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LEGAL CAUTION
The material contained in this training program is based on the information obtained from current state, local and company regulations and it is to be used for training purposes only. At the time of designing this program contained then current information. In the event of conflict between data provided herein and that in publications issued by the authority, the authority shall take precedence.

INTRODUCTION
This course is designed to provide you with knowledge of the principles, terms, history and operation of ACAS/TCAS systems on your aircraft and acquaint you with the changes involved in the Version 7.1. This course meets the training requirements of your State of Registry. Training in Version 7.1 is required as part of the upgrade to this version by your operator. This course is not intended to replace procedures or regulations in your State or individual operators operating manual or Aircraft Flight Manual.

ACAS II: an Airborne Collision Avoidance System which complying with ICAO Standards and Recommended Practices (SARPs) for ACAS II. The system has the capability to give both TAs and RAs. Virtually the same thing as TCAS II with Version 7.0. Some of the changes to Version 7.1 of the current TCAS II aural warning from "Adjust Vertical Speed, Adjust" to "Level Off, Level Off." Additionally it also corrects missed and late TCAS reversals. The TCAS reversal was introduced in TCAS version 7.0 to correct a changing situations where the original maneuver had clearly become the wrong thing to do, especially in the situation when one of the pilots decides not to follow the Resolution Advisory (RA), or ATC instructs the pilot to perform a particular maneuver. The solution in Change 7.1 introduces improvements to the current reversal logic to address late issuance of reversal RAs and potential failures to initiate reversal RAs.

The TCAS version 7.1 has four other minor enhancements to the system. The Version 7.1 corrects an issue when descending through 1000 ft. AGL. The new version 7.1 also modifies the "Datalink Capability Report" (this is a status report sent by the TCAS processor to the Mode S transponder) informing the systems that the TCAS processor is Hybrid Surveillance-capable. Version 7.1 also allows for the reporting of the TCAS processor part number and software level, and corrects TCAS multi-aircraft logic issues which reduces the risk of multiple aircraft in RVSM airspace.

Hybrid Surveillance: The new TCAS equipment which is capable of processing ADS-B messages may be used to enhance the performance of TCAS. Some TCAS manufacturers will incorporate this capability as a part of their TCAS version 7.1 upgrade. Hybrid surveillance uses reception of ADS-B messages from an aircraft to reduce the time for the TCAS equipment to interrogate that aircraft. ADS-B is used only to identify aircraft that can safely be interrogated at a lower rate.

After the 1st January 2016, all civil fixed-wing turbine-engine aircraft having a maximum take-off mass exceeding 5,700 kg, or a maximum approved passenger seating configuration of more than 19 is required to be equipped with ACAS II with Version 7.1. Operators, with aircraft takeoff weights below the regulated limits, do not have to have TCAS or may use TCAS I. If the operator has TCAS II, they must use Version 7.1 or later. US aircraft flying in EASA airspace have to comply with the rules governing that airspace.
THRESHOLDS
The ACAS/TCAS II thresholds are as follows:

For Traffic Advisories (TA):
- From FL 200-FL 300 a TA will be displayed if an aircraft gets within a closure time of 20-48 seconds of a CPA or 850 ft. vertically or within 1.3 NM horizontally of your aircraft.
- From FL 300-FL 420 a TA will be displayed if an aircraft gets within a closure time of 20-48 seconds of a CPA or 850 ft. vertically or within 1.1 NM horizontally of your aircraft.
- Above FL 420 a TA will be displayed if an aircraft gets within a closure time of 20-48 seconds of a CPA or within 1200 ft. vertically or 1.1 NM horizontally of your aircraft.

For Resolution Advisories (RA):
Preventative/Corrective RA
- From FL 200-FL 420 a RA will be alerted when an aircraft gets within 15-35 seconds of a CPA or within 600 ft. vertically or within 1.1 NM horizontally of your aircraft.
- Above FL 420 an RA will be alerted when an aircraft gets within 15-35 seconds of a CPA or within 700 ft vertically or within 1.1 NM horizontally of your aircraft.

Once these thresholds are exceeded the appropriate ACAS/TCAS advisory is made to the aircrew and appropriate corrective action must be taken within 2.5-5 seconds.

Both GPWS and Windshear have priority over ACAS/TCAS advisories. ACAS/TCAS advisories are inhibited on most aircraft during either a GPWS or Windshear alert.

While descending RAs are inhibited below 900 ft. AGL or below 1100 ft. AGL while climbing. No descent RAs are given below 1000 ft. AGL while descending and no descent RAs are given below 1450 ft. AGL while climbing. The ACAS/TCAS audio is inhibited below 400 ft. AGL on approach and below 600 ft. AGL on takeoff.

