NATS tracks down why business jets figure prominently in altitude deviations in U.K. airspace.

Battling

© Stephen Rudolph/Dreamstime; Embraer

Deviating from your cleared flight level is never a good idea, especially in Europe's crowded skies, where a level bust could lead to a loss of separation with another aircraft. Business aviation, which accounts for about 7 percent of flights in the United Kingdom, was responsible for almost 20 percent of the level busts recorded in that airspace in the 2007–2008 period.

Between January and September 2008 in the airspace in which National Air Traffic Services (NATS) provides air traffic control (ATC) service in the U.K., there were 356 incidents involving business jets. Fourteen of these incidents were within the higher-risk category and involved a loss of separation, mainly due to level busts.

As part of its efforts to reduce the number and severity of level busts, the NATS Level Bust Workstream, a working group of representatives from across the company, has become increasingly concerned about the prominence of business aviation aircraft, in particular non-U.K.-registered, non-commercial operators, in the statistics. Of concern are not only the numbers but the severity of the busts; business jets caused five of the eight most serious losses of separation resulting from level busts in the six-month period that ended in June 2008 (Table 1).

The NATS Level Bust Workstream determined that the evidence of a problem is compelling. Going back to January 2007, the business aviation community accounted for 10 of the 19 most serious level busts recorded, 52 percent of serious bust events. Eight of those 10 events involved non-U.K.-registered aircraft. Given this disproportionate involvement in the higher-severity events, it is clear there is a need to focus effort on working in partnership with the business aviation community.

NATS believes that there are many reasons for the unwelcome prominence of corporate jets in the level bust event data. The nature of business flying is such that crews often find themselves flying into airports and associated airspace for the first time. For infrequent visitors, a lack of familiarity with some of the more challenging procedures in U.K. airspace is probably a major factor. Among these challenging procedures are step-climb standard instrument departures (SIDs), a feature at many of the London region's outer airports, where business aircraft are frequent visitors.

There have been many instances recorded, and not only among the business aviation community, of crews

Level Busts

BY PETER RILEY

"falling up the stairs" on a stepped profile. For business aviation, if the aircraft is flown by a single pilot, or if the crew is distracted from briefing the profile correctly — perhaps by having to perform functions that otherwise would be delegated to a flight attendant — the possibility of an incorrect or incomplete brief is increased. Throw into the mix that many business aviation crews may not have the level of flight operations support available to airline crews, and the very high performance of the aircraft that are being flown, especially in climb, and the reasons behind the prominence of corporate jets in the data become more obvious.

NATS has made great efforts to reduce the level bust threat, having introduced Mode S radars that display each aircraft's selected flight level (SFL) on the radar workstations within the Manchester Area Control Centre and in the London Terminal Control Operations Room at Swanwick Centre. Although this has had a very positive effect on reducing level busts, with controllers now able to see the flight level dialed into the mode control panel/flight control unit (MCP/FCU) by pilots following an instruction to climb or descend, it has not been the complete solution.

Serious Level Busts in NATS Airspace

Date and Aircraft	Summary	Primary Causal Factors
Jan. 14, 2008 Falcon 10/100	The airplane descended below its cleared level and came into conflict with a Boeing 737-800, which was under the control of a different sector. Slow TCAS response was to "maintain passenger comfort."	Incorrect TCAS response Rate of turn/climb/descent
March 7, 2008 Falcon 2000	The airplane was instructed to climb to FL 140 but climbed to FL 144 and into conflict with other traffic. The airplane had a very high rate of climb and may have misinterpreted a TCAS RA.	Incorrect TCAS response Rate of turn/climb/descent
March 10, 2008 Falcon 50	The airplane was instructed to climb to FL120. Approaching FL 110, it was given traffic information on an aircraft 1,000 ft above. The FA50 climbed to FL127.	Incomplete readback by correct airplane Not heard
March 11, 2008 Falcon 50	On departure the airplane was instructed to climb to FL 80. The airplane was later observed at FL 87. The pilot was climbing on the QNH local pressure altimeter setting.	Altimeter setting error Not seen
April 1, 2008 Cessna 560	An inbound airplane was descended to FL 120. An outbound Cessna was climbed to FL 110. Both airplanes approached BPK at the same time. The Cessna was observed climbing to FL 117 before descending again. The inbound airplane received a TCAS RA.	Incorrect TCAS response Poor manual handling
April 11, 2008 Learjet 45	A Learjet was instructed to climb to FL 80 against traffic descending to FL 90. The descending traffic reported a TCAS climb. The Learjet reported that it had also received a TCAS climb. It had climbed at 2,500 fpm with less than 1,000 ft to go.	Incorrect TCAS response Responded to TCAS/GPWS
May 26, 2008 Boeing 737-300	On climbout, the student pilot exceeded the cleared level by 600 ft before the training captain could intervene.	Correct pilot readback, incorrect action Pilot under training
June 3, 2008 Boeing 737-800	Traffic in a holding pattern was cleared to descend to FL 70. The pilot's readback was garbled by another airplane's transmission. The clearance was not clarified by the controller and an incorrect airplane descended to FL 70, causing a loss of separation.	Pilot readback by incorrect airplane Not heard

