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EUROCONTROL

ACAS II Bulletin
"Traffic, traffic"
TCAS Traffic Advisories

WELCOME

TCAS II issues two types of alerts: Traffic Advisories (TAs) and Resolution Advisories (RAs). Thus far, our Bulletins have discussed mainly RAs as these alerts provide specific guidance in respect of how the aircraft should be manoeuvred and are safety critical. In this issue we will concentrate on TAs and issues surrounding them.

The objective of a TA is to aid visual acquisition of an intruder and prepare the crew for a possible RA. Traffic Advisories (sometimes referred to as 'Traffic Alerts') occur more frequently than RAs, therefore pilots' exposure to them is much higher and it is important that these alerts are properly understood.

Although ICAO provisions state that pilots shall not manoeuvre their aircraft solely in response to a TA, cases have been reported in which pilots have manoeuvred on this basis. The purpose of this Bulletin is to explain why manoeuvres based solely on a TA are not appropriate. We will provide examples and also discuss what can happen, in various theoretical scenarios, if a pilot changes the vertical rate or performs a lateral manoeuvre just because of a TA.

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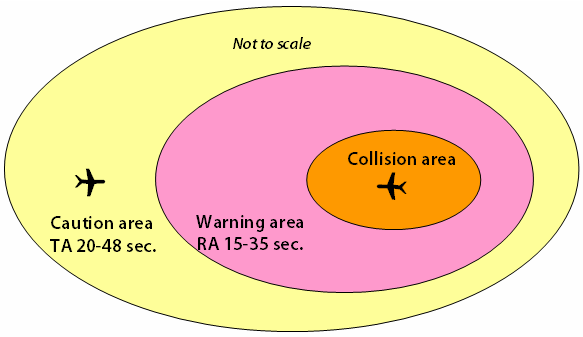
Traffic Advisories

The TCAS Traffic Advisory function uses an algorithm similar to the RA generation logic but with larger alert thresholds. TAs are nominally generated 20–48 seconds prior to the predicted Closest Point of Approach which would be 10–13 seconds earlier than any RA, although shorter generation times are possible in some geometries – indeed, in certain cases an RA can occur without a preceding TA. The majority of TAs will not be followed by an RA because often the separation between the aircraft does not drop below the alert threshold for an RA. On average, only 1 in 10 TAs will be followed by an RA.

A TA is announced as "Traffic, traffic" and the intruder aircraft symbol on the TCAS traffic display changes to a yellow or amber solid circle. No manoeuvres shall be made in response to a TA and TAs are not required to be reported to ATC.

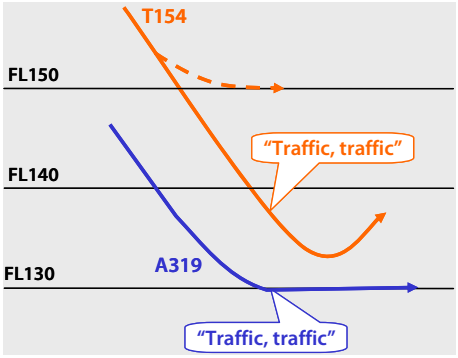


RAs are coordinated if both aircraft are TCAS-equipped. There is no similar mechanism for TAs as TAs do not recommend, nor require, any manoeuvres.

TAs and RAs may be generated before the standard ATC separation has been lost.

Although the normal operating mode of TCAS II is TA/RA, there may be circumstances where TCAS II should be selected to TA-only mode. In the TA-only mode, the equipment still performs the surveillance function (i.e. it scans for proximate traffic) but it will only generate TAs. Other TCAS II aircraft can still generate uncoordinated RAs against the aircraft which has its TCAS II in TA-only mode. The TA-only mode may be explicitly specified in operating procedures as a response to in-flight malfunctions such as an engine failure with consequent aircraft performance implications or a pressurisation system failure followed by an emergency descent.

Event 1 – TA but no RA despite close proximity



An Airbus 319 and a Tupolev 154 descending to the same airport are converging towards the same reporting point. The A319 is 0.7 NM ahead and already 1000 feet below the T154. For sequencing, the A319 is instructed to fly on a heading of 180 degrees and descend to FL130. Subsequently, the T154 is given an instruction to turn onto a heading of 150 degrees and descend to FL150. The instruction is correctly acknowledged.

