

TCAS II OPERATION IN REDUCED VERTICAL SEPARATION MINIMUM (RVSM) AIRSPACE

INTRODUCTION. This material has been developed by the Flight Technologies and Procedures Division (AFS-400) at FAA Headquarters. An AFS-400 representative chaired the North Atlantic System Planning Group (NATSPG) Ops/Air sub-group which developed aircraft and operator RVSM approval guidance for the North Atlantic (NAT). An AFS-400 representative now chairs the Ops/Air sub-group of the ICAO Pacific RVSM Implementation Task Force.

Traffic Alert and Collision Avoidance System (TCAS) Compatibility With RVSM Operations: Appendix G to 14 CFR Part 91 requires all TCAS II equipped aircraft operating in RVSM airspace after March 31, 2002 to be equipped with TSO C-119b (Version 7.0), or a later version unless otherwise authorized by the Administrator.

Training Considerations for Using TCAS in an RVSM Airspace, was originally published on October 11, 1996. It has been used since that time to train pilots on TCAS II (Version 6.04) operations in airspace where RVSM is implemented. The attachment to this cover letter (dated June 30, 1999) provides minor updates to the original paragraph 1 (Introduction) and in paragraph 1d recommends that, as soon as possible, TCAS II (Change 7) be installed on aircraft used in RVSM operations.

REVISIONS. This 9 August 2004 version updates the contacts for pilot reporting of RA's to the TCAS Transition Program at ARINC. See page 9.

BACKGROUND.

NORTH ATLANTIC RVSM. RVSM refers to a separation minimum of 1,000 feet in the vertical dimension between flight levels 290 and 410. RVSM was implemented in North Atlantic (NAT) Minimum Navigation Performance Specification (MNPS) airspace in stages. Stage 1 implemented RVSM between flight level (FL) 330 and 370 (inclusive) on March 27, 1997. Stage 2 implemented RVSM between FL 310 and 390 (inclusive) on October 8, 1998. Schedules for expansion of RVSM to other FL's in the NAT will be established by the NAT Air Traffic Services Provider authorities after consideration of user needs and readiness.

PACIFIC RVSM. RVSM was implemented in Pacific oceanic airspace between FL 290 and 390 (inclusive) on February 24, 2000. The ground rules for RVSM implementation in specific Flight Information Regions (FIR's) are published in State NOTAMS and Aeronautical Information Publications.

AIRCRAFT/OPERATOR APPROVAL. Handbook Bulletin for Air Transpiration (HBAT) 97-02 (2/28/97) states that the **Interim Guidance Material on the Approval of Operators/Aircraft For RVSM Operations** (3/14/94), **as amended**, provides an acceptable means of operator and aircraft approval for RVSM. The interim guidance contains information on operating practices and

procedures related to RVSM that must be incorporated into pilot training programs. In Change 1 to IG 91-RVSM (6/30/99), Appendix 4, paragraph 7, lists TCAS operation in an RVSM environment as a Special Emphasis Item for pilot training.

ACTION.

The attachment to this memo is a training package that addresses the effect of RVSM on TCAS II operation. Responsible authorities must ensure that, prior to flying in RVSM airspace, pilots are trained on this subject. The TCAS Program Office at FAA Headquarters has developed and coordinated the attached material. It provides an acceptable means of conducting such training.

We have coordinated the following with the TCAS Program Office: in that pilots will have already received training on and obtained operating experience with TCAS, we have concluded that initial training on the material addressing the effect of RVSM on TCAS operation may take the form of a pilot bulletin. Operators may, however, show other methods of training to be acceptable. As paragraph 4 of the attachment (Recurrent Training) states, "recurrent training programs should also be updated to include information that ensures that pilots maintain an adequate level of knowledge on the subject."

