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: 7/21/16 **AC No:** 91-85A
Initiated by: AFS-400 **Change:**

This advisory circular (AC) applies to all Operators conducting Reduced Vertical Separation Minimum (RVSM) operations. The AC can be used to obtain an initial operational authorization, or amend an existing, operational authorization. The AC appendices include supportive information relating to RVSM airworthiness certifications, training programs, operating practices and procedures, RVSM operations in oceanic and remote continental airspace, and review of height-keeping parameters.

This AC describes acceptable means, but not the only means, for an Operator to obtain authorization to conduct flight in airspace or on routes where RVSM is applied. The advisory material contained in this AC has been substantially modified since the AC was issued in its original form in 2009.

ORIGINAL SIGNED by

/s/ John Barbagallo
Deputy Director, Flight Standards Service

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CHAPTER 1. INTRODUCTION

1.1 What is the Purpose of This Advisory Circular (AC)? This AC is not mandatory and does not constitute a regulation. This AC describes an acceptable means, but not the only means, for an Operator to obtain an initial operational authorization, or amend an existing operational authorization to conduct flight in airspace or on routes where Reduced Vertical Separation Minimum (RVSM) is applied. Additionally, this AC provides information on RVSM performance specifications, obtaining and maintaining RVSM airworthiness certification for aircraft, specific elements of an RVSM authorization, and policy and procedures for 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 ft (300 m).

1.2 Who Does This AC Apply To? This AC applies to operators who want to apply for authorization to conduct operations in RVSM airspace.

1.3 What Does This AC Cancel? This AC cancels AC 91-85, Authorization of Aircraft and Operators for Flight in Reduced Vertical Separation Minimum Airspace, dated August 21, 2009, which provided guidance on aircraft and Operator approval for operating in RVSM airspace.

1.4 What Regulations Apply to RVSM Operations? Title 14 of the Code of Federal Regulations (14 CFR):

- Part 43;
- Part 91, §§ 91.180, 91.411, 91.413, 91.705, 91.706, and Appendix G;
- Part 121;
- Part 125;
- Part 129;
- Part 135; and
- Part 145.

1.5 What Other Reading Material is Helpful to an Applicant?

- Federal Aviation Administration (FAA) Aeronautical Information Manual (AIM).
- FAA Order 8900.1, Flight Standards Information Management System (FSIMS) (http://fsims.faa.gov).
- FAA Documentation Web site: http://www.faa.gov/air_traffic/separation_standards/rvsm/documentation/.
- International Civil Aviation Organization (ICAO) Document 4444, Procedures for Air Navigation Services, Air Traffic Management.

- ICAO Annex 6, Operation of Aircraft, Part I—International Commercial Air Transport—Aeroplanes and Part II—International General Aviation—Aeroplanes.
- ICAO Document 7030, Regional Supplementary Procedures.
- ICAO Document 9574, Manual on Implementation of a 300 m (1000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive.

1.6 What Do Some of the Capitalized Terms Used in This AC Mean? For the purposes of efficiency and consistency, when the various capitalized terms below are used in this AC, then they have the following meanings. Or you can find their meanings in the paragraphs specifically mentioned in the definition.

- **Operator.** The person who should be the RVSM authorization applicant and holder. See paragraph 3.4 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.
- **RVSM-Authorization Element(s).** Individually or together, RVSM-Compliant Aircraft or RVSM-Knowledgeable Pilots. (See paragraph 2.3.)
- **RVSM-Compliant Aircraft.** An aircraft the FAA has found to comply with the requirements of part 91 appendix G, section 2, for the purposes of conducting RVSM operations. (See paragraph 3.2.)
- **RVSM-Knowledgeable Pilots.** Pilots who have been trained according to RVSM operating policies and/or procedures for pilots (and, if applicable, dispatchers) the FAA has found are sufficient to ensure each pilot has adequate knowledge of RVSM requirements, policies, and procedures. (See paragraph 3.3.)
- **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 the FAA may contact to gather such information when such a need arises. (See paragraph 3.5.)
- **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 3.5.)

CHAPTER 2. AUTHORIZATION OVERVIEW

2.1 Why are RVSM Authorizations Required, and How has the Authorization Process Changed Since RVSM Authorizations were Initially Implemented on a World-Wide Basis?

2.1.1 Special Navigation Area of Operation. RVSM airspace is designated a special navigation area of operation. Both the individual Operator and the specific aircraft type or types the Operator intends to use must be authorized by the appropriate FAA offices before the Operator conducts flight operations in RVSM airspace.

2.1.2 RVSM Implementation. The FAA implemented RVSM in all of the airspace in the lower 48 states, Alaska, the San Juan flight information region (FIR), Gulf of Mexico, and Atlantic High Offshore Airspace on January 20, 2005. To safely operate in RVSM airspace, all aircraft needed to be configured and inspected to ensure the applicable RVSM performance requirements were complied with.

2.1.3 Reason for Change. Because the RVSM requirements were new to most Operators when they were first put into place, those aircraft and Operators had to be reviewed by the FAA as a first instance in order to ensure the basic requirements were being met. Since domestic RVSM implementation occurred in 2005, most existing aircraft have since been configured for compliance or have been newly manufactured in compliance with these requirements and have been reviewed at least once by the FAA. Also, most Operators have now developed pilot knowledge and/or training programs previously reviewed at least once by the FAA. Therefore, the initial "one-size-fits-all" authorization approach initially adopted in 2005, which assumed all Operators, aircraft, and pilot training programs had never been reviewed before, is no longer warranted with respect to the processing of new or amended RVSM authorizations.

2.1.4 FAA Order 8900.1 Guidance. In recognition of these changes, the FAA amended those portions of Order 8900.1, Flight Standards Information Management System (FSIMS), addressing the issuance of RVSM authorizations on January 24, 2014, in order to create guidelines improving efficiency in the authorization process. Based on the changes highlighted above, there is recognition of two key elements for a RVSM authorization. The two key elements are an RVSM-Compliant Aircraft and properly trained pilots who have met applicable RVSM-Knowledgeable Pilots requirements. The guidance was created along with a "decision matrix" (see paragraph 2.4) to allow the FAA to more efficiently direct attention to only the RVSM Authorization Elements requiring initial review. The guidance allows the reviewing safety inspector to accept previously reviewed RVSM Authorization Elements without further examination, so long as the appropriate information has been provided to the FAA as part of the application process.

2.1.5 AC Not Regulatory. The material contained in this AC is not regulatory. It provides several methods for an Operator to successfully apply to the FAA for an RVSM authorization with the goal of expediting the review and approval process.

2.2 What are the Basic Technical Requirements Associated with Obtaining an Appropriate RVSM Authorization?

2.2.1 Altimetry System Error (ASE). RVSM compliance proceeds on the basis of FAA certification of the altimetry system design and implementation, which is typically conveyed through type certification (TC) or Supplemental Type Certification (STC). It is generally acknowledged that one aspect of the design is an instrumentation system error budget allowing for a difference between the static pressure sensed and the actual altitude flown. This difference is not seen on the displayed altitude in the flight deck and it is not in the Mode C or Mode S reply from the aircraft transponder. Therefore, it is invisible to the pilot, to air traffic control (ATC), and to the Traffic Alert and Collision Avoidance System (TCAS).

2.2.2 Height Monitoring. Aircraft instructions for continued airworthiness (ICA) are designed to keep the altimetry system error (ASE) to within the limits of the error budget throughout the flight envelope. These limits vary between aircraft types and within a type, from airframe to airframe. Regardless, even with attention to continuing airworthiness, there are factors that can affect the ASE significantly and can go undetected in routine operations. Thus, through continuous sampling, the FAA independently monitors altimetry system performance of airframes in the population of aircraft participating in RVSM operations. This sampling is accomplished through operational monitoring flights using either special equipment brought on board the aircraft or through separate ground-based height monitoring systems. See paragraph 3.6.4.

2.2.3 RVSM Performance. Appendix A gives details regarding the ASE performance demands for safely operating in RVSM airspace.

2.3 What are the RVSM Authorization Elements? The definition and use of the two RVSM Authorization Elements—RVSM-Compliant Aircraft and RVSM-Knowledgeable Pilots—arose from recognizing these are the two basic building blocks needed to meet the technical requirements in order to safely conduct operations in RVSM airspace. These elements provide the basis for developing the RVSM Matrix (see paragraph 2.4). Once the FAA has found an aircraft to be RVSM-compliant, if it is properly maintained and monitoring shows that its performance has not degraded over time, the aircraft remains RVSM-compliant. Under these conditions, it is inefficient for the FAA to have to review the status of that aircraft again (as if it had never been compliant) when a subsequent Operator requires his/her/its own authorization to operate that aircraft in RVSM airspace. By specifically defining these two elements and putting certain safeguards into place (such as compliance statements by subsequent Operators), the FAA could then create the RVSM Authorization Matrix in order to streamline the process of reviewing and issuing new RVSM.

2.4 What is the RVSM 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 Elements

approval action the applicant is seeking. The full Matrix is provided in Chapter 4, but the following is a summary of how the Matrix works.

2.4.1 When Does Authorization Group I Apply? Authorization Group I applies to applicants seeking an administrative change only to an existing authorization. The following changes are considered to be administrative in nature only when all other existing 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.

2.4.2 When Does Authorization Group II Apply? 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 Contact Person 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 new proposed approved RVSM Operator seeks an RVSM authorization and will be utilizing one or more existing approved RVSM Authorization Elements.

2.4.3 When Does Authorization Group III Apply? 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.

2.4.4 What Additional Issues Should an Applicant be Aware of When Using the Matrix? The FAA has created inspector guidance in order 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 Flight Standards District Office (FSDO), certificate-holding district office (CHDO), International Field Office (IFO), 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 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.

2.5 What is a Summary of the Process Needed to Obtain a New RVSM Authorization? Chapters 3, 4, and 5 of this AC describe the RVSM authorization process in detail, but a summary of this process is as follows:

1. The applicant identifies the appropriate FAA office to apply to. (See paragraph 4.1.2.)
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 4.2.1.)
3. If only an amendment to an existing RVSM authorization is required, then the applicant will follow the procedures described in paragraph 4.2.1 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. (See paragraph 3.4.)
5. Once the appropriate Operator is determined, the applicant will determine if it will be utilizing any existing RVSM Authorization Elements, and if so, will then follow the process described in paragraph 4.2.2 with respect to Authorization Group II in the Matrix.
6. If the applicant determines they are unable to use any existing RVSM Authorization Elements, then the applicant will follow the process described in paragraph 4.2.4 with respect to Authorization Group III in the Matrix.

CHAPTER 3. RVSM AUTHORIZATION ELEMENTS

3.1 What is the Background Behind Using the RVSM Authorization Elements to Apply for an RVSM Authorization? The RVSM authorization process recognizes two key elements of any RVSM authorization—an RVSM-Compliant Aircraft and properly trained pilots who have met applicable RVSM-Knowledgeable Pilots requirements. An Operator must demonstrate to the FAA both of these elements exist to be authorized to operate in RVSM airspace. All of these RVSM Authorization Elements are described in this chapter.