However, the T154 crew busts the cleared level and continues the descent below FL150. When the T154 is passing FL137 toward the A319, the air traffic controller, alerted by the ATC Short Term Conflict Alert system, gives the T154 crew traffic information and an instruction to climb to FL140. The aircraft are equipped with TCAS II which generate TAs for both aircraft but despite close proximity there are no RAs. The T154 crew is able to establish visual contact with the A319. The T154 descends as far as FL133 before climbing back to FL140. According to the radar data the lowest separation between the aircraft was 800 feet and 1 NM.

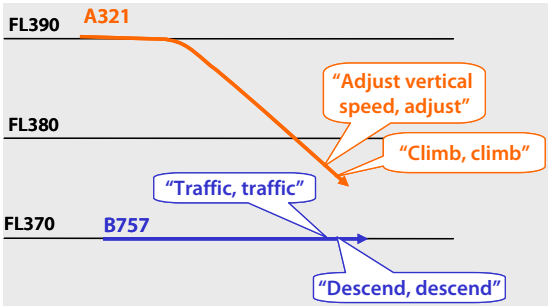
The geometry of this encounter was such that, despite the close proximity, the thresholds for RA generation have not been met (as the horizontal range was sufficient to preclude a collision).

Learning points:

- TAs provide crew with awareness of another aircraft and aid visual acquisition.
- In some cases RAs might not be issued despite close proximity if TCAS establishes that there is no risk of collision.

Event 2 – RA without preceding TA

Two aircraft, a Boeing 757 at FL370 and an Airbus 321 at FL390, are flying one above the other to the same destination. The A321 slowly overtakes the B757.



When the A321 crew asks for descent, the air traffic controller gives them a clearance direct to the approach fix and, forgetting about the B757 below, mistakenly gives a descent to FL250. The direct track causes the A321 to turn slightly to the left and the horizontal spacing between the aircraft slowly starts to increase while the A321 commences its descent. Its vertical speed reaches 3300 ft/min in 45 seconds. When the aircraft are 685 ft and 1 NM apart (abeam each other) the B757 receives a TA against the A321. Simultaneously, an RA is issued for the A321 without a TA. In quick succession the A321 gets an "Adjust vertical speed" RA (requiring a vertical rate of 0 ft/min, i.e. a level-off), followed by a "Climb" RA. A few seconds after the TA the B757 crew receives a "Descend" RA.

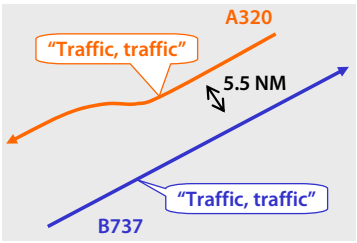
Learning points:

- In some situations (mainly due to high vertical rates) TAs will not precede RAs for one or both aircraft in the conflict pair.
- RAs can change in rapid succession due to high vertical rates.

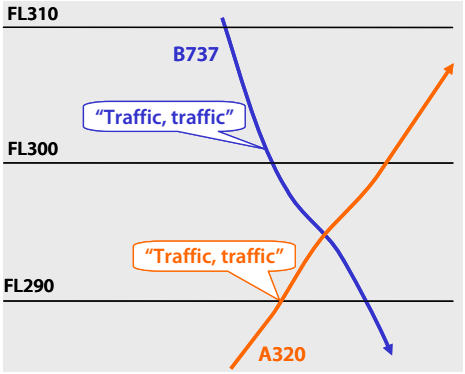
Event 3 – Unauthorised turn in response to TA

An Airbus 320 is cleared to climb from FL260 to FL340. On the opposite direction parallel track there is a Boeing 737 which is descending from FL320 to FL250. The predicted horizontal separation at the time the aircraft pass each other is 5.5 NM (i.e. 0.5 NM over the separation standard for this ATC unit). To ensure that separation is maintained both crews are instructed by the air traffic controller to continue on their current headings and are given traffic information.

Some twenty seconds before the aircraft pass each other the A320 crew initiates a right turn of 10 degrees and notifies the controller of the turn adding it was because of "a TCAS alert". The aircraft soon pass each other and the A320 crew sees the opposite direction traffic and returns to the previously assigned heading.



The controller asks the A320 crew whether they had a TA or RA. "*No, it was the beginning*" the A320 pilot replies.



