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HindSight

June 2006

AIRSPACE INFRINGEMENT

"Hindsight"
The ability or opportunity to understand and judge an event or experience after it has occured.

IS AIRSPACE PENETRATION AN ATC PROBLEM OR NOT?

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EUROCONTROL

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Editorial

** In most European countries, national procedures are based on ICAO Standards and Recommended Practices (SARPs); therefore the "Lessons Learned" listed in HindSight follow this guidance. Where national procedures do not follow ICAO SARPs, some "Lessons Learned" might not be applicable.*

IS AIRSPACE PENETRATION AN ATC PROBLEM OR NOT?

By Tzvetomir Blajev
EUROCONTROL Coordinator Safety Improvement Initiatives
and Editor in Chief of HindSight

I can't count the number of times I have heard someone say, "this is just pilot error, it is not our responsibility".

General aviation aircraft entering controlled airspace without authorisation, near misses in class "E" airspace, military aircraft infringing civil-controlled airspace, infringements of restricted access airspace, problems with gliders and parachute-dropping flights; these are the types of scenarios I have in mind.

Pilot error? Does such a thing as "human error" really exist? More and more the aviation industry is considering human error as a manifestation of a problem, rather than the problem itself. In our discussions we agree that human actions usually make sense, given the dynamics and the context of the situation in which they are taken. It is very easy with the benefit of hindsight, already knowing the outcome of the event, to find a different (better) course of action.

In spite of this, when we speak of airspace infringement we often say, **"This is just pilot error."** We are tempted to think that there is nothing we could have done, in the context in which the error happened i.e. regarding the airspace design and procedures, the quality of flight information service, the regulatory supervision of general aviation, etc. It seems that we agree on the concept, but applying the concept to real examples like airspace infringement, level bust and other pilot error seems to be beyond our ability. We sometimes even hear suggestions like, "the solution is simple - introduce fines for the pilots".

Of course there is no escaping the fact that in the majority of cases the pilot is wholly responsible. I am not trying to suggest anything to the contrary. But to say, "he is guilty - that is the end of the story" denies us an opportunity to make a real contribution to reducing the chance for error.

The last Safety Improvement Sub-Group meeting decided to closely examine the whole subject of airspace infringements. A new Safety Improvement Initiative has been launched to consider the factors that cause pilots to make errors and penetrate controlled airspace. It will look at the context of the incidents and also the operational environment. Operational environment and context cannot be determined while sitting alone in a closed office. For this reason, the SISG Secretariat has already established close liaison with several agencies working in this field.

If it is true that there are different scenarios, it is also true that ATC is often part of the context. We must ask ourselves whether ATC is perhaps contributing to the errors in some way. We must also ask, "even if we are not always part of the problem - **could we become part of the solution?**"

UPA becomes AI

The EUROCONTROL initiative for the prevention of Unauthorised Penetration of Airspace (UPA) has been renamed as the Airspace Infringement Initiative. This will comprise three areas of concern:

- Unauthorised entry into controlled airspace;
- Infringement of restricted, prohibited or other special use airspace; and,
- Loss of separation in Class E airspace.

A precise definition of this initiative is under consideration.

You have in your hands the third edition of the HindSight publication. The main theme this time is airspace infringement. As usual we also cover a range of different subjects, which I hope you will find interesting and useful.

ABOUT HINDSIGHT

The main function of the *HindSight* magazine is to help operational air traffic controllers to share in the experiences of other controllers who have been involved in ATM-related safety occurrences. In this way, they will have an opportunity to broaden their experience of the problems that may be encountered; to consider the available solutions; and so to be better prepared should they meet similar occurrences themselves.

Material contained in *HindSight* falls into three distinct classes:

- Editorial
- 121.5 - Safety Alerts and
- The Briefing Room - Learning from Experience.

On page 2, you will find a table of contents listing articles under these three headings. Editorial material, such as this article, needs no explanation but a few words on the other two classes may prevent any misunderstanding.

121.5 Safety Alerts

From time to time EUROCONTROL issues Early Warning Messages and Safety Reminder Messages to draw the attention of the ATM community to emerging safety issues. The messages are intended to encourage discussion on the prevalence and seriousness of the issue and on the most appropriate reaction to them. Summaries of some recent messages are included.

The Briefing Room - Learning From Experience

The majority of *HindSight* is taken up with articles concentrating on specific safety issues. These usually comprise a study of an actual accident or incident(s) together with a summary of lessons learned. These articles are coded to reflect the subject material.

Some incidents relate to the performance of ATCOs or the ATM system, while others illustrate pilot errors which can arise from incorrect interpretation of ATC instructions, or other unpredictable situations.

