



U.S. Department  
of Transportation  
Federal Aviation  
Administration

# Advisory Circular

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**Subject:** Air Carrier Operational Approval and  
Use of TCAS II

**Date:** 2/23/11

**AC No:** 120-55C

**Initiated by:** AFS-400

**Change:**

**1. PURPOSE.** This advisory circular (AC) provides an acceptable, but not the only, means to address Traffic Alert and Collision Avoidance System (TCAS) issues related to installation and use of TCAS II regarding compliance with Title 14 of the Code of Federal Regulations (14 CFR) parts 121, 125, and 129 requirements for air carriers.

**2. CANCELLATION.** This AC cancels AC 120-55B, Air Carrier Operational Approval and Use of TCAS II, dated August 22, 2001.

**3. APPLICABILITY.** This AC applies to air carriers operating under part 121, other organizations conducting training approved in accordance with part 121 (for example, training centers or aircraft manufacturers), operators under part 125, and foreign air carriers conducting operations in U.S. airspace under part 129. This AC also applies to those air carriers operating under 14 CFR part 135, § 135.180, as well as any aircraft operating under 14 CFR part 91, where the operator chooses to install a TCAS II system meeting Technical Standard Order (TSO)-C119A, TSO-C119B, or TSO-C119C, TCAS II, Traffic Alert and Collision Avoidance System (TCAS) Airborne Equipment. This AC describes the TCAS operational approval process, acceptable methods for TCAS training, acceptable programs for maintenance, operational policies for TCAS use, appropriate actions in the event of a TCAS occurrence, and criteria for foreign operator use of TCAS in U.S. airspace. In addition, this AC addresses commonly asked TCAS questions in order to facilitate timely and consistent application of part 121, § 121.356, part 125, § 125.224, and part 129, § 129.18. It should be noted, however, the international standard for TCAS II, referred to as Airborne Collision Avoidance System (ACAS), includes the latest software version (v 7.0), as detailed by the International Civil Aviation Organization (ICAO).

#### **4. RELATED 14 CFR REGULATIONS.**

- Part 1, §§ 1.1 and 1.2;
  - Part 71, §§ 71.9, and 71.33;
  - Part 91, §§ 91.3, 91.123, 91.213, 91.215, 91.217, 91.219, 91.221, and 91.413;
  - Part 119, §§ 119.7 and 119.49;
  - Part 121, §§ 121.345 and 121.356;
  - Part 125, §§ 125.224;
  - Part 129, §§ 129.11, 129.14, and 129.18; and
  - Part 135, § 135.180.
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**5. DEFINITIONS.** See Appendix 7. For convenience, some definitions are repeated from other pertinent FAA references. Other definitions are unique to this AC and their application is limited to use with TCAS.

**6. RELATED READING MATERIAL.**

**a. Where You Can Find ACs (current editions).** You can find ACs at [http://www.faa.gov/regulations\\_policies/advisory\\_circulars](http://www.faa.gov/regulations_policies/advisory_circulars). Inspectors can also access ACs through the Flight Standards Information Management System (FSIMS) at <http://fsims.avs.faa.gov> (see the link to <http://rgl.faa.gov>). Operators and the public may find this information at <http://fsims.faa.gov> (see the link to <http://rgl.faa.gov>).

(1) AC 20-131, Airworthiness and Operational Approval of Traffic Alert and Collision Avoidance Systems (TCAS II) and Mode S Transponders; and

(2) AC 20-151, Airworthiness Approval of Traffic Alert and Collision Avoidance Systems (TCAS II), Versions 7.0 & 7.1 and Associated Mode S Transponders.

**b. Where to Find TSOs.** You can find TSOs through FSIMS at <http://fsims.avs.faa.gov> (see the link to <http://rgl.faa.gov>).

(1) TSO-C112C, Air Traffic Control radar beacon system (ATCRBS/Mode S) Airborne Equipment; and

(2) TSO-C119A, TSO-C119B, and TSO-C119C, TCAS II Traffic Alert and Collision Avoidance System (TCAS) Airborne Equipment.

**NOTE: TSO-C119A, TSO-C119B, and TSO-C119C are in effect.**

**c. RTCA Technical Standards Documents.** These documents are available online at [www.rtca.org](http://www.rtca.org) or from RTCA Secretariat, 1828 L Street, NW, Suite 807, Washington, D.C. 20036.

(1) RTCA/DO-181D, Minimum Operational Performance Standards for ATCRBS/Mode S Airborne Equipment; and

(2) RTCA/DO-185B, Minimum Operational Performance Standards for Traffic Alert and Collision Avoidance System II (TCAS II) (for TCAS Logic Version 7.1).

**7. BACKGROUND.** Approval of TCAS for FAA type certificate (TC) or Supplemental Type Certification (STC) is comprehensively addressed in AC 20-131 and AC 20-151. This AC provides information for U.S. air carriers, aircraft and TCAS manufacturers, various inspectors, foreign air carriers operating in U.S. airspace, and other aviation organizations regarding standard means acceptable to the FAA to establish and ensure continued compliance with the 14 CFR as related to TCAS. This information is intended to promote timely and comprehensive program implementation, to encourage development of standard practices for the application of TCAS, and to provide for suitable followup to TCAS events.

## 8. APPROVAL TO USE TCAS IN PART 121 OPERATIONS.

### a. General.

(1) The use of TCAS in part 121 operations requires both FAA airworthiness certification and operational approval. Airworthiness certification of TCAS refers to an FAA approval of changes in an aircraft's type design by amendment to a TC or issuance of an STC. Operational approval pertains to changes to training and maintenance programs, manuals, operational procedures, minimum equipment lists (MEL), and other areas necessary for safe and effective TCAS use and the qualification of aircrews through the approved training programs. An airworthiness TC/STC of a TCAS system alone does not constitute operational approval for use of TCAS under the provisions of parts 121 and 135.

(2) The following are responsibilities of various FAA offices regarding TCAS.

(a) FAA Aircraft Certification Offices (ACO) approve changes to a type design or issuance of STCs.

(b) FAA Aircraft Evaluation Groups (AEG) formulate operational criteria for specific aircraft types related to training, checking, maintenance, Master Minimum Equipment Lists (MMEL), or other operational issues, as necessary.

(c) FAA Flight Standards District Offices (FSDO) use information developed by AEG to review a particular operator's programs. FSDOs approve a particular operator's training and maintenance programs, operational procedures, MELs, etc., provided they are consistent with criteria specified in the MMEL, Flight Standardization Board (FSB), Maintenance Review Board (MRB) reports, and policy guidance from the Flight Standards Service (AFS), Air Transportation Division, AFS-200, and the Airworthiness Maintenance Division, AFS-300.

**b. Airworthiness Approval.** Criteria for TCAS airworthiness approval (TC or STC) are addressed by AC 20-131 and AC 20-151. TCAS installations are to be made in accordance with a type design change, an aircraft manufacturer's FAA-approved Service Bulletin (SB), or by an STC.

### c. Operational Approval.

(1) **Approval Criteria.** Operational approvals are based on criteria specified and, if applicable, training, maintenance, MMEL, or other operationally related criteria formulated by AEGs. If the criteria for training or checking are other than as specified, the criteria are available in FSB reports applicable to a particular aircraft type. The MMEL for each aircraft type specifies provisions for dispatch with inoperative equipment. Maintenance requirements are as identified in paragraph 11, except as otherwise described by an MRB report for a specific aircraft type, or in FAA-approved maintenance instructions identified in conjunction with an STC or manufacturer's SB.

(2) **Approval Methods.** Accomplish TCAS operational approval through FAA approval of pertinent training programs, checklists, operations manuals, training manuals, maintenance programs, MELs, or other pertinent documents or document revisions applicable to the particular

air carrier. An operator's TCAS programs are usually approved for each specific aircraft type. However, programs common to one or more types may receive approval if TCAS program elements are common to different aircraft types, such as the same TCAS or procedures.

### **(3) Approval Procedures.**

(a) An FAA principal inspector (PI) issues approval to use TCAS. Operators should make early contact with their respective PIs to ensure timely FAA response. Initiate such contact at the time preparations for TCAS selection or purchase, are underway and generally not later than TCAS TC/STC application.

(b) Operations specifications (OpSpecs) issuance is normally not required for U.S. operators. The FAA reviews, accepts, and approves installations, training, maintenance programs, MELs, and other TCAS program elements in accordance with § 121.356.

## **9. PART 121 FLIGHTCREW QUALIFICATION FOR USE OF TCAS.**

### **a. General.**

(1) **TCAS Qualification.** Air carriers must ensure appropriate flightcrew TCAS qualification. The flightcrew must demonstrate proficiency in the following:

(a) Knowledge of TCAS concepts, systems, and procedures; and

(b) Cognitive, procedural, and motor skills necessary to properly respond to TCAS advisories.

(2) **Acceptable Qualification Methods.** First-time TCAS qualification must be accomplished for each airplane type. Qualification may be accomplished during initial, transition, or upgrade ground and flight training programs with appropriate differences. By this method, TCAS information will be integrated with other curriculum elements and modules. One may also accomplish first-time TCAS qualification as a stand-alone module of ground and flight training. Accomplish recurrent TCAS qualification during recurrent ground and flight training. Recurrent ground training will be a stand-alone module. However, TCAS will be fully integrated with the recurrent flight training during proficiency training (PT) or Line-Oriented Flight Training (LOFT). For first-time and recurrent TCAS qualification, an instructor will accomplish evaluation of TCAS objectives during training. There are no formal TCAS evaluation requirements for flight testing or checking. Include routine TCAS operations in all evaluation environments and check airmen/examiners should include TCAS as a routine discussion item.

(3) **Training Credit.** Principal operations inspectors (POI) may give an operator credit when training is conducted by another operator or training center stand-alone TCAS program for first-time qualification if that program has been approved by the FAA and if aircraft, TCAS system, procedures, and other relevant factors or circumstances are the same or equivalent to those of the operator seeking credit. The POI should consult with the appropriate division of AFS, National Simulator Evaluation Team (NSET), or the assigned AEG about the suitability of a proposed program for a particular version of TCAS or aircraft type.

