



EAC

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Operational Use And Pilot Training Guidelines For Airborne Collision Avoidance System (ACAS)

1- General

1.1 For the system to achieve its designed safety benefits, flight crews must operate the system and respond to ACAS alerts in a manner compatible with the system design. Many ACAS alerts will involve more than one ACAS-equipped aircraft. In these coordinated encounters, it is essential that each flight crew respond in a predictable manner. The issues discussed in this section form the basis for the Pilot Training Guidelines that follow in the next section. The guidelines define the knowledge of the system and its operation that should be included in pilot training programmers and include information on system performance, proper use of ACAS controls, and proper responses to ACAS alerts. The guidelines require both academic training and man oeuvre training conducted in either aircraft simulators or other computer based trainers. Flight crews must be tested to ensure they are wholly familiar with ACAS procedures, capabilities, and limitations and are able to respond correctly to ACAS indications. Moreover, regularly scheduled recurrent training sessions shall include ACAS training. The remaining includes findings from a review of existing pilot training programs, examples of ACAS events in which an improper response to an RA resulted in a decrease in separation with the intruder aircraft, and description of the procedure for reporting ACAS events to air traffic control units.

2- ACAS operational use

2.1 ACAS indications are intended to assist pilots in the avoidance of potential collisions and the active search for, and visual acquisition of, conflicting traffic. For ACAS to work as designed, immediate and correct crew response to ACAS advisories is essential. Delayed flight crew response to an RA or reluctance to man oeuvre the aircraft in response to an RA for whatever reason, can significantly decrease or negate the protection afforded by ACAS. Therefore, there should be a clear understanding among the flight crew of their respective responsibilities when an ACAS advisory occurs. Flight crews are expected to respond to ACAS indications in accordance with the following guidelines:

2.1.1 Respond to TAs by attempting to establish visual contact with the intruder aircraft and other aircraft that may be in the vicinity. Coordinate to the degree possible with other crew members to assist in searching for traffic. Do not deviate from an assigned clearance based only on TA information. For any traffic that is acquired visually, continue to maintain safe separation in accordance with current regulations and good operating practices. Pilots should not make horizontal maneuvers based solely on information shown on the traffic display. Slight adjustments in vertical speed while climbing or descending, or slight adjustments in airspeed while still complying with the ATC clearance are acceptable.

2.1.2 When an RA occurs, the PF (Pilot Flying) should respond immediately by looking at the RA displays and maneuvering as indicated, unless doing so would jeopardise the safe operation of the flight. The pilot's instinctive reaction should always be to respond to RAs in the direction and to the degree displayed, without delay.

2.1.3 If a decision is made not to respond to an RA, the flight crew negates the safety benefits provided by the own ACAS. A decision to not respond also decreases the safety benefits to all other aircraft involved in the encounter.

2.1.4 Maneuvers, or lack of maneuvers that result in a vertical speed opposite to the sense of the RA could result in a collision with the threat aircraft.

2.1.5 The following considerations should be taken into account.

2.1.5.1 The threat may also be equipped with ACAS and it may maneuver in an unexpected direction while responding to a complementary RA that has been coordinated with own aircraft's ACAS.

2.1.5.2 Traffic acquired visually may not be the traffic causing the RA, or it may not be the only aircraft to which ACAS is responding.

2.1.5.3 Visual perception of the encounter may be misleading. 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.

2.1.6 Respond to RAs by disconnecting the autopilot and by using prompt, smooth control inputs, man oeuvre in the direction and with the vertical rate ACAS requires. To

achieve the required vertical rate (normally 1,500 feet per minute) on aircraft where the RA is displayed on a vertical speed indicator, it is recommended that the aircraft's pitch is changed using the guidelines shown in the table below. Referring to the vertical speed indicator (VSI) or vertical speed tape, make any further pitch adjustments necessary to place the vertical speed in the green area.

