SAFETY FLASH

ACAS II bulletin No 5

EUROCONTROL

Controller and Pilot ACAS regulation and training

Editorial

Recent experience, including the lessons from the Überlingen mid-air collision, confirms that ICAO standard ACAS operational procedures needed to be reinforced. Revised ACAS procedures and pilot training guidelines are now included in ICAO PANS-OPS Doc 8168. Other ICAO documentation, including PANS-ATM Doc 4444, is also being reviewed to ensure consistency and completeness.

In Europe, complementary action is being taken by JAA to ensure that JAR-OPS ACAS provisions and associated guidance material are in line. Furthermore, the Strategic Safety Action Plan (SSAP) requires, as a high priority, action to be taken by aviation regulatory authorities, air navigation service providers, and airspace users to confirm that these ACAS regulations and procedures are correctly implemented and applied. IATA and other airspace user organisations support these initiatives. Every effort must be made to ensure that the relevant operations manuals include up-to-date ACAS procedures, and that appropriate training is provided to ensure that pilots and controllers are able to apply these standard ACAS procedures consistently.

The ACAS II equipment, known as TCAS II, is an independent airborne safety net. Nevertheless, to ensure that its operational effectiveness is maximised, both pilots and controllers need to understand ACAS II operational principles, and correctly apply the standard operational procedures.

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October 2004

Event 1: Mid-air collision near Überlingen

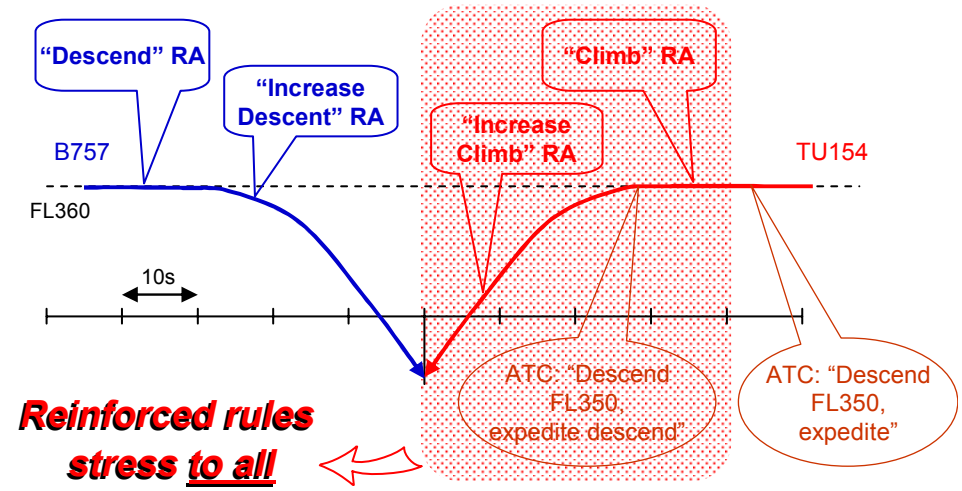
A B757, heading North, and a TU154, heading West, are level at FL360 in confliction on crossing tracks.

The controller instructs, late, the TU154 to expedite descent to FL350. As the flight crew starts to descend, a "Climb" RA is triggered by TCAS II. **Despite the "Climb" RA, the TU154 flight crew continues to descend** in accordance with their operations manual (the TCAS description wording was such that ATC instruction had the highest priority in collision avoidance).

A coordinated "Descend" RA is generated in the B757. The flight crew responds correctly and follows the RA. As the descent starts, the B757 TCAS strengthens to an "Increase Descent" RA, which is also correctly followed by the flight crew.

Because the TU154 flight crew has not acknowledged his instruction, **the controller repeats the instruction to expedite descent to FL350**. This time, the flight crew acknowledges and increases the rate of descent. **Despite an "Increase Climb" RA, the TU154 flight crew continues to descend** and the aircraft collide at 34890 ft.

The investigation of the accident by BFU (*) concluded that **one of the two immediate causes is that the TU154 flight crew manoeuvred in the opposite sense of the TCAS "Climb" RA** as they descended in response to the controller instruction. This is shown in the diagram below.



Reinforced rules stress to all FOLLOW THE RA!

(*) Source: BFU Investigation Report - AX001-1-2/02 – May 2004

Regulation context for the RA procedure

Following a near accident in Japan, ICAO took action to revise PANS-OPS; at the time of the Überlingen accident, this work was in progress.

In late 2003, a revised version of the PANS-OPS - Doc 8168 was published. It strengthens and clarifies provisions in ICAO documentation concerning the operation of ACAS II, particularly provisions on pilot responses to RAs.