The incidents fall into two categories:

- **Summaries of accident and serious incident reports**

The full report usually runs to many pages, so these reports must be summarised and simplified, concentrating on the ATM-related aspects and passing quickly over (or even ignoring) other issues which have no direct relevance to ATCOs. A reference to the original report is always supplied.

- **Dis-identified accounts of other ATM-related incidents**

Typically, the original reports are not in the public domain; however there are important lessons to be learned from them. The identifying features of the reports are altered without changing the substance of the reports in order to preserve the confidentiality of the reporter.

Lessons Learned

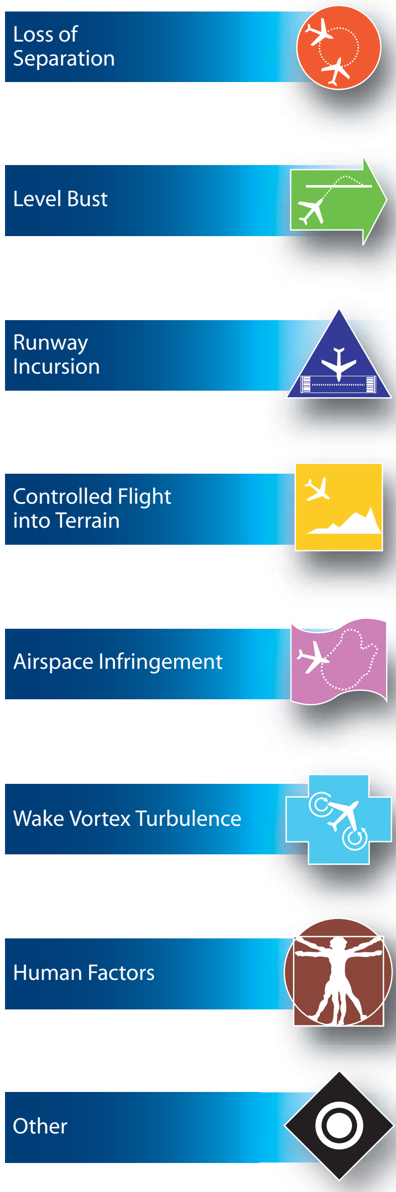
In the articles that follow, only the lessons learned from the featured accidents and incidents are listed. Posters listing all relevant learning points are in the course of preparation.

Knowledge Base

We intend to compile a Knowledge Base of all types of ATM-related safety reports, which may be accessed by persons carrying out research on particular subjects. This is a long-term project but we plan that the HindSight magazine should be integrated with it from the outset.

Coding of Subject Matter

To aid identification of subject matter, each article is coded and marked by a coloured icon which appears at its head.



FRONT LINE REPORT DO NOT ENTER

by Bert Ruitenberg

Bert Ruitenberg is a TWR/APP controller, supervisor and ATC safety officer at Schiphol Airport, Amsterdam, The Netherlands. He is the Human Factors Specialist for IFATCA and also a consultant to the ICAO Flight Safety and Human Factors Programme.

One of my favourite cartoon strips is called "Swamp", by the Australian artist Gary Clark. Aviation is a recurring theme in that strip, including air traffic control, and the artist is able to capture the true pilot and controller spirit in his jokes. Some years ago I read one particular strip from the series that I think is highly appropriate to the theme of this edition of Hindsight. In the first frame you see the air traffic controller (a duck) quietly sitting in his Tower (a tree), enjoying the view. The second frame shows the controller suddenly in a state of attention (wide eyes, exclamation marks). In the next frame the controller fires a shotgun at an invisible target. The last frame is almost identical to the first one, except the caption in a thought bubble over the controller's head, which reads "That will teach them not to stray into controlled airspace!"

I'm prepared to bet good money that all air traffic controllers have wished at some point in their careers that they could do what the duck in the strip was doing, when they were faced with yet another intruder in their airspace. We have all had to deal with this problem - and if you're a controller and say you haven't had any unauthorised traffic in your airspace, you're either very lucky or you haven't been paying attention well enough.

Having said this, when searching my memory to see just how big an issue this airspace infringement really is, I came up with the conclusion that to me it seemed to be more of an issue twenty years ago than it is now. So how could that be?

The easiest explanation of course would be that the number of airspace infringements today is much lower than it used to be. A quick trip to our incident investigation department however yielded the information that this explanation is incorrect. There are still quite high numbers of airspace infringements happening nowadays, and judging by the fact that EUROCONTROL's Safety Improvement Sub-Group (SISG) thinks it one of the high risk areas in European ATM, the problem isn't restricted just to the airspace over my country.