SPEED PITCH ADJUSTMENT

.80 MACH 2□

250 KIAS below 10 000 feet 4□

APPROACH below 200 KIAS 5□□ to 7□

2.1.6.1 On aircraft with pitch guidance for ACAS RA displays, follow the RA pitch command for initial, increase, and weakening RAs.

2.1.7 For ACAS to provide safe vertical separation, the PF is expected to initiate the appropriate RA maneuver within 5 seconds of when the RA is first displayed. Deviations from assigned altitude, when responding to an RA, typically will be no more than 300 to 500 feet. RA maneuvers should use vertical speeds within the green areas, or the indicated pitch angle, and avoid red areas on vertical speed indicators or tapes, or outlined pitch avoidance areas.

2.1.8 The PNF (Pilot Not Flying) should provide updates on the traffic location and monitoring the response to the RA. Proper crew resource management should be applied.

2.1.9 Respond immediately to any "increase" or "reversal" RA. Initiation of the increase or reversal RA maneuver is expected within 2 1/2 seconds after issuance of the advisory. Again, fly to the green area or indicated pitch angle and avoid red areas or outlined pitch avoidance areas.

2.1.10 If an RA is weakened, such as a 'climb' RA weakened to a 'do not descend' RA, respond to the weakening RA by adjusting the aircraft's vertical speed or pitch angle as required by the RA display.

Pilots are reminded that prompt and correct reaction to the weakened RA will minimize altitude deviations and disruptions to ATC. This will also reduce the possibility of additional RAs against the intruder or other traffic.

2.1.11 Excessive responses to RAs are disruptive to ATC and may result in additional RAs.

2.1.12 If an RA maneuver is inconsistent with the current ATC clearance, pilots shall follow the RA.

2.1.12.1 ATC may have older altitude data than ACAS and does not know when ACAS issues RAs, unless notified by the pilot. It is possible for ATC to unknowingly issue instructions that are contrary to the ACAS RA indications. When one aircraft maneuvers opposite the vertical direction indicated by ACAS and the other aircraft maneuvers as indicated by ACAS, a collision may occur. Do not maneuver contrary to the RA based solely upon ATC instructions.

2.1.12.2 ATC may not be providing separation service to the aircraft causing the RA or the intruder may not be known to ATC, e.g., military operations in some States.

2.1.13 If an 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 are expected to follow the RAs to resolve the immediate traffic conflict. Deviations from rules or clearances should be kept to the minimum necessary to satisfy an RA, but the RA must be satisfied.

2.1.14 If an RA response requires deviation from an ATC clearance, expeditiously comply with the current ATC clearance when the traffic conflict is resolved or the ACAS "clear of conflict" message is heard.

2.1.15 If an RA requires a deviation from an assigned altitude, communicate with ATC immediately

(1) immediately return to their previously assigned clearance and advise ATC of that maneuver, or

(2) comply with any amended clearance issued.

2.1.17 Stall warning, windshear, and Ground Proximity Warning System (GPWS) alerts take precedence over ACAS RAs. Pilots shall respond to these alerts instead of RAs.

2.1.18 Pilots should use ACAS traffic information displays to assist in establishing visual contact with other aircraft. Certain Electronic Flight Information System (EFIS) ACAS 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 searching for nearby aircraft.

2.1.19 Pilots are expected to operate ACAS while in-flight in all airspace.

2.1.20 When feasible, flight crews should use the same altitude data source that is being used by the PF to provide altitude information to ACAS and the ATC transponders. Using a common altitude source precludes unnecessary RAs due to differences between altitude data sources.

2.2 ACAS does not alter or diminish the pilot's basic authority and responsibility to ensure safe flight. Since ACAS does not track aircraft that are not transponder equipped or aircraft with a transponder failure, ACAS alone does not ensure safe separation in every case. It after responding to the RA. The phraseology for communicating with the controller is specified in *Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444)*.

2.1.16 When the RA is cleared, the flight crew should be particularly important that pilots maintain situational awareness and continue to use good operating practices and judgment when following ACAS RAs. Maintain frequent outside visual scan, "see-and-avoid" vigilance, and continue to communicate as needed and as appropriate with ATC.