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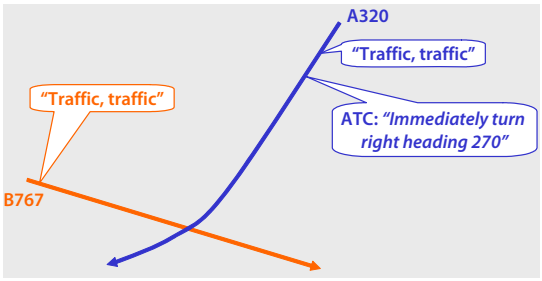
Learning points:

- Pilots shall not manoeuvre their aircraft in response to TAs only.
- TCAS II does not provide horizontal avoiding instructions.
- The TCAS traffic display must not be used for self-separation due to its limited accuracy. See ACAS Bulletin no. 6 for more information about the TCAS traffic display.
- In controlled airspace, any manoeuvres unauthorised by ATC can result in a loss of separation with a third party aircraft.
- In opposite heading encounters with standard separation TAs can still occur for a sufficiently high closing speed (e.g. at FL350 with 5 NM separation, if the closing speed exceeds 725 kts there will be a traffic advisory).

Event 4 – Unauthorised climb in response to TA

A Boeing 767 at FL370 and an Airbus 320 climbing to FL360 are on crossing tracks. As a result of an ATC error, the A320 is cleared to climb further to FL380.

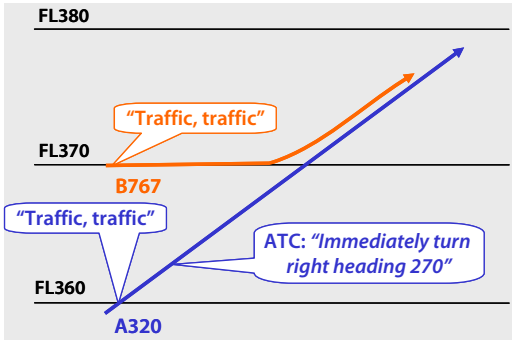


As the A320 is climbing through FL360 both pilots receive a TA. The B767 pilot asks the controller about the traffic coming from the left-hand side. The controller does not respond to the B767 as at the same time he gets an ATC Short Term Conflict Alert system alert. Consequently, he instructs the A320, which is already passing through FL363, to "immediately turn right heading 270" (which is approximately a 70-degree turn) to ensure that horizontal spacing between the aircraft is maintained. At this point, the turn would not prevent a separation loss but it would diminish the risk of a collision. However, the A320 crew is slow commencing the turn.

After receiving the TA the B767 pilot, observing the A320 below on a TCAS traffic display, starts to climb. Because of the A320 right turn, the aircraft are not converging horizontally any more but both are now climbing simultaneously, at more or less the same vertical speed.

When the B767 reaches FL377 the tracks cross at a distance of 2.2 NM and the aircraft start to diverge. Soon after, the B767 stops its climb and descends back to FL370. The A320 levels off at FL380.

In this case, the horizontal separation between the aircraft remained large enough to inhibit the generation of RAs.



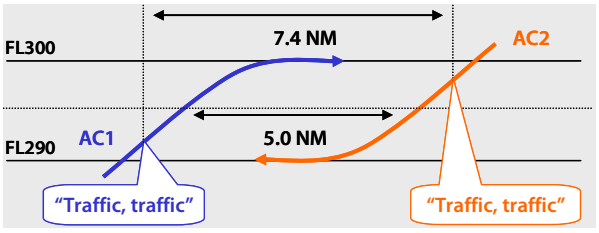
Learning points:

- Pilots shall not manoeuvre their aircraft in response to TAs only.
- While the TCAS traffic display may be used as an aid to visually acquire conflicting traffic, it must not be used for self-separation.
- Traffic acquired visually might not be the aircraft which is the cause of a TCAS alert (TA or RA).
- As the trajectory and intentions of other aircraft are not known, any avoidance manoeuvres based solely on a TA may cause the situation to deteriorate further.
- Pilots should give prompt attention to any ATC instruction beginning with the phrase "avoiding action" or containing the word "immediately" (since the word "immediately" may also be used to indicate that an avoiding manoeuvre is required).

Theoretical examples: Vertical rate or heading change in response to TA

Theoretical examples below will illustrate how in some geometries, vertical rate or heading changes after a TA can actually be a trigger for an RA which otherwise would not have been generated.