A more plausible explanation may be that since almost all today's aircraft operate transponders, the element of surprise posed by an intruder is (far) smaller than I remember from the early days of my aviation career (mid-80s). There is nothing that will make your heart rate go up like a call from a line pilot who says "by the way, we just passed a Cessna at FL 55" when you thought there was only one aircraft in that area. That the Cessna's pilot doesn't communicate with the appropriate controller is one thing, but if his aircraft is also invisible (or at best hard to see) on the radar the situation becomes very difficult to manage for ATC.

In those days general aviation aircraft accounted for the majority of airspace infringements, so it is definitely an improvement that transponders are fitted in most of them. Another improvement is in the field of navigation - thanks to GPS fewer private pilots seem to get lost now than happened in the past. Now if only we could get all private pilots to correctly operate their GPS and their transponder, including the Mode C, the situation would become almost manageable for ATC.

But does the fact that we can see them make intruders less of a problem? Well, sometimes it does, sometimes it doesn't. The one piece of information that is lacking with an intruder is its intention. Where is it going? What will it do next? Will it stay at its present altitude or level? Depending on the position of the intruder this uncertainty may cause a considerable amount of extra work for ATC to manage the situation safely - the only good news is that ATC can see where the intruding aircraft is.

So far I've only discussed airspace infringement caused by general aviation pilots, something we as controllers are pretty familiar with. But there is another category that we may not like to talk about so much: airspace violations by traffic that is controlled by another ATC unit. Or in other words, ATC-induced airspace infringements.

These violations typically occur near airspace boundaries, and may be caused by something as obvious as a controller forgetting to transfer an aircraft to the next frequency. However, they may also be caused by a controller who thinks the other controller won't mind if he continues to separate traffic just slightly inside the other's airspace without coordination. Regardless of how brilliant the evolving solution may be, from the other controller's perspective this is just an airspace infringement! And how sure can the first controller be that on his radar he really sees all the relevant targets outside the borders of his own airspace? Wasn't there a rule in radar control somewhere that you were never supposed to come closer to a boundary than half your radar separation minimum?

Multi-radar tracking may have increased the range and coverage of most radar operations today, yet that old rule is still in place (at least as far as I know). Have you ever heard a controller tell pilots "yes I know you have TCAS but there is traffic out there that you can't see"? Well, the same may apply to us as controllers working with multi-radar tracking.

So, whenever you find yourself issuing instructions to aircraft near the boundary of your airspace (or beyond it!) make a point of coordinating with the controller who is responsible for the airspace on the other side. It could make life easier for your colleague - and also for yourself.

Since I find myself on a somewhat educational note here, I thought it might be nice to end this column with an episode of the cartoon strip that I mentioned at the start. If airspace infringements persist, perhaps education of the pilot community is the next step we have to consider...

IS YOUR SYSTEM PREPARED FOR THE UNEXPECTED?

by Professor Sidney Dekker, Ph.D.

Sidney Dekker is Professor of Human Factors & Aviation Safety at Lund University in Sweden. He gained his PhD in Cognitive Systems Engineering at The Ohio State University in the US. His books include "The Field Guide to Human Error Investigations" and "Ten Questions about Human Error".

Shortly after the evening rush on the 5th of November 2002, a Cessna 172 flew into the Gothenburg TMA without having received permission. The pilot had been radar-identified by Gothenburg, where the controller acknowledged ("Roger") its intention to fly to a field on the other side of the TMA. The controller did not explicitly give the Cessna permission to cross the TMA. Twenty minutes later, well into the TMA, the Cessna came into conflict with an A320 turning toward the final approach into Gothenburg. A TCAS alert helped the A320 pilots avoid the Cessna, and minimum separation between the two aircraft became 1NM. They were at the same altitude.

For a controller, unauthorized entry into airspace, whether VFR or IFR traffic, almost always comes unexpectedly. Unexpected events - once detected - have a way of upsetting plans. Typically, they create additional workload and a need to revise tactics. The controller has to deal with the intrusion, but without dropping everything else. In other words, the anomaly needs to be managed while maintaining process integrity. This extra burden and the interactions it produces, places new, unanticipated demands on a controller.

What separates effective handling of unauthorized entry into airspace from a less effective one? The Gothenburg case strongly demonstrates that it is only partly about a controller's ability, if at all. Yet it reveals interesting ways in which a sudden, escalating situation can create its own demands that stem from the way it is managed. Unexpected events such as an airspace intrusion can produce a cascade of effects. Typically, demands for new knowledge increase (Who is this? Where did he come from? Where is he going? Do I have a label somewhere?). Demands for coordination increase too (Whose airspace is he from or will he go to? Does my planner know anything? Whose scope of responsibility does this event fall into?). And all the time, margins and chances to rectify the problem may be shrinking.