2.3 The following ACAS good operating practices have been identified during the use of ACAS throughout the world.

2.3.1 To preclude unnecessary transponder interrogations and possible interference with ground radar surveillance systems, ACAS should not be activated (TA-only or TA/RA mode) until taking the active runway for departure and should be deactivated immediately after clearing the runway after landing. To facilitate surveillance of surface movements, it is necessary to select a mode in which the Mode S transponder can nevertheless squatters and respond to discrete interrogations while taxiing to and from the gate. Operators must ensure that procedures exist for pilots and crews to be able to select the operating mode where ACAS is disabled, but the Mode S transponder remains active.

2.3.2 During flight, ACAS traffic displays should be used to assist in visual acquisition. Displays that have a range selection capability should be used in an appropriate range setting for the phase of flight.

For example, use minimum range settings in the terminal area and longer ranges for climb/descent and cruise as appropriate.

2.3.3 The normal operating mode of ACAS is TA/RA. It may be appropriate to operate ACAS in the TA only mode only in conditions where States have approved specific procedures permitting aircraft to operate in close proximity or in the event of particular in-flight failures or performance limiting conditions as specified by the Airplane Flight Manual or operator. It should be noted that operating in TA only mode eliminates the major safety benefit of ACAS.

2.3.3.1 Operating in TA/RA mode and then not following an RA is potentially dangerous. If an aircraft that does not intend to respond to an RA and operates in the TA only mode, other ACAS-equipped aircraft operating in TA/RA mode will have maximum flexibility in issuing RAs to resolve encounters.

2.3.4 When safe, practical, and in accordance with an operator's approved operating procedures, pilots should limit vertical speeds to 1,500 fpm or less (depending on performance characteristics of the aircraft) when within 1 000 feet of assigned altitudes. This procedure will reduce the frequency of unnecessary RAs and be in conformance with the ICAO guidance contained in PANS-OPS.

2.3.4.1 Some States have taken actions to require vertical speed reductions when approaching an assigned altitude. These requirements, defined in the State's AIPs, were implemented as a means for reducing the probability of unnecessary RAs when an aircraft is climbing or descending to level at an adjacent altitude to another aircraft.

3- Pilot training

3.1 The training objectives cover five areas: theory of operation; pre-flight operations; general in flight operations; response to TAs; and response to RAs. The training objectives are further divided into the areas of: ACAS academic training; ACAS maneuver training; ACAS initial evaluation; and ACAS recurrent qualification.

3.2 Under each of these four areas, the training material has been divided into those items that are considered an essential training item and those that are considered

desirable. Those items that are deemed to be essential are a requirement for each ACAS operator. In each area, a list of objectives and acceptable performance criteria is defined.

3.3 In developing this material, no attempt was made to define how the training programme should be implemented. Instead, objectives were established that define the knowledge a pilot operating ACAS is expected to possess and the performance expected from a pilot who has completed ACAS training. Therefore, all pilots who operate ACAS equipment are required to receive the ACAS training described below.

3.4 ACAS academic training

3.4.1 This training is typically conducted in a classroom environment. The knowledge demonstrations specified in this section may be completed through the successful completion of written tests or providing correct responses to non-real-time computer-based training (CBT) questions.

3.4.2 Essential items

3.4.2.1 Theory of operation. The pilot must demonstrate an understanding of ACAS operation and the criteria used for issuing TAs and RAs. This training should address the following topics:

(a) System operation

Objective: Demonstrate knowledge of how ACAS functions.

Criteria: The pilot must demonstrate an understanding of the following functions:

(1) Surveillance:

- (i) ACAS interrogates other transponder-equipped aircraft within a nominal range of 14 NM; and
- (ii) ACAS surveillance range will be reduced in geographic areas with a large number of ground interrogators and/or ACAS II-equipped aircraft. A minimum surveillance range of 4.5 NM is guaranteed for ACAS aircraft that are airborne.