The attached material is published on the FAA RVSM website in the Documentation section. The FAA RVSM website can be accessed by typing:

www.faa.gov; then clicking on RVSM and Go in the Quick Jump Menu

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**TRAINING CONSIDERATIONS FOR USING TCAS II VERSION 6.04 AND VERSION 7
IN AN RVSM AIRSPACE**

1. INTRODUCTION

a. **UPDATES.** This material was originally issued on October 11, 1996. It has been used since that time to provide guidance on TCAS II (Version 6.04) operation in an RVSM environment. This update (3/19/02) makes minor revisions throughout the document that reflect the use of TCAS II (Version 7).

b. Since the introduction of Reduced Vertical Separation Minimum (RVSM) in the North Atlantic (NAT) in March 1997, TCAS II (Version 6.04) has issued traffic advisories (TAs) during normal RVSM operations, i.e., when aircraft are maintaining required separation. There also remains a potential for TCAS to issue unnecessary resolution advisories (RAs) under certain RVSM operating conditions. These training guidelines outline those areas of TCAS which a pilot is expected to have knowledge of prior to operating in an RVSM airspace.

c. **Very few RAs have occurred in oceanic airspace during normal RVSM operations.** TA's, however, have occurred regularly when aircraft pass within close proximity to one another at adjacent flight levels (FL). (See page 4, (i) RVSM Airspace Operations). It is important, therefore, that pilots understand the effect of RVSM on TCAS operation.

d. TCAS II (Version 7). TCAS II (Version 7) contains modifications that enhance TCAS compatibility with RVSM operations. (See page 8, (iii) Modifications to TCAS). The FAA recommends that operators that are now or plan to conduct RVSM operations install TCAS II (Version 7) on aircraft to be used in such operations.

d. It is expected that all pilots operating a TCAS-equipped aircraft in airspace where RVSM is implemented will have successfully completed an approved TCAS training program and have had some line operating experience with the system. Because of this, these training considerations do not provide a complete TCAS Training Program; instead they highlight those areas in which TCAS may behave differently due to the introduction of RVSM.

2. SCOPE

a. This paper presents a set of proposed training standards for pilots operating TCAS II in an RVSM airspace above FL 290. These standards cover four major topics: TCAS operating characteristics and parameters applicable to RVSM airspace; the interaction between TCAS and the reduced separation standards; operating recommendations; and the requirements for reporting TCAS events in this environment, along with a review of the available means of reporting.

TRAINING EMPHASIS: (See page 8, (3) **OPERATING RECOMMENDATIONS.** There are certain TCAS and aircraft operating recommendations, that if followed, will minimize the disruptions caused by the issuance of unnecessary TAs and RAs.) . In airspace where RVSM is applied, limiting climb and descent rates to 1000 feet per minute (fpm) when operating in close proximity to other aircraft will mitigate the potential for RVSM to affect TCAS operations.

b. **FORM OF TRAINING.** The training outlined in this paper can be accomplished in any manner an operator can demonstrate to be effective. In that pilots will have previously received TCAS training and obtained operating experience, initial training on the affect of RVSM on TCAS operation may take the form of a pilot bulletin. As stated on page 10, paragraph 4, information should also be incorporated into recurrent training programs to ensure that pilots maintain an adequate level of knowledge on the subject. It is recommended that the training include a means for determining that pilots understand the concepts contained in the training. (A sample TCAS/RVSM quiz is provided in Attachment 1).

c. In developing these training guidelines, objectives are established that define the minimum knowledge a pilot operating TCAS in an RVSM airspace is expected to possess and the performance expected from a pilot who has completed this training. When appropriate, notes are included within the performance standards which amplify or clarify the material addressed by the training objective.

3. TRAINING OBJECTIVES

a. Initial Training

(1) TCAS Operating Characteristics and Parameters. The pilot must demonstrate an understanding of basic TCAS operations and the criteria used for issuing TAs and RAs above FL 290. This section of the training should address the following topics.

(i) Basic TCAS Operation and Thresholds Above FL 290

Objective: Demonstrate knowledge of how TCAS issues TAs and RAs.

Criteria: The pilot must demonstrate an understanding of the methodology used by TCAS to issue TAs and RAs, and the general criteria for the issuance of these advisories.

Information:

a. TCAS will issue a TA or an RA only when another aircraft is "close" in both range and altitude. Figure 1 shows these criteria and the RA threshold values used by TCAS above FL 290.

b. TAs and RAs can be issued based on either the time to closest point of approach (CPA) or a fixed distance. In most airspace, most TAs and RAs will be issued based on time; however with RVSM, some advisories will be caused by the fixed range and altitude thresholds.

