

~~THE NEW BEAUJOLAIS HAS~~

TCAS II version 7.1 has arrived

by Stanislaw Drozdowski

New "Level off, level off" RA

My article in the July 2007 issue of *HindSight* about TCAS mentioned a forthcoming change to TCAS II the introduction of the new version 7.1. After an admittedly rather lengthy process, a regulatory decision was published on 20 December 2011: all existing TCAS II version 7.0 installations must be upgraded to version 7.1 before 1 December 2015 and new aircraft must be equipped with version 7.1 from 1 March 2012 if operating in European airspace¹. The first aircraft equipped with version 7.1 are probably already operating in the skies above us, so it is important to understand the effect on ATC operations which the new version will have.

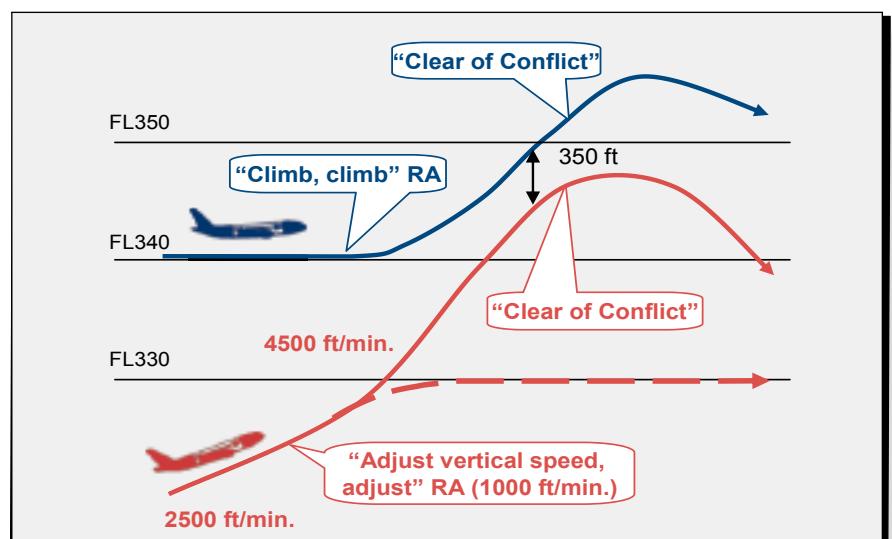
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The development of version 7.1 was initiated by EUROCONTROL following the discovery of two safety issues with the current TCAS II version 7.0. Since its introduction in Europe in 2000, TCAS II has been the subject of monitoring. In the course of analysing recorded and reported events, many cases were found in which pilots did not respond correctly to the "Adjust vertical speed, adjust" Resolution Advisories (RAs). In a few of these cases a midair collision was avoided by chance.

The "Adjust vertical speed, adjust" RA requires the reduction of vertical speed to 2000, 1000, 500, or 0 ft/min., as indicated on the flight instruments. In those cases involving an incorrect response, the pilots increased their vertical speed instead of reducing it, consequently causing a deterioration of the situation. This is currently the most common RA, representing up to two-thirds of the total RAs.

Additionally, there have been numerous cases of level bust when pilots following the "Adjust vertical speed, adjust" RA went through their cleared level, often causing a follow-up RA for the other aircraft above or below, and disrupting ATC operations.

In version 7.1 the "Adjust vertical speed, adjust" RA is replaced with a new "Level off, level off" RA. The new RA always requires a reduction of vertical rate to 0 ft/min, i.e. a level off which needs to be achieved promptly, not at the next standard flight level (e.g. FL 200, FL 210, etc.). The "Level off, level off" RA may be issued as an initial RA or as a weakening RA following, for instance, a "Climb, climb" or "Descend, descend" RA as the vertical distance between the aircraft increases due to the initial response taking effect.



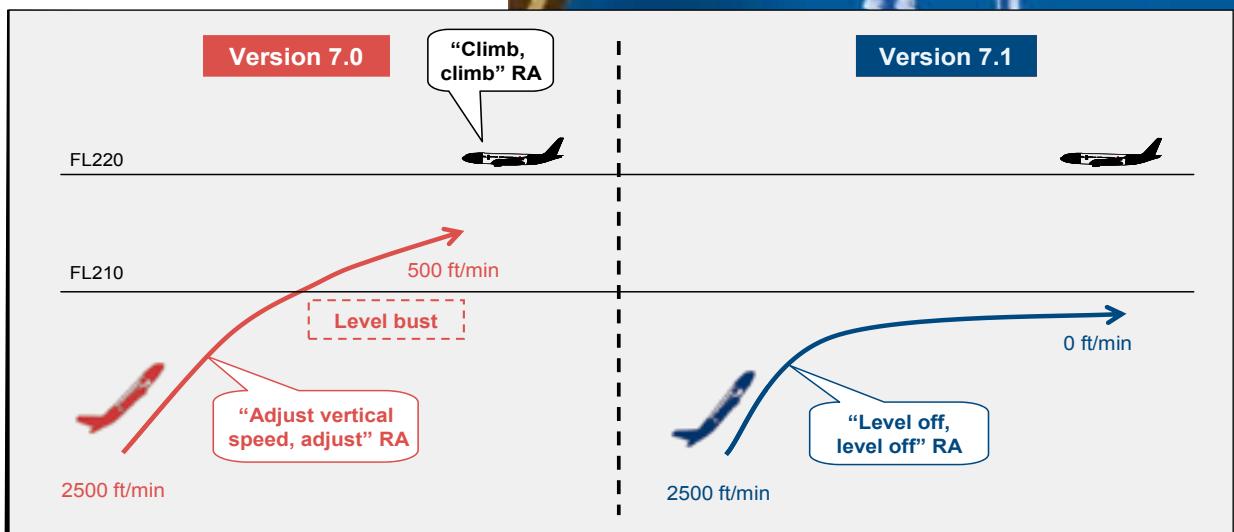
1- The European version 7.1 mandate sets earlier equipage requirements than those published by ICAO (1 January 2014 – new installations, 1 January 2017 – existing units).

