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FLIGHT SAFETY

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In this issue

NEWSLETTER TEAM

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Damaged left wing & tail

Undamaged right wing & tail

Flight Safety/aircraft Accident Links

kacops.kuwaitairways.com
www.ntsb.gov
www.bea-fr.org/anglaise/index.htm
www.bst.gc.ca/en/index.asp
www.bfu-web.de
www.aaib.gov.uk/home/index.cfm
www.atsb.gov.au/

Editorial

The Newsletter team wishes all the readers a very happy 2007. As in the previous years, let us resolve to make this year also a safe year. With this issue we have changed the newsletter format.

In this issue, we look into the recent midair collision in Brazil, the ACAS & TCAS and winter storms which could occur in U.S. and Europe.

Our thanks to Capt.Yacoub Al Najjar and Capt. Fahad Al-Musallam for the useful inputs.

We look forward to your feedback, suggestions and contributions which can be sent to our division.

The Crash of GOL Boeing 737-800

Based on NTSB and other reports

On September 29, 2006, a midair collision occurred over the Brazilian Amazon jungle between a Boeing 737-800(PR-GTD) operated by GOL Airlines of Brazil, and an Embraer Legacy 600 business jet(N600XL) owned and operated by Excelaire of Long Island, New York.

The accident occurred around 4:57 pm Brasilia standard time. The Boeing 737 was destroyed by in-flight breakup and impact forces; all 154 occupants were fatally injured. The wreckage of the 737 was located in a remote jungle terrain with very difficult access. Brazilian military search and rescue personnel have located the flight recorders and all significant portions of the wreckage except the outer portion of the left wing. The Legacy N600XL experienced damage to its left wing and left horizontal stabilizer and performed an emergency landing at the Cachimbo Air Base, approximately 60 miles northwest of the collision site. There was no further damage to the airplane, and the 2 crew members and 5 passengers were not injured. The airplane remained at the base and significant components have been tested and recovered from the aircraft.

Visual meteorological conditions prevailed in the area of the accident. Both aircraft were operating on IFR, on instrument flight plans and clearances. The Boeing 737 was a scheduled domestic air carrier flight from Manaus to Rio de Janeiro via Brasilia. The Legacy N600XL was enroute from San Jose dos Campos(SBSJ), to a stopover in Manaus, and eventually enroute back to the U.S. This was Excelaire's initial flight with this aircraft, taking delivery from the Embraer factory and a planned flight to Excelaire's home base in New York.

The Legacy N600XL departed SBSJ at about 2:51 pm. The filed flight plan included a routing via the OREN departure procedure to Pocos beacon, then airway UW2 to Brasilia VOR (BRS), airway UZ6 to Manaus. The cruise altitude was filed as FL370, with a planned change to FL360 at BRS, and to FL380 at the TERES navigational fix, approximately 282 miles north of BRS.

After takeoff, N600XL was issued a number of interim altitudes during climb, all of which were read back. The flight was cleared to proceed direct to Araxa VOR (on airway UW2), and at 3:11 pm was cleared to climb to FL370. At 3:33 pm, the airplane leveled at FL370.

At 3:35 pm, the Boeing 737 departed Manaus, requesting FL370 as a cruise altitude, and a routing via UZ6 to BRS. The airplane reached FL370 at 3:58 pm. <u>There were no anomalies in communications with or radar surveillance of the Boeing 737 throughout the flight.</u>

At 3:51 pm, an air traffic controller in the Brasilia ACC (CINDACTA 1) instructed N600XL to change frequencies to the next controller's sector. The crew of N600XL reported in on the assigned frequency that the flight was level at FL370. ATC acknowledged and instructed the crew to "ident" (flash their transponder). Radar indicates that the ident was observed. <u>This was the last two-way communication between N600XL and ATC</u>. At this time the airplane was approximately 40 nautical miles south of BRS.

At 3:56pm the Legacy N600XL passed BRS level at FL370. There is no record of a request from N600XL to the control agencies to

Wreckage of Boeing 737

conduct a change of altitude, after reaching flight level 370. The airplane made calls, but there is no communication in which it requested a change of flight level.

When the airplane was about 30miles north-northwest of BRS, at 4:02 pm, the transponder of N600XL was no longer being received by ATC radar. A transponder reports a unique code, aiding radar identification, and provides an accurate indication of the airplane's altitude. Additionally, the transponder is a required component for the operation of Traffic Collision Avoidance System (TCAS).