**b. TCAS Training Program Requirements.**

(1) **Curriculum.** Appendix 6 contains the required areas of instruction for ground training for the first-time TCAS qualification. For subsequent type airplanes and for recurrent training, only the new, revised, or emphasized items need to be addressed. Appendix 6 also contains the objectives and related simulation characteristics required for flight training.

**(2) Evaluation of TCAS Knowledge and Skills (Maneuvers).**

(a) Evaluate TCAS knowledge with written, oral, or computer-based instructional tests. Combinations of these methods may be used if the required body of knowledge is completely covered. For any of these methods, one must achieve a passing grade of 90 percent. First-time qualification in any type airplane must include evaluation of all knowledge areas. For recurrent training, complete coverage of the knowledge requirements must be completed every 36 months.

(b) An instructor must evaluate TCAS skills (maneuvers) for first-time TCAS qualification in each type airplane. This evaluation may be accomplished by an instructor in a qualified flight training device (FTD), simulator, or computer-based instruction (CBI) approved for each maneuver. For recurrent training, maneuver training must include response to all types of RAs during any 36-month training period. Recurrent training is desirable in an FTD or simulator approved for the maneuvers.

(3) **LOFT.** LOFT programs using simulators equipped with TCAS should be enhanced by an interactive TCAS. In addition, LOFT programs should consider proper crew vigilance for aircraft that may not be transponder or Mode C equipped. Advisories accomplished during LOFT are creditable toward first-time or recurrent qualification.

**c. Training Center Approval.** Training centers conducting training, such as contract training or aircraft manufacturers may have TCAS elements of those programs approved if curriculum requirements (ground and flight) provided in Appendix 6 are met.

**d. Initial Evaluation of TCAS Knowledge and Skills.** Evaluate individual crewmember TCAS knowledge and skills prior to TCAS use. Acceptable means of initial assessment include the evaluation by an authorized instructor or check airman using written, computer-based, or oral tests, and a simulator, FTD, or CBI system capable of depicting traffic encounters.

**e. TCAS Recurrent Training.** Integrate TCAS recurrent training into other established recurrent training programs. Recurrent training for TCAS must include both ground and flight (maneuver) and should address any significant issues identified by line Operating Experience (OE), system changes, procedural changes, or unique characteristics such as the introduction of new aircraft/display systems or operations in airspace where high numbers of traffic advisories (TA) and Resolution Advisories (RA) have been reported.

**f. TCAS Recurrent Evaluation.** Incorporate recurrent TCAS as an element of routine proficiency training.

**g. Line Checks and Route Checks.** When using TCAS-equipped aircraft during line or route checks, check airmen should routinely incorporate proper TCAS use as a discussion item.

**h. LOFT.** LOFT programs using simulators equipped with TCAS should be enhanced by interaction with the TCAS. In addition, LOFT programs should consider proper crew vigilance for aircraft which may not be transponder or Mode C equipped.

**i. Crew Resource Management (CRM).** CRM programs should address effective teamwork in responding to TCAS events with emphasis on the following areas:

- (1) The crew should conduct preflight briefings on how to handle TCAS advisories; and
- (2) The proper reaction to a TA by the Pilot Flying (PF) and the pilot monitoring (PM).

## 10. OTHER OPERATIONAL ISSUES.

**a. Manuals and Other Publications.** Airplane flight manuals, operating manuals, maintenance manuals, general policy manuals, other manuals, publications, or written material (such as operating bulletins that may relate to TCAS use) must be appropriately amended to describe TCAS equipment, procedures, and operational policies according to the appropriate regulation.

### **b. MMEL/MEL.**

(1) Operators formulate necessary TCAS revisions to their MELs for each particular fleet (for example, B727, DC10). MEL revisions must be consistent with the FAA MMEL established for each aircraft type. A summary of the process for addressing the necessary changes to MEL items as well as examples of MMEL and acceptable MEL provisions for TCAS are in Appendix 3.

(2) The MMEL changed April 6, 2000, and the relief category changed from C to B for the entire system.

**c. Aircraft with TCAS Differences.** Operators who have aircraft with TCAS differences in displays, controls, procedures, or involved with interchange operations must account for those TCAS differences. Accomplish this as part of an approved differences training program in accordance with § 121.418, or as otherwise specified in applicable FAA FSB reports concerning crew qualification pertaining to a particular airplane type.

**d. Issues Unique to a Particular Operator.** Operators should address any TCAS issues that may be unique to their particular route environment, aircraft, procedures, or TCAS display and control features. Examples include the following:

(1) **Route Environment Issue.** Air carriers having takeoffs or landings outside of the reference TCAS performance envelope (for example, airport elevations outside of the range between sea level and 5,300 feet mean sea level (MSL), or temperatures outside the range of International Standard Atmosphere (ISA) ( $\pm 50^\circ$  F) should advise crews of appropriate procedures and precautions regarding RA compliance. To ensure proper response to the TCAS in

limiting performance conditions (for example, TCAS RA during takeoff climb or in final landing configuration at high altitude airports such as Mexico City and La Paz), specific procedures or training may be necessary, unless a bulletin or manual information can adequately address these situations.

(2) **A Procedural Issue.** Air carriers should describe the use of TA-only mode of operation when required on certain aircraft with an engine failure.

(3) **A Unique TCAS Issue.** Do not use TCAS flight level or absolute display of traffic altitude on a traffic display during operations when the altimeter is set to reference zero feet at field elevation (QFE).

**e. Response to TCAS RA for Aircraft at Maximum Certified Altitude.**

(1) Aircraft not inhibited to climb when at maximum certified altitude should climb in response to TCAS climb RAs.

(2) Aircraft that are climb inhibited from TCAS climbs at maximum certified altitude will be issued a “DO NOT DESCEND” RA.

**11. MAINTENANCE.**

**a. General.** Maintenance procedures for TCAS receive approval or acceptance as part of an operator’s initial maintenance manual approval or as a revision to that manual. TCAS maintenance procedures should be consistent with the TCAS manufacturer’s maintenance procedures and/or aircraft manufacturer’s maintenance procedures for TCAS.

**b. Maintenance Training.** An operator must provide adequate TCAS maintenance training in accordance with the appropriate regulation to ensure that its maintenance personnel or contract maintenance personnel are able to properly implement TCAS-related maintenance programs. This includes, but is not limited to, addressing installation, modification, correction of reported system discrepancies, and use of test equipment, procedures, MEL relief, and return-to-service authorizations. The training procedures should address testing installed transponders and automatic pressure altitude reporting equipment on the ground in such a way that false targets are not generated in airborne TCAS systems. A method for eliminating potential interference with TCAS-equipped aircraft during transponder testing would be the use of shields for the transponder antennas. ACs 20-131 and 20-151 provide more detailed information and guidance concerning the proper procedures to follow when conducting operational testing of TCAS II or transponders on the ground.

**c. TCAS Software Updates.** When necessary, operators should ensure that appropriate TCAS software updates are incorporated. The latest version of software for TCAS II is version 7.1. To ensure compatibility with international standards, the FAA encourages the installation of this software as soon as practical. Software version 6.04A, version 7.0, and version 7.1 are all approved for operations in U.S. airspace.

## 12. TCAS OPERATIONAL USE.

**a. General.** Operationally, those skills addressed and the guidance provided on TCAS training in paragraph 9 should be followed and implemented by each operator electing to use TCAS II.

**NOTE: In no case should a pilot maneuver opposite to a TCAS RA.**

**b. Pilot Responsibilities.** A TCAS is intended to serve as a backup to visual collision avoidance, application of right-of-way rules, and air traffic separation service. For TCAS to work as designed, immediate and correct crew response to TCAS advisories is essential. Delayed crew response or reluctance of a flightcrew to adjust the aircraft's flightpath as advised by TCAS due to air traffic control (ATC) clearance provisions, fear of later FAA scrutiny, or other factors could significantly decrease or negate the protection afforded by TCAS. Flightcrews should respond to a TCAS in accordance with the following guidelines when responding to alerts:

(1) Respond to TAs by attempting to establish visual contact with the intruder aircraft and other aircraft which may be in the vicinity. Coordinate to the degree possible with other crewmembers to assist in searching for traffic. Do not deviate from an assigned clearance based only on TA information. For any traffic acquired visually, continue to maintain safe separation in accordance with current regulations and good operating practices.

(2) When an RA occurs, the PF should respond immediately by direct attention to RA displays and maneuver as indicated, unless doing so would jeopardize the safe operation of the flight or the flightcrew can assure separation with the help of definitive visual acquisition of the aircraft causing the RA. By not responding to an RA, the flightcrew effectively takes responsibility for achieving safe separation. In so choosing, consider the following cautions:

(a) The traffic may also be equipped with TCAS and it may maneuver in response to an RA coordinated with your own TCAS.

(b) The traffic acquired visually may not be the same traffic causing the RA.

(c) Visual perception of the encounter may be misleading. Unless it is unequivocally clear that the target acquired visually is the one generating the RA and there are no complicating circumstances, the pilot's instinctive reaction should always be to respond to RAs in the direction and to the degree displayed.

(3) Satisfy RAs by disconnecting the autopilot (if necessary) and auto throttle system, (when required by the airframe manufacturer's procedures), and using prompt positive control inputs in the direction and with the magnitude the TCAS advises. To achieve the required vertical rate (normally 1,500 feet per minute (fpm) climb or descent), first adjust the aircraft's pitch using the suggested guidelines shown in the table below. Then refer to the vertical speed indicator (VSI) and make all necessary pitch adjustments to place the VSI in the green arc.

<b>SPEED</b>	<b>PITCH ADJUSTMENT</b>
.80 MACH	2°
250 knots indicated airspeed (KIAS) below 10,000 feet	4°
APPROACH below 200 KIAS	5° to 7°

(a) On aircraft with pitch guidance for TCAS RA displays, follow the RA pitch command for initial, increase, reversal, and weakening RAs.