The later a controller begins to counteract and compensate for this cascade, the more difficult it can become to recover from it, and the more time a controller may have to spend on dealing with the effects of his/her own delay rather than with the initial effects of the intrusion. Obviously, the later the detection of an intruder, the smaller a controller's margins may have become. Later intervention can imply that the tempo of assessments and actions will have to go up. It can also mean that more traffic may have become affected by the intrusion - which will give the controller more to do and less time in which to do it.

In the case above, the controller did not know that the Cessna was in his TMA until the announcement from the A320. This was not the controller's fault. It was the entire operation that was not well-prepared enough to recognize and absorb an intrusion in its plans.

The Gothenburg position could switch off the labels of traffic not under control. In normal practice, this "OTH OFF" switch is used only during short, workload-intensive periods, to highlight the

traffic actually under control by that position. Automatic correlation of traffic such as the Cessna 172 was not an option at the time. A label would have had to have been made and entered for it manually. Although the Cessna had been radar-identified, the controller did not make a label for it. With the position in "OTH OFF", the Cessna was not only uncorrelated, it was also, technically speaking, "OTH" traffic. Irrelevant traffic. Traffic not under the control of that position. Traffic not in the picture.

At this stage the only trigger to "see" the Cessna, and understand its intentions, was the controller's memory of a brief, two-phrase exchange a continually increasing number of minutes ago. No strip on the board, no label on the screen. Just a small dot of "OTH" traffic. It was only when the A320 announced its TCAS alert and went around on the basis of it, that the controller realised the Cessna had continued on its course, right into his TMA, but "under the radar", so to speak.

Left to wonder

The incident investigation tells us nothing about the reasons for this self-constructed, systemically-inbuilt brittleness - which of course, is unfortunate. In the psychology behind the actions lie many of the keys to improving and preventing situations such as this one. We could ask many questions. And we should seek answers to them. How normal was it to have approach positions in "OTH OFF"? Were there particular situations in which this was more usual than others? Were some situations proscribed from having this switch on? How normal was it for controllers to not switch back to "OTH ON"? Had others been caught out by this too? How often does programming unplanned VFR traffic get delayed? For how long? Whose role is it, if you have a two-person system? Who double-checks?

The investigation report relies, unfortunately but not uncharacteristically, on "human errors" to carry the explanatory load of the incident. The controller in this case essentially "forgot" three things. He "forgot" to put back "OTH ON", he "forgot" to integrate the Cessna strip and programme a label for it, and he "forgot" to give the Cessna a real clearance to enter the TMA. All three are "omissions", which appear more likely after a workload peak (we can still only speculate about the possible psychological mechanisms). Omissions are also more likely with fatigue (which hinges on time-on-task, work and rest schedules, previous sleep, etc.).

But errors are not causes. Errors are consequences. They are effects. They come from somewhere. When confronted with a "human error", we should start our journey, our investigation - not conclude it. It is easy for us, in hindsight, to say what the controller should have done. But this gets us nowhere. The controller must have come to work to do a good job, as we assume everybody does. Instead we should ask: why did it make sense to delay the preparation, to delay the switch back to "OTH ON" after the evening traffic peak had receded? It must have made sense at the time - otherwise the controller would not have done it. And if it made sense to one controller, it could make sense to another, to you, to others in your organization.

Escalation

As it turned out, the margins for recovery became slimmer and slimmer with the increasing delay in recognizing the intrusion. While "under the radar", out of sight of the controller, the situation escalated. What did not help was that Gothenburg did not have STCA. In Sweden only Stockholm and Malmö ATCC did at the time of the incident. Without STCA, even more margins were shaved from an increasingly slim situation. The situation was made even worse by an operational system that was not well-prepared for the unexpected. It exploded into view only when the A320 made its announcement. This generates a number of coordinative and cognitive effects which could be typical for such situations:

- Demands for cognitive activity increase as the effects of the problem cascade or suddenly explode into view. The need for more knowledge is mounting or increases suddenly. Actions to protect the integrity and safety of systems need to be identified, carried out, and monitored for their effectiveness. Existing plans need to be modified or new plans formulated.
- Demands for coordination increase as the effects of the problem cascade or suddenly come to the fore. Knowledge may reside in different people or different parts of the operational system.

The Cessna's intrusion was unexpected, not necessarily because of the Cessna. After all, it had planned to fly to that airport across the TMA all along, an intention that had been communicated and acknowledged with a "roger" by the controller. The intrusion was unexpected because the ANS system was unable to recognize the intention for what it was worth, absorb it in the rest of its work, and adapt to it. Is your operation well-calibrated enough to know whether and how it will handle an intrusion like this? Unexpected events such as unauthorized airspace intrusions will remain unexpected. But that does not mean your operation cannot be prepared for them.