1. BOTH AIRCRAFT LEVEL: ALERT BASED ON TIME TO CPA AND VERTICAL DISTANCE BETWEEN AIRCRAFT. TA may be issued when the two aircraft are within 48 seconds of CPA horizontally and within ± 1200 feet (Version 6.04) or ± 850 feet (Version 7) vertically. An RA may be issued when the two aircraft are within 35 seconds of CPA horizontally and within ± 800 feet (Version 6.04) or ± 700 feet (Version 7) vertically. If the vertical separation between the two aircraft is less than 700 feet (Version 6.04) or 600 feet (Version 7), a corrective RA requiring a change in altitude will be issued. These thresholds are used when the two aircraft are converging horizontally with closure rates above 100 knots and with both aircraft level. **OR,**

2. ONE OR BOTH AIRCRAFT WITH VERTICAL RATE: ALERT BASED ON TIME TO VERTICAL AND HORIZONTAL CONFLICT. A TA may be issued when the two aircraft are within 48 seconds of CPA horizontally and within 48 seconds of being at the same altitude. An RA may be issued when the two aircraft are within 35 seconds of CPA horizontally and within 35 seconds of being at the same altitude. If the TCAS aircraft is level and another aircraft is climbing or descending, the RA will be delayed until the two aircraft are within 30 seconds of being at the same altitude to provide additional time for TCAS to detect a level off by the other aircraft. If the vertical separation between the two aircraft at CPA is *estimated* to be less than 700 feet (Version 6.04) or 600 feet (Version 7), a corrective RA requiring a change in vertical speed will be issued. If the vertical separation between the two aircraft at CPA is *estimated* to be between 700 and 800 feet (Version 6.04) or within 700 feet (Version 7), a preventive RA will be issued. These thresholds are used when the two aircraft are converging horizontally with closure rates above 100 knots and when one or both aircraft have a vertical rate. **OR,**

3. BOTH AIRCRAFT LEVEL: ALERT BASED ON HORIZONTAL AND VERTICAL DISTANCE. A TA may be issued when the two aircraft are within 1.3 NM of each other horizontally and within ± 1200 feet (Version 6.04) or ± 850 feet (Version 7) vertically. An RA may be issued when the two aircraft are within 1.1 miles of each other horizontally and within ± 800 feet (Version 6.04) or ± 700 feet (Version 7) vertically. If the vertical separation between the two aircraft is less than 700 feet (Version 6.04) or 600 feet (Version 7), a corrective RA requiring a change in altitude will be issued. These thresholds are used when the two aircraft are converging horizontally with slow closure rates (less than 100 knots) and with both aircraft level. This is typical of an overtaking situation in which an aircraft on the same track at an adjacent altitude passes another aircraft. **OR,**

4. ONE OR BOTH AIRCRAFT WITH VERTICAL RATE: ALERT BASED ON HORIZONTAL DISTANCE AND TIME TO VERTICAL CONFLICT. A TA may be issued when the two aircraft are within 1.3 NM of each other horizontally and within 48 seconds of being at the same altitude. An RA may be issued when the two aircraft are within 1.1 NM of each other horizontally and within 35 seconds of being at the same altitude. If the vertical separation between the two aircraft at CPA is *estimated* to be less than 700 feet (Version 6.04) or 600 feet (Version 7), a corrective RA requiring a change in vertical speed will be issued. If the vertical separation between the two aircraft at CPA is *estimated* to be between 700 and 800 feet (Version 6.04) or within 700 feet (Version 7), a preventive RA will be issued. These thresholds are used when the two aircraft are converging horizontally with slow closure rates (less than 100 knots) and when one or both aircraft

have a vertical rate. This is typical of an overtaking situation in which aircraft are on the same track and maneuvering vertically towards each other to establish the reduced separation.

5. **POTENTIAL FOR EXTENDED RA DISPLAY.** With the current version of TCAS, it is possible for an RA to remain displayed for an extended period of time (two to five minutes) without being modified, if the RA is issued after the two aircraft have started to diverge in a slow overtake encounter. The original RA will remain displayed even though adequate vertical separation has been obtained during the initial response to the RA.

c. In the transition areas, it is most likely that TAs and RAs will be issued as aircraft are changing altitudes to obtain the 1000 feet of vertical separation. In the NAT, a majority of advisories will be issued when a faster aircraft on the same track passes another aircraft with 1000 feet of vertical separation (Version 6.04). **Very few RAs have occurred in oceanic RVSM operations,** but a TA can be expected every time an aircraft passes another at the next level.

