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ATC Matters

WELCOME

In this issue of the ACAS II Bulletin we will look into an essential element of today's aviation – the interactions between flight crews and ATC and how these may be influenced by the use of the TCAS traffic display and reporting RAs to ATC.

While the TCAS traffic display plays an important role in enhancing pilots' situational awareness, pilots must not use its indications to initiate self-separation manoeuvres, such as turns or altitude changes. As illustrated in events 1 and 2, such manoeuvres are inappropriate and cause unnecessary workload for pilots and controllers. In some cases they may even lead to a loss of separation. Unless an RA has been issued, ATC clearances always take precedence.

When an RA is issued, ATC will not necessarily be aware of it until a report has been made by the pilot. An RA report would indicate to ATC that they should stop issuing instructions to the reporting pilot. But sometimes pilot reports are fragmented and may not convey the necessary information and be a source of confusion. Event 3 describes a case in which the pilot's report confused the controller regarding his responsibilities. Further examples of how RA reporting phraseology should and should not be used are given in Events 4 and 5.

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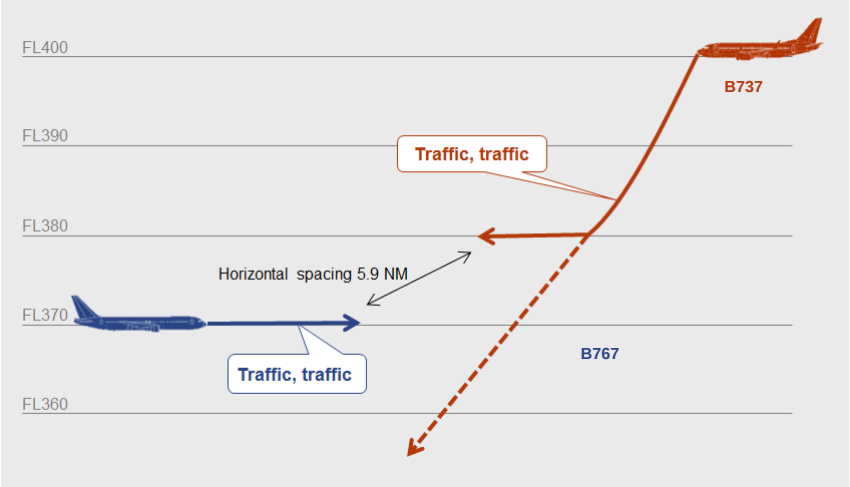
Event 1: Descent stopped due to TA

A Boeing 737 is maintaining FL400 heading northwest, while a Boeing 767 is flying in the opposite direction at FL370. The tracks are almost parallel, with the horizontal spacing of 6 NM. When the B737 approaches its top of descent, ATC instructs the B767 to continue its present heading and then clears the B737 to descend to FL320, also on its present heading, so the horizontal spacing is maintained. Additionally, the B737 is instructed to descend with a rate of 1500 ft/min. or more, to stay clear of other traffic ahead.

Just over a minute later, the controller instructs the B737 crew to continue their descent to FL300, with the rate of 2000 ft/min. The B737 pilot replies that they are very close to the B767 and, therefore, will level-off at FL380. He adds that once they are clear of the traffic they will continue their descent. ATC informs the B737 crew that the B767 is on their two o'clock at a distance of over 6 NM. The crew responds saying "*We have a TCAS on him*". The controller asks the B737 pilot for clarification whether they had a TA or RA. The pilot says they had a TA requiring them to limit their rate of descent in line with company procedures. The B767 crew confirms that they have also received a TA.

The aircraft pass each other with the horizontal separation of 5.9 NM (5 NM radar separation required in this airspace).



Learning points:

- No self-separation manoeuvres are allowed in response to Traffic Advisories (TAs).
- All ATC vertical rate instructions must be followed.

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Air traffic control

One of the standard air traffic control techniques is "locking" aircraft on their headings to ensure that no turns are made and, therefore, the standard ATC horizontal separation will be maintained. Pilots will be instructed to "maintain present heading" or to turn onto a specified heading. The ATC issued heading (radar heading) shall be continued until a new instruction or clearance is received.