Between 3:51 pm and 4:26 pm, there were no attempts to establish radio communications from either the crew of N600XL or ATC. At 4:26 pm the CINDACTA 1 controller made a "blind call" to N600XL. Subsequently until 4:53 pm, the controller made an additional 6 radio calls attempting to establish contact. The 4:53 call instructed the crew to change to frequencies 123.32 or 126.45. No replies were received.

There is no indication that the crew of N600XL performed any abnormal maneuvers during the flight. Flight Data Recorder information indicates that the airplane was level at FL370, on course along UZ6, and at a steady speed, until the collision. Primary (non-transponder) radar returns were received corresponding to the estimated position of N600XL until about 4:30 pm. For 2 minutes, no returns were received, then returns reappeared until 4:38 pm. After that time, radar returns were sporadic.

Beginning at 4:48 pm, the crew of N600XL made a series of 12 radio calls to ATC attempting to make contact. At 4:53, the crew heard the call instructing them to change frequencies, but the pilot did not understand all of the digits, and requested a repeat. No reply from ATC was received. The pilot made 7 more attempts to establish contact. At 4:56:54 pm the collision occurred at FL370, at a point about 460 nautical miles north-northwest of BRS, on airway UZ6.

There was no indication of any TCAS alert on board either airplane, no evidence of pre-collision visual acquisition by any flight crew member on either aircraft, and no evidence of evasive action by either crew.

According to NTSB, the "Wreckage and damage examination indicates that it is likely the left winglet of the Legacy (which includes a metal spar) contacted the left wing leading edge of the Boeing 737. The impact resulted in damage to a major portion of the left wing structure and lower skin, ultimately rendering the 737 uncontrollable. Flight recorder information ceased at an approximate altitude of 7,887 feet."

The Brazilian government supports this theory in its preliminary report.

After the collision, the crew of N600XL made numerous further calls to ATC declaring an emergency and their intent to make a landing at the Cachimbo air base. At 5:02 pm, the transponder returns from N600XL were received by ATC.

At 5:13 pm, an uninvolved flight crew assisted in relaying communications between N600XL and ATC until the airplane established communication with Cachimbo tower.

The accident investigation is being conducted under the authority of the Brazilian Aeronautical Accident Prevention and Investigation Center (DIPAA). Under the provisions of ICAO Annex 13, the United States has provided an accredited representative and technical advisors for the investigation. The U.S. team includes accredited representative from the major aviation accident investigations division of the NTSB, as well as technical advisors in operations, systems, air traffic control, flight recorders, and aircraft performance. Additional technical advisors from Boeing, Excelaire, Honeywell, and FAA have also been included.

Flight recorders from both airplanes were recovered and downloaded at the Transportation Safety Board of Canada laboratories. Transcriptions of CVRs were prepared and data from flight data recorders obtained.

Initial interviews and medical examinations were conducted with the crew of the Legacy. Air Traffic Control data was gathered. Preliminary tests of the avionics equipment on the Legacy were performed. Wreckage of the 737 was examined.

Both Boeing 737 and Legacy 600 were new aircraft equipped with TCAS. But neither received any advisories!

According to the reports the investigation is expected to take about 10 months.

This mid-air collision reminds us of one that occurred over Germany.

On July1, 2002, a Bashkirian airlines TU154 collided with DHL Boeing 757 cargo over Uberlingen near lake Constance in South Germany resulting in 71 fatalities. Both the aircraft were equipped with TCAS. The TCAS systems had instructed the B757 to descent and TU154 to ascent. But the conflicting input from the ATC(and the Russian SOP emphasis to ATC over TCAS) resulted in TU154 also descending and colliding with B757.

Following the investigation of this collision and other incidents now the crew is clearly instructed to follow the TCASII RAs.

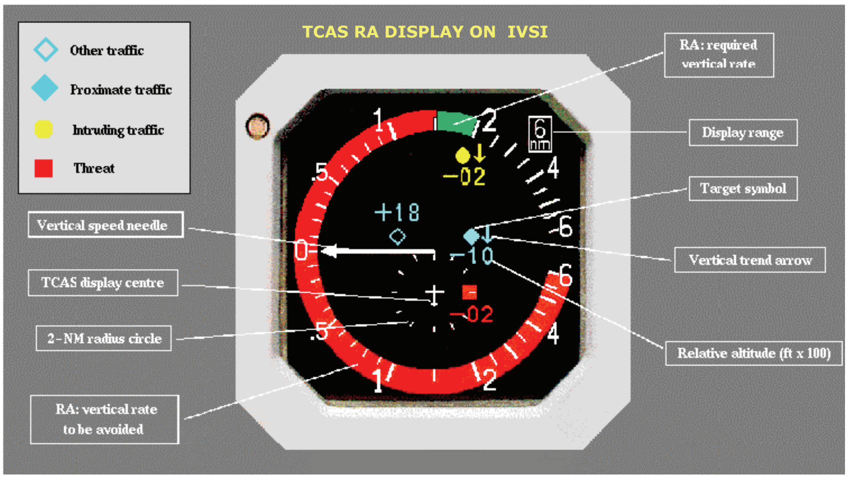
Kuwait Airways OPM under section 4.15 clearly instructs the crew to follow the TCAS RA.