(b) For the TCAS to provide safe vertical separation, initial Vertical Speed (VS) response is required within 5 seconds of when the RA is first displayed. Excursions from assigned altitude, when responding to an RA, typically should be no more than 300 to 500 feet to satisfy the conflict. VS responses should be made to avoid red arcs or outlined pitch avoidance areas and, if applicable, to accurately fly to the green arc or outlined pitch guidance area.

(4) Respond immediately to any increase or reversal RA maneuver advisories. Initial VS response to an increase or reversal RA is expected by the TCAS within 2 1/2 seconds after issuance of the advisory. Again, avoid red arcs or outlined pitch avoidance areas and fly to the green arc or outlined pitch guidance area.

(5) The PM should advise the PF on the progress of achieving the vertical rates commanded by the TCAS. The PM and any onboard observers will assist in the visual search for the intruder and continue to cross-check the TCAS displayed information with other available traffic information to ensure the RA response is being flown correctly.

(6) If an initial corrective RA is downgraded or weakened, such as a “climb” RA downgraded to a “do not descend” RA, pilots should respond to the weakening RA and adjust the aircraft’s VS to the rate depicted by the green (fly to) arc or line on the instantaneous VS indicator (IVSI) or other suitable indicator, while keeping the needle or pitch guidance symbol out of the red arc or outlined pitch avoidance area. Pilots should remember that attention to the RA display and prompt reaction to the weakened RA will minimize altitude excursions and potential disruptions to ATC. This will allow for proper resolution of encounters and reduce the probability of additional RAs against the intruder or other traffic.

(7) Evasive maneuvering must be limited to the minimum required to comply with the RA. Excessive responses to RAs are not desirable or appropriate because of other potential traffic and ATC consequences. From level flight, proper response to an RA typically results in an overall altitude deviation of 300 to 500 feet in order to successfully resolve a traffic conflict.

(8) In some instances it may not be possible to respond to a TCAS RA and continue to satisfy a clearance at the same time. Even if a TCAS RA maneuver is inconsistent with the current clearance, respond appropriately to the RA. Since TCAS tracks all transponder-equipped aircraft in the vicinity, responding to an RA for an intruder assures a safe avoidance maneuver from that intruder and from other Mode C equipped aircraft. Guidance in this paragraph does not conflict with that in paragraph 12b(2).

(9) If a TCAS RA requires maneuvering contrary to right of way rules, cloud clearance rules for visual flight rules (VFR), instrument flight rules (IFR), or other such criteria, pilots

should follow the TCAS RAs to resolve the immediate traffic conflict. Deviations from rules or clearances should be kept to the minimum necessary to satisfy a TCAS RA.

(10) If a TCAS RA response requires deviation from an ATC clearance, expeditiously return to the current ATC clearance when the traffic conflict is resolved, the TCAS “clear of conflict” message is heard, or follow any subsequent change to clearance as advised by ATC. In responding to a TCAS RA that directs a deviation from assigned altitude, communicate with ATC as soon as practicable after responding to the RA. When the RA is cleared, the flightcrew should advise ATC that they are returning to their previously assigned clearance or should acknowledge any amended clearance issued. In addition, the flightcrew’s discretionary use of other types of reports may be desired. See Appendix 5 for suggested phraseology.

(11) If a TCAS RA maneuver is contrary to other critical cockpit warnings, then those other critical warnings are respected as defined by TCAS certification and training (that is, responses to stall warning, windshear, and ground proximity warning system (GPWS) take precedence over a TCAS RA, particularly when the aircraft is less than 2,500 feet above ground level (AGL)).

(12) Pilots should use TCAS traffic information displays to increase their awareness of nearby traffic and to assist in establishing visual contact with other aircraft. Certain electronic flight information system (EFIS) TCAS installations operating in conjunction with “track up” mode may require the pilot to make allowances for the difference between the aircraft heading and track when visually sighting nearby aircraft.

(13) Unless approved by the Administrator, pilots should operate TCAS while in-flight in all airspace, including oceanic, international, and foreign airspace.

(14) When feasible, flightcrews should use the same altitude data source used by the PF to provide altitude information to TCAS and the ATC transponders. Using a common altitude source precludes unnecessary RAs due to differences between altitude data sources.

(15) Note and accurately report TCAS encounters and system anomalies in accordance with operator policies so that remedial improvements to TCAS or the National Airspace System (NAS) can be made.

**NOTE: ARINC operates a Web-based data collection scheme on behalf of the FAA. The Web site can be found at [www.tcasreport.com](http://www.tcasreport.com).**

(16) The TCAS does not alter or diminish the pilot’s basic authority and responsibility to ensure safe flight. Since the TCAS does not respond to aircraft which are not transponder equipped or aircraft with a transponder failure, a TCAS alone does not ensure safe separation in every case. TCAS RAs may, in some cases, conflict with flight path requirements due to terrain, such as an obstacle-limited climb segment or an approach to rising terrain. Since the basis for many approved instrument procedures and IFR clearances is avoiding high terrain or obstacles, it is particularly important that pilots maintain situational awareness (SA) and continue to use good operating practices and judgment when following TCAS RAs. Pilots should make frequent outside visual scans while using see-and-avoid techniques. Communication with ATC should be initiated as necessary.

**c. Consequences of Disregarding RA Information.** The potential consequences of disregarding RA information include:

(1) An aircraft seen visually may not necessarily be the aircraft causing the RA or may not be the only aircraft to which TCAS is responding.

(2) It is difficult to visually determine the vertical displacement of other aircraft especially when ground reference information is unreliable or at cruise altitudes where the earth's horizon is obscured. Therefore, disregarding RA information and maneuvering vertically based solely on visual acquisition may result in a loss of safe separation.

(3) ATC may not know when TCAS issues RAs. It is possible for ATC to unknowingly issue instructions that are contrary to the TCAS RA indications. Safe vertical separation may be lost during TCAS coordination when one aircraft maneuvers opposite the vertical direction indicated by TCAS and the other aircraft maneuvers as indicated by TCAS. As a result, both aircraft may experience excessive altitude excursions in vertical chase scenarios due to the aircraft maneuvering in the same vertical direction. Accordingly, during an RA, do not maneuver contrary to the RA based solely upon ATC instructions.

(4) ATC may not be providing separation service or be communicating with the aircraft causing the RA.

(5) Disregarding RA during a coordinated encounter with another TCAS-equipped aircraft can result in loss of safe separation.

**d. TCAS Good Operating Practices.** The following are identified TCAS good operating practices:

(1) To preclude unnecessary transponder interrogations and possible interference with ground radar surveillance systems, do not activate TCAS (TA-only or TA/RA mode) until taking the active runway for departure. A transponder selected to "XPDR" or "ON" is adequate for ATC and nearby Automatic Dependent Surveillance-Broadcast (ADS-B)-equipped aircraft to "see" the aircraft while taxiing on the airport surface.

(2) Following landing and clearing of the runway, de-select TCAS from TA or TA/RA mode. Select "XPDR" or "ON" while taxiing to the ramp area. Upon shutdown, select "STBY" on the transponder.

(3) During flight, use TCAS displays to enhance SA. Use displays which have a range selection capability in an appropriate range setting for the phase of flight. For example, use minimum range settings in the terminal and longer ranges for climb/descent and cruise as appropriate.

(4) Note that TCAS RAs can be generated while aircraft are legally separated.

(5) It is appropriate to operate TCAS in the TA-only mode in circumstances where unnecessary RAs frequently occur and where such RAs are disruptive to the operation of the aircraft. These circumstances may include:

(a) During takeoff towards known nearby traffic that is in visual contact and which could cause an unwanted RA during initial climb, such as a visually identified helicopter passing near the departure end of the runway. Select the TA/RA mode after the potential for an unwanted RA ceases to exist, such as after climbing above a known VFR corridor.

(b) In instrument or visual conditions during approaches to closely spaced parallel runways.

(c) In visual conditions, when flying in close proximity to other aircraft.

(d) At certain airports, during particular procedures, or in circumstances identified by the operator as having a significant potential for unwanted or inappropriate RAs.

(e) In the event of particular in-flight failures, such as engine failure, as specified by the Aircraft Flight Manual (AFM) or operator.

(f) During takeoffs or landings outside of the nominal TCAS reference performance envelope for RAs, as designated by the AFM or operator. TCAS reference performance for RAs is typically attainable during takeoffs and landings at airports within the envelope of ISA  $\pm 50^{\circ}\text{F}$ , sea level to 5,300 feet MSL. When takeoffs or landings are outside of this envelope, use of a TA only may be appropriate during the limited time period when TCAS reference performance cannot be achieved. This typically occurs when the aircraft is at low speed in specified limiting configurations during takeoff or landing at hot day high altitude airports, such as Mexico City or La Paz.

(6) When safe, practical, and in accordance with the air carrier's approved operating procedures, pilots should limit VS to 1,500 fpm or less when within 2,000 feet of assigned altitudes. This procedure will reduce the frequency of unnecessary RAs and be in conformance with the Aeronautical Information Manual (AIM) and ICAO guidance.

**e. Operator Responsibilities.** Operators have the following general responsibilities regarding TCAS:

(1) Assure followup and evaluation of unusual TCAS events; and

(2) Periodically assess TCAS training, checking, and maintenance programs to ensure their correctness, pertinence, timeliness, and effectiveness.

**f. ATC Responsibilities.** Highlighted below are ATC responsibilities relating to TCAS.

(1) Controllers will not knowingly issue instructions that are contrary to RA guidance when they are aware that a TCAS maneuver is in progress. When an aircraft deviates from its clearance in response to an RA, ATC is still responsible for providing assistance to the deviating aircraft as requested until:

(a) The pilot informs ATC that the RA conflict is clear; and the aircraft has returned to the previously assigned altitude; or

(b) Alternate ATC instructions have been issued and acknowledged.

**NOTE: See Appendix 5 for suggested phraseology.**

(2) Workload permitting, controllers may continue to provide pertinent traffic information in accordance with the current edition of FAA Order 7110.65, Air Traffic Control.

(3) Maintain awareness of TCAS programs and program changes.

(4) Train ATC specialists on TCAS and expected flightcrew responses to TCAS advisories and provide familiarization flights for specialists on TCAS-equipped aircraft to the extent possible.