Reporting period Jan. 1, 2008–June 30, 2008

Source: NATS

Table 1

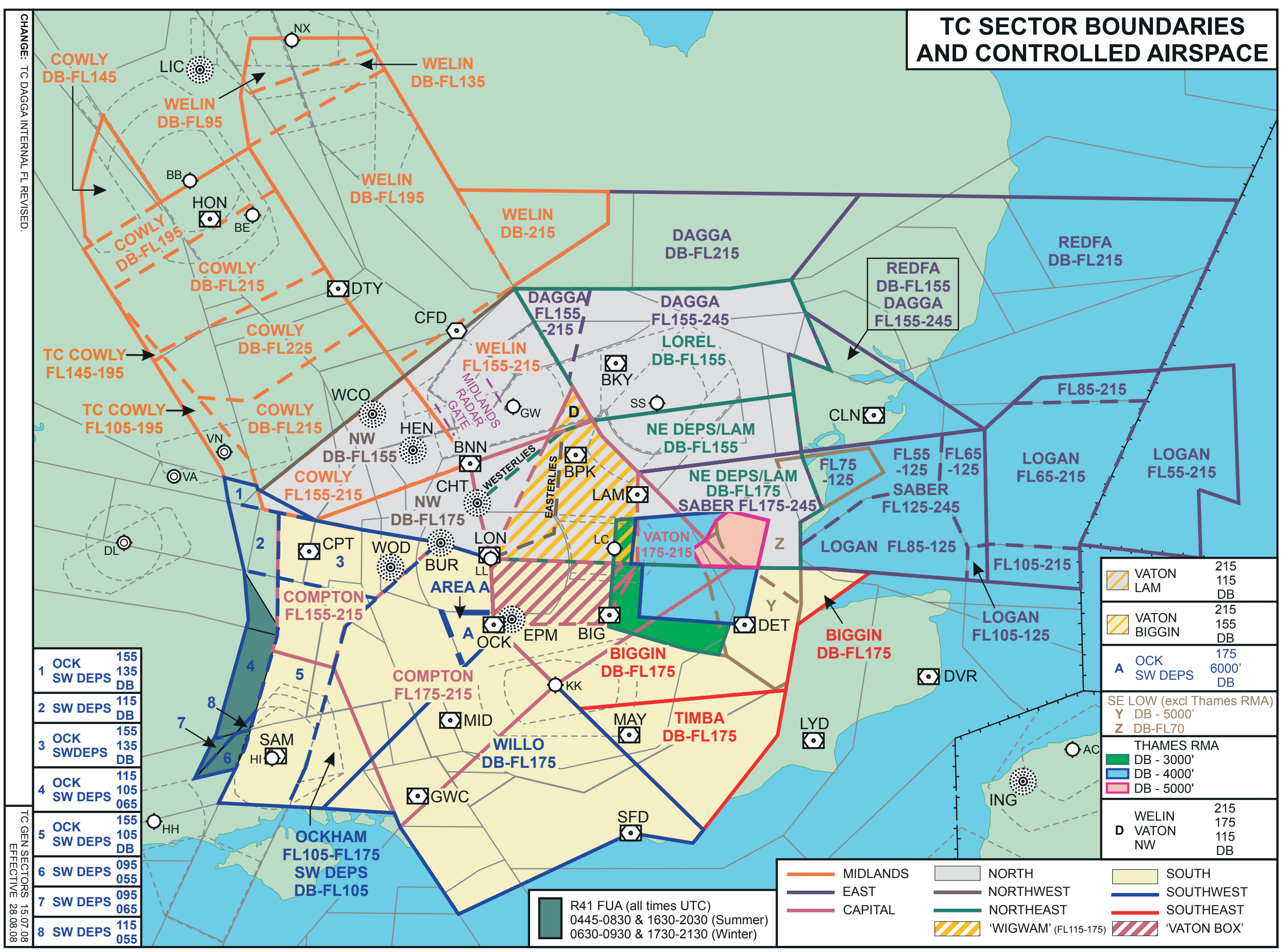
For example, the displayed SFL will not take into account any altimeter setting error made by the pilot. This is a common causal factor of level busts in the U.K. where the transition altitude — the boundary between setting altimeters for flight levels or for altitudes — is 6,000 ft in controlled airspace and 3,000 ft outside it.