The only correct way to implement this new regulation is through training. Therefore, it is imperative that the ACAS training of both controllers and pilots is made a priority.

New regulation for the RA procedure

Revision of PANS-OPS, Doc 8168: Operation of ACAS II equipment

The new procedures result out of the experience gained from a decade of worldwide ACAS II operations and as a result of several monitoring programmes.

The most important change is related to the procedure when an RA is generated. The new procedure clearly states that:

> ***"Pilots shall respond immediately by following the RA as indicated, unless doing so would jeopardise the safety of the aeroplane"***

> ***"Pilots shall follow the RA even if there is a conflict between the RA and an ATC instruction to manoeuvre"***
>
> ***"Pilots shall not manoeuvre in the opposite sense of an RA"***

As a reminder, in situations where an ATC instruction is contrary to an RA, the phraseology to be used by the pilot is: "*UNABLE, TCAS RESOLUTION ADVISORY*".

The key for maximum safety benefits from ACAS II is to follow all RAs promptly and accurately.

PANS-OPS now states that **visual acquisition is no longer an acceptable reason not to follow an RA.**

> ***"Note 2.— Visually acquired traffic may not be the same traffic causing an RA. Visual perception of an encounter may be misleading, particularly at night."***

In addition, the need for pilots to **notify all RAs to the controller** is reinforced:

> ***"Pilots shall, as soon as permitted by flight crew workload, notify the appropriate ATC unit of the RA, including the direction of any deviation from the current ATC instruction or clearance"***

The current **ACAS II phraseology is defined in PANS-ATM, Doc 4444**, Chapter 12, Para 12.3.1.2. However, ICAO is reviewing the ACAS II phraseology to ensure that it is consistent with the new ACAS procedure now included in the PANS-OPS.

The procedure for TAs has also been updated in accordance with the procedure for RAs. It emphasises the fact that **the primary goal of the TA is "*to alert the pilot of the possibility of an RA*".** To assist the pilot in visual acquisition is only a secondary objective.

Amendment to JAR OPS 1.398

To reflect the revised PANS-OPS, an amended version of JAR OPS will be published soon, which will emphasise that all RAs shall be followed.

In particular, it is expected that the option for the flight crew to decide whether or not to follow an RA (based on visual acquisition or on own judgment) will be removed.

However, operators should not wait until the publication of revised JAR OPS to review their operating procedures in accordance with the revised ICAO procedures.

Event 2: Opposite manoeuvre to an RA despite revised PANS-OPS

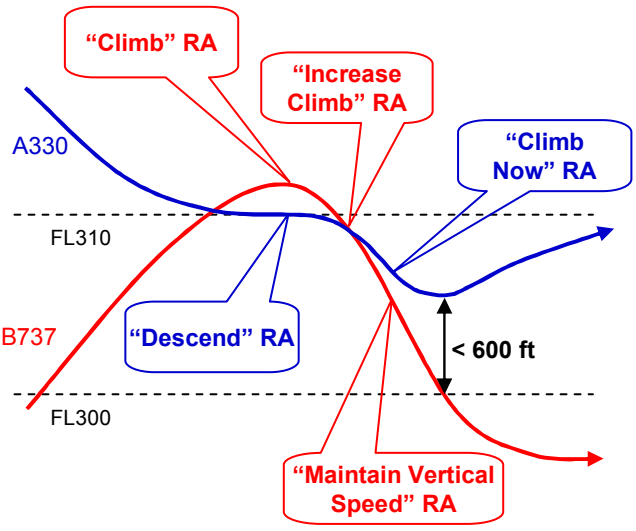
Due to a coordination problem between two sectors, a B737 is cleared to climb to FL320 against an A330 that has been cleared to descend to FL310 on a conflicting track.

The controller issues late instructions, to the B737 to descend immediately to FL290 and to the A330 to climb immediately to FL320.

Simultaneously, both aircraft receive coordinated RAs: the A330 has a "Descend" RA and the B737 a "Climb" RA.

The A330 flight crew immediately informs the controller and initiate a descent whereas t**he B737 flight crew decides to ignore their "Climb" RA** "*since [they] have intruding aircraft visual*". Instead, they continue a steep descent while initiating an evasive turn.

The manoeuvre of the B737 in the opposite direction to the "Climb" RA forces both TCAS units to reverse the RA senses. As a result, the minimum distance is 0.9 NM at less than 600 ft according to radar data and 300 m at the same level according to the B737 pilot, who filed an Airprox.