(5) When requested by the flightcrew, and if appropriate, provide separation from TCAS observed traffic and assistance in returning to the assigned clearance. Issue additional clearance instructions when the situation so requires.

(6) Advise pertinent FAA offices, such as a FSDO, via TCAS questionnaires about airspace or airports where excessive numbers of RAs occur. This facilitates initiation of corrective actions related to TCAS enhancements, TCAS procedures, and airspace adjustments. Forward the information to [www.tcasreport.com](http://www.tcasreport.com).

(7) Advise the FAA if you become or are aware of other hazardous conditions, situations, or events possibly related to TCAS.

### **13. TCAS EVENT REPORTING.**

**NOTE: ARINC operates a Web-based data collection scheme on behalf of the FAA. The Web site can be found at [www.tcasreport.com](http://www.tcasreport.com).**

**a. General.** Operators and manufacturers are encouraged to develop procedures to ensure effective identification, tracking, and followup of significant TCAS-related events, as appropriate. Such procedures should focus on providing useful information to:

(1) Properly assess the importance of TCAS events;

(2) Follow up on information related to specific TCAS events, as necessary; and

(3) Keep the industry and the FAA informed of the performance of TCAS in the NAS and in international operations.

#### **b. Pilot Reports.**

(1) **TCAS-Specific Reports.** Pilots should make the following reports for TCAS RAs, as necessary.

(a) Upon query from ATC, or after a deviation from an ATC clearance, make radio communications as appropriate to report a response to a TCAS advisory. Refer to section 4 of the AIM, ATC Clearance/Separations, for guidance, and Appendix 5 for recommended phraseology.

(b) Reports, as specified by the operator, concerning TCAS anomalies, procedural difficulties, or system failures typically are made by pilots through one or more of the following methods:

- Pilot/observer questionnaire;
- Logbook entry and Aircraft Communications Addressing and Reporting System (ACARS), etc.; or
- Other record used by that operator, such as a captain's report. An example of a typical reporting form for TCAS event information is shown in Appendix 2.

## (2) Other Reports Incidental to TCAS.

(a) **Near Midair Collision (NMAC) Reports.** Flightcrews should continue to submit NMAC reports in accordance with existing policies and procedures. Crews should be aware that there is no requirement to submit an NMAC report solely due to a TCAS event and that a TCAS report does not constitute an NMAC report.

(b) **ATC Clearances and Instructions Reports.** Unless required due to other circumstances, reports in compliance with § 91.123, compliance with ATC clearances and instructions reports, regarding emergency deviation from an ATC clearance are not necessary solely as a result of a TCAS maneuver.

(c) **Aviation Safety Reporting System (ASRS) Reports.** The flightcrew may file ASRS reports at their discretion.

(d) **National Transportation Safety Board (NTSB) Mandatory Reports.** As of March 8 2010, new rules add the following to the list of reportable events that require immediate notification of the NTSB Airborne Collision and Avoidance System (ACAS) RAs issued either:

1. When an aircraft is being operated on an IFR flight plan and compliance with the advisory is necessary to avert a substantial risk of collision between two or more aircraft; or
2. To an aircraft operating in Class A airspace.

c. **Maintenance Personnel Reports.** Maintenance personnel should report TCAS problems that relate to system performance, manufacturers, and/or vendors to the appropriate principal avionics inspector (PAI).

d. **FAA ATC.** Report the following:

- (1) TCAS events to FSDOs, as necessary; and
- (2) Any significant TCAS-related events regarding NAS performance to the Air Traffic Procedures Division, AJP-100, Washington, D.C.

e. **TCAS Manufacturer Reports.** TCAS avionics manufacturers report problems found with specific TCAS systems in accordance with established Service Difficulty Report (SDR) procedures. Report generic problems, such as those that may relate to the definition of collision

avoidance system algorithms as defined by RTCA/DO-185, to the Aircraft Engineering Division, AIR-100, Washington, D.C.

**14. FAA RESPONSE TO TCAS EVENTS.** Regarding regulatory compliance issues, the FAA will not initiate enforcement action solely on the basis of a TCAS event. Letters of investigation will not be sent to pilots involved in a TCAS-related deviation provided:

**a. Aircrafts Equipped with TCAS.** The aircraft was equipped with TCAS, the system was operable, and the equipment was turned on at the time of the event;

**b. Compliance with ATC Clearances.** The pilots have properly operated their aircraft in compliance with ATC clearances prior to the TCAS-related deviation;

**c. Compliance with TCAS Training.** The pilots have successfully completed their air carrier's FAA-approved TCAS training program; and

**d. Compliance with § 91.123.** The pilots have otherwise complied with the requirements of § 91.123.

#### **15. FOREIGN AIR CARRIERS.**

**a. General.** Section 129.18 requires TCAS II installation and use by certain foreign air carriers when operating in U.S. airspace. Foreign air carriers are not required to install and use TCAS for any aircraft or operations taking place outside of the U.S. 12 NM territorial limit (§ 71.9), even though separation services may be provided by a U.S. ATC facility (for example, in oceanic airspace). Various states may abide by ICAO guidance found in ACAS Standards and Recommended Practices (SARPS).

**(1) TCAS Approval for Foreign Air Carriers.** The FAA does not approve TCAS installation, training programs, MELs, or maintenance programs for foreign operators operating non-U.S.-registered aircraft. Such authorizations are addressed as specified by the State of Operator or by ICAO. However, since compatibility of TCAS and Mode S transponders with other aircraft and NAS facilities within U.S. airspace is essential, the FAA issues part 129 operations guidelines for TCAS to all foreign air carrier operations within U.S. airspace. Compliance with these TCAS provisions ensures both TCAS system and procedural compatibility. The issuance of OpSpecs, or an amendment to existing OpSpecs for TCAS, must take place before a foreign air carrier operating a TCAS-equipped aircraft in U.S. airspace, in accordance with § 129.18. Standard provisions for foreign air carriers for TCAS are shown in Appendix 4.

**(2) Guidance.** Guidance for foreign air carriers operating under part 129 applies to non-U.S.-registered aircraft as well as U.S.-registered aircraft flying in U.S. airspace. The plan of State of Registry for U.S.-registered aircraft operated by foreign operators is, for practical purposes, that of the U.S. or the same as that for any U.S. operator in order to meet the requirements of § 129.14.

**b. Application and Approval.** Foreign air carriers should contact their FAA POI to obtain application information for part 129 TCAS OpSpecs. When a foreign air carrier submits the necessary information to the respective PI showing that its aircraft is in compliance, the PI may approve those OpSpecs or an amendment. Standard OpSpecs provisions regarding TCAS for foreign air carriers are shown in Appendix 4. Although not mandatory, foreign operators should comply with the provisions, or equivalent provisions specified by the State of Operator or specified by ICAO.

/s/  for

John M. Allen  
Director, Flight Standards Service

**APPENDIX 1. ACRONYMS AND ABBREVIATIONS**

14 CFR	Title 14 of the Code of Federal Regulations
ACARS	Aircraft Communications Addressing and Reporting System
ACAS	Airborne Collision Avoidance System
AC	Advisory Circular
ACO	Aircraft Certification Office
AD	Airworthiness Directive
ADS-B	Automatic Dependant Surveillance-Broadcast
AEG	Aircraft Evaluation Group
AFM	Aircraft Flight Manual
AFS	Flight Standards Service (FAA)
AGL	Above Ground Level
AHRS	Attitude and Heading Reference System
AIM	Aeronautical Information Manual
AIR	Aircraft Certification Service (FAA)
ALIM	Altitude Limit
AP	Autopilot
ASRS	Aviation Safety Reporting System
ARINC	Aeronautical Radio Incorporated
ATCRBS	ATC radar beacon system
ATC	Air Traffic Control
ATP	Air Traffic Procedures Division (FAA)
CAA	Civil Aviation Authority
CBI	Computer-Based Instruction
CFR	Code of Federal Regulations
CHDO	Certificate-Holding District Office
CPA	Closest Point of Approach
CRM	Crew Resource Management
DME	Distance Measuring Equipment
EFIS	Electronic Flight Instrument System
FAA	Federal Aviation Administration
FOEB	Flight Operation Evaluation Board
fpm	Feet Per Minute
FSB	Flight Standardization Board
FSDO	Flight Standards District Office
FTD	Flight Training Device
GPWS	Ground Proximity Warning System
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IRS	Inertial Reference System
ISA	International Standard Atmosphere
IVSI	Instantaneous Vertical Speed Indicator
KIAS	Knots Indicated Air Speed
LOFT	Line-Oriented Flight Training
MEL	Minimum Equipment List
MMEL	Master Minimum Equipment List

MRB	Maintenance Review Board
MSL	Mean Sea Level
NAS	National Airspace System
NM	Nautical Mile
NMAC	Near Midair Collision
NSET	National Simulator Evaluation Team
OE	Operating Experience
OpSpec	Operations Specification
PAI	Principal Avionics Inspector
PF	Pilot Flying
PI	Principal Inspector
PM	Pilot Monitoring
PMI	Principal Maintenance Inspector
POI	Principal Operations Inspector
PRM	Parallel Runway Monitor
PT	Proficiency Training
QFE	Altimeter Reference to Zero Feet at Field Elevation
RA	Resolution Advisory
RTCA	Formerly known as Radio Technical Commission for Aeronautics
SARPS	Standards and Recommended Practices (ICAO)
SB	Service Bulletin
SDR	Service Difficulty Report
STC	Supplemental Type Certificate
TA	Traffic Advisory
TC	Type Certificate
TCAS	Traffic Alert and Collision Avoidance System
TTP	TCAS Transition Programming
TSO	Technical Standard Order
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
VSI	Vertical Speed Indicator
XPDR	Transponder
ZTHR	Altitude Threshold

## APPENDIX 2. SAMPLE TCAS EVENT REPORTING INFORMATION TCAS MONITORING PROGRAM

### Pilot Event Questionnaire

The FAA and the airline industry have established the TCAS Transition Program to assess the operational acceptability of TCAS in the NAS. Your participation in the program is essential to the success of the program. Please complete and return this questionnaire as quickly as possible. The information contained herein will be used only by the program participants to assess the operation of TCAS and will not be released to the public in a manner which allows the identification of you or the airline. The information *WILL NOT* be used to initiate or pursue enforcement action against you or the crew. Once the data is entered into the TCAS Transition Programming (TTP) databases the questionnaire will be maintained for no longer than 60 days, at which time it will be destroyed. Please fill out the form in full and check all that apply. NOTE: TCAS events may be reported electronically at [www.tcasreport.com](http://www.tcasreport.com).