Note.— If the operator's ACAS implementation provides for the use of the Mode Extended squatters, the normal surveillance range may be increased beyond the nominal 14NM. However, this information is not used for collision avoidance purposes.

(2) Collision avoidance:

- (i) TAs can be issued against any transponder-equipped aircraft even if the aircraft does not have altitude-reporting capability;
- (ii) RAs can be issued only in the vertical plane and only against aircraft that are reporting altitude ;
- (iii) RAs issued against an ACAS-equipped intruder are coordinated to ensure complementary RAs are issued; and
- (iv) Failure to respond to an RA deprives own aircraft of the collision protection provided by its ACAS. Additionally, in ACAS-ACAS encounters, it also restricts
- (v) The choices available to the other aircraft's ACAS and thus renders the other aircraft's ACAS less effective than were own aircraft not ACAS equipped.

(b) Advisory thresholds

Objective: Demonstrate knowledge of the criteria for issuing TAs and RAs.

Criteria: The pilot must be able to demonstrate an understanding of the methodology used by ACAS to issue TAs and RAs and the general criteria for the issuance of these advisories to include:

- (1) ACAS advisories are typically based on time to closest point of approach (CPA).
- (2) 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 are different from those against which ACAS issues alerts;
- (3) In encounters with a slow closure rate, ACAS advisories will be issued based on distance thresholds for issuing a TA or RA vary with altitude. The thresholds are larger at higher altitudes;
- (4) TAs generally occur 8 to 15 seconds prior to an RA.
- (5) RAs occur from 15 to 35 seconds before the projected CPA; and
- (6) RAs are chosen to provide the desired vertical miss distance at CPA. As a result, RAs can instruct a climb or descent through the intruder aircraft's altitude.

(c) ACAS limitations

Objective: To verify the pilot is aware of the limitations of ACAS. **Criteria:** The pilot must demonstrate a knowledge and understanding of the ACAS limitations including:

- (1) ACAS will neither track nor display non-transponder equipped aircraft, nor aircraft with an inoperable transponder.
- (2) ACAS 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 on-board* systems such as an inertial reference system (IRS) or attitude heading reference system (AHRS) may result in an ACAS failure. Individual operators should ensure their pilots are aware of what types of aircraft system failures will result in an ACAS failure.

- (3) Some aircraft within 380 ft above ground level (AGL) (nominal value) will not be displayed. If ACAS is able to determine that an aircraft below this altitude is airborne, it will display it;
- (4) ACAS may not display all proximate, transponder-equipped aircraft in areas of high density traffic;
- (5) Because of design limitations, the bearing displayed by ACAS is not sufficiently accurate to support the initiation of horizontal maneuvers based solely on the traffic display;
- (6) Because of design limitations, ACAS will neither display nor give alerts against intruders with a vertical speed in excess of 10 000 ft/min. In addition, the design implementation may result in some short-term errors in the tracked vertical speed of an intruder during periods of high vertical acceleration by the intruder; and
- (7) Stall warnings, ground proximity warning systems/terrain avoidance warning systems (GPWS/TAWS) warnings, and windshear warnings take precedence over ACAS advisories. When either a GPWS/TAWS or windshear warning is active, ACAS aural annunciations will be inhibited, and ACAS will automatically switch to the TA only mode of operation. ACAS will remain in TA Only mode for 10 seconds after the GPWS/TAWS or windshear warning is removed.

(d) ACAS inhibits

Objective: To verify the pilot is aware of the conditions under which certain functions of ACAS are inhibited.

Criteria: The pilot must demonstrate knowledge and understanding of the various ACAS inhibits including:

- (1) Increase descent RAs are inhibited below 1 450 (\square 100) ft AGL;
- (2) Descend RAs are inhibited below 1 100 (\pm 100) ft AGL;
- (3) All RAs are inhibited below 1 000 (\pm 100) ft;
- (4) All ACAS aural annunciations are inhibited below 500 (\pm 100) ft AGL. This includes the aural annunciation for TAs; and
- (5) Altitude and configuration under which climb and increase climb RAs are inhibited. ACAS can still issue climb and increase climb RAs when operating at the aircraft's maximum altitude or certified ceiling. Responses to climb RAs while operating at the maximum altitude or certified ceiling are expected to be complied with in the normal manner.