3.2 What Do I Need to Know About RVSM-Compliant Aircraft?

3.2.1 What is an RVSM-Compliant Aircraft? An aircraft is an "RVSM-Compliant Aircraft" when (1) the FAA has determined the aircraft design satisfies RVSM performance requirements and (2) the aircraft has been properly maintained on an on-going basis to conduct such operations. An aircraft will satisfy RVSM performance requirements if it complies with part 91 appendix G, section 2. (See paragraph 3.2.2 below for more detail concerning meeting these performance requirements.) Aircraft may be produced RVSM-compliant or brought into compliance through the application of appropriate Service Bulletins (SB), Service Letters (SL), Engineering Change Orders (ECO), or STCs.

3.2.1.1 If the aircraft was manufactured RVSM-compliant, the date of the Airworthiness Certificate is usually the compliancy date. (For additional information see the Airplane Flight Manual (AFM), AFM Supplement (AFMS), and/or Type Certificate Data Sheet (TCDS).

3.2.1.2 If the aircraft was made RVSM-compliant through a 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.

3.2.2 How Does an Aircraft Achieve the Designation of Being an RVSM-Compliant Aircraft? Each aircraft type an Operator intends to use in RVSM airspace should have received FAA RVSM airworthiness approval in accordance with part 91 appendix G, section 2, before the operational authorization will be granted. Obtaining RVSM airworthiness approval is a two-step process. First, the manufacturer or design organization develops a data package through which to seek RVSM airworthiness approval and submits the package to the appropriate FAA Aircraft Certification Office (ACO) for approval. Once the ACO approves the data package, the Operator applies the procedures defined in the package to obtain approval from the FSDO/CHDO/certificate management office (CMO)/IFO (as appropriate) to use its aircraft to conduct flight in RVSM airspace. The initial airworthiness review process must consider continued airworthiness requirements, as described in Appendix A of this document. For more detail on RVSM aircraft airworthiness approvals see Appendix A.

3.2.3 How Does an Aircraft Retain the Designation of Being an RVSM-Complaint Aircraft? An aircraft once designated RVSM-compliant should retain that designation as long as properly configured and the maintenance procedures listed in the ICA are complied with. Subsequent modifications to the aircraft must be evaluated and determined to have no negative impact on RVSM design or performance.

3.3 What Do I Need to Know About RVSM-Knowledgeable Pilots?

3.3.1 Who are 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."

3.3.1.1 For an applicant operating only under part 91 or part 125 (including A125 Letter of Deviation Authority (LODA) holders), demonstrating it has RVSM-Knowledgeable Pilots will consist of providing sufficient evidence each pilot has an adequate knowledge of RVSM requirements, policies, and procedures as required in part 91 appendix G, section 3(c)(2).

- The following are acceptable means for the Operator to show the FAA its pilots have adequate knowledge of the RVSM operating practices and procedures: 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.

3.3.1.2 For an applicant who operates under part 91 subpart K (part 91K), 121, or 135, in addition to meeting the adequate 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) in order to demonstrate they are using RVSM-Knowledgeable Pilots. Therefore, part 91K, 121, and 135 Operators should submit training syllabi and other appropriate material to the FAA showing operating practices and procedures and training items related to RVSM operations are incorporated in initial and, where warranted, recurrent training programs. (Training for dispatchers should be included, where appropriate.)

3.3.2 What Additional Operational Policy and Procedure Components Should be Considered with Respect to RVSM-Knowledgeable Pilots?

3.3.2.1 Applicants should consider standardizing practices and procedures in the following areas using the guidelines in Appendix B: flight planning, preflight procedures at the aircraft for each flight, procedures prior to RVSM airspace entry, in-flight procedures, and flightcrew training procedures. Paragraph B.7 contains special emphasis items for flightcrew training. Also, pilots and dispatchers (where applicable) should be knowledgeable on contingency and other procedures unique to an operator's specific areas of operation. Also, Appendix C contains guidance on operations in oceanic and remote continental airspace.

3.3.2.2 Aircraft approved for RVSM can be used in RVSM operations worldwide. This includes RVSM operation in continental areas such as Europe and the United States. Aircraft equipage and altitude-keeping performance requirements were developed using the highest density traffic counts in the world so aircraft could receive one-time approval for worldwide operations. Operators starting RVSM operations in an RVSM area of operation new to them should ensure their RVSM programs incorporate any operations or continued airworthiness requirements unique to the new area of operations.

3.4 Who is the Proper Party to be the Applicant for, and the Operator Under, an RVSM Authorization?

3.4.1 Who is the Correct Person to Apply for and Have Issued 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 FSDO or a 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:

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, in which event the authorization will be issued in the form of an appropriate operations specification (OpSpec) or management specification (MSpec).
2. For non-commercial 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, in which event the authorization will be issued in the form of an appropriate letter of authorization (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.

3. It is both possible and common to have multiple Operators for part 91, 91K, and/or 125/135 aircraft over a short period of time and on a non-exclusive basis (for example, 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.

3.5 Who is a "Responsible Person," and What Duties Does this Person Fulfill, Under an RVSM Authorization?

3.5.1 Who is a Responsible Person and How Does this Relate to RVSM Authorizations?
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:

3.5.1.1 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 who that individual person or entity has contracted with in order to act on behalf of the individual person or legal entity with respect to the RVSM authorization.

3.5.1.2 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 the FAA may contact to gather such information when such a need arises.

3.5.1.3 The Operator may use one individual to fulfill both roles as described in paragraphs 3.5.1.1 and 3.5.1.2, or the Operator may elect to designate separate persons to fulfill these roles.

3.5.1.4 Whoever the Operator designates to fulfill the role described in paragraph 3.5.1.1 will be designated as the "Responsible Person," and that Responsible Person will sign LOAs, as appropriate.

3.5.1.5 If the Operator chooses to use separate individuals, then the person fulfilling the role described in paragraph 3.5.1.2 will be designated as the "RVSM-POC." In such 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.

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

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

Note: See LOA template B046 for further details regarding Responsible Persons.

3.6 What Other Issues Should be Addressed by Applicants with Respect to Requests for RVSM Authorizations?

3.6.1 RVSM Configuration List. The applicant should provide a configuration list, for the applicable aircraft, which details components and equipment relevant to RVSM operations. (See Appendix A for a discussion of equipment for RVSM operations.)

3.6.2 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.

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

3.6.4 RVSM Height Monitoring. RVSM height monitoring was implemented with the establishment of RVSM airspace to ensure implementation and continued operation of RVSM meets safety objectives. Compliant height-keeping performance of airplanes is a key element in ensuring safe operations in RVSM airspace. RVSM is a "performance-

based" operation requiring ongoing, independent monitoring to ensure that the RVSM airspace airplane population adheres to stringent altimetry system requirements.

Note 1: The requirement for operational flight monitoring may not be included in the Operator's ICA.

Note 2: For a detailed discussion of RVSM height monitoring, see the RVSM Height Monitoring Guide for U.S. Operators on the FAA's RVSM Web page in the Monitoring Requirements and Procedures section.

3.6.4.1 Who must participate in RVSM height monitoring? All Operators wishing to conduct operations in RVSM-designated airspace are required to participate in RVSM height monitoring.

1. Existing rule part 91, § 91.180 requires operations within airspace designated as RVSM to "comply with the minimum standards of appendix G of this part." Part 91 appendix G, section 2(d), (e), and (f) stipulate the requirements for ASE containment.
2. Part 91 appendix G, section 3 stipulates how the Operator, in a manner prescribed by the Administrator, must provide evidence "it is capable to operate and maintain each aircraft or aircraft group for which it applies for approval to operate in RVSM airspace." Height monitoring is the method prescribed to verify ASE remains within required performance limits.

3.6.4.2 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 transfers to a new owner and may be used to meet the monitoring requirements.
3. When calculating the 1,000 hour provision of the minimum monitoring requirement, the calculation of the flight time should be from the last satisfactory height monitoring date on record.

3.6.4.3 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 Chart. The

current version of this chart can be found on the FAA's RVSM Web page in the Monitoring Requirements and Procedures section.

Note: An Operator that is unable to meet the minimum height monitoring requirements within the specified time frame should contact the responsible CHDO/CMO/FSDO/IFO prior to exceeding the specified time frame. (See paragraph 3.6.4, Note 1.)

3.6.4.4 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 Global Positioning System (GPS)-based monitoring unit (GMU) onboard 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, Airplanes Geometric Height Monitoring Elements (AGHME) (requires Mode-S equipment); or
   - Approved ground-based height measuring systems in other regions (e.g., Europe or Japan).
3. An RVSM-authorized aircraft equipped and operating with Automatic Dependent Surveillance-Broadcast (ADS-B) Out avionics meeting the performance requirements of § 91.227 at an RVSM altitude where ADS-B height monitoring is provided.

Note: The height monitoring requirements are globally harmonized and the ICAO Regional Monitoring Agency for North America is the North American Approvals Registry and Monitoring Organization (NAARMO). The NAARMO coordinates RVSM monitoring results with the more than 30 other ICAO Regional Monitoring agencies throughout the world.

3.6.4.5 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.

3. For North American Operators, the database can be accessed from the FAA RVSM Web site under the section RVSM Documentation or on the FAA's NAARMO website at: https://www.faa.gov/air_traffic/separation_standards/naarmo/rvsm_approvals/.

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

1. Number and identification (registration number/serial number) of airplanes to be monitored.
2. Expected time frame for completion of monitoring requirements.
3. Expected method for monitoring.

3.6.5 Can Non-RVSM Aircraft Be Accommodated in RVSM Airspace? Operators must be authorized and aircraft must be certified to fly in designated RVSM airspace with limited exceptions.

3.6.5.1 In Domestic U.S., Alaska Offshore Airspace, the following aircraft can be accommodated on a workload-permitted basis. The vertical separation standard applied between aircraft not approved for RVSM and all other aircraft must be 2,000 ft:

1. Department of Defense (DOD) aircraft.
2. Flights conducted for aircraft certification and development purposes.
3. Active air ambulance flights utilizing a "MEDEVAC" call sign.
4. Aircraft climbing/descending through RVSM flight levels (FL) (without intermediate level off) to/from FLs above RVSM airspace.
5. Foreign State (government) aircraft.

3.6.5.2 In addition to the accommodation categories listed in paragraph 3.6.5.1, in U.S.-controlled oceanic airspace, the following aircraft can be accommodated on a workload-permitted basis:

1. Aircraft being initially delivered to the State of Registry or Operator.
2. Aircraft that was formerly RVSM-approved but has experienced an equipment failure and is being flown to a maintenance facility for repair in order to meet RVSM requirements and/or obtain approval.
3. Aircraft being utilized for mercy or humanitarian purposes.