The new RA will have an effect on ATC operations:

aircraft may level off hundreds of feet before the cleared level when responding to the "Level off, level off" RA.

At this point, I can see many air traffic controllers getting concerned that an aircraft leveling off hundreds of feet before its cleared level may get into a conflict with third aircraft.

This issue was considered during the design stages of version 7.1. The decision to replace the "Adjust vertical speed, adjust" RA with the new "Level off, level off" RA was preceded by detailed analysis of events and radar data from several places in Europe and from two busy TMAs in the USA. The radar data analyses indicated that the new RA will not cause secondary conflicts with third aircraft more frequently than occur with the current version of TCAS. The new RA is also expected to contribute to an overall reduction in the number of RAs because follow-up RAs should not occur any more.



TCAS II version 7.1 has arrived (cont'd)

Improved reversal logic

A second change is also introduced in version 7.1 – improved reversal logic, which is also expected to enhance safety. This change is transparent to controllers and pilots.

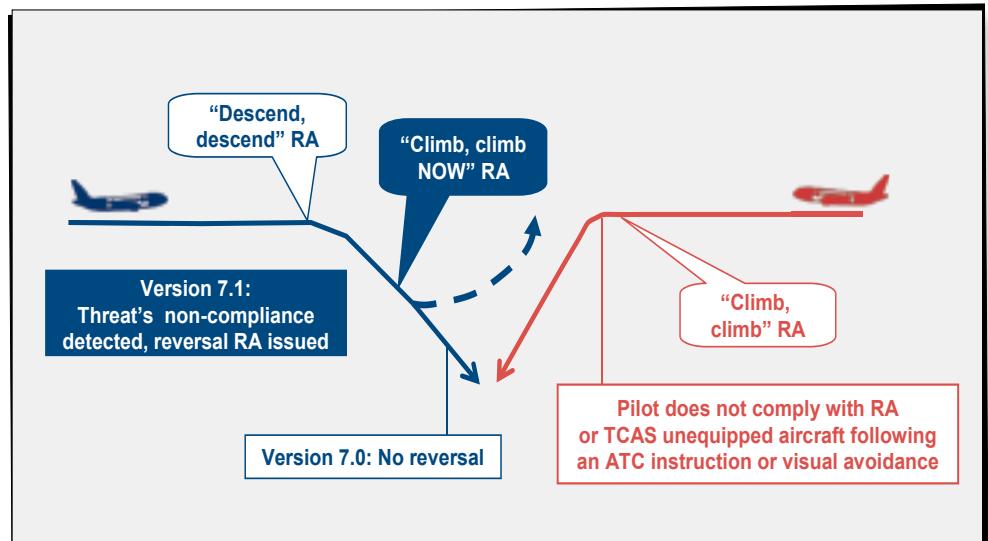
Version 7.0 allows reversal RAs (i.e. "Climb, climb NOW" and "Descend, descend NOW") to be issued when the current RA is no longer predicted to provide sufficient vertical spacing.

However, there have been cases in which a reversal RA failed to occur when two converging aircraft remained within 100 feet of each other. This scenario can occur when one aircraft is not following the RA properly or is not TCAS II equipped and follows an ATC instruction or performs an avoidance manoeuvre based on visual acquisition. Significant examples of such events include the Yaizu (Japan) near midair collision (2001) and the Überlingen (Germany) midair collision (2002).



**Stanislaw
Drozdowski**

is an ATM Expert at EUROCONTROL HQ in Brussels, working in the area of ground and airborne safety nets. Previously, he worked as a system engineer with Northrop Grumman and as an Air Traffic Controller in Poland and New Zealand.



The new version 7.1 is compatible with all existing versions being operated today, both version 7.0 and version 6.04a (which is still in use by some aircraft, mainly outside Europe). There is therefore no need for ATC to know which version of TCAS II the aircraft operates because proper TCAS-TCAS coordination is taking place in all coordinated encounters.

Version 7.1 improves the reversal logic by detecting situations in which, despite the RA, the aircraft continue to converge vertically. A feature has been added to the TCAS logic which monitors RA compliance in coordinated encounters (i.e. when both aircraft are TCAS II equipped). When version 7.1 detects that one of the aircraft is not responding correctly to an RA, it will

issue a reversal RA to the aircraft which is manoeuvring in accordance with the RA on the basis that it is this aircraft which is more likely to respond correctly to a reversal RA.

In single equipage encounters (i.e. when only one of the conflicting 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.

Compatible versions

Until the whole fleet of aircraft operating in European airspace has been upgraded, conflicts will occur between aircraft using different versions of TCAS II. The new version 7.1 is compatible with all existing versions being operated today, both version 7.0 and version 6.04a (which is still in use by some aircraft, mainly outside Europe). There is therefore no need for ATC to know which version of TCAS II the aircraft operates because proper TCAS-TCAS coordination is taking place in all coordinated encounters. In fact, ATC does not need to know whether the aircraft is TCAS equipped or not or is operating with TCAS temporarily inoperative (as allowed under Minimum Equipment List exemptions), because the provision of air traffic services to aircraft equipped with TCAS shall be identical to those that are not equipped.