(2) **Interaction Between TCAS and RVSM.** Because the TCAS thresholds for issuing TAs and RAs were designed for an environment with 2,000 feet of vertical separation above FL 290, after RVSM is implemented, TCAS may issue TAs and RAs when aircraft are operating in accordance with required separation standards. This section of the training will highlight the types of TAs and RAs that can be expected in both an RVSM airspace and in the Transition Areas at the entry and exit points of the RVSM airspace.

(i) **RVSM Airspace Operations**

(A) **TAs**

Objective: Demonstrate knowledge about the frequency of TAs and the types of TAs that can be expected.

Criteria: The pilot must be able to demonstrate a knowledge of the types of maneuvers and encounter geometries that will result in TAs being issued while operating in the RVSM airspace. These include:

Information:

a. A TA will be issued whenever an aircraft operating 1,000 feet above or below the own aircraft passes the aircraft, or is passed by the own aircraft. The TA may be displayed for as long as five minutes, depending on the closure rate. (In this situation, if a second intruder aircraft passes own aircraft within TA parameters, a second TA with associated aural alert will be issued). If the closure rate is less than a 100 knots, the TA will not be issued until the aircraft are approximately 1.3 NM apart. On most traffic displays, if the selected display range is greater than 10 NM, the intruder's aircraft symbol will be touching the own aircraft symbol when the TA is issued.

b. When the closure rate between two aircraft is extremely slow (ground speeds within 20 knots), multiple TAs may be issued against the same intruder just prior to the TA being removed.

c. It is also possible to have multiple TAs issued against the same intruder during a crossing as the winds at the adjacent altitude change and alter the ground speed of the two aircraft.

d. If an aircraft changes altitude while in the RVSM airspace using a vertical speed greater than approximately 1500 fpm while in close horizontal proximity (less than two NM) to an aircraft that is level, it is possible for TCAS to issue a TA.

(B) RAs

Objective: Demonstrate knowledge about the types of RAs that can be expected and the typical deviation required to resolve the RA.

Criteria: The pilot must be able to demonstrate a knowledge of the types of maneuvers and encounter geometries that will result in RAs being issued while operating in the RVSM airspace. These include:

Information:

a. **POTENTIAL FOR EXTENDED RA DISPLAY: AIRCRAFT WITHIN TWO NM HORIZONTALLY, ONE AIRCRAFT WITH VERTICAL RATE OF APPROXIMATELY *1500 FPM AND APPROACHING ADJACENT FLIGHT LEVEL.** If an aircraft changes altitude while in the RVSM airspace using a vertical speed greater than approximately 1500 fpm while in close horizontal proximity (within two NM) to another aircraft, it is possible for TCAS to issue an RA as the climbing or descending aircraft approaches its altitude. For the climbing or descending aircraft, the RA is likely to be an RA commanding a reduction in the climb or descent rate. For the level aircraft, the RA is likely to be a Climb or Descend RA. In a typical encounter, the Climb or Descend RA will be displayed until the level aircraft has climbed between 500 and 700 feet. If the climbing or descending aircraft is also TCAS equipped, the required displacement of the level aircraft will be less.

*NOTE: (See page 8, **OPERATING RECOMMENDATIONS.** . In airspace where RVSM is applied (including Transition Areas), limiting climb and descent rates to 1000 fpm when operating in close proximity to other aircraft will mitigate the potential for RVSM to affect TCAS operation.

b. In the situation described in paragraph a above, if the maneuvering aircraft is diverging in range at a slow rate with the own aircraft, the Climb or Descend RA may remain displayed for several minutes, even though the maneuvering aircraft has leveled off. **WHILE THIS IS EXPECTED TO BE RARE**, such an event can cause very large displacements from the assigned altitude while complying with the RA. If a Climb or Descend RA remains displayed for an extended period of time, it may be indicative of a slow closure rate encounter and pilots should use all available data (TCAS traffic display, visual cues, knowledge of other aircraft's clearance, etc.) to determine if the vertical separation between the two aircraft is still converging. It is likely that a long duration Climb or Descend RA (displayed for more than 30 seconds) is in response to this type of encounter which the current version of TCAS has difficulty resolving. However, pilots must also

be aware that a long duration RA may also occur when an intruder aircraft “chases” the TCAS aircraft, i.e., the intruder continues to climb after the TCAS aircraft responds to a Climb RA. In a situation where a second intruder aircraft passes own aircraft within RA parameters, a second RA with associated alerts will be issued.