3.6.5.3 An aircraft or Operator not authorized for RVSM operations or an Operator/aircraft without operable RVSM equipment is referred to as non-RVSM. If either the Operator or the aircraft or both have not received RVSM authorization, the Operator or dispatcher must not file the RVSM equipment code in the flight plan. The pilot of non-RVSM aircraft must inform the controller of the lack of RVSM approval in accordance with the direction provided in the FAA Aeronautical Information Manual (AIM), paragraph 4-6-8, Pilot/Controller Phraseology.

3.6.5.4 The procedures for accommodation of non-RVSM aircraft in RVSM airspace for operations in Domestic U.S., Alaska Offshore Airspace and the San Juan Flight Information Region (FIR) are contained in the FAA Aeronautical Information Manual (AIM), Section 6, paragraph 4-6-10. For operations within oceanic airspace, see the U.S. Aeronautical Information Publication (AIP), Enroute, Section 7.

CHAPTER 4. SUBMITTING AN APPLICATION FOR RVSM AUTHORIZATION.

4.1 What is the First Step an Applicant May Consider Taking When Applying for an RVSM Authorization?

4.1.1 Should an Applicant Request a Preapplication Meeting? The regulations do not require an applicant 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.

4.1.2 Where Should an Applicant Request a Preapplication Meeting? 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 jurisdictional CHDO, CMO, or FSDO of its intent to obtain authorization for RVSM operations. (See FAA Order 8900.1, Volume 3, Chapter 2, Section 2, paragraph 3-55.)
2. In accordance with FAA Order 8900.1, Volume 3, Chapter 2, Section 2, part 91 Operators apply for an RVSM LOA to the FSDO 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 responsible IFO's geographic Area of Responsibility (AOR) on the following Web site: http://www.faa.gov/about/office_org/field_offices/ifo/. Once on the Web site, click on the service area under each IFO for additional information.

4.2 What are the Applicable Steps and Information Required to Seek an RVSM Authorization?

Prior to making a request for service, each applicant should review the information provided in Chapter 3 as well as the RVSM decision Matrix in Figure 4-1 to determine if the applicant should apply procedures for Authorization Group I, Authorization Group II, or Authorization Group III. Each of these groups is summarized in paragraph 4.2, with the RVSM-Decision Matrix (Figure 4-1) provided for detailed examples and information for the application process.

Note: The written request discussed in paragraphs 4.2.1.2, 4.2.2.2, and 4.2.3.2 is your letter to the CHDO requesting service. Using the RVSM Decision Matrix in Figure 4-1, you should 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. For part 91 LOAs, samples of the needed administrative information is located on the FAA Web site, http://www.faa.gov/air_traffic/separation_standards/rvsm/documentation. Scroll down to the "Getting Started" section and locate the appropriate document titled Information Sheet for Part 91 RVSM Letter of Authorization (LOA). Use of the information sheet will help you organize required information needed for authorization. Providing sufficient information to the CHDO can assist in

streamlining the application process and help prevent processing delays while the inspector waits for the needed information to be submitted.

4.2.1 What are the General Steps an Applicant will take when its Application Falls Within RVSM Authorization Group I, RVSM Authorization Amendments?

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

4.2.1.2 That authorization holder should then submit a written request to the responsible FSDO, CHDO, or IFO 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.

4.2.1.3 The authorization holder should also provide such further information as the FSDO, CHDO, or IFO may request in order to efficiently process the request.

4.2.2 What are the General Steps an Applicant will take when its Application Falls Within RVSM Authorization Group II, RVSM Authorization Based on One or More Existing RVSM Authorization Elements?

4.2.2.1 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.

4.2.2.2 Submit a written request to the responsible FSDO, CHDO, or IFO 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 any of the other RVSM Authorization Elements listed in Chapter 3; and

4. Asks for the issuance of an RVSM authorization applying to the operation of the aircraft by that proposed RVSM Operator.

4.2.2.3 Provide such further information as the FSDO, CHDO, or IFO may request in order to efficiently process the request.

4.2.3 What are the General Steps an Applicant will take when its Application Falls Within RVSM Authorization Group III, RVSM Authorization Not Based on One or More Existing RVSM Authorization Elements?

4.2.3.1 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.

4.2.3.2 The applicant should submit a written request to the responsible FSDO, CHDO, or IFO with sufficient evidence to show its ability to comply with each of the RVSM Authorization Elements in Chapter 3, and the FSDO, CHDO, or IFO 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.

4.2.3.3 The applicant should also provide such further information as the FSDO, CHDO, or IFO may request in order to efficiently process the request**.**

4.2.4 The RVSM Matrix. A detailed description of Figure 4-1 is provided in paragraph 2.4.

Figure 4-1. 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.

RVSM DECISION MATRIX	
	4. Removal of an RVSM-Compliant Aircraft from an existing RVSM authorization having 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 none of the previously accepted RVSM Authorization Elements are changing. 2. That authorization holder should then submit a written request to the responsible FSDO, CHDO, or IFO that: a. States which of the applicable administrative changes are occurring; b. 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 c. Requests the issuance of an amendment to the existing RVSM authorization acknowledging the administrative changes being made. 3. If the nature of the requested amendment is to change the primary business address from one FSDO, CHDO, or IFO service area to another, it must notify, in writing, the losing (previously responsible) FSDO, CHDO, or IFO of the new physical location and mailing address within 30 calendar-days following relocation. The losing FSDO, CHDO, or IFO will then request the WebOPSS Help Desk move the Operator's database to the responsible receiving FSDO, CHDO, or IFO. The losing FSDO, CHDO, or IFO will also notify the receiving FSDO, CHDO, or IFO of the change. The receiving FSDO, CHDO, or IFO will then update and reissue the Operator's A001 template to reflect the new address, and the receiving FSDO, CHDO, or IFO becomes the responsible FSDO, CHDO, or IFO for processing new LOAs for that Operator. 4. The authorization holder should also provide such further information as the FSDO, CHDO, or IFO may request in order to efficiently process the request.
I.	**C. Applicable Procedures the Responsible FSDO, CHDO, or IFO Will Follow Upon a Request for an Administrative Change to an Existing RVSM Authorization**
	1. Review the request and supporting documentation received from the RVSM authorization holder to determine if it appears an amended RVSM authorization amendment is warranted. 2. Re-issue the amended RVSM authorization identical to the initial RVSM authorization in all respects other than reflecting the new amended information; and 3. If the nature of the requested amendment is to change the primary business address from one FSDO service area to another, see the additional applicable guidance in FAA Order 8900.1, Volume 3, Chapter 2, Section 2, Responsibility of Part 91 Letters of Authorization (LOA). 4. If an existing RVSM authorization holder has made a written affirmation none of the underlying previously accepted RVSM Authorization Elements has changed or will change, and there is no other information provided to the FSDO raising any questions or concerns with respect to the on-going validity or applicability of those RVSM Authorization Elements, then, subject to paragraph 2.4.4, the FSDO, CHDO, or IFO should issue the requested amendment without further inspections being required.

RVSM DECISION MATRIX	
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 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.	
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 Contact Person 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, for example, 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, together with a previously accepted RVSM-Knowledgeable Pilots requirements. Examples of this type of situation may include: a. An Operator takes delivery of a newly-manufactured aircraft type certified as RVSM-compliant. b. An approved RVSM aircraft is being operated under an RVSM authorization issued to a part 135 air carrier, and the underlying owner or a separate lessee will occasionally use that specific aircraft while it is maintained under part 135 air carrier's Maintenance Program 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, while also utilizing the same previously accepted RVSM-Knowledgeable Pilots requirements. 3. An existing or new 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 new proposed RVSM Operator is seeking an RVSM authorization utilizing at least one previous RVSM Authorization Element (i.e., an existing RVSM-Compliant Aircraft and/or RVSM-Knowledgeable Pilots requirements). 2. Submit a written request to the responsible FSDO, CHDO, or IFO that: a. Provides complete documentation of an RVSM compliance program, including written information evidencing the specific aircraft meets the requirements of an RVSM-Compliant Aircraft;

RVSM DECISION MATRIX	
	b. 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; 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 applying to the operation of the aircraft by that proposed RVSM Operator. 3. Provide such further information as the FSDO, CHDO, or IFO may request in order to efficiently process the request.
II.	**C. Applicable Procedures to be Followed by the Responsible FSDO, CHDO, or IFO**
	1. Review the request and supporting documentation received from the RVSM authorization applicant to determine if it appears the requested RVSM authorization is warranted. 2. To the extent the RVSM applicant has provided written documentation evidencing 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 not 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 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 FSDO, CHDO, or IFO raising any questions or concerns with respect to the on-going 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 2.4.4, the FSDO, CHDO, or IFO 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 not based on any existing RVSM Authorization Element, then neither Authorization Group I nor II above will apply, the applicant should submit sufficient evidence to show its ability to comply with each of the RVSM Authorization Elements, and the FSDO, CHDO, or IFO 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.

CHAPTER 5. FAA REVIEW AND EVALUATION OF RVSM APPLICATIONS.

5.1 What is the General Process the FAA will Follow Upon Submission of the Request for an RVSM Authorization or Amended Authorization? Once application is made, the FAA will begin the process of review and evaluation of the documentation submitted. When the FAA determines the airworthiness and operational requirements of the application are met, the FAA will proceed with issuing the authorization.

5.2 What are the Applicable Forms of the RVSM Authorization Documents?

5.2.1 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 paragraph from Part B (En Route Authorizations, Limitations, and Procedures) and Part D (Aircraft Authorization). 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 OpSpecs paragraph number to the appropriate area of operations in the Part B paragraph: Authorized Areas of En Route Operation Limitations and Procedures.

5.2.2 Part 129 Operators. The operational authorization of RVSM for part 129 is provided by the State of the Operator. OpSpec A003 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.

5.2.2.1 The current edition of this advisory circular (AC) (91 85, Authorization of Aircraft and Operators for Flight in Reduces Vertical Separation Minimum Airspace); and Joint Aviation Authority (JAA) Temporary Guidance TGL-6.

Note: For part 129 Operators, inspector guidance for paragraph A003 is contained in FAA Order 8900.1, Volume 12, Chapter 2, Section 3.

5.2.3 Part 91K Operators. Part 91K Operators' authorization to operate in RVSM airspace should be granted through the issuance of an MSpecs paragraph from Part B and Part D. Each aircraft for which the Operator is granted authority should be listed in MSpecs. Authorization to conduct RVSM operations in an RVSM area of operations new to the Operator should be granted by adding the Part B RVSM MSpecs paragraph number to the appropriate area of operations in the Part B paragraph.

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

Note: LODA is a formal authorization issued by the FAA CHDO, authorizing a deviation from specified sections of part 125 and identified in WebOPSS (125M database) as an A125 LODA operator.

5.2.5 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 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 a LOA to operate in RVSM airspace.