Source report:

Swedish Accident Investigation Board (2003). Loss of separation between aircraft SE-IBX and TS-INC in airspace north of Gothenburg/Landvetter airport, 5 November 2002 (Report RL 2003:31). Stockholm, Sweden: SHK (original report in Swedish).

121.5
SAFETY ALERTS

SAFETY WARNING MESSAGE SUMMARY

ICAO INTERIM GUIDANCE REGARDING A380 WAKE TURBULENCE SEPARATION MINIMA

Origin: ICAO Regional Director, Europe and North Atlantic
Issued: 30 January 2006

THE PROBLEM

- An ad hoc group of experts under the auspices of the FAA, EUROCONTROL, the JAA and Airbus is currently developing guidance on wake vortex separation criteria for the A380. Following extensive flight testing and analysis of flight data, it is anticipated that this guidance will be made available in 2006.
- Flight trials of the A380 will predominantly take place in France so it is unlikely that any ANSPs will encounter the A380 before the separation minima guidance is issued by ICAO.
- In the meantime, to provide some interim guidance to ANSPs, the ICAO Regional Director issued State letter T 13/3-05.0661.SLG on 10 November 2005 providing interim guidance regarding wake turbulence spacing between A380 aeroplanes and other aircraft. This guidance is conservative and is only intended for ANSPs who encounter an A380 during one of its limited number of trial flights.

INTERIM ICAO GUIDANCE

1. Departure spacing:

a) one additional minute to be added to all separations listed in Procedures for Air Navigation Services - Air Traffic Management (PANS-ATM, Doc 4444), paragraph 5.8, when an A380 is the leading aircraft;

b) one additional minute to be added to the separation in PANS-ATM, paragraph 5.8.5.

2. Horizontal spacing:

a) where both aircraft are established on final approach, 10 NM between an A380 and any other following aircraft;

b) 15 NM minimum radar spacing for all other phases of flight, including enroute, between an A380 and all other aircraft operating directly behind at the same altitude or less than 300 m (1000 ft) below. (See also paragraph 3 below.)

3. Vertical spacing:

Vertical spacing guidance will not be completed for several months. There are indications, however, from the initial analysis of data, that wake vortex from an A380 may be encountered by aircraft flying 300 m (1000 ft) below at greater strengths than from current aircraft of the heavy wake turbulence category. Because it has not yet been possible to establish the level of hazard associated with these wake vortices, offset tracks or additional vertical spacing is advised until the final vertical spacing guidance has been established.

SAFETY WARNING MESSAGE SUMMARY

UPDATE ON ERRONEOUS '0607' SQUAWK

Origin: EUROCONTROL - Mode S & ACAS Programme
Issued: 9 March 2006

THE PROBLEM

- A design deficiency with the Rockwell Collins Mode S TPR-901 transponder can cause it to transmit an incorrect Mode A code (0607), instead of the code entered by the crew, when it is interrogated by radar systems. As the incorrect code is not displayed in the cockpit, the crew are unaware of this problem.

- This deficiency can occur both on the ground and in the air, resulting in a loss of code/callsign correlation and flight data on ATC radars. This increases air traffic controllers' workload, reduces their ability to carry out tasks efficiently and has the potential to cause a serious incident. The operation of the ACAS safety net, however, is not affected by this issue.

- This problem was first identified at the end of 2004 and appears to be most prevalent within European airspace, although it has also been observed in airspace outside Europe (e.g. Australia).

- This Safety Warning Message provides an update on the progress of the transponder modification programme now underway.

TRANSPONDER MODIFICATION PROGRAMME

- A hardware modification to rectify this fault has been developed and is available through the implementation of Rockwell Collins TPR-901 Service Bulletin 10.

- Rockwell Collins is responsible for managing the update programme for all affected units. The programme is based on a database containing the serial number of every transponder shipped to date and it includes a number of milestones leading to 100% modification of the units in the field. An aggressive field modification schedule began at the end of November 2005 and will be completed by 21 November 2006, with priority given to modifying units fitted to aircraft operating in Europe. Globally, in excess of 2,500 aircraft are affected.

- Progress of the field modification programme is closely monitored by EASA and the Mode S & ACAS Programme. To date, the transponder modification programme is on schedule.

RECOMMENDED CONTROLLER ACTION

In the event that an aircraft is affected with the erroneous '0607' code issue consider the following:

- Thoroughly and systematically check all flight progress displays/strips for possible conflicts prior to issuing instructions.