c. EFFECT OF TURBULENCE WITH AIRCRAFT WITHIN 1.1 NM OF EACH OTHER. Moderate and severe turbulence can induce aircraft motion which TCAS can interpret as a climb or descent. These vertical speed changes can result in TCAS projecting the vertical separation to be less than 800 feet (Version 6.04) or 700 feet (Version 7) at CPA, which can result in an RA being issued if the aircraft is in close proximity (1.1 NM) of another aircraft at an adjacent altitude.

d. EFFECT OF CERTAIN SOFT ALTITUDE HOLD SYSTEMS WITH AIRCRAFT WITHIN 1.1 NM OF EACH OTHER. FAA RVSM approval criteria requires that soft altitude hold systems contain altitude variations within 130 feet. Prior to the introduction of this requirement, aircraft equipped with CERTAIN soft altitude hold systems have caused numerous RA reports from operators. The soft altitude hold mode permits oscillation about the selected altitude and can result in either the actual or projected vertical separation between the TCAS aircraft and an intruder being reduced to less than 800 feet (Version 6.04) or 700 feet (Version 7). If the intruder aircraft is within approximately 1.1 NM horizontally when the actual or projected altitude separation falls below 800 feet (Version 6.04) or 700 feet (Version 7), an RA will be issued.

e. POTENTIAL FOR EXTENDED RA DISPLAY. The RAs issued in the types of encounters described in d above, range from preventive Do Not Climb/Descend to corrective Climb or Descend. If the closure rate between the two aircraft is very slow (again less than 20 knots), it is possible for the RA to remain displayed for several minutes. Because of the TCAS design, in some conditions, the initial Climb or Descend RA will not be changed during this time, which can result in large displacements from the assigned altitude if the pilot continues to comply with the RA. However, if a third aircraft is within 1.1 NM and at the adjacent altitude not occupied by the oscillating aircraft, the Climb or Descend RA will be modified.

f. TYPICAL RA DISPLAY. When a Climb or Descend RA is issued in either the NAT or the transition area, this RA will typically be removed or weakened to permit the altitude displacement to be stopped after the TCAS aircraft has deviated between 500 and 700 feet from an assigned altitude.

(ii) Transition Area Operations

(A) TAs

Objective: Demonstrate knowledge about the types of TAs that can be expected.

Criteria: The pilot must be able to demonstrate a knowledge of the types of maneuvers and encounter geometries that will result in TAs being issued while operating in the Transition Areas. These include:

Information:

a. If an aircraft changes altitude while in the transition area using a vertical speed greater than approximately 1500 fpm while in close horizontal proximity to another aircraft that is level, it is possible for TCAS to issue a TA.

b. If two aircraft are maneuvering vertically to attain 1,000 feet of vertical separation for entry into the RVSM airspace, and are in close horizontal proximity to each other in either distance (1.3 NM) or time (48 seconds), it is possible for TCAS to issue TAs to both aircraft if the *combined* vertical speed of the two aircraft is greater than 1500 fpm.

c. Once two aircraft attain 1,000 feet of vertical separation in the transition area, the same types of TAs outlined on page 4 (RVSM Airspace Operations: TAs) may occur.

d. In the transition area at the RVSM airspace exit point, very few TAs are expected because aircraft should be diverging from each other vertically.

(B) RAs

Objective: Demonstrate knowledge about the types of RAs that can be expected.