5.3 What are the Conditions That Would Require the Removal of an RVSM 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.

5.3.1 Height-Keeping Errors. The incidence of height-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 follow-up reports. Errors which should be reported and investigated are: Total Vertical Error (TVE) equal to or greater than ±300 ft (±90 m), ASE equal to or greater than ±245 ft (±75 m), and assigned altitude deviation (AAD) equal to or greater than ±300 ft (±90 m).

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

5.3.3 Effective, Timely Response. The operator should make an effective, timely response to each height-keeping error. The FAA may consider removing RVSM operational authorization if the operator response to a height-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.

5.3.4 Review Relevant OpSpec/MSpec/LOA Paragraphs. Operators may also consider reviewing all relevant paragraphs of their respective OpSpec, MSpec, or LOA (e.g., A001) for other reasons which may affect RVSM authorizations.

5.4 What Happens if I Change RVSM Equipment After Operational Authorization has been Granted? Any change to an RVSM Critical Component or RVSM System as defined in the initial application must be reported to the responsible office for evaluation. The responsible office will determine if the aircraft is RVSM compliant.

APPENDIX A. RVSM AIRWORTHINESS CERTIFICATION

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A.1 Introduction.

A.1.1 General. This Appendix provides guidance on the aircraft airworthiness certification process for Reduced Vertical Separation Minimum (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 Field Office serving your geographic area for guidance. Contact information for Aircraft Certification Offices (ACO) can be found on the FAA Web site at www.faa.gov.

A.1.2 Definitions.

1. Aircraft Group. A group of aircraft of nominally identical design and build with respect to all details that could influence the accuracy of height-keeping performance.
2. Air Data Sensor. Line replaceable units designed to detect air data characteristics (e.g., pressure, temperature, etc.) to support the air data system of the aircraft.
3. Air Data System. 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.
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 in. Hg/1013.25 hPa) and free stream pressure altitude.
5. Assigned Altitude Deviation (AAD). The difference between the altitude transmitted by a Mode C transponder and the assigned altitude/flight level (FL).
6. Automatic Altitude Control System. Any system designed to automatically control the aircraft to a referenced pressure altitude.
7. 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.
8. Basic RVSM Envelope. The range of Mach numbers and gross weights within the altitude ranges FL 290 to FL 410 (or max available altitude) where an aircraft is expected to operate most frequently.

9. 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 wing span, but share the same altimetry system architecture. In addition, derivative aircraft share the same SSEC at RVSM flight levels. 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.
10. Full RVSM Envelope. The entire range of operational Mach numbers, W/δ, and altitude values over which the aircraft is operated within RVSM airspace.
11. Height-Keeping Capability. Aircraft height-keeping performance expected under nominal environmental operating conditions with proper aircraft operating practices and maintenance.
12. Height-Keeping Performance. The observed performance of an aircraft with respect to adherence to a flight level.
13. Instruction 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. Residual Static Source Error (SSE). The amount by which SSE remains undercorrected or overcorrected after application of an SSEC.
16. Reduced Vertical Separation Minimum (RVSM). Designated airspace, typically between FL 290 and FL 410, where 1000’ vertical separation between aircraft is applied. This airspace is considered special qualification airspace.
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.

A.1.3.1 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.1.3.2 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 vs. Mach would be required for each aircraft gross weight. Aircraft performance engineers commonly use the following technique to solve this problem.

A.1.3.3 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.1.3.4 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.1.3.5 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 number, W/δ, and altitude values over which the aircraft can operate within RVSM airspace. Table A.2-1 establishes the parameters to consider.

Table A.2-1. Full RVSM Envelope Boundaries

	Lower Boundary is defined by:	**Upper Boundary is defined by:**
Altitude	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 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 Mach number plus .04 Mach unless limited by available cruise thrust, buffet, or other aircraft flight limitations.

A.2.3.2 Long Range Cruise 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 height-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 (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 avionic 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 A5.2.1 and A5.2.2, or A5.3.2, 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 A.5.3.2, as appropriate.

A.4.1.1.6 Static Source Error Correction (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 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 A.5.3.2, as appropriate.

A.4.1.1.7 Output to the Automatic Altitude Control and Altitude Alert Systems. The altimetry 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 Appendix A. The output may be used either directly or combined with other sensor signals. If SSEC is necessary in order to satisfy the requirements of paragraphs A.5.2.1 and A.5.2.2, or 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 1×10^{-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 Air Data Systems and Configurations with Multiple Static Source Inputs. Many aircraft are produced with air data systems 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 air data systems meet the requirements of paragraphs A4.1.1.1 through A4.1.1.8. Upon failure of one air data system, a second system must remain fully functional in compliance with the requirements of paragraphs A4.1.1.1 through A4.1.1.8.

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( ) or TSO C112( ), 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 line replaceable units (LRU), or it may be an integral part of a flight management system or flight management computer.

1. 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.

   - For aircraft for which application for type certification 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).
   - For aircraft for which application for type certification 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 6 presents additional options for automatic altitude control configurations found on older, "legacy" aircraft.

A.4.1.4.1 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.

- Aircraft types for which application for type certification is on or before April 9, 1997, which are equipped with an automatic altitude control system with flight management system(FMS)/performance management system inputs allowing variations up to ±130 ft (±40 m) under nonturbulent, nongust conditions do not require retrofit or design alteration.
- 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.

A.4.1.4.2 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 ICAO Doc. 9574, Manual on the Implementation of a 300 m (1,000 ft) Vertical Separation Minimum Between FL 290-FL 410 Inclusive, for a population of aircraft (see Appendix D) 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 ASEmean 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 ASEmean plus 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 ASEmean 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 ASEmean 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 ASEmean exceeds 120 ft (37 m) and/or the absolute value of ASEmean 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 type certification 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 part 21, § 21.21b(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 of this Appendix, is as follows:

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

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

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

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

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 Appendix A, sections A.5.2 and A.5.3 should not be confused with the ASE values stated in the height keeping section 5.3. Appendix A sections A.5.2 and A.5.3 represent the ASE performance specification for RVSM airframe airworthiness certification, and is a key element of the RVSM airplane airworthiness certification process. Section 5.3 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 jet, and turboprop aircraft, etc.) for which RVSM approval is sought.

A.6.2 Single Autopilot Installation. Paragraph A.4.1.1.7 states the air data system 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:

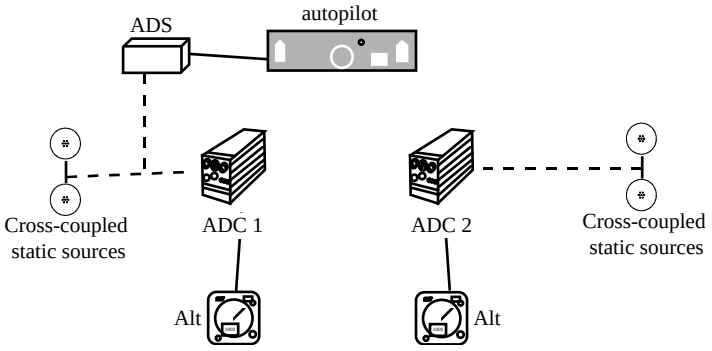
1. The retrofit costs are a significant percentage of the total worth of the airframe.
2. The retrofit is not possible without replacement of the autopilot.
3. The retrofit increases air data system complexity, which in turn increases the scenarios and rates of failure.
4. Upgraded avionics (i.e., ADCs) 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.6-1, Example of Air Data System/Autopilot Configuration.
2. Figure A.6-2, Single Air Data Computer Configuration for Autopilot Input.

A.6.2.4 Independent Source for Altitude Hold Input to the autopilot.

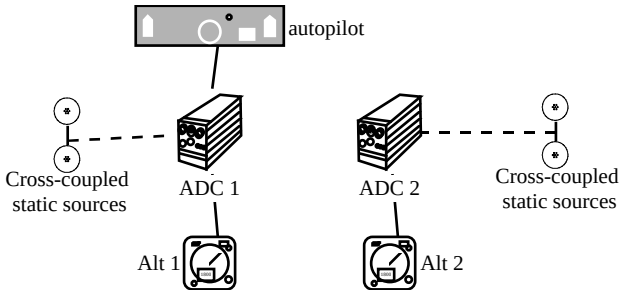
Figure A.6-1. Example of Air Data System/Autopilot Configuration



1. The air data sensor (ADS) 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 component comprising the air data system. The ADS 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).
2. Airplanes equipped with the avionics configuration shown in Figure A.6-1 may show compliance as follows:
   - The airplane must maintain altitude to within ±65 ft of the acquired altitude as required by paragraph A.4.1.4.1. 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.
   - The altitude alerter should function if the ADS/ADC fails. If the altitude alert function is not operational, altitude hold performance must be monitored manually.
   - The ADS 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.
   - The altimetry systems meet the RVSM accuracy requirements specified in paragraphs A.5.2.1 and A.5.2.2, or A.5.3.2, as appropriate.
   - All other requirements set forth in this advisory circular (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 (Figure A.6-2). In most models, a second ADC is also present, or provisions exist so a second can be installed.

Figure A.6-2. Single Air Data Computer Configuration for Autopilot Input



1. Airplanes equipped with the avionics configuration shown in Figure A.6-2 may show compliance as follows:

   - The airplane must maintain altitude to within ±65 ft of the acquired altitude required by paragraph A.4.1.4.1. This may be substantiated with flight test data or manufacturer's specification data.
   - The altitude alerter should function if either air data system or ADC fails. If the altitude alert function is not operational, altitude hold performance must be monitored manually.
   - If ADC1 fails, the airplane must be controlled manually until 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.
   - The altimetry systems meet the RVSM accuracy requirements specified in paragraphs A.5.2.1 and A.5.2.2, or A.5.3.2, as appropriate.
   - 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.6-1 and A.6-2, 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 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 Altimetry System Error (ASE) Variability.

A.7.2.1 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 standard deviation (SD) values for ASE, expressed as ASEmean 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:

A.7.2.1.1 Unit to unit variability of avionics.

A.7.2.1.2 Effect of environmental operating conditions on avionics.

A.7.2.1.3 Effect of transducer and/or avionics component error drift over time.

A.7.2.1.4 Effect of flight operating condition on SSE.

A.7.2.1.5 Airframe to airframe variability of SSE, including the following:

- Skin waviness, skin splices/joints, access panels, 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.7.2.2 Assessment of ASE, whether based on measured or predicted data, must include the factors listed above in paragraphs A.7.2.1.1 through A.7.2.1.5. The effect of item A.7.2.1.4 as a variable can be eliminated by evaluating ASE at the most adverse flight condition in an RVSM flight envelope.

A.7.2.3 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 paragraphs 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 trade-off 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 air data system 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 Altimetry System Error (ASE) Components.

A.8.2.1 **General.** Figure A.8-1, 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 Altitude” is the pressure altitude corresponding to the undisturbed ambient pressure.

