

United Kingdom Overseas Territories Aviation Circular

OTAC 91-5

119-8

121-6

125-6

135-6

ACAS Training for Pilots

Issue 1

15 September 2011

Effective date: on issue

GENERAL

Overseas Territories Aviation Circulars are issued to provide advice, guidance and information on standards, practices and procedures necessary to support Overseas Territory Aviation Requirements (OTARs). They are not in themselves law but may amplify a provision of the Air Navigation (Overseas Territories) Order or provide practical guidance on meeting a requirement contained in the Overseas Territories Aviation Requirements.

PURPOSE

This OTAC gives guidance on appropriate flight crew training for the use of ACAS. It is not a substitute for training, and **this information alone is not sufficient to equip a pilot for the use of such systems.**

RELATED REQUIREMENTS

This Circular relates to OTAR Part 91, 121, 125 and 135.

CHANGE INFORMATION

First issue.

ENQUIRIES

Enquiries regarding the content of this Circular should be addressed to Air Safety Support International at the address on the ASSI website www.airsafety.aero or to the appropriate Overseas Territory Aviation Authority.

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1 Terminology

Although the terms ACAS and TCAS are often used interchangeably, they are not synonymous:

ACAS is the term for airborne collision avoidance systems generally.

ACAS is also the term used by ICAO to mean ACAS II - a collision avoidance device that meets the technical performance parameters specified in ICAO Annex 10, Volume IV.

TCAS is the term used in the FAA Technical Standard Orders (TSO) in relation to the approval of such equipment.

TCAS II version 7.0 is the only system which is compliant with ICAO ACAS II technical standards.

TCAS II version 7.1 will, from 1 January 2017, be the only system which is compliant with ICAO ACAS II technical standards.

2 The requirement for training

The requirement that applies to the flight crew of aircraft registered in the Territory and to all aircraft operating or navigating within the Territory is in Part 91 -

91.910 Flight crew qualification

The pilot-in-command shall satisfy himself that:

- (e) where an aircraft is equipped with an airborne collision avoidance system, that each flight crew member has been appropriately trained to competency in the use of that equipment and the avoidance of collisions.

3 Appropriate training

3.1 It is the responsibility of the pilot-in-command to ensure that each flight crew member (including himself) has been appropriately trained to competency in the use of the aircraft's ACAS equipment and the avoidance of collisions.

3.2 Under the OTARs, aircraft that are required to have ACAS must be equipped with ACAS II. Procedures for the use of ACAS II equipment are specified in the Procedures for Air Navigation Services — Aircraft Operations (PANS-OPS, Doc 8168), Volume I — *Flight Procedures*.

3.3 *ACAS II Training Guidelines for Pilots* are provided in PANS-OPS, Volume I, Attachment to Part III, Section 3, Chapter 3; and in Appendix A to this OTAC.

3.4 **For flying an aircraft equipped with ACAS II** the following may be taken as evidence of appropriate training:

- (a) Possession of a type rating for an aeroplane equipped with ACAS II, where the operation and use of ACAS II are included in the training syllabus for the type rating; or

- (b) Possession of a document issued by a training organisation, or a person approved by the aviation authority of an ICAO Contracting State to conduct training for pilots in the use of ACAS II, indicating that the holder has been trained in accordance with the guidelines referred to in paragraph 3.3 above.

3.5 **For flying aircraft equipped with one of the simpler ACAS systems** e.g. TCAS I

- (a) Although carriage of the equipment is not mandatory, the pilot-in-command must still ensure that each flight crew member has been appropriately trained to competency in the use of that equipment. If this were not done, any lack of understanding could lead a pilot to manoeuvre in conflict with an aircraft that is ACAS II equipped.
- (b) Pilots of aircraft with the simpler ACAS systems should have received, as a minimum, a comprehensive pre-flight briefing by a pilot who has been trained in the use of ACAS II in accordance with the guidelines referred to in paragraph 3.3 above.

Note: Provisions for conduct and recording of differences training are in OTAR Part 61.