- If possible, annotate the affected aircraft's flight progress display/strip in some fashion for the duration of time that it is being controlled, to act as an aide-memoir and help the conflict-checking process.

- Assess the potential effect on controller workload and conflict detection in deciding when to split ATC sectors.

- Advise subsequent controllers of any persistent observations of the erroneous '0607' code issue involving specific aircraft.

- File an appropriate report should any unusual performance or additional safety risks relating to the erroneous '0607' code issue arise.

REQUEST FOR SUPPORT MESSAGE SUMMARY:

DEVIATION FROM ATC CLEARANCE - PARACHUTE DROPPING

Origin: European ANSP - Safety Management
Issued: 10 February 2006

THE PROBLEM

- Parachute-dropping flights take place at about 25NM from the main national airport operating VFR in the airspace of a busy departure sector (airspace classes E & C). These have caused infringement of separation minima to IFR flights on SID by climbing above the cleared FL or by dropping without clearance.
- These cases are complicated because it is normal practice for these flights to operate on the Terminal Flight Information (TFI) frequency and not on the frequency of the TMA lower radar sector dealing with all IFR Departures (to avoid frequency congestion).
- The radar controller of the lower sector is responsible for applying separation to/from these VFR flights.

The ANSP requested help from other organisations, asking how they dealt with this and related problems.

RESPONSE RECEIVED FROM OTHER ORGANISATIONS

A number of organisations responded to this request, reporting similar experiences. The following are among suggestions made:

- Parachute aircraft must be Mode A and C equipped;
- Aircraft should follow parachutists down so that Mode C indicates the top of the parachuting activity;
- Ensure that airspace within busy TMAs is class "A";
- Confine parachute operations to designated areas/height bands, which do not conflict with SIDs/STARs;
- Permit only one parachute flight at a time within each designated area;
- Parachute flights must climb and descend within designated areas;
- Provide standard separation for IFR traffic from the edge of designated areas;
- Require operators to obtain RTF clearance before entering controlled airspace and before commencing dropping;
- In high workload areas, develop special procedures that minimise RTF transmissions but still retain positive control;
- Special procedures include pre-departure contact by telephone and allocation of SSR code;
- Where designated areas are at edge of controlled airspace, procedures may permit operation without RTF contact.

AIRSPACE INFRINGEMENTS - PILOTS' PROBLEMS

The problem of airspace infringement seldom affects airlines. Airlines usually follow designated air routes within controlled airspace. The intended routing is known in advance and if, for example, it must be changed due to temporary restricted airspace, a re-route is issued, often before the aircraft leaves the ground. The airline is usually under the control of an air traffic unit from the moment it begins to taxi until it comes to a halt at its destination, so any deviation from the cleared flight plan is quickly detected and equally quickly corrected. The opportunity for airspace infringement is small and the training and professionalism of airline pilots makes it a rare event indeed.

General aviation (GA), on the other hand, operates largely outside controlled airspace. For the amateur pilot, air routes, control areas and the like may be something of a mystery, and the correct procedures for entering or crossing it may not be properly understood. Even the experienced flying instructor or air-taxi pilot may not be fully conversant with the requirements. It is not surprising, therefore, that the majority of airspace infringement incidents involve general aviation. An appreciation of the pilots' perspective will help us to understand their problems and the reasons why this takes place. This understanding may help us to take appropriate defensive action in good time and prevent airspace infringement incidents having dangerous consequences.

Pilots' Problems

Unlike commercial airline pilots, private pilot training is often very basic and standards are not subject to the same frequent rigorous checks. There is a strong tendency for flying instructors to concentrate on the skills the student pilot needs to handle the aircraft safely and pass the required examinations at the end of the course. Other matters are not dealt with at any great depth and may even be ignored. For newly qualified GA pilots, the learning curve is steep; limited flying hours may mean that a long time passes before a real understanding of the airspace environment is acquired together with the necessary skill and experience to navigate it safely and efficiently.

On many GA flights there is only one pilot, so there is no-one with whom to share the workload or to discuss problems. Even when two pilots are present, the second pilot may be no more experienced than the first. Light aircraft are often not very well equipped, with no auto-pilot or at best a very basic instrument. Navigation may be fairly primitive and where GPS is fitted, lack of familiarity with the equipment may result in considerable distraction when re-programming is necessary. Correct transponder setting may also present difficulties.

Added to this, many small aerodromes do not have extensive flight-planning facilities where the pilot may easily brief himself on NOTAMs and the latest changes to airspace structure and procedures. If experienced staff are present, the pilot may not know the right questions to ask to equip himself for a flight into controlled airspace. It is therefore clear that the possibilities for airspace infringement are considerable. Let us consider a hypothetical case.