Similarly, pilots may be instructed to descend (or climb) with a specified vertical rate to make sure the aircraft gets below or above any conflicting traffic.

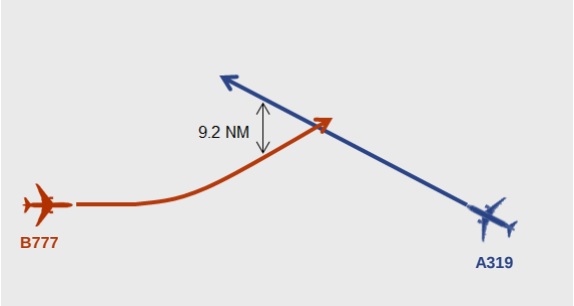
Both techniques allow ATC to manage traffic flows efficiently and decrease workload for all involved by preventing, for instance, unnecessary altitude changes. Although, ICAO Annex 6 recommends that, when the pilot is made aware of another aircraft at or approaching an adjacent altitude or flight level, the vertical rate is reduced to **1500 ft/min. or less in the last 1000 feet of climb or descent** to the assigned level, this recommendation is not applicable if ATC has issued a vertical rate instruction. Aircraft operators should specify appropriate procedures covering these cases.

What actions are appropriate during a TA?

ICAO provisions are clear on the matter: "pilots shall not manoeuvre their aircraft in response to traffic advisories (TAs) only". After receiving a TA, the pilot must still comply with ATC instructions and clearances. If in doubt, the pilot should ask the controller before performing any manoeuvre. **Only an RA authorises the pilot to deviate from ATC clearance.**

Event 2: Unauthorised turn

A Boeing 777 heading east is cleared to climb to FL270 while a northwest bound Airbus 319 is descending to FL250. The predicted horizontal spacing between the aircraft is over 10 NM. When the B777 is passing FL260 and the A319 FL285, the B777 crew starts a left turn and informs ATC that they are turning onto a heading of 070° to "*avoid traffic*", which they observe on the TCAS traffic display at their 10 o'clock position. At this point the distance between the aircraft is 18 NM.



ATC informs the B777 crew that the horizontal separation with the traffic at 10 o'clock (i.e. the A319) is going to be 9 NM. The controller adds that the standard radar separation in his airspace is 5 NM. Still, the B777 crew replies "*too close, too close*".

The B777 crew did not realise that the left turn has actually brought them closer to the A319. Neither crew received a TA or RA.

Learning points:

- Pilots shall not manoeuvre or make self-separation decisions based on traffic display indication.
- All ATC heading instructions must be followed.
- **A deviation from ATC clearance or instruction is authorised only in a response to Resolution Advisories (RAs).** Once an RA has been issued it must be followed promptly.

TCAS II traffic display

TCAS traffic display is useful in helping pilots with visual acquisition of aircraft in the vicinity and maintaining general situational awareness. However, the traffic display can easily be misinterpreted as it provides only partial information and has limited accuracy. It has not been designed for the purposes of self-separation or sequencing, and using it for these purposes is inappropriate, and could also be hazardous.

The bearing displayed by TCAS II is not sufficiently accurate to support the initiation of horizontal manoeuvres as the reference for the traffic display is the position of own aircraft, there are neither speed vectors nor information about other aircraft intentions. All that may lead to misinterpretation of relative motion of other traffic on the display.