4 **Pilot responsibilities**

- 4.1 ICAO PANS-OPS Volume I — *Flight Procedures* states that in the event of an ACAS Resolution Advisory (RA) pilots shall respond immediately by following the RA as indicated, unless doing so would jeopardise the safety of the aircraft.
- 4.2 This does not diminish the authority and responsibility of the pilot-in-command to ensure safe flight.
- 4.3 ACAS 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 many approved instrument procedures and IFR clearances are predicated on avoiding high terrain or obstacles, it is particularly important that pilots maintain situational awareness and continue to use accepted operating practices and judgement when following ACAS RAs.
- 4.4 Since ACAS does not respond to aircraft unless they are equipped with a functioning transponder, ACAS does not ensure safe separation in every case. It is important, wherever possible, to maintain frequent outside visual scan, use see-and-avoid vigilance and to continue to communicate with ATC as appropriate.

5 **Some important points on use of ACAS**

- Pilots need to be aware of the ACAS version they use, and its limitations; and be trained according that version.
- To support the effectiveness of ACAS, the pilot of any aircraft that is fitted with a transponder (even when flying VFR and not ACAS equipped) should select the transponder ON with an appropriate code, with altitude reporting function (ALT, Mode C) if possible, at all times unless specifically requested otherwise.

- Some of the simpler ACAS systems, including TCAS I, can give only Traffic Alerts (TA) and cannot generate Resolution Advisories (RA).
- The objective of the TA is to assist the pilot in visual acquisition of conflicting traffic, i.e. where to look for the other aircraft.
- Visually acquired traffic may not be the same traffic as that causing a TA.
- The bearing displayed by ACAS is not sufficiently accurate to support the initiation of horizontal manoeuvres based solely on the traffic display. Pilots should be aware that the bearing indication may be up to 30 degrees in error.
- **Pilots must not manoeuvre in response to a Traffic Alert (TA) only.**
- With TCAS II, the purpose of the TA is to alert the pilot so that he can be prepared to respond to any RA that might follow.
- Pilots must not deviate from an assigned clearance on the basis of a TA only.
- TAs should not be reported to air traffic controllers. Similarly, "TCAS contact" should not be reported, e.g. after receiving traffic information from ATC.
- Pilots of aircraft fitted with TCAS II version 6.04A need to be aware that they will experience a much greater number of TAs and RAs, e.g. when flying in RVSM airspace. It is important they follow all RAs, even though the number is greater than with TCAS II version 7.0.
- Reducing vertical rate before level-off will reduce the number of RAs due to high vertical rate encounters, i.e. <1500 feet per minute by 1000 feet from the assigned level (and monitor autopilot performance during altitude capture).
- **Pilots must always respond promptly and accurately to all RAs as indicated, whatever the airspace, unless doing so would jeopardise the safety of the aircraft.**
- Visually acquired traffic may not be the same traffic as that causing an RA.
- When following an RA, the alteration of the flight path must be limited to what is necessary to comply with the RA; and pilots must never manoeuvre in the opposite sense to an RA.
- Vertical speed must be reduced in response to "Adjust Vertical Speed" RAs.
- Pilots who deviate from an air traffic control instruction or clearance in response to an RA must promptly return to the terms of that instruction or clearance when the conflict is resolved. ATC must be notified, as soon as practicable of the deviation and its direction, and when the deviation has ended.

Appendix A

Guidance on flight crew training programmes for use of ACAS II

This appendix is based on *ACAS II Training Guidelines for Pilots* in PANS-OPS, Volume I, Attachment to Part III, Section 3, Chapter 3 and *JAA TGL No.11 (Rev 1)*.

1 Purpose

- 1.1 During the implementation of the airborne collision avoidance system (ACAS) several operational issues were identified that were attributed to deficiencies in pilot training programmes. To address these deficiencies, a set of performance-based training objectives for ACAS pilot training has been developed.
- 1.2 This guidance contains performance-based training objectives for ACAS II flight crew training. Information contained in this paper that relates to traffic advisories (TAs) is also applicable to ACAS I and ACAS III users.
- 1.3 The information given is valid for TCAS II Version 6.04A as well as for Version 7 (ACAS II); where there are differences, these are identified.

2 Scope

- 2.1 The training objectives cover five areas: theory of operation; pre-flight operations; general in-flight operations; response to traffic advisories (TAs); and response to resolution advisories (RAs).
- 2.2 The training objectives are further divided into the areas of: academic training; ACAS manoeuvre training; ACAS initial evaluation; and ACAS recurrent qualification. In each area, objectives and acceptable performance criteria are defined.
- 2.3 No attempt has been made to define how the training programme should be implemented. Instead, objectives define the knowledge a pilot operating ACAS is expected to possess and the performance expected from a pilot who has completed ACAS training. However, the guidelines do indicate those areas in which the pilot receiving the training should demonstrate his/her understanding, or performance, using a real-time, interactive training device, i.e. a simulator or a computer-based training (CBT) aid.