ACAS II AND TCAS II

Airborne Collision Avoidance System (ACAS) is an ICAO standard specified in ICAO Annex 10 Vol. IV which provides pilots with a system independent of air traffic control to detect the presence of other aircraft which may present a threat of collision. Where the risk of collision is imminent, the system provides an indication of a maneuver that will reduce the risk of collision.

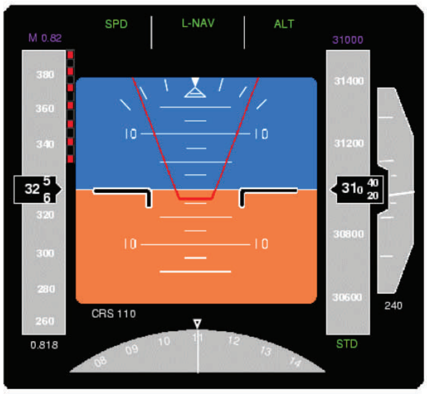
Traffic alert and Collision Avoidance System (TCAS) is an implementation of the Airborne Collision Avoidance System mandated by ICAO to be fitted to all aircraft over 5700 kg or authorized to carry more than 19 passengers, designed to reduce mid-air collisions. In glass cockpit aircraft the TCAS display may be integrated in the ND (Navigation Display). In older glass cockpit aircraft and those with mechanical instrumentation, the mechanical IVSI (Instantaneous Vertical Speed Indicator - which indicates the speed with which the aircraft is descending or climbing) is replaced by an electronic instrument which incorporates the TCAS display.

As of now, the only implementation that meets the ACAS II standards set by ICAO is Version 7.0 of TCAS II (Traffic Alert and Collision Avoidance System)

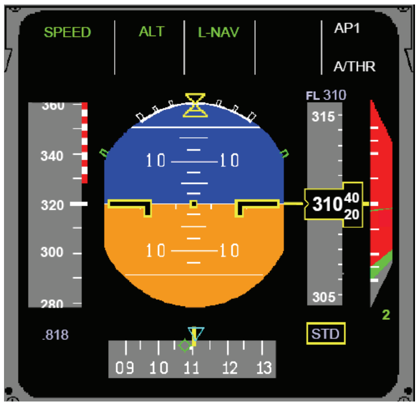


produced by two manufacturers: Rockwell Collins and Honeywell.

The TCAS displays any other TCAS- or Mode C Transponder-equipped aircraft within a range selected by the pilot, which can vary from 2.5 to about 30 miles. If another aircraft appears to be a potential collision threat, a Traffic Advisory (TA) is issued. The TA warns the pilot that another aircraft is in near vicinity, announcing *"traffic, traffic"*, but does not offer any suggested remedy. However, if the situation worsens and collision with another aircraft appears imminent, an audio and visual warning, called a Resolution Advisory (RA) will occur, indicating the incoming aircraft, and audibly signaling the action to be taken by the pilot. The suggestive action may be "positive", suggesting the pilot change altitude by announcing *"descend, descend"* or *"climb, climb"*. By contrast a "preventive" RA may be issued which simply warns the pilots not to deviate from their present altitude, announcing, for example, *"monitor vertical speed"*. Of course, the TCAS system in the other aircraft will offer an opposite instruction so a collision can be avoided. TCAS II systems coordinate their resolution advisories before issuing commands to the pilots. This ensures that both systems will not issue the same command. It is desirable to have one aircraft go up and the other go down as TCAS will always increase separation between aircraft.



Pitch cue implementation



Vertical Tape implementation

TCAS Ra display implemented on a PFD

When a threat has passed, the system announces *"clear of conflict"*. TCAS is an active interrogation system, which interrogates surrounding aircraft transponders on 1030 MHz. Once a transponder receives this interrogation, it then responds on 1090 MHz.

It should be noted that TCAS is able to locate only aircraft that have a correctly operating transponder.

TCAS operates on transponders and sees the transmitted radio signal and not the physical aircraft. i.e. if your transponder is switched off you cannot be seen by others.