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

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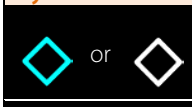
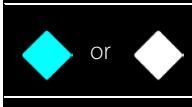
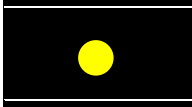
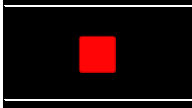
TCAS traffic display symbology and associated actions			
Symbol	**Type**	**Pilot action**	**Report to ATC**
	**Other traffic**	Visual acquisition. Vertical speed reduction if traffic is at the level adjacent to the cleared level.	None.
	**Proximate traffic:** Aircraft within 6 NM and 1200 feet of own aircraft	Visual acquisition. Vertical speed reduction if traffic is at the level adjacent to the cleared level.	None.
	**Traffic advisory (TA):** Nominally generated 20-48 sec. before Closest Point of Approach (CPA)	Visual acquisition. Vertical speed reduction if traffic is at the level adjacent to the cleared level. Prepare for possible RA.	None.
	**Resolution advisory (RA):** Nominally generated 15-35 sec. before CPA	Follow the RA as indicated by changing or maintaining the vertical speed.	Report the RA if it is causing a deviation from ATC clearance.
	**Vertical trend arrow and relative altitude** will be shown next to each symbol (in the matching colour). The relative altitude is displayed in hundreds of feet, above the symbol if the intruder is above own aircraft and below the symbol in the opposite case.		

Reporting RAs

A TCAS RA has important consequences for responsibilities of pilots and air traffic controllers: pilots are required to immediately comply with all RAs, even if the RAs are contrary to ATC clearances or instructions. When the RA causes a deviation from the ATC clearance pilots are required to report the RA to ATC. Once an aircraft departs from its ATC clearance or instruction in compliance with an RA, or a pilot reports an RA, the controller ceases to be responsible for providing separation between that aircraft and any other aircraft affected as a direct consequence of the manoeuvre induced by the RA.

If the controller is unaware of the RA, he/she is also unaware of the change in the responsibility for providing separation. Therefore, RA reports to ATC should be timely and also they must clearly specify the callsign and state unambiguously that the aircraft is responding to an RA: *"[Callsign] TCAS RA"*. Reporting the sense (i.e. climb or descend) of the RA is not appropriate as it may change during the encounter. Any deviations from the standard phraseology may introduce uncertainties and confusion.

It is equally important that pilots report to ATC when they receive a TCAS "Clear of conflict" message. This report indicates to the controller that the RA is over and ATC must resume responsibility for providing separation.

If during an RA, the crew receives an ATC clearance or instruction that is contradictory to the RA, the pilot must follow the RA and inform ATC as follows: "*[Callsign] Unable, TCAS RA*". See page 4 for the full list of RA reporting phraseology.

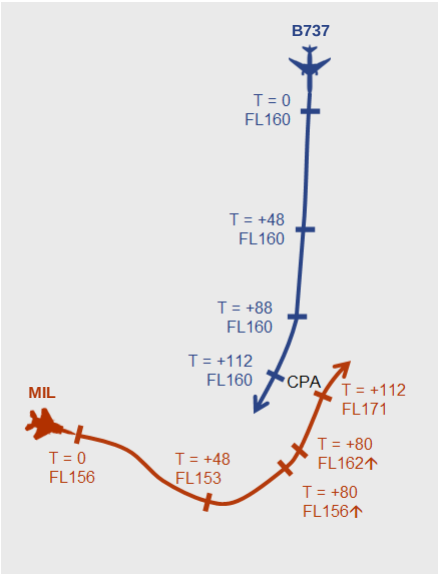
Event 3: Ambiguous report

A Boeing 737 is flying south descending to FL160 towards its destination. The controller sees on his screen an unknown target on an easterly heading. The aircraft are initially far apart but then the unknown aircraft turns onto a collision course. The controller instructs the B737 to turn right onto a heading of 210° in order to provide spacing with the unknown aircraft. The B737 crew complies with the instruction.

When the B737 is 6 NM north of the unknown aircraft, the latter is again observed turning towards the B737 and starting to climb. This manoeuvre results in a TA being generated for the B737. The B737 pilot makes a partially unintelligible call to ATC: "*Confirm … we got TCAS traffic in front five miles … avoiding*".