Simulations indicate that if the B737 flight crew had followed the "Climb" RA, the vertical distance would have been greater than 800 ft, and there would have been no reversal RAs nor subsequent altitude crossing.

This event occurred in February 2004, after the PANS-OPS had been revised to avoid such scenario. Pilots should be aware of the updated ACAS procedures and know how to apply them correctly, through reinforced training.

ACAS II training

ICAO training guidelines for pilots

ICAO has developed a set of performance-based training objectives for ACAS II pilot training to enable appropriate training programmes to be established. These objectives take into account issues that have been identified during ACAS II operational monitoring conducted by several States.

These training objectives were developed to both define what knowledge a pilot operating ACAS is expected to possess and the performance expected from a pilot who has completed ACAS training.

These ACAS II Training Guidelines are the basis for documents developed by JAA, EUROCONTROL or other organisations.

Complementary relationship of ICAO and JAA documents

To ensure an even more effective application of the ACAS procedures, the revised JAA TGL No. 11 will place stronger emphasis than the ICAO ACAS II Training Guidelines on two points.

- *The use of the TA-only mode is now limited to aircraft specific procedures, e.g. engine failure.*
- *No manoeuvre should be made on the sole basis of a TA, except that in case of a high vertical rate approaching the cleared flight, vertical rate should be reduced to less than 1500 fpm.*

Significantly, the PANS-OPS and the forthcoming revised JAR-OPS and TGL No. 11 emphasise the importance of following all RAs.

JAA – Temporary Guidance Leaflet No. 11

In line with the ICAO ACAS II Training Guidelines, JAA is revising TGL No. 11 "Guidance for operators on training programmes for the use of ACAS" to address both TCAS II version 7 characteristics and the revised PANS-OPS procedure for RA responses. The updated version is expected to be released by the end of 2004.

The identified training objectives will be divided into four areas:

- **ACAS academic training**. Items related to the theory of operation and to the operating procedures are defined. A list of objectives and acceptable performance criteria is further defined for each item.
- **ACAS manoeuvre training**. This addresses pilot responses to TAs and RAs. It is essential to verify that the pilot properly interprets and responds to TAs and RAs.
- **ACAS initial evaluation**. This is to assess pilot understanding of the academic training items and of the manoeuvre training items.
- **ACAS recurrent training**. This ensures that pilots maintain the appropriate ACAS knowledge and skills. It should include both academic and manoeuvre training and address any feedback experience on significant issues.

These four areas are fundamental elements of an effective ACAS training programme. ACAS manoeuvre and recurrent training are both most effective when accomplished in **a TCAS-equipped flight simulator with a wide range of scenarios.**

Air traffic controller training

Based on the experience gained with ACAS operations, it is strongly recommended that air traffic controllers be provided with formal training programmes.

The ACAS training for controllers should include:

- **Ab-initio training**: a basic course on ACAS theory and procedures, plus a demonstration with RITA2 for example;
- **Qualifying phase**: simulations including ACAS events; this is called "training to unusual occurrences" and is compliant with the European Safety Regulation Requirements;
- **Recurrent training**: a review of the theory of ACAS and the procedures associated with the triggering of alerts, a quiz to assess knowledge retention, and a simulation with some ACAS events.

Additional ACAS information may also be given during recurrent training (e.g. EUROCONTROL ACAS Safety Bulletins, use of RITA2).

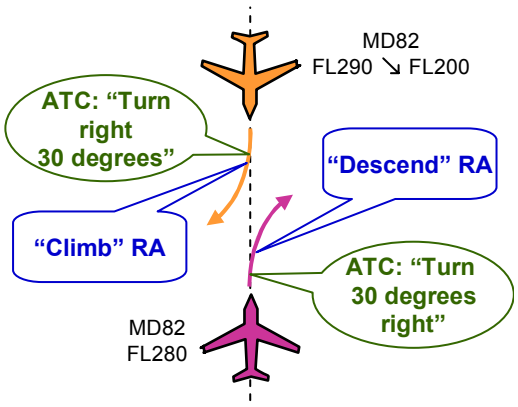
PANS-ATM is being revised accordingly.

Event 3: ATC instructions complementary to RAs

A MD82 is cleared to descend by mistake before having crossed an opposing one.

The controller, who is not aware of any RA, gives **horizontal avoidance instructions, which are complementary to the RAs** subsequently received by both aircraft.

The pilots can follow both their RA and the avoiding instruction of the controller.



