISTING RVSM AUTHORIZATION ELEMENTS

In the event a proposed new or existing approved RVSM operator seeks the issuance of an RVSM authorization that will not be based on any existing RVSM Authorization Element, then neither Authorization Group I nor II above will apply. The proposed approved RVSM operator should submit sufficient evidence to show his or her ability to comply with each of the RVSM Authorization Elements, and the appropriate Flight Standards office should process the request as a new and unique request by reviewing all of the materials provided by the applicant to ensure that each of the RVSM Authorization Elements have been met.

Advisory Circular Feedback Form

If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by contacting the Flight Technologies and Procedures Division at 9-AWA-AFS400-Coord@faa.gov or the Flight Standards Directives Management Officer at 9-AWA-AFB-120-Directives@faa.gov.

Subject: AC 91-85B, Authorization of Aircraft and Operators for Flight in Reduced Vertical Separation Minimum (RVSM) Airspace

Date: _____

Please check all appropriate line items:

☐ An error (procedural or typographical) has been noted in paragraph _____ on page _____.

☐ Recommend paragraph _____ on page _____ be changed as follows:

_____

_____

☐ In a future change to this AC, please cover the following subject:
(Briefly describe what you want added.)

_____

_____

☐ Other comments:

_____

_____

☐ I would like to discuss the above. Please contact me.

Submitted by: _____ Date: _____