3 Performance Based Training Objectives

3.1 ACAS Academic Training

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

3.1.2 Essential Items

3.1.2.1 *Theory of operation.* The pilot should 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:

(i) Surveillance:

- ACAS interrogates other transponder-equipped aircraft within a nominal range of 14 NM; and
- ACAS surveillance range can 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 provided for ACAS aircraft that are airborne.

Note: If the operator's ACAS installation provides for the use of the Mode S extended squitter, the normal surveillance range may be increased beyond the nominal 14 NM. However, this information is not used for collision avoidance purposes.

(ii) 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;

Note: SSR transponders having only Mode A capability do not generate TAs. However, ACAS will track and may display aircraft equipped with an operating Mode A/C transponder whether or not the altitude reporting function has been enabled.

- RAs can be issued only against aircraft that are reporting altitude and in the vertical plane only;
- RAs issued against an ACAS-equipped intruder are co-ordinated to ensure complementary RAs are issued;
- Failure to respond to an RA deprives the aircraft of the collision protection provided by its ACAS. Additionally, in ACAS-ACAS encounters, it also restricts the choices available to the other aircraft's ACAS and thus renders the other aircraft's ACAS less effective than if the first aircraft were not ACAS equipped; and
- Manoeuvring in a direction opposite to that indicated by an RA is likely to result in further reduction in separation. This is particularly true in the case of an ACAS-ACAS co-ordinated encounter.

b. *Advisory Thresholds*

- OBJECTIVE: Demonstrate knowledge of the criteria for issuing TAs and RAs.
- CRITERIA: The pilot should 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:

- (i) ACAS 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 a TA or RA can be issued. The separation standards provided by air traffic services are different from those against which ACAS issues alerts;

- (ii) Thresholds for issuing a TA or RA vary with altitude. The thresholds are larger at higher altitudes;
- (iii) TAs generally occur from 20 to 48 seconds prior to CPA. When ACAS is operated in TA-only mode, RAs will be inhibited;
- (iv) RAs occur from 15 to 35 seconds before the projected CPA; and
- (v) RAs are chosen to provide the desired vertical separation at CPA. As a result, RAs can instruct a climb or descent through the intruder aircraft's altitude.

c. *ACAS Limitations*

- OBJECTIVE: To verify that the pilot is aware of the limitations of ACAS.
- CRITERIA: The pilot should demonstrate a knowledge and understanding of the ACAS limitations including:
 - (i) ACAS will neither track nor display non-transponder equipped aircraft, nor aircraft with an inoperable transponder, nor aircraft with a Mode A transponder; and
 - (ii) ACAS will automatically fail if the input from the aircraft's barometric altimeter, radio altimeter or transponder is lost.

Note 1: 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 failures will result in an ACAS failure.

Note 2: ACAS may react in an improper manner when false altitude information is provided to own ACAS or transmitted by another aircraft. Individual operators should ensure that their pilots are aware of what type of unsafe condition can arise. Pilots should ensure that when they are advised that their own aircraft is transmitting false altitude reports, an alternative altitude reporting source is selected, or altitude reporting is switched off.

- (iii) 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 be displayed;
- (iv) ACAS may not display all proximate transponder-equipped aircraft in areas of high density traffic; however, it will still issue RAs as necessary;
- (v) Because of design limitations, the bearing displayed by ACAS is not sufficiently accurate to support the initiation of horizontal manoeuvres based solely on the traffic display;
- (vi) 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
- (vii) Stall warnings, ground proximity warning systems (GPWS)/ enhanced ground proximity warning systems (EGPWS/TAWS) warnings, and windshear warnings take precedence over TAs and RAs. When either a GPWS/EGPWS/TAWS or windshear warning is active, ACAS will automatically switch to the 'TA-only' mode of operation except that ACAS aural annunciations will be inhibited. ACAS will remain in 'TA-

only' mode for 10 seconds after the GPWS/EGPWS/TAWS or windshear warning is removed.