It is appreciated that specific standard operating procedures (SOPs) are chosen to enhance operational effectiveness according to the nature of the operation. However, where a pilot has programmed a step-climb profile into the flight management system (FMS), unless there is an additional SOP to set the profile restrictions in the MCP, there can be a disparity between the aircraft's SFL and the programmed SID, which can increase controllers' workload as they try to ascertain whether a level bust is developing.

While there is little possibility that step-climb SIDs will be eliminated in the short term, avoidance of this procedure now is enshrined as a basic design principle for all future NATS airspace changes. In the interim, some successful mitigation measures have been applied at some NATS units; for example, providing with the departure clearance an explicit warning of the existence of a step-climb SID.

While Mode S SFL capabilities are helpful, data are beginning to indicate that new threats may develop: When the SFL displays the correct level to which an aircraft is cleared, controllers have a confidence in the crew's correct handling of the climb or descent that may turn out to be misplaced if the pilots do not adhere to sound airmanship principles of reducing the rate of climb or descent approaching the assigned level.

London's complex airspace can trip up infrequent visitors.



Avoiding Level Busts

NATS has identified a number of things that aircrew, especially business aviation crews, can do to minimize their chances of being involved in a level bust.

Crew preparation can be improved by:

- Ensuring that departure and arrival briefs are complete and include the transition altitude (which likely is lower in the U.K. than elsewhere), first-stop altitudes on stepped-climb SIDs, and the impact of low altimeter settings when transitioning between altitudes to flight levels; and,
- Understanding the profile, briefing the profile, flying the profile. Avoiding "falling up the stairs" on stepped climbs. Carrying out a specific review of the SID to be flown, with both pilots participating.

Communication can be improved by the following practices:

- Both pilots should wear headsets, monitor the frequencies and listen to the clearance;
- Use standard phraseology and avoid unnecessary radio chatter. When not sure, do not repeat clearances as a question; ask ATC to "say again";
- When changing the radio frequency, listen after the change before transmitting; be alert for similar call signs on your frequency; if you hear a readback error, let ATC know;
- Beware of confusing heading and level numbers; do not confuse 2s and 3s — for example, Flight Level (FL) 230/FL 330. Beware of a non-existent first digit — for example, FL 90, not FL 190; and,
- On first contact, always pass to ATC your current cleared level.

The following are examples of operational good habits:

- One pilot programs the FMS, another checks it; cross-check every MCP/FCU change, visually and verbally; cross-check altimeter settings;
- Apply crew resource management (CRM) skills (e.g., the pilot monitoring makes a standard call for altimeter setting on passing a set flight level); call out altitudes passing and feet to go when approaching the level-off;
- Avoid high rates of climb or descent approaching the level-off point to prevent unnecessary TCAS alerts; consider limits of 3,000 fpm with 3,000 ft to go; 2,000 fpm with 2,000 ft to go; 1,000 fpm with 1,000 ft to go;
- Understand how TCAS works and how to respond to TCAS RAs, including those not frequently practiced in the simulator;
- Set the clearance given, not the clearance expected; and,
- Maintain a sterile cockpit below FL 100.