DATE: \_\_\_\_\_ TIME: \_\_\_\_\_ UTC AIRLINE: \_\_\_\_\_ FLIGHT #: \_\_\_\_\_  
 \_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_  
 A/C TYPE: \_\_\_\_\_ TAIL NUMBER: \_\_\_\_\_ ORIGIN: \_\_\_\_\_ DESTINATION: \_\_\_\_\_  
 \_\_\_\_\_  
 OWN ALTITUDE: \_\_\_\_\_ OWN POSITION: \_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_  
 FT  
 PHASE OF FLIGHT  DEPARTURE (TAKEOFF TO 10,000 FT)  CLIMB (10,000 FT TO TOC)  
 CRUISE  DESCENT (TOC TO 10,000 FT)  APPROACH (BELOW 10,000 FT)  
 TCAS DISPLAY RANGE SETTING:  5 NM  10 NM  20 NM  30 NM  OTHER \_\_\_\_\_ NM  
 VOR RADIAL DME

#### INTRUDER AIRCRAFT

ID (IF KNOWN): \_\_\_\_\_ TCAS-EQUIPPED (IF KNOWN)?  YES  NO  
 RELATIVE ALTITUDE AT TA: \_\_\_\_\_ FT CLOCK POSITION: \_\_\_\_\_ EST. RANGE AT TA: \_\_\_\_\_ NM  
 WERE MULTIPLE TAs (AURALs) ISSUED ON THE SAME AIRCRAFT?  YES  NO IF YES HOW MANY? \_\_\_\_\_  
 RELATIVE ALTITUDE AT RA: \_\_\_\_\_ FT CLOCK POSITION: \_\_\_\_\_ EST. RANGE AT RA: \_\_\_\_\_ NM  
 WERE MULTIPLE RAs ISSUED ON THE SAME AIRCRAFT?  YES  NO IF YES HOW MANY? \_\_\_\_\_  
 ESTIMATED CLOSEST PROXIMITY RANGE \_\_\_\_\_ NM ALTITUDE \_\_\_\_\_ NM

**INITIAL RA ISSUED**  CLIMB, CLIMB  CLIMB, CLIMB, CLIMB  DESCEND, DESCEND  
 LEVEL OFF, LEVEL OFF  DESCEND, DESCEND, DESCEND  CLIMB, CROSSING CLIMB  DESCEND, CROSSING DESCEND  
 ADJUST VERTICAL SPEED, ADJUST  REDUCE CLIMB, REDUCE CLIMB  REDUCE DESCENT, REDUCE DESCENT  
 MONITOR VERTICAL SPEED  MAINTAIN VERTICAL SPEED, MAINTAIN  MAINTAIN VERTICAL SPEED, CROSSING MAINTAIN  ADJUST VERTICAL SPEED, ADJUST

#### DID THE INITIAL RA CHANGE ANY OF THE FOLLOWING?

ADJUST VERTICAL SPEED, ADJUST  INCREASE CLIMB, INCREASE CLIMB  INCREASE DESCENT, INCREASE DESCENT  
 CLIMB, CLIMB, NOW  DESCEND, DESCEND NOW  LEVEL OFF, LEVEL OFF

#### TYPE OF RA DISPLAY IN YOUR AIRCRAFT

IVSI  PITCH CUES  VERTICAL SPEED TAPE

FOR THE ENCOUNTER, PLEASE INDICATE THE SEQUENCE OF EVENTS (E.G., ATC ADVISORY 1, VISUAL CONTACT 2, TA 3, RA 4)

ATC ADVISORY: \_\_\_\_\_ TA: \_\_\_\_\_ RA: \_\_\_\_\_ VISUAL CONTACT: \_\_\_\_\_

WAS THE RA

FOLLOWED:  YES  NO NECESSARY FOR THE SITUATION:  YES  NO

CONFLICT WITH ATC INSTRUCTIONS:  YES  NO RESULT IN A CLEARANCE DEVIATION:  YES  NO

IF YES, WHAT WAS THE DEVIATION? \_\_\_\_\_ FT

REMARKS: (PLEASE PROVIDE COMMENTS/CONCERNS ON THIS ENCOUNTER)

\_\_\_\_\_

\_\_\_\_\_



### APPENDIX 3. TCAS MEL AND MMEL PROVISIONS

**1. DISPATCHING WITH MEL PROVISIONS.** Each operator with authority to dispatch an aircraft with a TCAS system or component temporarily inoperative must do so in accordance with provisions of a MEL. MELs are approved for each operator and type of aircraft, within provisions of the FAA MMEL for that type. When proposed MEL provisions are consistent with the FAA MMEL, POIs may approve the MEL. If requesting a less restrictive MEL or different MEL provisions, forward a proposal for consideration of an FAA MMEL change to the AEG assigned for that aircraft type. No relief will be granted for the voice command portion of the TCAS system when functioning in the TA-only mode. The audio will be provided via a speaker, which may also service windshear and ground proximity equipment. Enhanced features (those above and beyond the basic TCAS system) may be inoperative provided that the inoperative features do not degrade the system (for example, flight level traffic altitude selection feature for a traffic display).

**2. BACKGROUND.** The intent of the provisos and repair category intervals was to grant the operator sufficient relief, especially during the early stage of the TCAS transition, in order to promote the installation process, as well as support the use of a practical system. Both equipment reliability and operational experience dictated whether any revision to the MMEL relief was considered.

**3. REVISIONS.** The original Policy Letter 32 in the automated MMEL system outlined policy for TCAS II. On April 6, 2002 MMEL Policy Letter 32, revision 5 was issued as updated guidance to the FOEB for standardized MMEL relief for the TCAS. The most significant change in revision 5 is to change the relief category from C to B for the entire system when required by 14 CFR.

**4. EXAMPLES.** The following list is the standard set of provisos for all aircraft for which one grants relief for the TCAS I and II systems and it is extracted from MMEL Policy Letter 32, revision 7, dated July 7, 2006:

**TCAS MEL AND MMEL PROVISIONS**

TCAS I	B   -   O	(M) (O) May be inoperative provided: a) System is deactivated and secured; and b) Enroute or approach procedures do not require its use.
	C   -   O	(M) (O) May be inoperative provided: a) Not required by 14 CFR; b) System is deactivated and secured; and c) Enroute or approach procedures do not require its use.
TCAS II	B   -   O	(M) May be inoperative provided: a) System is deactivated and secured; and b) Enroute or approach procedures do not require its use.
	C   -   O	(M) (O) May be inoperative provided: a) Not required by 14 CFR; b) System is deactivated and secured; and c) Enroute or approach procedures do not require its use.
1) Combined TA and RA Dual Display System(s)	C   2   1	May be inoperative on the non-flying pilot side provided: a) TA and RA visual display is operative on the flying pilot side; and b) TA and RA audio function is operative on the flying pilot side.
2) RA Display System(s)	C   2   1	May be inoperative on non-flying pilot side:
	C   -   O	(O) May be inoperative provided: a) TA visual display and audio functions are operative; b) TA-only mode is selected by the crew; and c) Enroute or approach procedures do not require its use.
3) Traffic Alert Display System(s)	C   -   O	(O) May be inoperative provided: a) RA visual display and audio functions are operative; and b) Enroute or approach procedures do not require its use.
4) Audio Functions	B   1   O	a) Enroute or approach procedures do not require use of TCAS.

**APPENDIX 4. 14 CFR PART 129 PROVISIONS FOR USE OF TCAS IN U.S. AIRSPACE**

- 1. MODE S TRANSPONDERS.** An appropriate Mode S transponder must be installed and operated on a suitable code specified by ATC during flight in U.S. airspace. In addition, a valid unique aircraft-specific Mode S address must be assigned to the airplane, and the Mode S transponder must be set to this address. Valid addresses are those consistent with the ICAO Mode S address allocation plan contained in Appendix C, part I, ICAO Annex 10, and plan of the State of Registry for the specific aircraft. The unique address, when properly set, may not be altered, set to a duplicated address, or set to an address that potentially interferes with ATC or TCAS safety functions (for example, must not be set to all ones or all zeros, or the country address must not be set without the unique aircraft specific address). This guidance is appropriate for non-U.S.-registered or U.S.-registered aircraft operated by a foreign air carrier in U.S. airspace.
- 2. REQUIREMENTS.** A TCAS II System capable of coordinating with TCAS units meeting TSO-C119A, TSO-C119B, or TSO-C119C must be installed. Except as provided for by MEL provisions acceptable to the State of Operator, the TCAS system must be operated in an appropriate TCAS mode during flight in U.S. airspace.
- 3. STANDARDIZATION.** Training and procedures for use of TCAS as specified by ICAO, this AC, or other equivalent criteria acceptable to the FAA must be used when operating in U.S. airspace.
- 4. UNSAFE CONDITIONS.** Report unsafe conditions or performance related to TCAS operation which potentially could affect continued safe operations in the U.S. NAS to the FAA POI within 10 business-days of identifying such a hazard.



**APPENDIX 5. PHRASEOLOGY FOR TCAS EVENTS**

**1. RADIO COMMUNICATION.** In order to keep everyone informed during a TCAS maneuver, radio communication should be in terminology common to all parties on the frequency regarding a TCAS RA. All transmissions should contain:

- Name of the ATC facility,
- Aircraft identification (ID), and
- Nature of the TCAS deviation.

**2. TCAS RAs.** When a flightcrew receives a TCAS RA to either climb or descend from their assigned altitude, or the RA otherwise affects their ATC clearance, the crew should inform ATC when beginning the excursion from clearance or as soon as workload allows in the following manner:

- “XYZ Center, (Aircraft ID), TCAS RA.”
- Example: “New York Center, Quantum 321, TCAS RA.”