Note— In some aircraft types, climb or increase climb RAs are never inhibited.

3.4.2.2 Operating procedures. The pilot must demonstrate the knowledge required to operate ACAS and interpret the information presented by ACAS. This training should address the following topics:

(a) Use of controls

Objective: To verify the pilot can properly operate all ACAS and display controls.

Criteria: Demonstrate the proper use of controls including:

- (1) Aircraft configuration required to initiate a Self Test;
- (2) Steps required initiating a Self Test;
- (3) 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;
- (4) Recommended usage of traffic display range selection. Low 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;

- (5) 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;
- (6) Recognition that the configuration of the traffic display, i.e., range and Above/Below selection, does not affect the ACAS surveillance volume;
- (7) Selection of lower ranges on the traffic display to increase display resolution when an advisory is issued;
- (8) If available, proper selection of the display of absolute or relative altitude and the limitations of using the absolute display option if a barometric correction is not provided to ACAS;
- (9) Proper configuration to display the appropriate ACAS information without eliminating the display of other needed information; and
- (10) Selection of various ACAS and transponder operating modes.

Note. — The wide variety of display implementations makes it difficult to establish more definitive criteria. When the training programme is developed, these general criteria should be expanded to cover specific details for an operator's specific display implementation.

(b) Display interpretation

Objective: To verify a pilot understands the meaning of all information that can be displayed by ACAS.

Criteria: The pilot must demonstrate the ability to properly interpret information displayed by ACAS including:

- (1) Other traffic, i.e. traffic within the selected display range that is not proximate traffic, or causing a TA or RA to be issued;
- (2) Proximate traffic, i.e. traffic that is within 6 NM and $\square \square 1\ 200$ ft;
- (3) Non-altitude reporting traffic;
- (4) No bearing TAs and RAs;
- (5) Off-scale TAs and RAs. The selected range should be changed to ensure that all available information on the intruder is displayed;
- (6) Traffic advisories. The minimum available display range that allows the traffic to be displayed should be selected to provide the maximum display resolution;
- (7) Resolution advisories (traffic display). The minimum available display range of the traffic display that allows the traffic to be displayed should be selected to provide the maximum display resolution;
- (8) Resolution advisories (RA display). Pilots should demonstrate knowledge of the meaning of the red and green areas or the meaning of pitch or flight path angle cues displayed on the RA display. For displays using red and green areas, demonstrate knowledge of when the green areas will and will not be displayed. Pilots should also demonstrate an understanding of the RA display limitations, i.e. if a vertical speed tape is used and the range of the tape is less than 2500 ft/min, how an Increase Rate RA and a Maintain Rate RA will be displayed;
- (9) If appropriate, awareness that navigation displays oriented "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 programme is developed, these criteria should be expanded to cover details for an operator's specific display implementation;

(c) Use of the TA only mode

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.

Criteria: The pilot must demonstrate the following:

- (1) Knowledge of the operator's guidance for the use of TA only;
- (2) Reasons for using this mode and situations in which its use may be desirable. These include operating in known close proximity to other aircraft such as when visual approaches are being used to closely spaced parallel runways or taking-off towards aircraft operating in a VFR corridor. If TA only is not selected when an airport is conducting simultaneous operations from parallel runways separated by less than 1200 ft, and to some intersecting runways, RAs can be

expected. If an RA is received in these situations, the pilot should follow the RA, and

- (3) The TA aural annunciation is inhibited below 500 ft (± 100 ft) AGL. As a result, TAs issued below 500 ft AGL may not be noticed unless the TA display is included in the routine instrument scan;

(d) Crew coordination

Objective: To verify pilots adequately brief other crew members on how ACAS advisories will be handled.