TEN FUNDAMENTAL DOs and Don'ts of TCAS II

The Operational monitoring programmes show that TCAS II is extremely effective to improve flight safety. To maximize the safety benefits and operational compatibility with ATC, the following ten fundamental dos and don'ts must be observed.

1. TCAS II must be operated in RA mode to provide full safety benefits
2. Pilots must follow all RAs promptly and accurately
3. Pilots must never maneuver in the opposite sense of RA
4. Pilots must report RAs to controllers as soon as possible
5. Controllers must not interfere with pilot's reaction to RAs
6. Vertical speed must be reduced in response to "Adjust Vertical speed" RAs
7. TCAS traffic displays must not be used for self-separation
8. Vertical speed must be reduced when approaching the cleared flight level
9. VFR pilots must operate their altitude reporting transponder
10. Pilots and controllers must be recurrently trained on ACAS II operations

WINTER WEATHER OPS - SEASONAL STORMS REQUIRE EXTRA PLANNING

Adopted from Karsten Shein's article of the same title in November 2006 issue of Professional Pilot

In Europe, Canada, USA and other parts of the world winter implies severe drop in mercury to negative digits, blowing snow, and ice. But that is not all, the atmosphere conspires to give a chaotic mess in the form of a winter cyclone. As we operate in Europe and USA, we could encounter one of these cyclones. Let us know more about winter storms.

These winter storms are much larger and more organized than those that occur in the summer, and some have closed airports for days. Pilots have to fly whether it is rain or shine. So it helps to know about these, so that pilots are aware of what to expect and how to handle them.

Winter cyclones can occur in the northern hemisphere any time between late October and late march, although they tend to be more intense near the edges of winter. They are called by many names depending on the region but for pilots they are just a menace.

These storms are large low pressure systems that can travel halfway around the world, can fill thousands of miles of sky with thick clouds, icing and turbulence, and if get positioned in the right place, can wreak havoc on the air transportation system. When major airports in the mid-latitudes close because of a blizzard, the ripple effect can be lengthy delays world-wide, even at tropical airports.

These giant winter storms are more properly known as mid-latitude cyclones. They are a swirling mass of bad weather wrapped around a central low pressure cell. These lows tend to form in the vicinity of the polar front—the boundary zone between cold air of the arctic ad warmer air from the subtropics.

On a typical weather map, the northern hemisphere polar front is draped from west to east across north America, Europe and Asia. In most places, the surface front appears as a stationary front—in others, usually ahead of or behind a low, the front is represented by warm or cold front symbology, respectively. It is these lows, and their cold and warm fronts, that comprise the winter cyclone. Around the low the air swirls counter-clockwise, forcing warmer and more humid surface air aloft in advance of the low, and drawing colder, drier air into the regions behind the low.

Any jet stream chart will provide a clue as to how these storms form. Immediately noticeable is that the jet stream tends to be positioned more or less directly above the surface polar front. We can also see that neither the polar front nor the jet stream travels in straight line– instead, they wrap around the planet in serpentine fashion, sometimes dipping into the lower latitudes in what resembles a large trough, and other times climbing into the higher latitudes to appear as a ridge when seen from above. These troughs and ridges have lot to do with the formation, track and severity of winter storms.

As the jet stream winds, flowing

west to east, dive into a trough, they tend to converge, meaning more air must share less space. In turn, this drives some of the air toward the surface, increasing the surface pressure and often generating a surface high below the west (entrance) side of the trough. As the air speeds through the base of the trough and out to the east (exit) side, it is able to diverge. The divergence of air aloft helps to draw air up from the surface, meaning that a surface low tends to form out ahead of the trough aloft. Surface lows that form in other places relative to these upper air troughs do not normally receive the upper air support needed to grow into strong winter storms that those that form under the trough exit are often capable of becoming.

The amount of convergence and divergence taking place in the jet stream air flow is what largely determines the strength of the surface lows and highs under an upper air trough. In general, the more the winds aloft speedup going into the trough, the stronger the surface pressure systems can become. When forecasting a developing surface low, if there is a jet streak—a small region of very fast winds—in the trough base above, the low has the potential to grow very strong.

Also, the amplitude of the trough will play a big role. Steep troughs tend to represent much greater forces acting on the air than do more gently sloping troughs. Troughs which are tilted—i.e. not symmetrical about their axis— also mean potentially strong forces will aid the strengthening of a surface pressure system.

Predictably, because these winter storms rely on the upper air for support, those under the favorable divergence conditions of a jet stream trough tend not to strengthen much, and will even fill in, weakening until eventually they die in the cold air poleward of the jet stream as a "cutoff" low. It is the lows that track up along the exit path of the trough that need watching—they can continue to strengthen, or at least maintain their intensity, as they move along.