— NATS

Further, a high rate of climb or descent can trigger a traffic alert and collision avoidance system (TCAS) warning on one or more aircraft under these circumstances, and the resolution advisory (RA) often is to continue the ongoing climb or descent. When this occurs, the SFL indication quickly becomes meaningless, and a situation the controller had every reason to believe was under control can quickly become a level bust. This is one of the reasons an "incorrect response to TCAS" might be attributed to a level bust, even though the actual response to the RA may have been correct.

In fact, an incorrect response to TCAS is recorded in half the level bust events.

Analyses of TCAS-related events by the NATS TCAS Working Group have found three major contributory factors. The most numerous by far were aircraft with high rates of climb or descent approaching the cleared level; about 75 percent of recorded TCAS events involve aircraft cleared to vertically separated levels generating "nuisance" TCAS RA maneuvers. Incorrect responses to TCAS RAs were less frequent, but often had far more serious consequences.

The causes behind an incorrect TCAS response varied. In some, crews reported choosing not to follow the RA to maintain passenger comfort or because they had visually acquired the other aircraft in the encounter. A more common cause was misinterpreting an RA, in particular misunderstanding an "adjust vertical speed" RA, an instruction to reduce the rate of climb or descent.

A normal TCAS response also can cause pilots to fail to maintain their ATC-cleared level when correctly following an RA; for example, an aircraft is climbed to a level with 1,000 ft standard separation below another aircraft and receives an "adjust vertical speed" RA. While staying within the green arc of the TCAS climb/descent guidance, the aircraft can level at 600 ft beneath the traffic, preventing a collision but eroding standard ATC separation.

The increased risk of non-response, late response or incorrect response to TCAS — as well as possible delayed reporting by pilots of a deviation in response to a TCAS RA — are some of the many issues that have been identified as being more common in single-pilot operations. The introduction of very light jets (VLJs), particularly when operated by one pilot, complicates this picture. Although low performance VLJs are likely to be treated from a controlling perspective much the same way as current turboprops, mid-performance VLJs will have higher cruising levels combined with slower speeds than other aircraft at those levels. This is likely to add to controller workload; and, given the evidence of incorrect response to TCAS already identified, NATS will need to monitor closely the level bust performance of single-pilot aircraft.

For NATS, having identified the level bust trend in the business aviation sector, the greatest challenge is to reach the correct audience with its mitigations. NATS has a very successful safety partnership agreement with many commercial operators in which it exchanges data and discusses issues in an open and frank forum. It also provides on a quarterly basis specific data on level bust performance to nearly 50 operators, including business jet fleet operators such as NetJets.

However, for the business aviation community beyond the U.K. air operator's certificate–holder sector, it has proven very difficult to reach the crews effectively. Small operators are too numerous, transitory, dispersed and infrequent U.K. airspace visitors to develop the longer-term relationship necessary to bring down level bust numbers. NATS has worked to develop ties with trade associations and simulator training providers, and has taken advantage of relationships with local handling agents to provide publicity and awareness initiatives. Ultimately, however, these strategies do not address the fundamental issue of directly engaging the target audience.

In an attempt to go further in addressing this issue, NATS has created a new workstream whose focus is on business aviation, as well as cooperating with the U.K. Business Aviation Safety Partnership. The work of these groups will consider improvements in pilot training, regulation and briefing.

Among training considerations are the following areas:

- Pilot training for global airspace and not just the country within which they are learning; and,
- Pilot training for a variety of conditions — emergencies, poor weather, etc.

Regulatory goals include:

- Promoting carriage of specific avionic equipment, such as Mode S transponders and, in some airspace, airborne collision avoidance systems; and,
- Adequate licensing, training and competency arrangements to expand knowledge of TCAS responses and airspace, airports and poor weather operations.

Briefing improvements may be achieved by:

- Facilitating access to adequate briefing material through handling agents, etc.; and,
- Encouraging correct briefing by the operators.

The focus of these groups is supported by the publication on Aug. 15, 2008, of the *Business Jet Safety Research Report, a Statistical Review and Questionnaire Study of Safety Issues Connected with Business Jets in the U.K.* This, in turn, has resulted in the formulation of a U.K. Civil Aviation Authority–led Safety Action Plan for Business Aviation. Although the work is not yet finalized in this area, it is clear that the need for specific attention to this sector of the aviation industry is greater than ever.

Peter Riley, a controller now working at NATS Corporate and Technical Centre in the United Kingdom, was NATS Level Bust Workstream Lead.