**3. SEPARATION.** Following such a communication, the designated air traffic facility is not required to provide approved standard separation to the TCAS maneuvering aircraft until the TCAS encounter is cleared and standard ATC separation is achieved. If workload permits, traffic information should be provided in accordance with the current edition of FAA Order 7110.65, Air Traffic Control. When the RA is clear, the flightcrew should advise ATC that they are returning to their previously assigned clearance or subsequent amended clearance in the following manner:

- “ABC Center, (Aircraft ID), clear of conflict, returning to assigned altitude.”
- Example: “Boston Center, Northern 429, clear of conflict, returning to assigned altitude.”

**4. RENEGOTIATED CLEARANCES.** When the deviating aircraft has renegotiated its clearance with ATC, the designated air traffic facility should resume providing appropriate separation services in accordance with FAA Order JO 7110.65.

**NOTE: No communication is required if the pilot is able to satisfy the RA guidance and maintain the appropriate ATC clearance.**



**APPENDIX 6. TCAS II GROUND AND FLIGHT TRAINING REQUIREMENTS**

**1. INTRODUCTION.** This appendix provides a set of training standards for TCAS II pilot training. The information contained in this appendix related to TAs is also applicable to TCAS I users. Training standards are divided into areas of instruction required for ground training (academics) and the performance objectives for the maneuvers required in flight training.

**2. TCAS GROUND TRAINING.** Ground training must cover the following areas:

**a. General Concepts of TCAS Operation.** TCAS ground training should cover, in general terms, TCAS theory to the extent appropriate to ensure proper operational use. Aircrews should understand basic concepts of TCAS logic, closest point of approach (CPA), tau, altitude separation thresholds for the issuance of RAs, as well as the relationship between displayed traffic information and issuance of TAs and RAs. The ground training program should address the following:

- (1) The meaning of TAs and preventive versus corrective RAs;
- (2) Increase, reversal, crossing, and weakened RAs;
- (3) That TCAS II assures separation from aircraft equipped with an altitude reporting transponder;
- (4) The detection and protection provided by TCAS against altitude reporting and nonaltitude reporting intruders;
- (5) That the system detects multiple aircraft;
- (6) TCAS-to-TCAS coordination;
- (7) The potential impact of not following RAs;
- (8) TCAS surveillance range versus display range;
- (9) When an intruder will not be displayed;
- (10) TCAS onground performance; and
- (11) The continued applicability of the see-and-avoid concept.

**b. Expected Flightcrew Response and Level of Protection Provided by TCAS.** Academic training should explain the normal, expected pilot response to TAs, RAs, use of displayed traffic information to establish visual contact, and constraints on maneuvering based solely on TAs.

**c. TCAS General Limitation.** There are several system, operational, and/or performance limitations which should be understood that apply to all aircraft types. System limitations include the inability of TCAS to detect nontransponder-equipped aircraft, no RAs issued for traffic without an altitude reporting transponder, etc. Operational limitations include some RA inhibit

altitudes, certain RAs being inhibited by aircraft performance constraints, the inability to comply with an RA due to aircraft performance limitations after an engine failure, and appropriate response to RAs in limiting performance conditions, such as during heavy weight takeoff or while en route at maximum altitude for a particular weight.

**d. ATC Communication and Coordination.** Training should discuss communication and coordination with ATC related to or following a TCAS event, when to contact ATC, and accepted TCAS phraseology.

**e. TCAS Equipment Components Controls, Displays, Audio Alerts, and Annunciations.** Academic training should include a discussion of TCAS terminology, symbology, operation, and optional controls and display features, including any items particular to an air carrier's implementation or unique to its system.

**f. Interfaces and Compatibility with Other Aircraft Systems.** Training should discuss the role of the Mode S transponder with a correct, discreet address installed, radar altimeter inputs to TCAS, and weather radar/EFIS interfaces, including any items particular to an air carrier's implementation or unique to its system.

**g. AFM Information.** AFM provisions should be addressed, including information on TCAS modes of operation; normal and atypical flightcrew operating procedures; and response to TAs, RAs, and any AFM limitations.

**h. MEL Operating Provisions.**

**i. Pilot Response.** Appropriate pilot response to TCAS RAs and TAs, ATC clearance compliance, nuisance alerts, and other such issues.

**j. TCAS Event Reporting.** The air carrier's TCAS event reporting policies for flightcrews.

**k. Reporting TCAS Malfunctions.** Flightcrew procedures for reporting TCAS malfunctions or irregularities, if not otherwise addressed by routine maintenance procedures of that operator.

**3. Classroom Training.** An understanding of TCAS operation and the criteria used for issuing TAs and RAs may be assessed using the following objectives and criteria. This training should address the following topics:

**a. System Operation.**

**(1) Objective.** Demonstrate knowledge of how TCAS functions.

**(2) Criteria.** The pilot must demonstrate an understanding of the following functions:

**(a) Surveillance:**

- TCAS interrogates other transponder-equipped aircraft within a nominal range of 14 NM.

- TCAS surveillance range can be reduced in geographic areas with a large number of ground interrogators and/or TCAS II equipped aircraft.

**(b) Collision Avoidance:**

- TAs can be issued against any transponder-equipped aircraft which responds to the ICAO Mode C interrogations, even if the aircraft does not have altitude reporting capability.
- RAs can be issued only against aircraft that are reporting altitude and in the vertical plane only.
- RAs issued against a TCAS-equipped intruder are coordinated to ensure the issuance of complementary RAs.

**b. Advisory Thresholds.**

**(1) Objective.** Demonstrate knowledge of the criteria for issuing TAs and RAs.

**(2) Criteria.** The pilot must be able to demonstrate an understanding of the methodology used by TCAS to issue TAs and RAs and the general criteria for the issuance of these advisories to include:

**(a)** TCAS advisories are based on time to closest point of approach (CPA) rather than distance. The time must be short and vertical separation must be small, or projected to be small, before an advisory can be issued. The separation standards provided by Air Traffic Services (AAT) are different from the missed distances against which TCAS issues an alert.

**(b)** Thresholds for issuing a TA or RA vary with altitude. The thresholds are larger at higher altitudes.

**(c)** The TA tau threshold (trigger point) varies from 20 to 48 seconds before the projected CPA and the RA tau threshold varies from 15 to 35 seconds.

**(d)** RAs are chosen to provide the desired vertical missed distance at CPA. As a result, RAs can instruct a climb or descent through the intruder aircraft's altitude.

**c. TCAS Limitations.**

**(1) Objective.** To verify the pilot is aware of the limitations of TCAS.

**(2) Criteria.** The pilot must demonstrate a knowledge and understanding of the TCAS limitations including:

**(a)** TCAS will neither track nor display nontransponder-equipped aircraft, nor aircraft not responding to TCAS Mode C interrogations.

**(b)** TCAS will automatically fail if the input from the aircraft's barometric altimeter, radio altimeter, or transponder is lost.

**NOTE: In some installations, the loss of information from other onboard systems such as an inertial reference system (IRS) or Attitude Heading Reference System (AHRS) may result in a TCAS failure. Individual operators should ensure their pilots are aware of what types of failures will result in a TCAS failure.**

(c) An intruder aircraft within 380 feet AGL (nominal value) may or may not be displayed by your TCAS (i.e., declared to be airborne or on the ground, respectively) depending upon whether the intruder is Mode S or ATCRBS Mode C equipped and whether your TCAS-equipped aircraft is airborne or on the ground.

(d) TCAS may not display all proximate transponder-equipped aircraft in areas of high density traffic.

(e) Because of design limitations, the bearing displayed by TCAS is not sufficiently accurate to support the initiation of horizontal maneuvers based solely on the traffic display.

(f) Because of design limitations, TCAS will not track intruders with a VS in excess of 10,000 feet per minute (fpm). In addition, the design implementation may result in some short term errors in the tracked VS of an intruder during periods of high vertical acceleration by the intruder.

(g) GPWS warnings and windshear warnings take precedence over TCAS advisories. When either a GPWS or windshear warning is active, TCAS aural annunciations will be inhibited.

**d. TCAS Inhibits.**

(1) **Objective.** To verify the pilot is aware of the conditions under which certain functions of TCAS are inhibited.

(2) **Criteria.** The pilot must demonstrate knowledge and understanding of the various TCAS inhibits including:

(a) Increase descent RAs are inhibited below 1,450 ( $\pm 100$ ) feet AGL.

(b) Descend RAs are inhibited below 1,100 ( $\pm 100$ ) feet AGL.

(c) All RAs are inhibited below 1,000 ( $\pm 100$ ) feet AGL.

(d) All TCAS aural annunciations are inhibited below 500 ( $\pm 100$ ) feet AGL. This includes the aural annunciation for TAs.

(e) Altitude and configuration under which Climb and Increase Climb RAs are inhibited. Know if your aircraft type issues climb and increase climb RAs when operating at the aircraft's certified ceiling. If your aircraft type provides RA climb and increase climb commands at certified ceiling, the commands are to be followed.

**NOTE: In some aircraft types, climb or increase climb RAs are never inhibited.**

**e. Use of Controls.**

(1) **Objective.** To verify the pilot can properly operate all TCAS and display controls.

(2) **Criteria.** Demonstrate the proper use of controls including:

(a) Aircraft configuration required to initiate a self-test.

(b) Steps required to initiate a self-test.

(c) Recognizing when the self-test was successful and when it was unsuccessful. When the self test is unsuccessful, recognizing the reason for the failure, and if possible, correcting the problem.

(d) Low display ranges are used in the terminal area and the higher display ranges are used in the en route environment and in the transition between the terminal and en route environment.

(e) If available, recommended usage of the “Above/Below” mode selector. “Above” mode should be used during climb and the “Below” mode should be used during descent.

(f) Recognition that the configuration of the display does not affect the TCAS surveillance volume.

(g) Selection of lower ranges when an advisory is issued to increase display resolution.

(h) If available, selection of the display of absolute altitude instead of relative altitude and the limitations of using this display if a barometric correction is not provided to TCAS.

(i) Proper configuration to display the appropriate TCAS information without eliminating the display of other needed information.