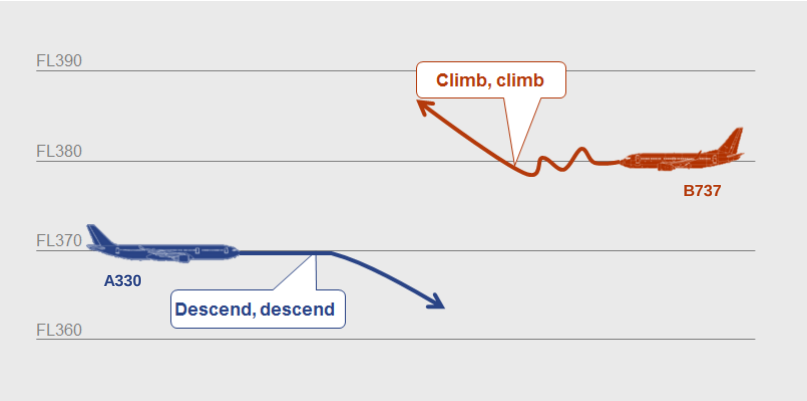
Based on the words "*TCAS*" and "*avoiding*", the controller concludes that the B737 crew is reporting that they are responding to an RA. The controller provides no more instructions, just tells the pilot to continue as required to avoid. The B737 remains on its heading and flight level and soon the unknown aircraft passed to the east of the B737. At the CPA (Closest Point of Approach) the separation between the two aircraft was 1.6 NM and 1100 feet.

A subsequent investigation established that unknown aircraft was a military fighter which strayed off course and no RA was generated on the B737 as the thresholds for RA generation had not been met.



Event 4: RA report

A northwest bound Boeing 737 is maintaining FL380 while an eastbound Airbus 330 is at FL370. Their tracks are expected to cross with a horizontal separation of less than 1 NM. When the aircraft are approximately 8 NM apart the B737 experiences turbulence and some altitude fluctuations. Its altitude remains within 100 feet of FL380 but rapid altitude changes and closing speed to the A330 trigger RAs on both aircraft as TCAS assumes that the B737 is descending towards the other aircraft. The A330 gets a Descend RA while the B737 receives a Climb RA. Both pilots promptly follow their RAs.



The A330 crew reports the RA to the controller who provides them with traffic information. Soon after, the aircraft pass each other and the TCAS "Clear of conflict" message is issued on both aircraft. The B737 crew reports the receipt of clear of conflict message and they are descending back to FL380. "Clear of conflict" is also reported by the A330 crew who asks the controller to confirm their cleared level before climbing back to FL370.

The RA report by the A330 crew informed the controller why the aircraft was departing from its assigned flight level and the "Clear of conflict" by both pilots indicated to the controller when he should resume responsibility for separation. The timely and accurate reports by both pilots enabled this situation to be handled in an optimum manner.

Event 5: Emergency?

In another event with the geometry almost identical to the one described in Event 4 above and with turbulence again causing the RA, one of the crews reported: "*Mayday, mayday, mayday [callsign] TCAS descend*".

TCAS RA is not an emergency situation and use of the phrase "*Mayday*" is not justified.

Learning points:

- **Only RAs causing a deviation from ATC deviation clearance shall be reported to ATC.**
- Report RAs and clear of conflict using standard phraseology to minimise possible misunderstanding (see the box below). Both reports will allow the controllers to cease and subsequently resume their responsibility for separation in a timely manner.

RA reporting phraseology

All reports listed below must be preceded by the **callsign**.

After a flight crew starts to deviate from any ATC clearance or instruction to comply with an RA:
Pilot: ***TCAS RA*** (pronounced *Tee-Cas-Ar-Ay*)
ATC: ***Roger***

After the response to an ACAS RA is completed and a return to the ATC clearance or instruction is initiated:
Pilot: ***Clear of conflict, returning to*** (assigned clearance)
ATC: ***Roger*** (or alternative instructions)

After the response to an RA is completed and the assigned ATC clearance or instruction has been resumed:
Pilot: ***Clear of conflict*** (assigned clearance) ***resumed***
ATC: ***Roger*** (or alternative instructions)

After an ATC clearance or instruction contradictory to the RA is received, the flight crew will follow the RA and inform ATC directly:
Pilot: ***Unable, TCAS RA***

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