During takeoff and climb the ACAS/TCAS system should be selected into the ‘Above’ mode. This clears a path from 2700 ft. beneath the present altitude of your aircraft and clears up to 9000 ft. above. This gives the pilots a much better picture of possible traffic conflict as they climb.

Once the aircraft reaches level flight, select the ‘Normal’ mode, which monitors from 2700 ft. above the aircraft to 2700 ft. below the aircraft cruise altitude for intruders.

During descent, select the ‘Below’ mode, which clears a path from 2700 ft. above the aircraft to 9000 ft. below the aircraft. This gives a much better information on intruders during the descent.

Both pilots should monitor the Traffic Display Unit for information on the intruder’s location, altitude and range. They should then visually attempt to locate the intruder to determine if further action is necessary. NEVER manœuvre the aircraft based solely a Traffic Advisory. Do not make vertical or horizontal adjustments to your flight level or course based on a TA only. Pilots will have up to 15 seconds to respond if the intruder continues to close on your aircraft on causes an RA.
A ‘Preventive RA’ is an alert of an intruder within the threshold for an indication of an RA, however a manoeuvre is not required at present (you maintain your present vertical progress). The RA is indicated on the Traffic Display Unit as a solid red square with an altitude above or below the square based on the vertical distance from your aircraft. If the aircraft is climbing or descending at more than 500 fpm an arrow will also be indicated showing the relative movement of the intruder vertically. The display will also show a red and green arc to display the proper vertical deviation if needed. An aural alert will also be made. During a Preventive RA this aural alert is generally ‘Maintain Vertical Speed’ or continue your present vertical profile. The display will show your progress in the green arc. A red arc will also be displayed indicating the vertical direction of the intruder in relationship to your aircraft and a manoeuvre in that vertical direction is to be avoided.

A ‘Corrective RA’ is an alert that requires a manoeuvre vertically to avoid a possible collision and must be followed unless in the judgment of the Pilot-in-Command a safer action is advised. The pilots should not manoeuvre contrary to the advised manoeuvre provided by the ACAS/TCAS system even if told to by ATC. The Mode S transponders have already computed the proper corrective action via datalink for both your aircraft and the intruder and each system is mandating the safest corrective action for each aircraft. Each aircraft has 5 seconds to respond to the corrective RA and mandates a climb or descent using 0.25 Gs to meet the optimum corrective action. Failure to respond in a timely manner can reduce or eliminate the safety cushion provided by the system. The system allows for a safe corrective response without the use of excessive G forces or maneuvering that could harm passengers or crew.

The Pilot Flying should initiate a climb or descend as directed, until the Vertical Speed Indicator shows that the aircraft climb or descent rate is in the green arc or appropriate indication on the PFD. This indicates that your aircraft is at the proper climb/descent rate to avoid collision with the intruder aircraft. The Pilot Not Flying should confirm that the aircraft is safely maintaining airspeed and vertical speed to meet the mandate of the ACAS/TCAS system. If time and conditions permit, the Pilot Not Flying should advise ATC.

The ‘Changing RA’ is an update to the Corrective RA. They usually indicate a rapidly deteriorating situation. The ACAS/TCAS system continues to process the progress of the maneuver to assure the conflict with the intruder will be eliminated. If the ACAS/TCAS system determines that the corrective action is not going to provide the proper clearance between your aircraft and the intruder, the system will issue a Changing RA calling for a more aggressive correction or a reversal of the initial Corrective RA. In these situations the pilots have only 2.5 seconds to respond and the response will call for an increase to 0.35 Gs in the corrective action.

In the example below, you can see demonstrated the Version 7.1 changes to the current TCAS II aural warning from "Adjust Vertical Speed, Adjust" to "Level Off, Level Off."
If the ACAS/TCAS system computes that the intruder aircraft has taken the wrong corrective action, the intensity of the commands will dramatically increase, for example ‘Descend, Descend Now’. This may be a reversal of the initial Corrective RA to ‘Climb, Climb’.

In the example below you can see a feature has been added to the TCAS II version 7.1 logic which monitors RA compliance in coordinated encounters (i.e. when both aircraft are TCAS II equipped). When it is detected that an aircraft is not responding correctly to an RA, a reversal RA will be issued to the aircraft which manoeuvres in accordance with the RA. In single equipage encounters (i.e. when only one aircraft is TCAS II equipped), version 7.1 will recognise the situation and will issue a reversal if the unequipped threat aircraft moves in the same vertical direction as the TCAS II equipped aircraft. The reversal logic change is transparent to flight crews, it will, nevertheless, bring significant safety improvements.

After a Corrective or Changing RA manoeuvre has eliminated conflict with the intruder, the system will notify the pilots with an aural call of ‘Clear of Conflict’. Following this aural alert the crews should return to the originally assigned Flight Level.

End of the Course