**NOTE: The wide variety of display implementations makes it difficult to establish more definitive criteria. When developing the training program, expand these general criteria to cover specific details for an operator’s specific display implementation.**

**f. Display Interpretation.**

(1) **Objective.** To verify that a pilot understands the meaning of all information that TCAS can display.

(2) **Criteria.** The pilot must demonstrate the ability to properly interpret information displayed by TCAS, including:

(a) **Other Traffic.** Other traffic, for example traffic within the selected display range that is not proximate traffic, or causing a TA or RA to be issued.

(b) **Proximate Traffic.** Proximate traffic, for example, traffic that is within 6 NM and  $\pm 1200$  feet.

(c) **Non-Altitude Reporting.** Non-altitude reporting traffic.

(d) **TAs and RAs.** No bearing TAs and RAs.

(e) **Off-Scale TAs and RAs.** Change the selected range for off-scale TAs and RAs to ensure that all available information on the intruder is displayed.

(f) **TAs.** Select the minimum available display range which allows the display of TAs to provide the maximum display resolution.

(g) **RAs (Traffic Display).** The minimum available display range of the traffic display which allows the traffic to be displayed should be selected to provide the maximum display resolution.

(h) **RAs (RA Display).** Pilots should demonstrate knowledge of the meaning of the red and green areas displayed on the RA display and when the green areas will and will not be displayed. Pilots should also demonstrate an understanding of the RA display limitations (for example, if a VS tape is used and the range of the tape is less than 2,500 fpm, an Increase rate RA cannot be properly displayed).

(i) **Pilot Adjustments.** If appropriate, awareness that navigation displays oriented on track-up may require a pilot to make a mental adjustment for drift angle when assessing the bearing of proximate traffic.

**NOTE: The wide variety of display implementations will require the tailoring of some criteria. When the training program is developed, these criteria should be expanded to cover details for an operator's specific display implementation.**

**g. Use of the TA-Only Mode.**

(1) **Objective.** To verify that a pilot understands the appropriate times to select the TA-only mode of operation and the limitations associated with using this mode.

(2) **Criteria.** The pilot must demonstrate the following:

(a) Knowledge of the operator's guidance for the use of TA-only.

(b) If TA-only is not selected when an airport is conducting simultaneous operations from parallel runways separated by less than 1,200 feet, and to some intersecting runways, RAs can be expected.

(c) The TA aural annunciation is inhibited below 500 feet AGL. As a result, TAs issued below 500 feet AGL may not be noticed unless the TA display is included in the routine instrument scan.

(d) When this mode is selected, TAs will be issued at the time an RA is normally issued.

#### **h. Crew Coordination.**

(1) **Objective.** To verify the pilot adequately briefs other crew members on how TCAS advisories will be handled.

(2) **Criteria.** The pilot must demonstrate his or her preflight briefing addresses the procedures that will be used in responding to TAs and RAs including:

(a) Division of duties between PF and PM.

(b) Expected callouts.

(c) Communications with ATC.

(d) Conditions under which an RA may not be followed and who will make this decision.

**NOTE: Different operators have different procedures for conducting preflight briefings and for responding to TCAS advisories. These factors should be taken into consideration when implementing the training program.**

**NOTE: The operator must specify the conditions under which an RA need not be followed, reflecting advice published by the State Civil Aviation Authority (CAA). This should not be an item left to the discretion of a crew.**

**NOTE: This portion of the training may be combined with other training such as CRM.**

#### **i. Reporting Requirements.**

(1) **Objective.** To verify the pilot is aware of the requirements for reporting RAs to the controller and other authorities.

(2) **Criteria.** The pilot must demonstrate the following:

(a) The use of the phraseology contained in PANS-RAC (ICAO DOC. 4444).

(b) Where information can be obtained regarding the need for making written reports to various states when an RA is issued. Various states have different reporting requirements and the material available to the pilot should be tailored to the airline's operating environment.

**j. TCAS Flight Training (Maneuver).** The scenarios included in the maneuver training should include corrective RAs, initial preventive RAs, maintain rate RAs, altitude crossing RAs, increase rate RAs, RA reversals, weakening RAs, and multi-aircraft encounters. Training must provide pilots the opportunity to reach the TCAS proficiency indicated in the following TA and RA response objectives. A TCAS qualified instructor may assess and certify this proficiency.

**k. TA Responses.**

**(1) Objective.** To verify the pilot properly interprets and responds to TAs.

**(2) Criteria.** The pilot must demonstrate the following:

**(a)** The PF should continue to fly the airplane, and be prepared to respond to any RA that might follow. The PM should provide updates on the traffic location shown on the TCAS display, using this information to help visually acquire the intruder.

**(b)** Both pilots confirm that the aircraft they have visually acquired is that which has caused the TA to be issued. Use should be made of all information shown on the display, note being taken of the bearing and range of the intruder (amber circle), whether it is above or below (data tag), and its VS direction (trend arrow).

**(c)** Other available information is used to assist in visual acquisition. This includes ATC party-line information, traffic flow in use, etc.

**(d)** Because of the limitations that may exist with various display systems, the PF should not maneuver the aircraft based solely on the information shown on the TCAS display. No attempt should be made to adjust the current flightpath in anticipation of what an RA would advise.

**(e)** When visual acquisition is attained, right-of-way rules are used to maintain or attain safe separation. Do not initiate unnecessary maneuvers. The limitations of making maneuvers based solely on visual acquisition, especially at high altitude or without a definite horizon, are understood.

**l. RA Responses.**

**(1) Objective.** To verify the pilot properly interprets and responds to RAs.

**(2) Criteria.** The pilot must demonstrate the following:

**(a)** The PF responds to the RA with positive control inputs, when required, while the PM provides updates on the traffic location and cross-checks between the traffic display and monitors the response to the RA. Use proper CRM.

**(b)** Proper interpretation of the displayed information means the pilot recognizes the intruder causing the issuance of the RA (red square on display). Pilot responds appropriately.

(c) For corrective RAs, the response is initiated in the proper direction within 5 seconds of the RA being displayed.

(d) Recognition of the initially displayed RA being modified. Response to the modified RA is properly accomplished.

1. For increase rate RAs, the VS is increased within 2 1/2 seconds of the RA being displayed.

2. For RA reversals, the VS is reversed within 2 1/2 seconds of the RA being displayed.

3. For RA weakenings, the VS is modified to initiate a return towards the original clearance within 2 1/2 seconds of the RA being displayed.

4. For RAs which strengthen, the VS is modified to comply with the revised RA within 2 1/2 seconds of the RA being displayed.

(e) Recognition of altitude crossing encounters and the proper response to these RAs.

(f) For preventive RAs, the VS needle remains outside the red area on the RA display.

(g) For maintain rate RAs, the VS is not reduced. Pilots should recognize that a maintain rate RA may result in crossing through the intruder's altitude.

(h) If a decision is made to not follow an RA, no changes in the existing VS are made in a direction opposite to the sense of the displayed RA. Pilots should be aware that if the intruder is also TCAS equipped, the decision to not follow an RA may result in a decrease in separation at CPA because of the intruder's RA response.

(i) When the RA weakens, pilot initiates a return towards the original clearance, and when clear of conflict is annunciated, pilot completes the return to the original clearance.

(j) Inform the controller of the RA as soon as time and workload permit, using the standard phraseology.

(k) When possible, comply with an ATC clearance while responding to an RA. For example, if the aircraft can level at the assigned altitude while responding to a reduce climb or reduce descent RA, it should be done.

(l) If pilots simultaneously receive instructions to maneuver from ATC and an RA that are in conflict, the pilot should follow the RA.

(m) Knowledge of the TCAS multi-aircraft logic and its limitations is important. For example, TCAS only considers intruders that it believes to be a threat when selecting an RA. As such, it is possible for TCAS to issue an RA against one intruder that results in a maneuver

towards another intruder that is not classified as a threat. If the second intruder becomes a threat, the RA will be modified to provide separation from that intruder.

(n) The consequences of both responding to, and not responding to, an RA.

**m. Characteristics of Training Equipment Suitable for Maneuver Training.**

(1) **Acceptable Characteristics.** FTDs, simulators, and CBIs must have certain characteristics to be effective. This is due to the interactive nature of TCAS, the variety of encounter scenarios possible, the immediate and standardized pilot response required, and the instant and correct display interpretation that is necessary. Thus, training equipment used for TCAS flight training should have the following characteristics:

(a) The ability to functionally represent TCAS displays, controls, indications, and annunciations;

(b) Ability to depict selected traffic encounter scenarios, including TCAS display and audio advisories;

(c) Ability to show proper TCAS reaction to depicted scenarios and advisories; and

(d) Ability to interactively respond to pilot inputs regarding TCAS advisories, including responses to RAs displayed on relevant VS and pitch indicators.

(2) **Simulator and TCAS Fidelity.** For a particular TCAS, one may accomplish maneuver training in simulators or training devices that represent the specific aircraft or an aircraft that has similar characteristics. For the purposes of TCAS maneuver training, simulators or training devices may use simplified TCAS algorithms or displays and do not require TCAS logic or a TCAS processor. TCAS displays do not have to be identical, but must be functionally equivalent to the air carrier operator's specific aircraft in use.

(3) **Training Device or Simulator Approval.** The NSET qualifies training devices or simulators as meeting FAA criteria and the POI approves them for use. Any one or combination of the following devices or simulators which meet characteristics of paragraph 3m.(1) may be used:

(a) Level A through D simulators;

(b) Level 2 through 7 FTDs; or

(c) Dedicated TCAS training devices acceptable to the FAA, including those devices described in Order 8900.1, Flight Standards Information Management System (FSIMS), Volume 3, General Technical Administration, which are shown to be suitable for TCAS training and approved by the POI.