Criteria: Pilots must demonstrate during their preflight briefing the procedures that will be used in responding to TAs and RAs including:

- (1) Division of duties between pilot flying and pilot not flying, including a clear definition of who will fly the aircraft during a response to an RA;
- (2) Expected call-outs;
- (3) Conditions under which an RA may not be followed and who will make this decision; and
- (4) Communications with ATC .

Note 1. — Different operators have different procedures for conducting pre-flight briefings and for responding to ACAS advisories. These factors should be taken into consideration when implementing the training programme

Note 2. — The operator must specify the conditions under which an RA need not be followed. This should not be an item left to the discretion of a crew.

Note 3. — This portion of the training may be combined with other training such as crew resource management (CRM).

(e) Reporting requirements

Objective: To verify the pilot is aware of the requirements for reporting RAs to the controller and other authorities.

Criteria: The pilot must demonstrate the following:

- (1) The use of the phraseology contained in the PANS-ATM, Doc 4444; and
- (2) Where information can be obtained regarding the need for making written reports when an RA is issued.

3.4.3 Non-essential items

(a) Advisory thresholds

Objective: Demonstrate knowledge of the criteria for issuing TAs and RAs.

Criteria: The pilot needs to have an understanding of the methodology used by ACAS to issue TAs and RAs and the general criteria for the issuance of these advisories to include:

- (1) The TA altitude threshold is 850 ft below FL 420 and 1 200 ft above FL 420;
- (2) when the vertical miss distance is projected to be less than the ACAS target, an RA requiring a change to the existing vertical speed will be issued. The ACAS-desired separation varies from 300 ft at low altitude to a maximum of 700 ft above FL 300;
- (3) When the vertical miss distance is projected to be just outside the ACAS goal, an RA which does not require a change to the existing vertical speed will be issued. This separation varies from 600 to 800 ft.; and
- (4) RA fixed range thresholds vary between 0.2 at low altitude and 1.1 NM at high altitude. These fixed range thresholds are used to issue RAs in encounters with slow closure rates.

3.5 ACAS maneuver training

3.5.1 Training pilots to properly respond to ACAS displayed information, TAs, and RAs is most effective when accomplished in a flight simulator equipped with an ACAS display and controls similar in appearance and operation to those in the aircraft. If a simulator is utilized, crew resource management (CRM) aspects of responding to TAs and RAs should be practiced during this training.

3.5.2 Alternatively, the required maneuver can be carried out by means of an inter-active CBT with an ACAS display and controls similar in appearance and operation to those in the aircraft. This interactive CBT should depict scenarios in which real-time responses must be made. The pilot should be informed whether or not the responses made were correct. If the response was incorrect or inappropriate, the CBT should show what the correct response should be.

3.5.3 The scenarios included in the maneuver training should include: initial RAs that require a change in vertical speed; initial RAs not requiring a change in vertical speed;

maintain rate RAs; altitude crossing RAs; increase rate RAs; RA reversals; weakening RAs; RAs issued while the aircraft is at a maximum altitude, and multi-aircraft encounters. The scenarios should also include demonstrations of the consequences of not responding to RAs, slow or late responses, and maneuvering opposite to the direction called for by the displayed RA as follows:

(a) TA responses

Objective: To verify the pilot properly interprets and responds to TAs.

Criteria: The pilot must demonstrate:

- (1) Proper division of responsibilities between the pilot flying and pilot not flying. Pilot flying should continue to fly the airplane and be prepared to respond to any RA that might follow. Pilot not flying should provide updates on the traffic location shown on the ACAS traffic display and use this information to help visually acquire the intruder;
- (2) Proper interpretation of the displayed information. 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 vertical speed direction (trend arrow);
- (3) Other available information is used to assist in visual acquisition. This includes ATC "party-line" information, traffic flow in use, etc.,
- (4) Unnecessary requests for traffic information are not made following TAs;
- (5) because of the limitations described in 3.4.2.1.c).5), that no maneuvers are made based solely on the information shown on the ACAS display; and
- (6) when visual acquisition is attained, right of way rules are used to maintain or attain safe separation. No unnecessary maneuvers are initiated. The limitations of making maneuvers based solely on visual acquisition are understood.