ACAS good practice recommendations

In addition to the training items and the regulation, some good practice recommendations should be included in the controller operating manual.

For instance, when controllers are not aware of an RA, and if they are providing the aircraft with instructions for avoiding action, ***horizontal instructions are more appropriate as they will not adversely affect any vertical manoeuvres required by TCAS II RAs****.*

Examples of actual ACAS II training programmes

ACAS II training programme in Air France

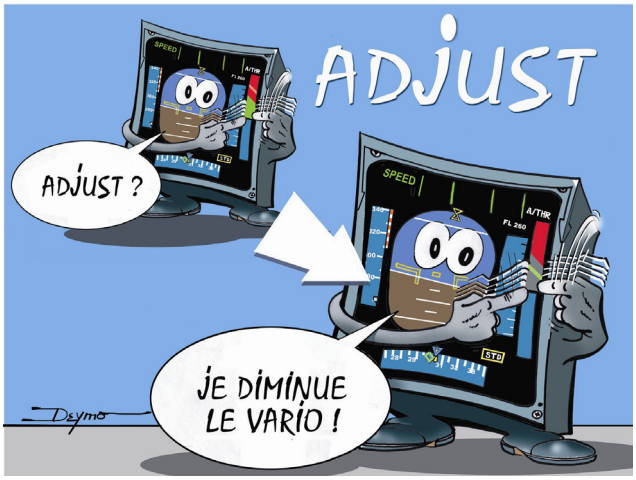
Both initial training and aircraft type qualification includes:

- Detailed TCAS II system and procedure description in the Flight Crew Operating Manual (FCOM);
- Course on how TCAS II works using CBT programmes;
- Study with a ground instructor covering all the TCAS II alerts;
- Practice session on the corresponding aircraft simulator involving TCAS II scenarios with RAs.

Subsequently, the required 6 month aircraft simulator practice session also includes some scenarios with RAs.

In addition to this training, Air France provides regular information and feedback on actual TCAS II events to all pilots. This additional information includes:

- Safety communication on specific TCAS II items (Flight Safety Bulletins, poster, etc.) when a significant issue is identified (e.g. inappropriate reactions to "Adjust Vertical Speed" RAs);
- Annual reports with the analysis of Air Safety Reports with RAs;
- Internal monthly publication of most relevant Air Safety Reports, which can include TCAS II events experienced by flight crews;
- External material relevant for TCAS II training (e.g. EUROCONTROL ACAS Safety Bulletins).



Poster developed by Air France to catch pilots attention regarding Adjust Vertical Speed" RAs (Je diminue le vario = I reduce the vertical rate)

ACAS II training in the DFS Deutsche Flugsicherung

The DFS controller training programme for ACAS II is divided into 2 parts.

Part 1 begins in the DFS Academy at Langen at the ab-initio training stage. The training is divided between the BASIC, ATC and RATING courses and includes:

- Theoretical lessons on TCAS II and the equipment required;
- EUROCONTROL TCAS II video;
- The phraseology of TCAS II;
- Exercises to practice the required controller responses to TCAS II.

During the RATING course every opportunity is used to practise TCAS II injects based on exercise developments in the Advanced Simulator. The students also receive a detailed TCAS II briefing, which includes Lufthansa pilot involvement.

Part 2 is the Unit training programme for licensed controllers. ACAS II training is included in:

- Annual briefings – RITA2 CD (EUROCONTROL);
- Pilot/controller forums to exchange experiences;
- Unusual Incidents training.

In addition, questions on ACAS II are also included in the controllers annual CBT theoretical knowledge assessment for Controller Competency.

ACAS training and guidance material

The EUROCONTROL is regularly producing material to support the ACAS training of controllers and pilots:

- *ACAS training brochure with useful operational and technical information about ACAS II;*
- *ACAS Safety Bulletins addressing issues related to ACAS II operations;*
- *ACTOR, an ACAS II training package for operations in the RVSM environment;*
- *RITA2 (PC based tool) & academic training, as a support for controller and pilot training.*

In addition, IANS supports ECAC Member State air traffic control ACAS training needs with an established training course.

Relevant material is available on these websites:

- ***http://www.eurocontrol.int/acas/***
- ***http://www.eurocontrol.int/ians/***
- ***http://www.jaa.nl/***
- ***http://www.arinc.com/tcas/***

ACAS II training is a key element to implement the new ACAS regulations

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This is one of a series of ACAS Bulletins planned to address specific TCAS operational issues. For more detailed information on ACAS and TCAS, please refer to the ACAS II brochure and training material available on the ACAS Programme website

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