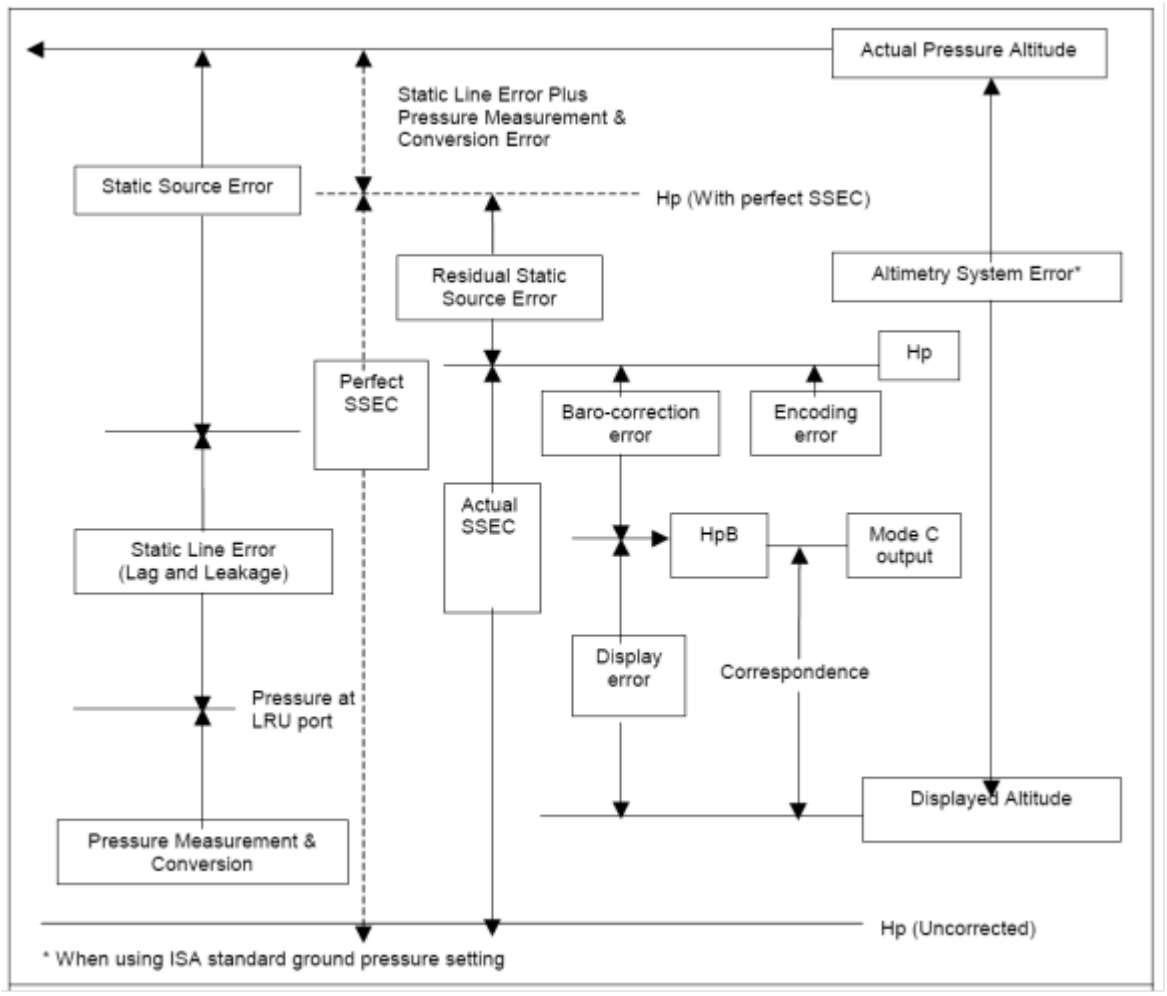
A.8.2.1.2 “SSE” is the difference between the undisturbed ambient pressure and the pressure within the static port at the input end of the static pressure line.

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 and Conversion Error” 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.8-1 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.

Figure A.8-1. Altimetry System Error and Its Components



A.8.2.1.6 "Residual SSE" 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 Between Hp and displayed altitude occur the baro-correction error and the display error. Figure A.8-1 represents their sequence for a self-sensing altimeter system. ADC systems can implement baro-correction in a number of ways that would modify slightly 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.

A.8.2.2 SSE Components. The component parts of SSE are presented in Table A.8-2, 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.8-1 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.8-2, plus the amount by which the actual SSEC differs from the value that would correct the reference value exactly, components 2a), 2b), and 2c) from Table A.8-3.

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.8-3 error component 2a) will therefore be fixed, for a particular flight condition, for the single aircraft or Group. Additional variable errors 2b) and 2c) 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.8-4, 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.8-2, and second, for its effect on the application of SSEC as in factor 2a)i) of Table A.8-3. 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 2a)ii) of Table A.8-3.

Table A.8-2. Static Source Error

(Cause: Aerodynamic Disturbance to Free-Stream Conditions)

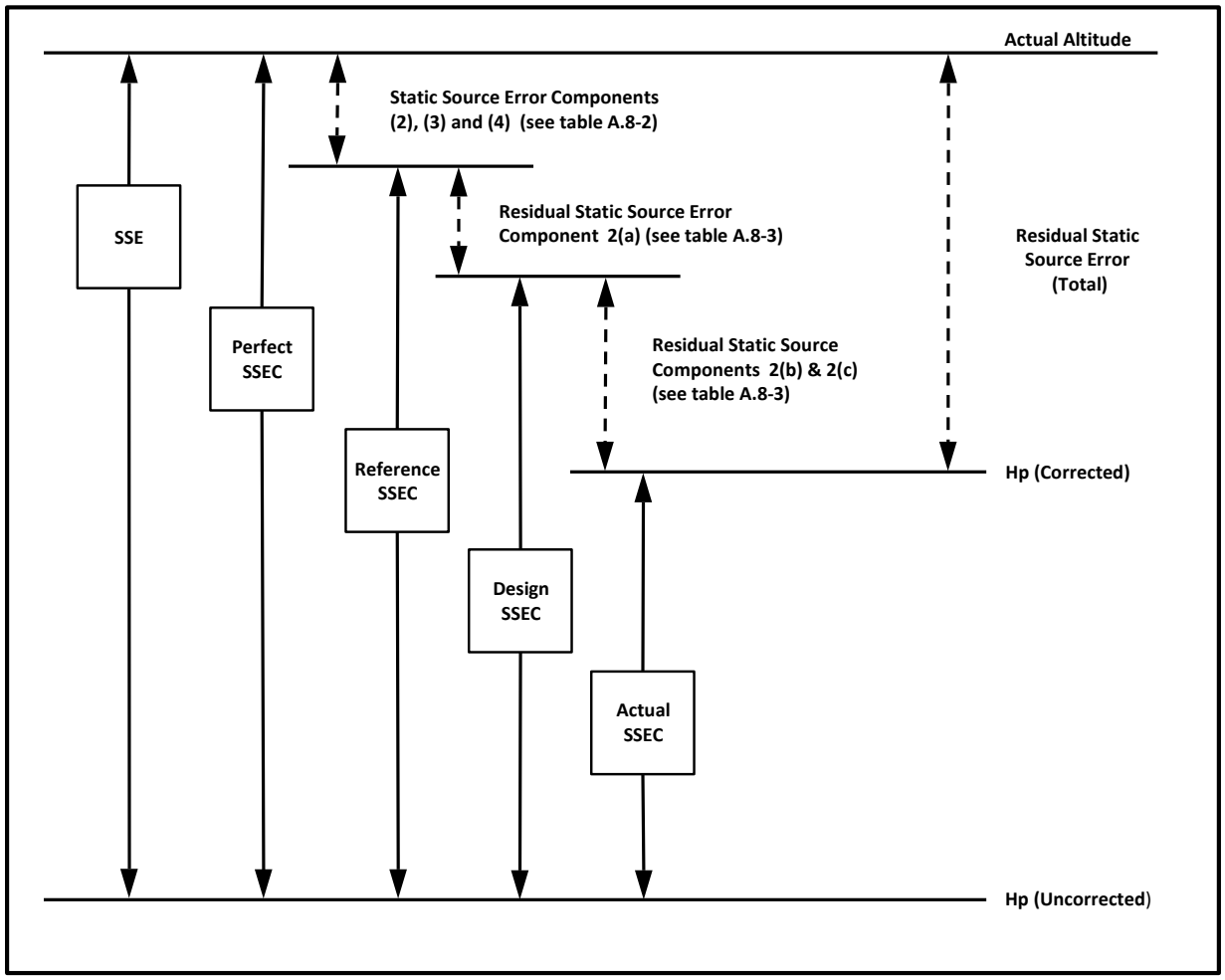
Factors	**Error Components**
Airframe Effects	
Operating Condition (M, Hp, ∝, β)* Geometry: Shape of airframe Location of static sources Variations of surface contour near the sources Variations in fit of nearby doors, skin panels, or other items Probe/Port Effects Operating Condition (M, Hp, ∝, β)* Geometry: Shape of probe/port Manufacturing variations Installation variations *M Mach, speed; Hp pressure altitude; ∝ angle of attack; 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.8-3. 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: 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.8-2. **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.8-4. 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:

1. Conversion of display input signal;
2. Graticule/format accuracy; and
3. 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 test 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. (For example, a fuselage stretch where the only difference in ASEmean 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 paragraph A.9, Figure A.9-2, 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 the resulting statistical statements of Appendix D, paragraphs D.1.5.1 and D.1.5.2. In the context of a statistical method, the statements of Appendix D, paragraph

D.1.5.3 required reassessment. This item states, "Each individual aircraft in the Group must be built to have ASE contained within ±200 ft." This statement 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 considering the risk analysis allows for a small proportion of aircraft to exceed 200 ft. 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 paragraph A.7.2.1.1 through A.7.2.1.5 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.

A.9.1.1.1 One process for showing compliance with RVSM requirements is shown in Figure A.9-1, Process for Showing Initial and Continued Compliance of Airframe Static Pressure System. Figure A.9-1 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.9.1.1.2 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.9-2 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.9.1.1.1 above.