(b) RA responses

Objective: To verify the pilot properly interprets and responds to RAs. Criteria: The pilot must demonstrate:

- (1) Proper division of responsibilities between the pilot flying and pilot not flying. Pilot flying should respond to the RA with positive control inputs, when required, while the pilot not flying is providing updates on the traffic location, checking the traffic display and monitoring the response to the RA. Proper CRM should be used. If the operator's procedures require the pilot in command to fly all RAs, transfer of aircraft control should be demonstrated.
- (2) Proper interpretation of the displayed information. The pilot recognizes the intruder causing the RA (red square on the traffic display) and responds appropriately;
- (3) For RAs requiring a change in vertical speed, initiation of a response in the proper direction is made within 5 seconds of the RA being displayed. The change in vertical speed is accomplished with an acceleration of approximately 1/4g to obtain the required vertical rate. ATC is notified of the RA response without delay after initiating the maneuver using the standard phraseology;
Note 1. — PANS-OPS, states that in the event of an RA, pilots shall respond immediately and maneuver as indicated, unless doing so would jeopardize the safety of the aero plane. Neither crossing RAs, which cause the flight crew to direct the aircraft towards the altitude of the other aircraft, nor RAs that are contrary to ATC instructions should be considered to jeopardize the safety of the aircraft; both are routine.
Note 2. — Timely notification to ATC that an RA is in progress is essential to ensure that the controller is aware of the RA and will not issue conflicting clearances or instructions. The pilot's initial responsibility after receiving an RA is to modify the aircraft's vertical speed to comply with the RA. Once the required vertical speed is established, the next responsibility is to advise ATC of the RA
- (4) Recognition of and the proper response to modifications to the initially displayed RA:
 - (i) For Increase Rate RAs, the vertical speed is increased within 2-1/2 seconds of the RA being displayed. The change in vertical speed is accomplished with an acceleration of approximately 1/3 g;

- (ii) For RA reversals, the maneuver is initiated within 2-1/2 seconds of the RA being displayed. The change in vertical speed is accomplished with an acceleration of approximately 1/3 g;
 - (iii) For RA weakening, the vertical speed is modified to initiate a return towards level flight within 2-1/2 seconds of the RA being displayed. The change in vertical speed is accomplished with an acceleration of approximately 1/4 g; and
 - (iv) For RAs that strengthen, the maneuver to comply with the revised RA is initiated within 2-1/2 seconds of the RA being displayed. The change in vertical speed is accomplished with an acceleration of approximately 1/4 g;
- (5) Recognition of altitude crossing encounters and the proper response to these RAs;
 - (6) For RAs that do not require a change in vertical speed, the vertical speed needle or pitch angle remains outside the red area on the RA display;
 - (7) For Maintain Rate RAs, the vertical speed is not reduced. Pilots should recognize that a Maintain Rate RA may result in crossing through the intruder's altitude;
 - (8) That if a justified decision is made to not follow an RA, the resulting vertical rate is not in a direction opposite to the sense of the displayed RA;
 - (9) That the deviation from the current clearance is minimized by leveling the aircraft when the RA weakens, and when "Clear of Conflict" is annunciated, executing prompt return to the current clearance; and notifying ATC using the standard phraseology as soon as permitted by flight crew workload after resuming the current clearance;
 - (10) That when possible, an ATC clearance is complied with 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;
 - (11) That when simultaneous, conflicting instructions to maneuver are received from ATC and an RA, the RA is followed and ATC is notified using the standard phraseology as soon as permitted by flight crew workload;
 - (12) A awareness that ACAS is designed to cope with several simultaneous threats, and that ACAS can optimize separation from two aircraft by climbing or descending towards one of them. For example, ACAS only considers intruders that it considers to be a threat when selecting an RA. As such, it is possible for ACAS to issue an RA against one intruder, which 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;
 - (13) The consequences of not responding to an RA and maneuvering in the direction opposite to the RA; and
 - (14) A prompt response is made when a Climb RA is issued while the aircraft is at the maximum altitude.