d. *ACAS Inhibits*

- OBJECTIVE: To verify that the pilot is aware of the conditions under which certain functions of ACAS are inhibited.
- CRITERIA: The pilot should demonstrate a knowledge and understanding of the various ACAS inhibits including:
 - (i) "Increase Descent" RAs are inhibited below 1,450 ft AGL;
 - (ii) "Descend" RAs are inhibited below 1,100 ft AGL;
 - (iii) All RAs are inhibited below 1,000 ft AGL;
 - (iv) All ACAS aural annunciations are inhibited below 500 ft AGL (1000ft Version 6.04A); this includes the aural annunciation for TAs; and

Note: Inhibited below the heights stated ± 100 ft.

- (v) 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. However, if aircraft performance at maximum altitude is not sufficient to enable compliance with the climb rate required by a climb RA, the response should still be in the required sense but not beyond the extent permitted by aircraft performance limitations.

Note: In some aircraft types, "Climb" or "Increase Climb" RAs are never inhibited.

3.1.2.2 *Operating Procedures*

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

a. *Use of controls*

- OBJECTIVE: To verify that the pilot can properly operate all ACAS controls and display controls.
- CRITERIA: Demonstrate the proper use of controls including:
 - (i) Aircraft configuration required to initiate a Self Test;
 - (ii) Steps required to initiate a Self Test;
 - (iii) Recognising when the Self Test is successful, and when it is unsuccessful. When the Self Test is unsuccessful, recognising the reason for the failure, and, if possible, correcting the problem;
 - (iv) 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;
 - (v) If available, recommended usage of the 'Above/Below' mode selector. 'Above' mode should be used during climb, and 'Below' mode should be used during descent;

- (vi) Recognition that the configuration of the traffic display, i.e. range and 'Above/Below' selection, does not affect the ACAS surveillance volume;
- (vii) Selection of lower ranges on the traffic display to increase display resolution when an advisory is issued;
- (viii) 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; and
- (ix) Proper configuration to display the appropriate ACAS information without eliminating the display of other needed information.

Note: The wide variety of display implementations makes it difficult to establish 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 that a pilot understands the meaning of all information that can be displayed by ACAS.
- CRITERIA: The pilot should demonstrate the ability to properly interpret information displayed by ACAS including:
 - (i) Other traffic, i.e. traffic within the selected display range that is not proximate traffic, or causing a TA or RA to be issued;
 - (ii) Proximate traffic, i.e. traffic that is within 6 NM and $\pm 1,200$ ft;
 - (iii) Non-altitude reporting traffic;
 - (iv) No bearing TAs and RAs;
 - (v) Off-scale TAs and RAs. The selected range should be changed to ensure that all available information on the intruder is displayed;
 - (vi) Traffic alerts. 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;
 - (vii) Resolution advisories (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;
 - (viii) 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, pilots should 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 2,500 ft/min, how an Increase Rate RA will be displayed; and
 - (ix) 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 should demonstrate the following:
 - (i) Knowledge of the operator's procedures for the use of 'TA-only' mode;
 - (ii) Reasons for using this mode and situations in which its use may be desirable. These may include:
 - During take-off towards known nearby traffic which could cause an unwanted RA during initial climb, such as a visually identified helicopter passing near the departure end of the runway. The TA/RA mode should be selected after the potential for an unwanted RA ceases to exist, such as after climbing above a known VFR corridor.
 - In the event of particular in-flight failures, such as engine failure, as specified by the aircraft flight manual or the operations manual.
 - During take-offs or landings outside the normal ACAS reference performance envelope, use of 'TA-only' mode may be appropriate during the limited period when ACAS reference performance cannot be achieved; for example when the aircraft is at low speed in specified limiting configurations during take-off or landing at hot and high aerodromes.
 - (iii) TA aural annunciation is inhibited below 500 ft AGL (1,000 ft AGL for Version 6.04A). As a result, TAs issued below this height may not be noticed unless the TA display is included in the routine instrument scan.

Note: Inhibited below the height stated ± 100 ft.

d. *Crew Co-ordination*

- OBJECTIVE: To verify that the pilots adequately brief other crew members on how TAs and RAs will be handled.
- CRITERIA: Pilots should demonstrate that their pre-flight briefing addresses the procedures that will be used in responding to TAs and RAs including:
 - (i) Division of duties between the pilot flying and the pilot not flying, including a clear definition of whether the pilot flying or the pilot-in-command will fly the aircraft during a response to an RA;
 - (ii) Expected call-outs;
 - (iii) Communications with ATC; and
 - (iv) Conditions under which an RA may not be followed and who will make this decision.