The Inexperienced Pilot

John is a PPL with less than 200 hours total; it is several weeks since his last flight and several months since he last crossed controlled airspace. This is not his own aircraft, but one he has hired from the local flying club. There is no altitude capture on his autopilot and navigation will be by reference to VOR/DME supplemented by visual observation. Weather conditions for the route are VMC but with some cloud below, making map-reading difficult. He will have a tail-wind as he approaches the airway. He is the only pilot on board but his non-flying girlfriend is with him as passenger. While he is preparing his flight, his excited passenger is full of questions, distracting him from the task in hand. To John, the controller is an unknown quantity - not quite an adversary but not a friend. Flight in controlled airspace, however brief, is an adventure, so he takes time to consider where he intends to enter controlled airspace, what he will say and what he will do.

John calls up for crossing clearance about 6 minutes before reaching the airway but the frequency is very busy and the controller tells him to stand by. Instead of turning away, he continues on heading expecting to receive crossing clearance soon. The cloud below, coupled with his inexperience at map-reading make navigation difficult and because he has not annotated his chart with VOR radials and DME ranges he is uncertain of his position. Eventually he turns to avoid the airway, but with the tail-wind, he comes so close to an infringement that the controller has to give avoiding action to airways traffic.

When the controller calls John back, he is not where he intended to be and his carefully prepared information is out of date. He can't remember his aircraft registration, then remembers it is on a plate on his instrument panel. He doesn't know where he is relative to his intended entry point. The controller issues a squawk but John has forgotten how to set his transponder and some time passes before he is identified.

Eventually, the patient controller clears him to cross, but on a radar heading and at a different level from what he had planned. When he begins to descend, his passenger asks if they are about to land and while he is trying to explain what is happening, he overshoots his level and has to be alerted to the fact by the controller. Next, John tries to fix his position and work out a new route to his destination, but once again he loses situational awareness and drifts off heading, to the annoyance of the busy controller.

You may be thinking that you would have realised that John was likely to cause trouble and would not have given him crossing clearance in the first place. But controllers are a tolerant breed and do not like to say "No"; so probably, you would have done what our controller did and put him on a heading and at a level where he was safe, and then kept a close eye on him.

... No, crossing controlled airspace is not complicated. The difficult part is doing the flying at the same time ...

Other Considerations

Of course, if the pilot has not yet passed his full request, it will be impossible for you to decide if he/she is inexperienced and likely to cause problems. Moreover, if you do not know the aircraft altitude or the pilot's intentions, defensive action may affect many aircraft. Therefore, if you have had to tell the pilot to standby, you should call him/her back as soon as possible, either with a clearance or a refusal. The pilot's response may enable you to judge his/her ability and so decide whether it is necessary to take additional precautions.

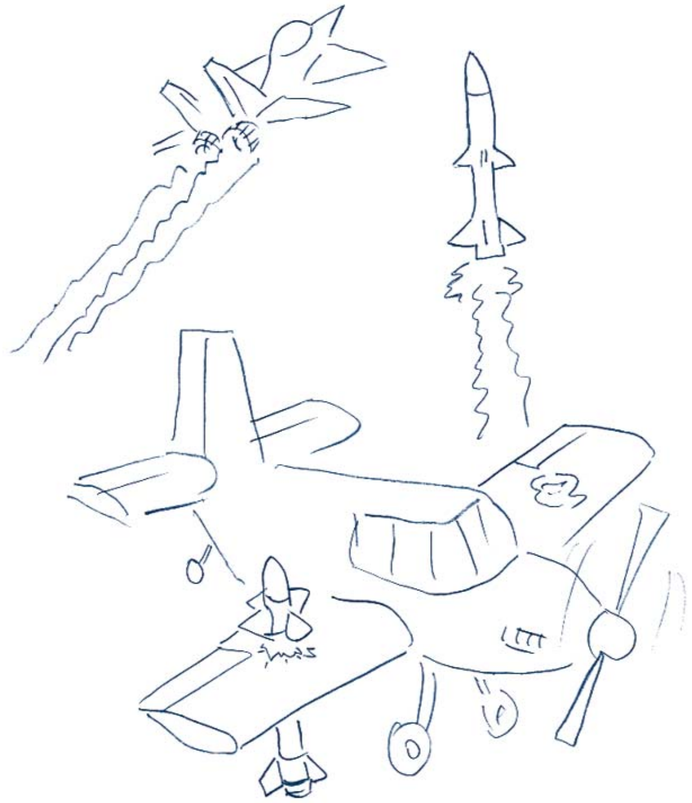
If it is necessary to instruct the pilot to change altitude, bear in mind that many GA aircraft have limited performance and a climb may take a considerable time. During the climb or descent the pilot will be performing other tasks, such as navigation, and without altitude capture, altitude alert, or similar warning devices may unintentionally overshoot the assigned altitude.