The pattern of the jet stream's undulations can give us a good idea of where these storms are going, and why the storms tend to hit the same places again and again. The jet forms a series of trough and ridge waves around the planet—and these planetary long waves tend not to move much.

Under normal circumstances, this pattern places a ridge over western North America and a trough over the eastern Midwest of the U.S. another trough exists over the gulf of Alaska and western Europe. This means that the regions under exit path of these long wave troughs will likely see many of these winter storms.

Along the long waves, smaller troughs, called short waves, will migrate. It is these short waves that force the formation and strengthening of the transient lows and highs that make up the winter storms. On jet stream charts it's possible to see these smaller short wave troughs embedded into the bigger troughs. When a short wave moves out from a long wave trough base, and a low is developing underneath, it will likely turn into a well organized storm that will move along the path of the jet stream at more or less the speed of the sort wave.

Sometimes the short waves can be very intense, and spawn a winter storm well outside a long wave trough. However, there must be good upper support, usually in the form of strong divergence, to keep a surface low alive and growing.

When a winter cyclone does organize and form, it always takes the same form. In the northern hemisphere, as the surface low begins to spin counterclockwise, the air is drawn inward and upward.(For southern hemisphere, it is clockwise and replace north with south). The warmer air from the south of the polar front begins to spin northward around the east side of the low. At the same time, the cooler air in the northeast quadrant is drawn around the northern side of the low, retreating as the warm southerly air glides over it. Where the two air masses meet is the warm front.

The gradual lifting of the warm, humid air results in low, thick stratus clouds that gain altitude as they flow northward ahead of the front's surface position. Moderate easterly winds are present north of the front, and light snow may be replaced by a mix and freezing rain and, finally, by moderate rainfall as the front is approached from the north. In these winter storms, this region is the most likely for freezing rain events, as the air under the front may be near freezing.

Trailing the low is the cold front. This is the region where the cold air to the northwest of the low is being pushed out of the high pressure cell and wrapped around the south side of the low, displacing the warm air. The cold air is more brutal about the displacement , forcing the warm air to rise rapidly, often generating convection that builds cumulonimbus clouds right in the vicinity of the surface front. These clouds generally produce heavier rain and snow showers, depending on the air temperature, and may— if the displaced warm air had sufficient energy—produce thunderstorms and even tornadoes. Rare thunder-snow is most often found along winter cold fronts.

Winds in the warm sector—ahead of the cold front and behind the warm– tend to be light and from the south or southeast, whereas in the cold sector behind the cold front winds will be quire strong and gusty out of the northwest. In estimating winds around low, keep in mind that the closer together the isobars on the weather map get, the stronger the winds are going to be.

The most dangerous sector of a winter storm, however, tends to be the northwest side. Here the isobars are most closely packed, meaning that this is where the strongest wines are found. In addition, the warm air that has been driven aloft and wrapped around the low– forming the classic comma head of these storms– is likely still producing snow which is now driven by the strong winds, and is also being blown around the ground, creating blizzard conditions with zero visibility.

A saving grace of the stronger winter storms is that they also tend to move quickly. This means that air travel can generally return to normal in a few days at most. Recovery can be sped along if you as a pilot have anticipated the passage of the storm and kept your aircraft out of the airspace system at the critical times, thus giving ATC one less aircraft to reroute. Also, most larger airports in regions normally affected by these winter cyclones have enough maintenance equipment to either keep the airport open, or—for the worst storms—reopen the airport a few hours after the storm passes.

Web Watch

http://www.tc.gc.ca/ASL-SAN - *Transport Canada Aviation Safety letter site—very useful*
http://aviation-safety.net/ - *Aviation Safety Net – site for occurrence data base, accident information*

The Confidential Aviation Hazard Reporting System (CAHRS) provides a means of reporting hazards and risks in the aviation system before there is loss of life, injury or damage. It is open to anyone who wishes to submit a hazard report or safety deficiencies confidentially and non-punitively. Reports help to identify deficiencies and provide safety enhancement in areas of aviation. CAHRS forms can be collected at different location of KAC (i.e. Flight Dispatch) Premises. Completed forms can be dropped in FS&QA allocated box at Flight Dispatch or e-mailed to kwioeku@kuwaitairways.com or faxed to 00965-4749823 or mail to Flight Safety and Quality Assurance office, Operations Department, P.O. Box 394, Safat 13004, Kuwait Airways –Kuwait.