A.9.1.1.3 The method illustrated in Figures A.9-1 and A.9-2 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.9-3, 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.9-1. Process for Showing Initial and Continued Compliance of Airframe Static Pressure System

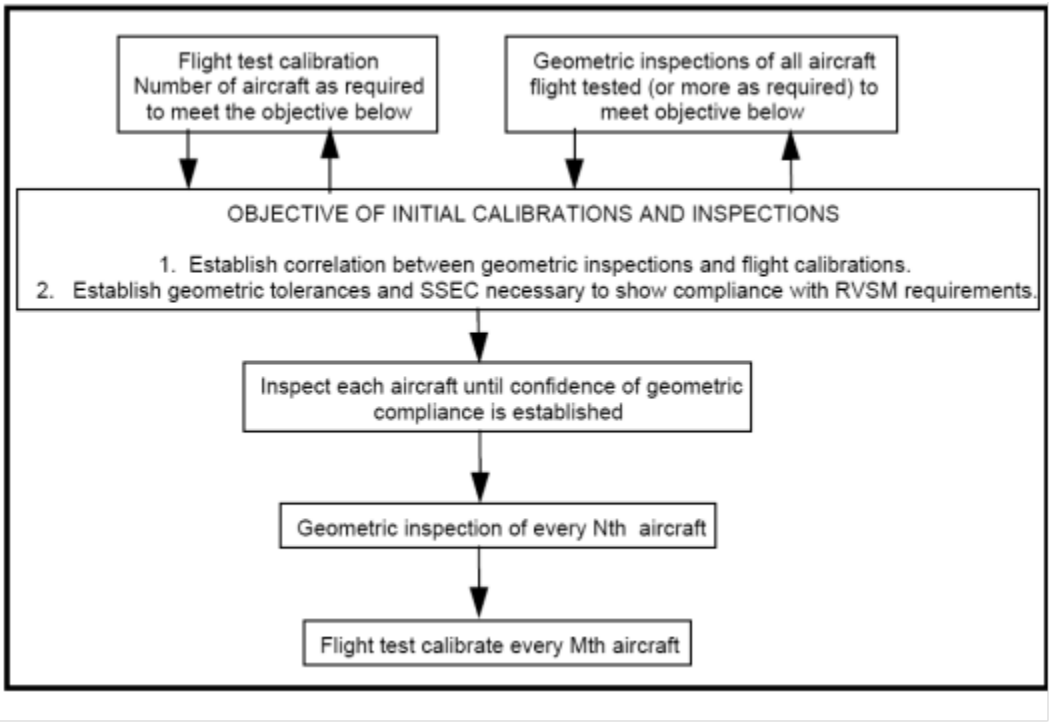


Figure A.9-2. Compliance Demonstration Ground-To-Flight Test Correlation Process Example

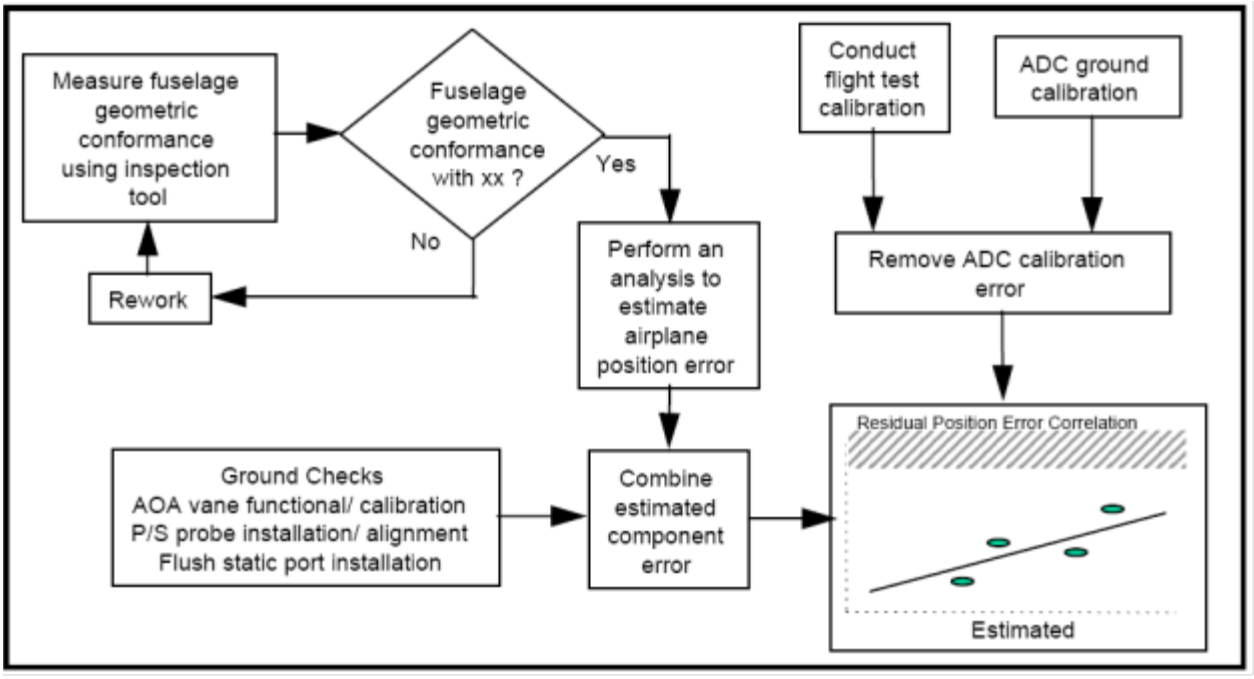
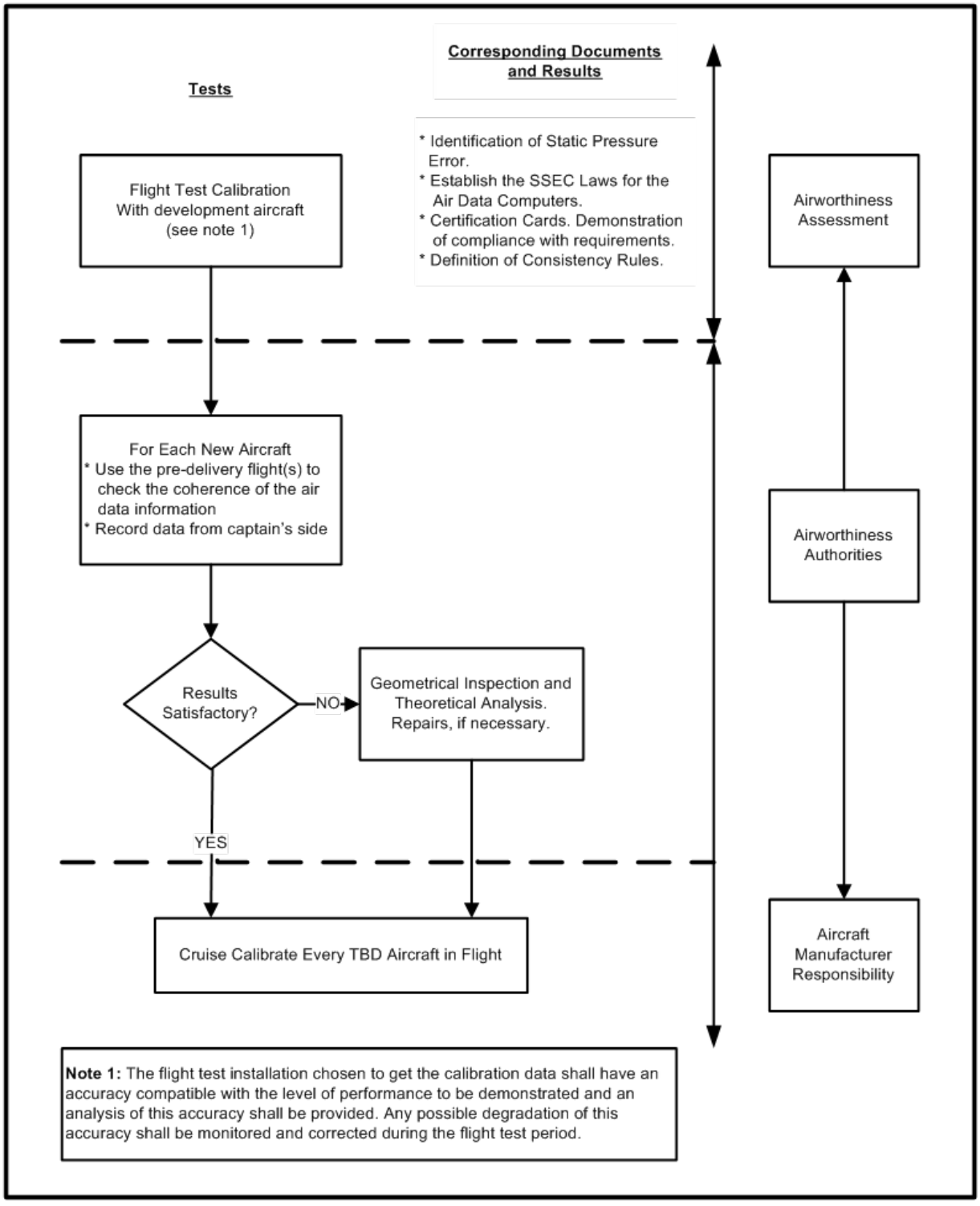


Figure A.9-3. Process for Showing Initial and Continued Compliance of Airframe Static Pressure Systems for In-Service and New Model Aircraft



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. Air Data System 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. Skin waviness, skin splices/joints, access panels, radome fit/fair, and damage.
4. Inspection of the pitot-static probe or static port. Erosion, corrosion, damage, static port orifice degradation, static port step-height, excessive or non-homogenous paint.
5. SmartProbe©. Inspection for corrosion, erosion, damage, 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 AFM, pilot operating manual, or a 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. Air Data System Modifications. Changes to the components comprising an RVSM-compliant air data system 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 Technical Standard Order (TSO) C74( ), 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 air data system 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 with special attention to the areas around the static source, angle of attack 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 a 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 (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 through which to seek airworthiness approval and submits the package to the appropriate ACO for approval. Once the ACO approves the data package, the operator applies the procedures defined in the package to obtain authorization from the Flight Standards District Office (FSDO)/certificate-holding district office (CHDO)/certificate management office (CMO)/International Field Office (IFO) (as appropriate) 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.

A.11.2.1 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 aircraft 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.11.2.2 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 advisory circular (AC) was written for use by a wide variety of operator types (e.g., 14 CFR part 91, 91K, 121, 125, 129, 135 operators) and therefore, certain items are included for purposes of clarity and completeness.

B.2 Flight Planning. During flight planning, the flightcrew and dispatchers, if applicable, should pay particular attention to conditions which may affect operation in Reduced Vertical Separation Minimum (RVSM) airspace. These include, but may not be limited to:

1. Verifying the aircraft is approved for RVSM operations.
2. Annotating the flight plan to be filed with the Air Traffic Service Provider to show the aircraft and operator are authorized for RVSM operations. Block 10 (equipment) of the International Civil Aviation Organization (ICAO) flight plan (FAA Form 7233-4) should be annotated with the letter W for filing in RVSM airspace.
3. For exceptions to the use of FAA Form 7233-4, see chapter 5 of the latest version of the FAA Aeronautical Information Manual (AIM) for the proper flight codes.

Note: An aircraft or operator not authorized for RVSM operations or an operator/aircraft without operable RVSM equipment is referred to as non-RVSM. If either the operator or the aircraft or both have not received RVSM authorization the operator or dispatcher will not file the RVSM equipment code in the flight plan.