3.6 ACAS initial evaluation

3.6.1 The pilot understands of the academic training items shall be assessed by means of a written test or interactive CBT that records correct and incorrect responses to questions.

3.6.2 The pilot understands of the maneuver training items shall be assessed in a flight simulator equipped with a ACAS display and controls similar in appearance and operation to those in the aircraft the pilot will fly, and the results assessed by a qualified instructor, inspector, or check airman. The range of scenarios shall include:

- (a) Initial RAs requiring a change in vertical speed (Climb and Descend RAs);
- (b) Initial RAs that require a reduction in vertical speed (negative RAs with the Adjust Vertical Speed, Adjust aural);
- (c) Initial RAs that do not require a change in vertical speed;
- (d) Maintain rate RAs;
- (e) Altitude crossing RAs;
- (f) Increase rate RAs;
- (g) RA reversals;
- (h) Weakening RAs;
- (i) RAs issued while the aircraft is at the maximum altitude, and
- (j) A And multi-aircraft encounters.

The scenarios should also include demonstrations of the consequences of not responding to RAs, slow or late responses, and maneuvering opposite to the direction called for by the displayed RA.

All pilots should fly at least one RA scenario during each simulator training session. Captains should fly all scenarios once every three years.

3.6.2.1 Operators should ensure that their instructors can select all the required RA scenarios on their simulators at any time during a simulator session.

3.6.3 If an operator does not have access to an ACAS-equipped simulator, the initial ACAS evaluation shall be conducted by means of an inter-active CBT with an ACAS display and controls similar in appearance and operation to those in the aircraft the pilot will fly. This inter-active CBT shall depict scenarios in which real-time responses must be made and a record made of whether or not each response was correct. The CBT shall include all types of RAs. Pilots should complete all scenarios once every two years if CBT is used. .3.7 ACAS recurrent training.

.3.7.1 ACAS recurrent training ensures that pilots maintain the appropriate ACAS knowledge and skills. ACAS recurrent training should be integrated into and/or conducted in conjunction with other established recurrent training programmes. An essential item of recurrent training is the discussion of any significant issues and operational concerns that have been identified by the operator.

3.7.2 ACAS monitoring programmers periodically publish findings from their analyses of ACAS events. The results of these analyses typically discuss technical and operational issues related to the use and operation of ACAS. Recurrent training programmers should address the results of monitoring programmers in both the academic and simulator portions of recurrent training visits.

3.7.3 Recurrent training shall include both academic and maneuver training and address any significant issues identified by line operating experience, system changes, procedural changes, or unique characteristics such as the introduction of new aircraft/display systems or operations in airspace where high numbers of TAs and RAs have been reported.

4- Findings from reviews of existing training programmes

4.1 A review of existing training programmes has been conducted in one State. This review encompassed major air carriers, regional air carriers, and business and corporate operators. The purpose of these reviews was to assess operators' compliance with published training guidelines.

4.2 The reviews consisted of reviewing an operator's manuals and training guidelines, and wherever possible, witnessing the academic and maneuver training.

4.3 The review indicated that various techniques are in use to train pilots in the use of ACAS. These techniques range from the use of academic training and a videotape to performing all ACAS-related training during the simulator portion of training.

4.4 These reviews have noted that some of the information contained in the operator and airframe manufacturer documentation regarding ACAS is incorrect and out of date. In some cases, the documentation referred to ACAS capabilities and limitations that were only applicable to the earliest versions of TCAS. The reviews of the simulator training indicated that a majority of the simulators did not provide the instructor with a means of training pilots on various types of RAs.