Criteria: The pilot must be able to demonstrate a knowledge of the types of maneuvers and encounter geometries that will result in RAs being issued while operating in the Transition Areas. These include:

Information:

a. **POTENTIAL FOR RA DISPLAY: AIRCRAFT WITHIN TWO NM HORIZONTALLY, ONE AIRCRAFT WITH VERTICAL RATE OF APPROXIMATELY 1500 FPM AND APPROACHING ADJACENT FLIGHT LEVEL.** If an aircraft changes altitude while in the Transition Area using a vertical speed greater than approximately 1500 fpm while in close horizontal proximity to another aircraft that is level, it is possible for TCAS to issue an RA as the climbing or descending aircraft approaches its altitude. For the climbing or descending aircraft, the RA is likely to be an RA commanding a reduction in the climb or descent rate. For the level aircraft, the RA is likely to be a Climb or Descend RA. It is possible for the long duration RAs described on page 5 (RAs) to also occur in the Transition Area.

b. **RA DISPLAY: COMBINED VERTICAL SPEED APPROXIMATELY 1500 FPM, AIRCRAFT WITHIN 1.1 NM OR 35 SECONDS AND APPROACHING ADJACENT FLIGHT LEVELS.** If two aircraft are maneuvering vertically to attain 1,000 feet of vertical separation for entry into the RVSM airspace, and are in close horizontal proximity to each other in either distance (1.1 NM) or time (35 seconds), it is possible for TCAS to issue RAs to both aircraft if the *combined* vertical speed of the two aircraft is greater than 1500 fpm.

c. Once two aircraft attain 1,000 feet of vertical separation in the transition area, the same types of RAs outlined on page 5 (RAs) may occur.

d. In the transition area at the RVSM airspace exit point, very few RAs are expected because aircraft should be diverging from each other vertically.

(iii) Modifications to TCAS

Objective: Demonstrate knowledge that the types of TAs and RAs described above exist with the existing implementation of TCAS. The TCAS software modification, Version 7, contains changes to make TCAS more compatible with reduced vertical separation above FL 290.

Information:

a. The TCAS design criteria (Version 6.04) is based on the 2,000 foot vertical separation standard applied above FL 290. Some TAs and RAs will occur after RVSM implementation due to TCAS design criteria (Version 6.04) not considering RVSM above FL 290. TCAS software modification, Version 7 addresses known issues and incompatibilities for TCAS operations in the RVSM airspace. The major areas for these modifications are:

- Reducing TA and RA thresholds.
- Permitting Climb or Descend RAs to weaken in slow closure rate encounters.

(3) OPERATING RECOMMENDATIONS. There are certain TCAS and aircraft operating recommendations, that if followed, will minimize the disruptions caused by the issuance of unnecessary TAs and RAs.

Objective: Verify the pilot understands the recommended operating configuration of TCAS in the RVSM airspace and Transition Area and the aircraft operating practices which will minimize the issuance of some unnecessary TAs and RAs.

RECOMMENDED OPERATING PRACTICES:

a. TCAS should be operated in the TA/RA mode during all operations in the RVSM airspace and Transition Areas.

b. Climb and descent rates in the RVSM airspace and Transition Areas should be limited to 1000 fpm when operating within five (5) NM and ± 2000 feet of other aircraft to minimize the generation of TAs and RAs.

(4) Reporting Requirements/Vehicles. After RVSM implementation, data will be collected on the frequency and types of RAs issued in the RVSM airspace and Transition Areas. A key part of these data will be inputs from the pilots.

Objective: Verify pilots are aware of the necessity for reporting RAs and TAs experienced.

Criteria: The pilot must demonstrate a knowledge of the necessity to report the receipt of an RA received in the RVSM airspace and Transition Areas, and how to make these reports.

Information:

a. A written report is needed for all RAs requiring a change in the existing vertical speed while operating in the RVSM airspace and Transition Areas.

b. U.S. operators should forward these reports, in any format, to the TCAS Transition Program (TTP). The use of the standard TTP Pilot Questionnaire is preferred, but not required. Reports can be forwarded to:

Dan Tillotson
M/S PHA
ARINC
2551 Riva Road
Annapolis, Md. 21401-74656

Fax 215-493-0323 Phone: 215-493-8016
Email: DTillots@arinc.com

c. European operators should forward these reports, in any format, to the Eurocontrol Experimental Centre. The use of the existing reporting format is preferred, but not required.

d. Reports on TAs are encouraged, but not required.