4. Reported and forecast weather conditions on the route of flight.
5. Minimum equipment requirements pertaining to height-keeping systems.
6. If required for the specific aircraft group, accounting for any aircraft operating restrictions related to RVSM airworthiness approval. (See Appendix A, paragraph A.10.1.3.)

B.3 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 and 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 local altimeter atmospheric pressure at nautical height (QNH) setting 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 field elevation (QFE) may also be used.

   Note: Both checks should be an emphasis item for training materials.

4. Before takeoff, equipment required for flight in RVSM airspace should be operational, and indications of malfunction should be resolved.

B.4 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 so as to avoid flight in this airspace. The following equipment should 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 should ascertain the requirement for an operational transponder in each RVSM area where operations are intended.

B.5 In-Flight Procedures. Incorporate the following policies into flightcrew training and procedures:

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 in. Hg/1013.25 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 air traffic control (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 flight levels, the aircraft should not be allowed to overshoot or undershoot the cleared flight level 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 should 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 should be operational.
7. At cruise flight level 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 stand by altimeters for use in contingency situations.
8. At intervals of approximately 1 hour, make cross-checks between the primary altimeters and the stand-by altimeter.
    - The normal pilot scan of flight deck instruments should suffice for altimeter crosschecking on most flights.
    - When operating in surveillance airspace (Radar/Automatic Dependent Surveillance-Broadcast (ADS-B)), the initial altimeter cross-check should be performed after level off.
    - 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.
    - 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 cleared flight level (CFL) as quickly as possible.

11. Contingency procedures after entering RVSM airspace. The flight crew 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.

B.6 Post Flight. In making maintenance logbook entries against malfunctions in height-keeping systems, the pilot should provide sufficient detail to enable maintenance to effectively troubleshoot and repair the system. The pilot should detail the actual defect and the crew action taken to try to isolate and rectify the fault. Note the following information when appropriate:

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 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.7 Special Emphasis Items: Flightcrew Training. The following items should also be included in flightcrew training programs:

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.

Note: Additional specific information on RVSM operational policy and procedures in the domestic U.S., Alaska, Offshore Airspace, and the San Juan flight information region (FIR) can be found in the AIM, Chapter 4, Section 6.

2. Importance of crewmembers cross-checking each other to ensure ATC clearances are promptly and correctly complied with.

3. Use and limitations in terms of accuracy of standby altimeters in contingencies. Where applicable, the pilot should review the application of static source correction error/position correction error (SSEC/PEC) through the use of correction cards.
4. Problems of visual perception of other aircraft at 1,000 ft (300 m) planned separation during night conditions, when encountering local phenomena such as northern lights, for opposite and same direction traffic, and during turns.
5. Characteristics of aircraft altitude capture systems leading to the occurrence of overshoots.
6. Operational procedures and operating characteristics related to Traffic Alert and Collision Avoidance System (TCAS)/Airborne Collision Avoidance System (ACAS) operation in an RVSM operation.
7. Relationship between the altimetry, automatic altitude control, and transponder systems in normal and abnormal situations.
8. Aircraft operating restrictions (if required for the specific aircraft group) related to RVSM airworthiness approval. (See paragraph A.10.1.3.)

APPENDIX C. OPERATIONS IN OCEANIC AND REMOTE CONTINENTAL AIRSPACE

C.1 Introduction. Reduced Vertical Separation Minimum (RVSM) was initially implemented in North Atlantic Minimum Navigation Performance Specifications (MNPS) Airspace in March 1997 (MNPS Airspace is currently planned to be renamed North Atlantic (NAT) High Level Airspace). Since then, RVSM operations have been implemented almost worldwide.

C.1.1 Basic Concepts for Contingencies.

1. With the increase over the years of flight in oceanic and remote airspace, contingency procedures have been developed to minimize the disruption of Air Traffic Services when unable to comply with a given air traffic control (ATC) clearance. Contingency procedures, when such events may be put in place, help to provide the continued safety of air navigation. Operators and pilots conducting oceanic and remote airspace operations should ensure their familiarity with and the actions expected of pilots in such contingency situations.
2. Specific Guidance. The basic concepts for contingencies in oceanic airspace are contained in International Civil Aviation Organization (ICAO) Doc. 4444, Procedures for Air Navigation Services—Air Traffic Management (PANS—ATM), Chapter 15.2, Special Procedures for In-Flight Contingencies in Oceanic Airspace.
3. 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.

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

C.1.2 Strategic Lateral Offset Procedures (SLOP). SLOP are approved oceanic procedures allowing aircraft to fly on a parallel track to the right of the center line 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 strategic lateral offset procedures must be coordinated among the States involved. Procedures for the conduct of SLOP are contained in ICAO Doc 4444, PANS—ATM, 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. (See FAA Aeronautical Information Manual (AIM), Guidance on Wake Turbulence.)

C.1.3 Guidance To The Pilot In The Event Of Equipment Failures Or Encounters With Turbulence After Entry Into RVSM Airspace (Including Expected ATC Actions).

C.1.3.1 The following material is provided with the purpose of giving the pilot guidance on actions to take under certain conditions of equipment failure and encounters with turbulence. It also describes the expected ATC controller actions in these situations. It is recognized the pilot and controller will use judgment to determine the action most appropriate to any given situation. The guidance material recognizes for certain equipment failures, the safest course of action may be for the aircraft to maintain the assigned flight level (FL) and route while the pilot and controller take precautionary action to protect separation. For extreme cases of equipment failure, however, the guidance recognizes the safest course of action may be for the aircraft to depart from the cleared FL or route by obtaining a revised ATC clearance; or if unable to obtain prior ATC clearance, executing the established ICAO Doc. 4444 and Doc. 7030 contingency maneuvers for the area of operation.

Note: Paragraph C.1.4 provides an expanded description of the scenarios detailed below.

C.1.3.2 Contingency Scenarios. The following paragraphs summarize pilot actions to mitigate the potential for conflict with other aircraft in certain contingency situations.

Figure C.1-1. Scenario 1

The pilot is: 1) unsure of the vertical position of the aircraft due to the loss or degradation of all primary altimetry systems; or 2) unsure of the capability to maintain cleared flight level (CFL) due to turbulence or loss of all automatic altitude control systems.

The pilot should:	**ATC can be expected to:**
Maintain CFL while evaluating the situation;	
Watch for conflicting traffic both visually and by reference to ACAS (TCAS), if equipped;	
If considered necessary, alert nearby aircraft by: 1) Making maximum use of exterior lights; 2) Broadcasting position, FL, and intentions on 121.5 MHz (as a back-up, the VHF inter-pilot air-to-air frequency may be used).	
Notify ATC of the situation and intended course of action. Possible courses of action include:	Obtain the pilot's intentions and pass essential traffic information.
1) Maintaining the CFL and route, provided	1) If the pilot intends to continue in RVSM

The pilot should:	ATC can be expected to:
ATC can provide lateral, longitudinal, or conventional vertical separation.	airspace, assess traffic situation to determine if the aircraft can be accommodated through the provision of lateral, longitudinal, or increased vertical separation, and if so, apply the appropriate minimum.
2) Requesting ATC clearance to climb above or descend below RVSM airspace if the aircraft cannot maintain CFL and ATC cannot establish adequate separation from other aircraft.	2) If the pilot requests clearance to exit RVSM airspace, accommodate expeditiously, if possible.
3) Executing the ICAO Doc. 4444 contingency maneuver to offset from the assigned track and FL, if ATC clearance cannot be obtained and the aircraft cannot maintain CFL.	3) If adequate separation cannot be established and it is not possible to comply with the pilot's request for clearance to exit RVSM airspace, advise the pilot of essential traffic information, notify other aircraft in the vicinity and continue to monitor the situation.
	4) Notify adjoining ATC facilities/sectors of the situation.

Figure C.1-2. Scenario 2

There is a failure or loss of accuracy of one primary altimetry system (e.g., greater than 200 ft difference between primary altimeters).

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

C.1.4 Expanded Equipment Failure and Turbulence Encounter Scenarios. Operators may consider this material for use in training programs.

Figure C.1-3. Expanded Scenario 1

All automatic altitude control systems fail (e.g., Automatic Altitude Hold).

The pilot should:	**ATC can be expected to:**
Initially maintain CFL, and	
Evaluate the aircraft's capability to maintain altitude through manual control.	
Subsequently watch for conflicting traffic both visually and by reference to TCAS, if equipped.	
If considered necessary, alert nearby aircraft by: 1) Making maximum use of exterior lights; 2) Broadcasting position, FL, and intentions on 121.5 MHz (as a back-up, the VHF inter-pilot air-to-air frequency may be used).	
Notify ATC of the failure and intended course of action. Possible courses of action include:	
1) Maintaining the CFL and route, provided the aircraft can maintain level.	1) If the pilot intends to continue in RVSM airspace, assess traffic situation to determine if the aircraft can be accommodated through the provision of lateral, longitudinal, or increased vertical separation, and if so, apply the appropriate minimum.
2) Requesting ATC clearance to climb above or descend below RVSM airspace if the aircraft cannot maintain CFL and ATC cannot establish lateral, longitudinal, or conventional vertical separation.	2) If the pilot requests clearance to exit RVSM airspace, accommodate expeditiously, if possible.
3) Executing the ICAO Doc. 4444 contingency maneuver to offset from the assigned track and FL, if ATC clearance cannot be obtained and the aircraft cannot maintain CFL.	3) If adequate separation cannot be established and it is not possible to comply with the pilot's request for clearance to exit RVSM airspace, advise the pilot of essential traffic information, notify other aircraft in the vicinity, and continue to monitor the situation.
	4) Notify adjoining ATC facilities/sectors of the situation.

Figure C.1-4. Expanded Scenario 2

Loss of redundancy in primary altimetry systems.

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

Figure C.1-5. Expanded Scenario 3

All primary altimetry systems are considered unreliable or fail.

The pilot should:	ATC can be expected to:
Maintain CFL by reference to the standby altimeter (if the aircraft is so equipped).	
Alert nearby aircraft by: 1) Making maximum use of exterior lights; 2) Broadcasting position, FL, and intentions on 121.5 MHz (as a back-up, the VHF inter-pilot air-to-air frequency may be used).	
Consider declaring an emergency. Notify ATC of the failure and intended course of action. Possible courses of action include:	Obtain pilot's intentions, and pass essential traffic information.
1) Maintaining CFL and route provided ATC can provide lateral, longitudinal, or conventional vertical separation.	1) If the pilot intends to continue in RVSM airspace, assess traffic situation to determine if the aircraft can be accommodated through the provision of lateral, longitudinal, or increased vertical separation, and if so, apply the appropriate minimum.
2) Requesting ATC clearance to climb above or descend below RVSM airspace if ATC cannot establish adequate separation from other aircraft.	2) If the pilot requests clearance to exit RVSM airspace, accommodate expeditiously, if possible.
3) Executing the ICAO Doc. 4444 contingency maneuver to offset from the assigned track and FL, if ATC clearance cannot be obtained.	3) If adequate separation cannot be established and it is not possible to comply with the pilot's request for clearance to exit RVSM airspace, advise the pilot of essential traffic information, notify other aircraft in the vicinity, and continue to monitor the situation.
	4) Notify adjoining ATC facilities/sectors of the situation.