Example 1 – Vertical rate change:
Two aircraft are flying on crossing tracks (90-degree angle): Aircraft 1 is climbing to FL300, while Aircraft 2 is descending to FL290, both with a vertical rate of 1000 ft/min. While passing FL292 and FL298 respectively and separated by 7.4 NM, they each receive a TA but no subsequent RA. When the aircraft cross in altitude they are separated by 5 NM.



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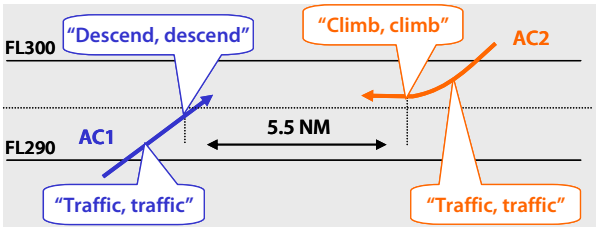
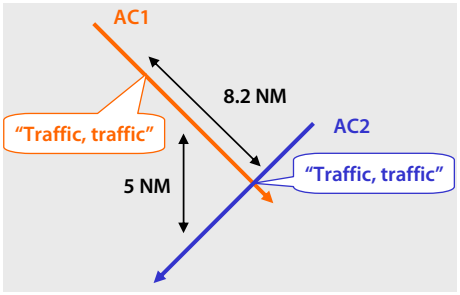
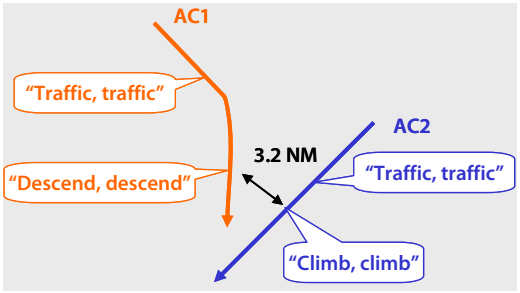
In the same geometry the Aircraft 2 crew start to level-off when, following the TA, they see that Aircraft 1 is indicated as 600 ft below and climbing. As the result of the change in the vertical rate, Aircraft 1 will receive a "Descend" RA and Aircraft 2 a "Climb" RA when the aircraft are 5.5 NM apart.



Example 2 – Horizontal manoeuvres:

Aircraft 1 is heading 135 degrees, while Aircraft 2 is heading 225 degrees, both at FL300. Aircraft 1 is 150 kts faster (ground speed) than Aircraft 2. At the time when Aircraft 2 passes in front of Aircraft 1 the distance between them is 8.2 NM and both aircraft receive a TA. At no time is the horizontal distance between the aircraft below 5 NM.





In the same geometry the Aircraft 1 crew observe Aircraft 2 on their TCAS traffic display and, 5 seconds after the TA, they incorrectly assume that a turn is required to avoid Aircraft 2. A 3-degree/second right turn onto a heading of 190 degrees is then initiated. As the result of the turn, Aircraft 1 will receive a "Descend" RA and Aircraft 2 a "Climb" RA when the aircraft are 3.2 NM apart and the minimum distance between the aircraft will decrease to 1.7 NM.

See ACAS Bulletin no. 6 for more information about the incorrect use of the TCAS traffic display.

Relevant ICAO Provisions:

The indications generated by ACAS shall be used by pilots in conformity with the following safety considerations:
a) pilots shall not manoeuvre their aircraft in response to traffic advisories (TAs) only;
Note 1. — TAs are intended to alert pilots to the possibility of a resolution advisory (RA), to enhance situational awareness, and to assist in visual acquisition of conflicting traffic. However, visually acquired traffic may not be the same traffic causing a TA. Visual perception of an encounter may be misleading, particularly at night.
Note 2. — The above restriction in the use of TAs is due to the limited bearing accuracy and to the difficulty in interpreting altitude rate from displayed traffic information.
b) on receipt of a TA, pilots shall use all available information to prepare for appropriate action if an RA occurs; […]

Source: ICAO PANS-OPS, volume I, III.3.3.3.2

Key learning points in this issue

- A TA is an indication that an aircraft in the vicinity may be a potential threat and that an RA may follow.
- No manoeuvres shall be made solely in response to a TA.
- The TCAS traffic display is an aid to visually acquisition of potentially conflicting traffic but it must never be used as a basis for self-separation (i.e. manoeuvring).
- Most TAs are not followed by RAs.
- A few RAs will not be preceded by TAs.
- Only a TCAS II RA provides guidance on the mitigation of collision risk.

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