Note 1: Different operators have different procedures for conducting pre-flight briefings and for responding to TAs and RAs. These factors should be taken into account when implementing the training programme.

Note 2: It is essential that the operator specifies the conditions under which an RA need not be followed, reflecting the Governor's advice (see paragraph 4.3 in the OTAC above). 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 that the pilot is aware of the requirements for reporting RAs to the controller and other authorities.
- CRITERIA: The pilot should demonstrate the following:
 - (i) The use of the phraseology contained in the *Procedures for Air Navigation Services - Air Traffic Management* (PANS-ATM, Doc 4444); and
 - (ii) Understanding that verbal reports should be made to the appropriate air traffic control unit:
 - Whenever any manoeuvre has caused the aircraft to deviate from an air traffic clearance;
 - When returning/returned to the current clearance, as soon as the conflict is resolved; and
 - When ATC issues instructions that, if followed, would cause the flight crew to manoeuvre the aircraft contrary to an RA with which they are complying.
 - (iii) 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. Reference should also be made to the requirements of OTAR Part 13, Occurrence Reporting.

3.1.3 Desirable Items

a. *Advisory thresholds*

- OBJECTIVE: Demonstrate knowledge of the criteria for issuing TAs and RAs.
- CRITERIA: The pilot should 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:
 - (i) The TA altitude threshold is 850 ft when below FL 420 and 1,200 ft when above FL 420;
 - (ii) When the vertical separation at CPA is projected to be less than the ACAS-desired separation, 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;
 - (iii) When the vertical separation at CPA is projected to be just outside the ACAS-desired separation, an RA that does not require a change to the existing vertical speed will be issued. This separation varies from 600 to 800 ft; and

- (iv) RA fixed range thresholds vary between 0.2 NM 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.

3.2 ACAS MANOEUVRE TRAINING

- 3.2.1 When training pilots in correct responses to ACAS-displayed information, TAs and RAs are 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 utilised, CRM aspects of responding to TAs and RAs should be practised during this training.
- 3.2.2 If an operator does not have access to an ACAS-equipped simulator, the initial ACAS training should be conducted by means of an interactive CBT with an ACAS display and controls similar in appearance and operation to those in the aircraft the pilot will fly. 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.
- 3.2.3 The scenarios in the manoeuvre training should include: initial RAs that require a change in vertical speed; initial RAs that do not require 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 maximum altitude; and multi-aircraft encounters. In all scenarios, excursions should be limited to the extent required by the RA. The scenarios should be concluded with a return to the original flight profile. The scenarios should also include demonstrations of the consequences of not responding to RAs, slow or late responses, and manoeuvring opposite to the direction called for by the displayed RA as follows:

Note: Examples of actual incidents are available in Eurocontrol ACAS II 'Safety flash' bulletins - www.eurocontrol/acas

a. *TA Responses*

- OBJECTIVE: To verify that the pilot properly interprets and responds to TAs.
- CRITERIA: The pilot should demonstrate the following:
 - (i) Proper division of responsibilities between the pilot flying and pilot not flying: Pilot flying should continue to fly the aeroplane and be prepared to respond to any RA that might follow. The pilot not flying should provide updates on the traffic location shown on the ACAS display and use this information to help visually acquire the intruder;
 - (ii) Proper interpretation of the displayed information: Visually search for the traffic causing the TA at a location shown on the traffic display. 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);
 - (iii) Other available information is used to assist in visual acquisition. This includes ATC "party-line" information, traffic flow in use, etc.;
 - (iv) Because of the limitations described in 3.1.2.1 c), the pilot flying should not manoeuvre the aircraft based solely on the information shown on the ACAS display; and

- (v) When visual acquisition is attained, right of way rules are used to maintain or attain safe separation. No unnecessary manoeuvres are initiated. The limitations of making manoeuvres based solely on visual acquisition, especially at high altitude or at night, or without a definite horizon are understood.

b. *RA Responses*

- OBJECTIVE: To verify that the pilot properly interprets and responds to RAs.
- CRITERIA: The pilot should demonstrate:

- (i) Proper division of responsibilities between the pilot flying and the 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.
- (ii) Proper interpretation of the displayed information: The pilot recognises the intruder causing the RA to be issued (red square on display). The pilot responds appropriately;
- (iii) RAs requiring a change in vertical speed, initiation of a response in the proper direction within 5 seconds of the RA being displayed. After initiating the manoeuvre, and as soon as possible, as permitted by flight workload, ATC is notified using standard phraseology;

Note: PANS-OPS Volume I — *Flight Procedures* states that in the event of an RA, pilots shall respond immediately and manoeuvre as indicated, unless doing so would jeopardise the safety of the aeroplane.

- (iv) Recognition of, and proper response to, modifications to the initially displayed RA:
- For Increase Rate RAs, the vertical speed is increased within 2 1/2 seconds of the RA being displayed;
 - For RA reversals, the manoeuvre is initiated within 2 1/2 seconds of the RA being displayed;
 - For RA weakenings, the vertical speed is modified to initiate a return towards level flight within 2 1/2 seconds of the RA being displayed; and
 - For RAs that strengthen, the manoeuvre to comply with the revised RA is initiated within 2 1/2 seconds of the RA being displayed;
- (v) Recognition of altitude crossing encounters and the proper response to these RAs;
- (vi) 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;
- (vii) For Maintain Rate RAs, the vertical speed is not reduced. Pilots should recognise that a Maintain Rate RA may result in crossing through the intruder's altitude;
- (viii) 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;

- (ix) That the deviation from the current clearance is minimised by levelling the aircraft when the RA weakens and when "Clear of Conflict" is annunciated, executing a prompt return to the current clearance; and notifying ATC as soon as possible, as permitted by flight crew workload;
- (x) 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; the horizontal (turn) element of an ATC instruction should be followed;
- (xi) That when simultaneous conflicting instructions to manoeuvre are received from ATC and an RA, the RA is followed and, as soon as possible, as permitted by flight crew workload, ATC is notified using standard phraseology;
- (xii) A knowledge of the ACAS multi-aircraft logic and its limitations, and that ACAS can optimise separations from two aircraft by climbing or descending towards one of them. For example, ACAS considers as intruders only aircraft that it finds 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 manoeuvre 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;
- (xiii) A knowledge of the consequences of not responding to an RA and manoeuvring in the direction opposite to the RA; and
- (xiv) That a prompt response is made when a climb RA is issued while the aircraft is at the maximum altitude.

3.3 ACAS INITIAL EVALUATION

- 3.3.1 The pilot's understanding of the academic training items should be assessed by means of a written test or inter-active CBT that records correct and incorrect responses to phrased questions.
- 3.3.2 The pilot's understanding of the manoeuvre training items should 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 pilot. The range of scenarios should include: initial RAs that require a change in vertical speed; initial RAs that do not require 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 maximum altitude; and multi-aircraft encounters. In all scenarios, excursions should be limited to the extent required by the RA. The scenarios should be concluded with a return to the original flight profile. The scenarios should also include demonstrations of the consequences of not responding to RAs, slow or late responses, and manoeuvring opposite to the direction called for by the displayed RA.
- 3.3.3 If an operator does not have access to an ACAS-equipped simulator, the initial ACAS evaluation should be conducted by means of an interactive CBT with an ACAS display and controls similar in appearance and operation to those in the aircraft the pilot will fly. This interactive CBT should depict scenarios in which real-time responses must be made, and a record should be made of whether or not each response was correct. The CBT should include all types of RAs described in 3.3.2.

3.4 ACAS RECURRENT TRAINING

3.4.1 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.

3.4.2 ACAS monitoring programmes periodically publish findings from their analyses of ACAS events. The results of these analyses typically discuss the technical and operational issues related to the use and operation of ACAS. This information is available from ICAO or directly from the monitoring programmes. ACAS recurrent training programmes should address the results of monitoring programmes in both the academic and simulator portions of recurrent training visits.

Note: ACAS monitoring programmes are carried out by, e.g. the FAA, and Eurocontrol - www.eurocontrol/acas

3.4.3 Recurrent training should include both academic and manoeuvre 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.

3.4.4 Pilots should fly all scenarios once every four years.

3.4.5 Pilots should complete all scenarios every two years if CBT is used.