Figure C.1-6. Expanded Scenario 4

The primary altimeters diverge by more than 200 ft (60 m).

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

Figure C.1-7. Expanded Scenario 5

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

The pilot should:	**ATC can be expected to:**
Watch for conflicting traffic both visually and by reference to TCAS, if equipped.	
If considered necessary, alert nearby aircraft by: 1) Making maximum use of exterior lights; 2) Broadcasting position, FL, and intentions on 121.5 MHz (as a back-up, the VHF inter-pilot air-to-air frequency may be used).	
Notify ATC of intended course of action as soon as possible. Possible courses of action include:	
1) Maintaining CFL and route provided ATC can provide lateral, longitudinal, or conventional vertical separation.	1) Assess traffic situation to determine if the aircraft can be accommodated through the provision of lateral, longitudinal, or increased vertical separation, and if so, apply the appropriate minimum.
2) Requesting flight level change, if necessary.	2) If unable to provide adequate separation, advise the pilot of essential traffic information and request pilot's intentions.

The pilot should:	ATC can be expected to:
3) Executing the ICAO Doc. 4444 contingency maneuver to offset from the assigned track and FL, if ATC clearance cannot be obtained and the aircraft cannot maintain CFL.	3) Notify other aircraft in the vicinity and monitor the situation.
	4) Notify adjoining ATC facilities/sectors of the situation.

C.1.5 Transponder Failure. The provider States will determine the specific actions ATC will take in the event of transponder failure in RVSM.

C.1.6 ICAO Regional Supplementary Procedures (SUPPS) and State Specific Guidance. 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.1.6.1 Operators should review ICAO Document 7030, Regional Supplementary Procedures, and State Aeronautical Information Publications prior to starting RVSM operations in an area new to the operator.

C.1.7 Additional Information. Additional information regarding RVSM operations can be found on the FAA RVSM Documentation Web page at: https://www.faa.gov/air_traffic/separation_standards/rvsm/documentation/.

APPENDIX D. REVIEW OF ICAO DOCUMENT 9574

D.1 ICAO Document 9574.

D.1.1 International Civil Aviation Organization (ICAO) Doc. 9574, Manual on the Implementation of a 300 m (1,000 ft) Vertical Separation Minimum Between FL 290-FL 410 Inclusive, covers the overall analysis of factors for achieving an acceptable level of safety in a given airspace system. The major factors are passing frequency, lateral navigation accuracy, and vertical overlap probability. Vertical overlap probability is a consequence of errors in adhering accurately to assigned flight level (FL), and this is the only factor addressed in the present document.

D.1.2 In ICAO Doc. 9574, Section 2.3.1 restated the vertical overlap probability requirement as the aggregate of height-keeping errors of individual aircraft, which must lie within the TVE distribution expressed as the simultaneous satisfaction of the following four requirements:

D.1.2.1 The proportion of height-keeping errors beyond 300 ft (90 m) in magnitude must be less than 2.0×10^{-3};

D.1.2.2 The proportion of height-keeping errors beyond 500 ft (150 m) in magnitude must be less than 3.5×10^{-6};

D.1.2.3 The proportion of height-keeping errors beyond 650 ft (200 m) in magnitude must be less than 1.6×10^{-7}; and

D.1.2.4 The proportion of height-keeping errors between 950 ft (290 m) and 1,050 ft (320 m) in magnitude must be less than 1.7×10^{-8}.

D.1.3 The following characteristics presented in ICAO Doc. 9574 were developed to satisfy the distributional limits in paragraph D.1.2.1, and to result in aircraft airworthiness having negligible effect on meeting the requirements in paragraphs D.1.2.2, D.1.2.3, and D.1.2.4. They are applicable statistically to individual groups of nominally identical aircraft operating in the airspace. These characteristics describe the performance the groups need to be capable of achieving in service, exclusive of human factors errors and extreme environmental influences, if the airspace system Total Vertical Error (TVE) requirements are to be satisfied. The following characteristics are the basis for development of this document:

D.1.3.1 The mean altimetry system error (ASE) of the group must not exceed ±80 ft (±25 m);

D.1.3.2 The sum of the absolute value of the ASEmean for the group and ASE3 SD within the group must not exceed 245 ft (75 m); and

D.1.3.3 Errors in altitude keeping must be symmetric about a mean of 0 ft (0 m), must have a standard deviation (SD) not greater than 43 ft (13 m), and the error

frequency should decrease with increasing error magnitude at a rate that is at least exponential.

D.1.4 ICAO Doc. 9574 recognized specialist study groups would develop the detailed specifications to ensure the TVE objectives can be met over the full operational envelope in Reduced Vertical Separation Minimum (RVSM) airspace for each aircraft group. In determining the breakdown of tolerances between the elements of the system, it was considered necessary to set system tolerances at levels recognizing the overall objectives must be met operationally by aircraft and equipment subject to normal production variability, including the airframe SSE, and normal in-service degradation. It was also recognized that it would be necessary to develop specifications and procedures covering the means for ensuring in-service degradation is controlled at an acceptable level.

D.1.5 Based on studies reported in ICAO Doc. 9536, Review of the General Concept of Separation Panel (RGCSP), Volume 2, ICAO Doc. 9574 recommended the required margin between operational performance and design capability should be achieved by ensuring the performance requirements are developed to fulfill the following requirements, where the narrower tolerance in paragraph D.1.5.2 is specifically intended to allow for some degradation with increasing age:

D.1.5.1 The mean uncorrected residual position error static source error (SSE) of the group will not exceed ±80 ft (±25 m);

D.1.5.2 The sum of the absolute value of the ASEmean for the group and ASE3 SD within the group will not exceed 200 ft (60 m);

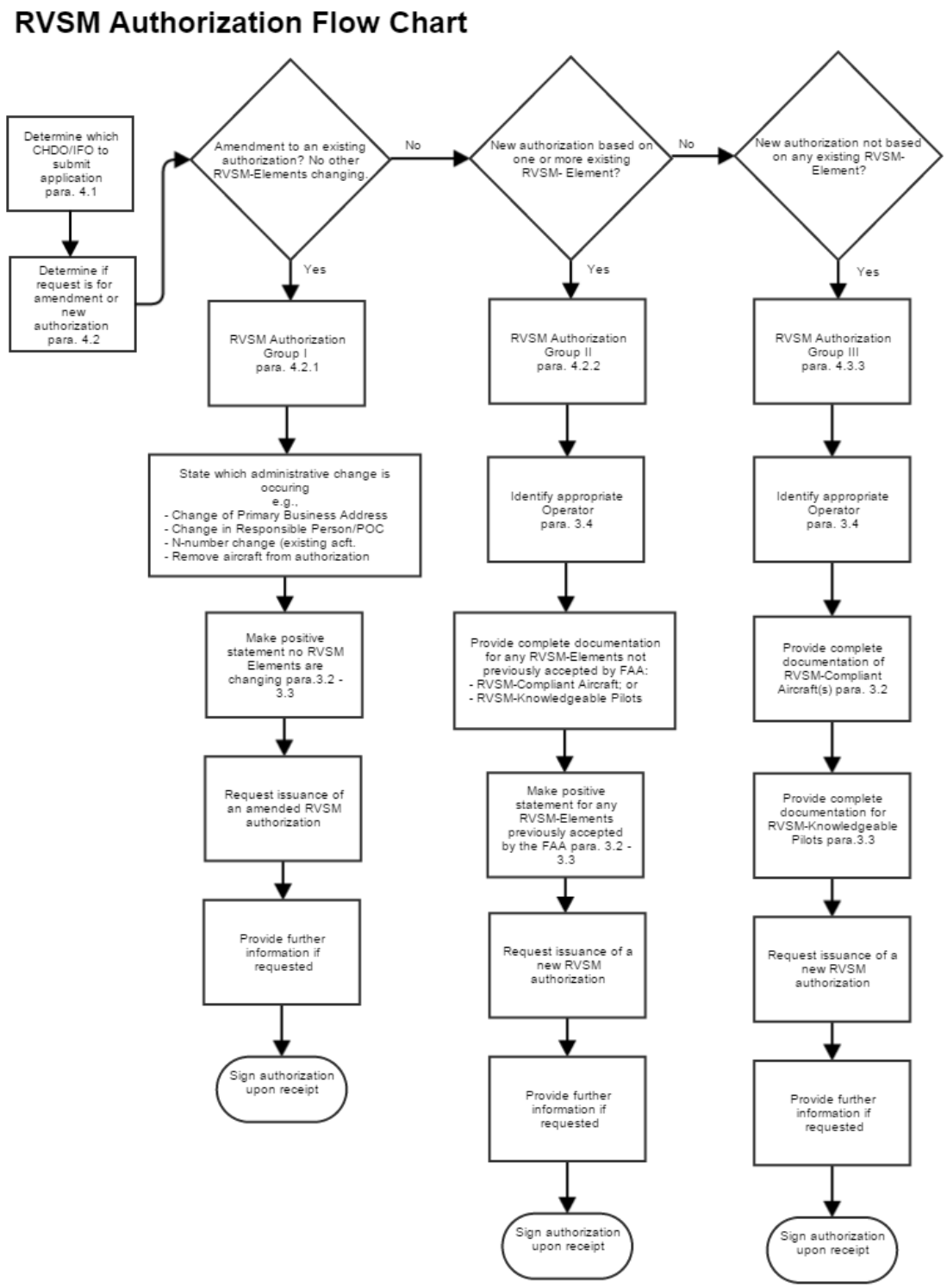
D.1.5.3 Each individual aircraft in the group will be built to have ASE contained within ±200 ft (±60 m); and

D.1.5.4 An automatic altitude control system will be required and will be capable of controlling altitude within a tolerance band of ±50 ft (±15 m) about commanded altitude when operated in the altitude hold mode in straight and level flight under nonturbulent, nongust conditions.

D.1.6 These standards provide the basis for the separate performance aspects of airframe, altimetry, altimetry equipment, and automatic altitude control system. It is important to recognize the limits are based on studies (ICAO Doc. 9536, Volume 2) which showed ASE tends to follow a normal distribution about a characteristic mean value for the aircraft group. Therefore, the document should provide controls precluding the possibility individual aircraft approvals could create clusters operating with a mean significantly beyond 80 ft (25 m) in magnitude, such as could arise where elements of the altimetry system generate bias errors additional to the mean corrected SSE.

APPENDIX E. RVSM AUTHORIZATION OVERVIEW

E.1 RVSM Authorization Process Overview.



Advisory Circular Feedback

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 emailing this form to RVSM@faa.gov.

Subject: AC 91-85A, 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: _____