4. RECURRENT TRAINING

a. Recurrent training programs should include information that ensures pilots operating TCAS in an RVSM airspace maintain the appropriate level of knowledge concerning the performance of TCAS in this environment.

b. This recurrent training should be integrated into and/or conducted in conjunction with other established recurrent training programs. This training should include discussions of all significant issues identified by the operator or the FAA related to the operation of TCAS in the RVSM airspace and Transition Areas; changes being made to the TCAS logic, parameters, or operating procedures; any unique TCAS characteristics of which pilots should be made aware; and any changes or modifications to aircraft operating procedures.

c. Where recurrent training utilizes flight simulators equipped with TCAS, typical encounters in the RVSM airspace and Transition Areas should be introduced in the course of in-flight training.

ATTACHMENT 1

SAMPLE TCAS/RVSM QUIZ

PURPOSE: It is anticipated that operators will develop material to emphasize specific areas of pilot knowledge. The following quiz is provided for example purposes.

1. TCAS should be operated in the TA Only mode in which of the following areas?
 - a. Transition area at the entry point of the NAT
 - b. Transition area at the exit point of the NAT
 - c. In the NAT
 - d. All of the above
 - e. None of the above

2. If two aircraft are level, a TA will be issued when the two aircraft are within _____ feet (Version 6.04) or _____ feet (Version 7) of each other and one aircraft overtakes the other at an adjacent flight level on the same track.
r
3. An RA will be issued when the vertical separation between two level aircraft is less than _____ feet (Version 6.04) or _____ feet (Version 7). An RA requiring a change in altitude will be issued when the vertical separation between the two level aircraft is less than _____ feet (Version 6.04) or _____ feet (Version 7).

4. When a level aircraft on the same track overtakes an aircraft that is also level at an adjacent flight level in the NAT, an RA will be issued when the overtaking aircraft is _____ miles from the other aircraft.
 - a. 2 NM
 - b. 1.3 NM
 - c. 1 NM
 - d. 1.1 NM

5. Numerous TAs and RAs can be expected in the transition area exiting the NAT.
 - a. True
 - b. False

6. When climbing or descending in either RVSM airspace or the Transition Area while within 5 NM and ± 2000 feet of other aircraft, the vertical speed should be limited to:
 - a. 500 fpm
 - b. 1000 fpm
 - c. 1500 fpm
 - d. 2000 fpm

7. In a typical TCAS event occurring in RVSM airspace or Transition Area, a Climb or Descend RA issued to a level aircraft will be displayed until the aircraft has maneuvered between 500 and 700 feet from the level altitude.
- a. True
 - b. False
8. It is possible for both TAs and RAs to remain displayed for several minutes while operating in RVSM or Transition Area.
- a. True
 - b. False
9. While operating in RVSM and in close proximity to other aircraft, it is possible to receive an RA because of the following conditions. (Circle all that apply)
- a. Overtaking, or being overtaken by, another level aircraft.
 - b. An aircraft climbing or descending to level within 1000 feet of a TCAS-equipped aircraft.
 - c. An aircraft climbing or descending away from a TCAS aircraft.
 - d. Operating in moderate or severe turbulence.
10. In a Transition Area, when two aircraft are in close horizontal proximity to each other and are maneuvering to attain 1000 feet of vertical separation, TCAS may issue an RA while approaching the clearance altitude if the combined vertical speed of the two aircraft is greater than:
- a. 500 fpm
 - b. 1000 fpm
 - c. 1500 fpm
 - d. 2000 fpm
 - e. 2500 fpm
11. When an RA is received, the following actions should be taken: (Circle all that apply)
- a. Follow the RA in accordance with approved procedures
 - b. Broadcast the response to the RA on 131.800 as soon as practical
 - c. Advise the controller of the RA on the appropriate frequency
 - d. Provide a written report for those RAs requiring a change in vertical speed.
12. When your aircraft is level, and another aircraft is climbing or descending to level off with 1000 feet of vertical separation, an RA will be issued when the climbing or descending aircraft is _____ seconds away from your altitude.

CORRECT RESPONSES TO SAMPLE QUIZ

1. e
2. 1200 feet (V. 6.04) or 850 feet (V. 7)
3. 800 feet (V. 6.04) or 700 feet (V. 7) / 700 feet (V. 6.04) or 600 feet (V. 7)
4. d
5. b
6. b
7. a
8. a
9. a, b, and d
10. c
11. a, c, and d
12. 35 seconds

Figure 1. Threat Detection Criteria