**NOTE: FTDs and simulators are as defined and qualified in accordance with the current edition of AC 120-45, Airplane Flight Training Device Qualification, and approved by the POI.**

## APPENDIX 7. DEFINITIONS

- 1. Aircraft Certification Office (ACO).** FAA offices responsible for determining an aircraft's airworthiness regarding issuance of TCs, STCs, issues related to 14 CFR parts 21, 23, 25, 33, and other similar airworthiness rules. ACOs are also responsible for technical assessment of service difficulties including issuance of Airworthiness Directives (AD).
- 2. Aircraft Evaluation Group (AEG).** FAA offices responsible for operational aspects of newly certificated, modified, or in-service aircraft. AEGs establish FAA criteria for pilot qualification, MELs, initial airworthiness, other such requirements as they relate to 14 CFR parts 43, 61, 91, 121, 135, and other operationally related regulations.
- 3. Altitude Limit (ALIM).** ALIM is the specified projected amount of vertical separation that TCAS is designed to provide between aircraft. The value of ALIM varies with aircraft barometric altitude.
- 4. Altitude Threshold (ZTHR).** The projected minimum ZTHR for the issuance of a preventive RA. The ZTHR varies with aircraft altitude.
- 5. Certificate-Holding District Office (CHDO).** A Flight Standards office that is responsible for administration of a parts 121 and 135 operating certificate for a particular operator.
- 6. Closest Point of Approach (CPA).** The occurrence of minimum range between your own TCAS aircraft and the intruder.
- 7. Coordination (as related to TCAS).** The process by which TCAS units in conflicting aircraft communicate with one another to select complementary RAs to resolve an encounter (for example, one unit selects a climb command and the other a descend command).
- 8. Flight Standards District Office (FSDO).** An FAA field office serving an assigned geographical area and staffed with Flight Standards personnel who serve the aviation industry and the general public on matters relating to the certification and operation of air carriers and general aviation aircraft.
- 9. Flight Standardization Board (FSB).** The FAA board responsible for establishing or revising crew qualification requirements (for example, training, checking, currency, and type rating(s)) for specific aircraft. FSBs are established for each large turbojet, turboprop, and special 14 CFR part 41 airplane type used in air transportation, as well as other part 25 airplanes, transport category multiengine helicopters, and large multiengine piston airplanes.
- 10. Follow-On STC (as related to TCAS).** A TCAS STC other than as described in paragraph 8. The following examples are follow-on STCs:
  - a. TCAS II Installation.** A previously approved TCAS II installation, which is installed in a subsequent type or model aircraft; and
  - b. Display Configuration.** Changes of display configuration (weather radar/TCAS display), supporting system (radar altimeter), or other aircraft interface (GPWS, etc.).

**11. Initial TC/STC (as related to TCAS).** The first FAA TCAS airworthiness approval in accordance with a TC or STC of any one or combination of the following components: a TCAS processor (computer), TCAS directional antenna, and/or Mode S transponder.

**NOTE: For previously approved TCAS systems, if the part number of any of the above components changes due to a significant modification, the system change requires an initial TC/STC.**

**12. Intruder.** An aircraft that has satisfied the TCAS TA detection criteria.

**13. Master Minimum Equipment List (MMEL).** An FAA document listing stipulations in accordance with parts 121, § 121.628 and 135, § 135.180 that provides authorization for the continuation of flight beyond a terminal point with certain inoperative equipment. AEGs develop MMELs in conjunction with an FOEB established for each aircraft type. FAA MMELs serve as the basis for an operator to develop specific MELs applicable to its particular aircraft and operational requirements.

**14. Maintenance Review Board (MRB).** An FAA board responsible for establishing maintenance requirements for a specific aircraft type. MRB requirements are usually formulated in conjunction with information provided by the manufacturer and prospective operators through industry working groups. FAA CHDOs apply MRB requirements in reviewing and approving each carrier's proposed maintenance program.

**15. National Airspace System (NAS).** The common network of U.S. airspace; air navigation facilities, equipment and services, airports or landing areas; aeronautical charts, information, and services; rules, regulations, and procedures; technical information, manpower, and material; and system components shared jointly with the military.

**16. National Simulator Evaluation Team (NSET).** Team of FAA operations specialists responsible for evaluating flight simulators to aid the POI in approving those simulators in accordance with 14 CFR requirements. For example, NSET evaluations support POI approval of a particular simulator for use in a specific part 121 program.

**17. Other Traffic.** Traffic shown on the traffic display that are not classified as proximate, TA, or RA.

**18. Principal Inspector (PI).** Refers to one of the following three FAA inspectors who is selected as primary for TCAS for an air carrier (normally the POI):

**a. Principal Avionics Inspector (PAI).** The FAA inspector responsible for overseeing all avionics issues relative to a specific operator, to include input on training programs, OpSpecs, MEL requests, etc.

**b. Principal Operations Inspector (POI).** The FAA inspector responsible for overseeing all operational issues relative to a specific operator, including training programs, OpSpecs approval, MEL approval requests, etc.

**c. Principal Maintenance Inspector (PMI).** The FAA inspector responsible for overseeing all maintenance issues relative to a specific operator, to include input on training programs, OpSpecs, MEL requests, etc.

**19. Proximate Traffic.** An aircraft that is within 6 NM in range and  $\pm 1,200$  feet vertically, but which does not meet the TCAS thresholds of a TA or RA.

**20. Resolution Advisory (RA).** Aural voice and display information provided by TCAS to a flightcrew, advising that a particular maneuver should or should not be performed to attain or maintain minimum safe vertical separation from an intruder.

**a. Corrective RA.** An RA that advises the pilot to either deviate from current vertical speed, such as climb when the aircraft is level or to maintain an existing climb or descent rate.

**b. Altitude Crossing RA.** An RA that directs a pilot to cross through the intruder aircraft's altitude to achieve safe vertical separation.

**c. Coordinated Crossing RA.** Initial RAs coordinated between TCAS-equipped aircraft and that direct the aircraft to cross in altitude.

**d. Increase Rate RA.** An RA that is issued after an initial climb or descend RA, which indicates that additional climb or descent rate is required to achieve safe vertical separation. An increase rate RA requires a climb or descent rate of 2,500 fpm.

**e. Preventive RA.** An RA that requires a pilot to avoid certain deviations from current vertical rate, such as a don't climb RA when the aircraft is level.

**f. Reversal RA.** An RA that indicates a change in the direction previously issued by TCAS and is required to achieve safe vertical separation. For example, an initial descend RA that reverses to a climb RA.

**g. Turn Around RA.** An initial corrective RA issued to a TCAS aircraft with an established vertical rate that directs the aircraft in the opposite direction. For example, a -1,500 fpm descend RA issued while climbing at +2,000 fpm.

**h. Weakened RA.** An initial corrective RA that changes to an RA calling for a return to level flight because TCAS has determined that safe vertical separation is projected. For example, a climb RA weakens to a do-not-descend advisory once the desired vertical separation has been achieved.

**21. Significant TCAS Events.** Significant TCAS events are those which meet any one of the following guidelines:

**a. Standard Air Traffic Control (ATC) Separation.** There is a loss of standard ATC separation resulting from compliance with a TCAS-generated RA;

**b. Performance.** TCAS is suspected of not performing as designed;

- c. Descent RA.** TCAS issues a descent RA when own aircraft is below 1,000 feet AGL;
  - d. Altitude Excursion.** There is an altitude excursion of more than 1,000 feet from an assigned level altitude;
  - e. Turn Around RA.** TCAS issues a turn around RA; or
  - f. Coordinated Crossing RA.** TCAS issues a coordinated crossing RA.
- 22. Supplemental Type Certificate (STC).** An FAA certificate attesting to the fact that modifications to the respective aircraft, engines, or other components meet 14 CFR airworthiness requirements.
- 23. Tau.** Greek symbol representing the time to CPA.
- 24. Threat.** An intruder which has satisfied the threat detection criteria and thus requires an RA.
- 25. Traffic.** Aircraft with an operating transponder capable of being tracked and displayed by a TCAS-equipped aircraft.
- 26. Traffic Advisory (TA).** Aural voice and display information provided by TCAS to a flightcrew, identifying the location of nearby traffic that meets certain minimum separation criteria.
- 27. Traffic Alert and Collision Avoidance System (TCAS).** A family of airborne devices meeting specified TSO and RTCA/DO-185 requirements, current edition, which function independently of the ground-based ATC system to provide collision avoidance information.
- a. TCAS I.** A TCAS providing only TAs to assist pilots in the visual acquisition of intruder traffic.
  - b. TCAS II.** A TCAS which provides TAs and RAs in the vertical plane, such as climb or descend.
- 28. TCAS Academic Training (as applied herein).** Part of ground training which exclusively addresses acquiring the required TCAS concepts, systems, limitations, or procedures knowledge (rather than skills), and demonstration of that knowledge. TCAS academic training generally is accomplished using a combination of classroom methods (standup instruction, slide/tapes, computer based instruction, tutorial, etc.), flight manual information bulletins, or self-study. See paragraph 9b for an expanded explanation of what should be taught.
- 29. TCAS Event.** For the purpose of this AC, one or more of the following occurrences or situations are related to TCAS:
- a. TCAS, RA, or TA.** Issuance of any TCAS RA or TA as specified by a flightcrew, regardless of whether it is valid, unwarranted, or a nuisance;

**b. In-Flight Traffic Conflicts.** Other TCAS-related in-flight traffic conflicts or potential conflicts as determined by a flightcrew;

**c. Near Midair Collision (NMAC).** NMACs involving a TCAS-equipped aircraft;

**d. System Failures.** TCAS system failures related to a traffic conflict, potential traffic conflict situation, or TCAS general system performance;

**e. System Error.** ATC system error involving a TCAS-equipped aircraft; or

**f. System Safety Performance.** Other TCAS occurrences or situations related to potential TCAS or ATC system safety performance.

**30. TCAS Maneuver Training.** Part of flight training that includes the integration of TCAS knowledge with the specific skills required to demonstrate satisfactory performance of a particular TCAS procedure or maneuver, or series of procedures or maneuvers.

**31. TCAS Transition Program (TTP).** A phased TCAS implementation and evaluation program established to assure timely and effective TCAS installation and use for U.S. air carrier aircraft and to assist in the integration of a large number of TCAS units in the NAS.

**32. Type Certificate (TC).** An FAA certificate attesting to the fact that the respective aircraft, engines, or other components meet 14 CFR airworthiness requirements.