An inexperienced pilot may have considerable difficulty dealing with a routing different from what he/she had planned; in less than ideal meteorological conditions a designated visual reference point may be misidentified, especially if the pilot is uncertain of his/her precise position to start with. If circumstances permit, a radar heading may be the best solution because it reduces the number of tasks the pilot has to perform, removing from the inexperienced pilot the necessity to navigate.

Action to be taken by controllers in the event of airspace infringement varies according to the type of airspace. In Classes A or D airspace, traffic information service and, if necessary, avoiding action should be passed. In Class E airspace, traffic information should be passed and, at the pilot's request, avoiding action. You will be familiar with the required action in your sector; the pilot may not.

When vectoring aircraft during the initial and intermediate approach phases, it is wise to ensure that the flight trajectory will not pass through Classes E or G airspace, where unknown traffic may occur without warning, causing a potential conflict with the vectored traffic.

Pilots engaged in aerial work such as parachute dropping while operating within controlled airspace require special consideration. Bear in mind that national authorities usually permit such work to be carried out by pilots having only a private pilot's licence. Therefore, there is the possibility that the pilot may be relatively inexperienced. Sometimes, the Sector Controller permits the pilot to work another frequency (e.g. the Aerodrome Flight Information Service) while on task. This practice is risky unless special procedures are developed and adhered to, and has resulted in deviation from the notified altitude or route due to unforeseen circumstances, such as weather, without being able to inform the Sector Controller, leading to loss of separation and AIRPROX.



Darling, don't get upset, I thought that "D Area" stood for "Destination Area" ...

LESSONS LEARNED

From the many lessons learned from this and other incidents concerning all members of the aviation community, the following relate particularly to Air Traffic Controllers:

- Familiarise yourself with the GA pilot's working environment, his problems and his workload.
- Bear in mind that many GA aircraft are poorly equipped and their pilots may be very inexperienced, and recognise the dangers that could result.
- Note that a "Standby" instruction issued to an aircraft requesting crossing or joining clearance should be followed as soon as possible by a call issuing clearance or refusal.
- Monitor the track of the aircraft when a "Standby" instruction is issued, to ensure that airspace infringement does not take place.
- Pay particular attention to the actions of apparently inexperienced pilots, to ensure that any unexpected deviation from clearance is noted promptly.
- Consider issuing a radar heading at a level clear of other traffic and monitor the aircraft's flight path closely if you suspect that a pilot may be overloaded, or may have difficulty complying with instructions.
- Note that when vectoring aircraft during the initial and intermediate approach phases, it is wise to ensure that the flight trajectory will not pass through Classes E or G airspace, where unknown traffic may appear without warning, causing a potential conflict with the vectored traffic.
- Bear in mind that pilots engaged in aerial work within controlled airspace may have to deviate from their cleared flight parameters and communication may be difficult if they are working a different frequency.

LOSS OF SEPARATION THE BLIND SPOT

Given the traffic density in some European airspace, it is not surprising that dangerous situations are very occasionally overlooked. In most cases, the problem will be detected by the controllers themselves or STCA will be triggered in time to be able to correct the situation.

In other cases though, controllers of all experience levels sometimes completely overlook an aircraft when clearing another in the direct vicinity (in one area there were some 20 separation infringements in 3 years). There are some examples below.

Common elements found in these incidents:

- Most happen in low or medium traffic situations. The risk is increased after a peak or during the period after a handover (when you think you've 'settled in' on the sector).
- Descending aircraft are often involved: inbound traffic often needs to meet certain restrictions. Coupled with aiming for the top-of-descent point, this sometimes results in an incomplete scan of the affected traffic. In occasional climbing situations, a crew's request is acted on immediately without a proper scan of its immediate vicinity.
- The conflicting traffic may be in the immediate vicinity of the cleared aircraft. Typically, the controller spots potential problems that are further away, but doesn't detect the traffic that is closest to the aircraft that he/she is clearing.
- In cases of close proximity (less than 10 to 15 Nm and 1,000 ft), STCA will only give a very short warning before separation is infringed or even when it is already too late.
- Quite a number of occurrences involve traffic under someone else's control. The different colour(s) used for these aircraft may lead to subconsciously filtering them from your scan. Quite often, the overlooked aircraft has already been passed to the next sector. As such, it was considered 'dealt with', erased from memory and overlooked. The second person on the sector does not detect the problem; their workload often prevents them following the actual traffic situation.

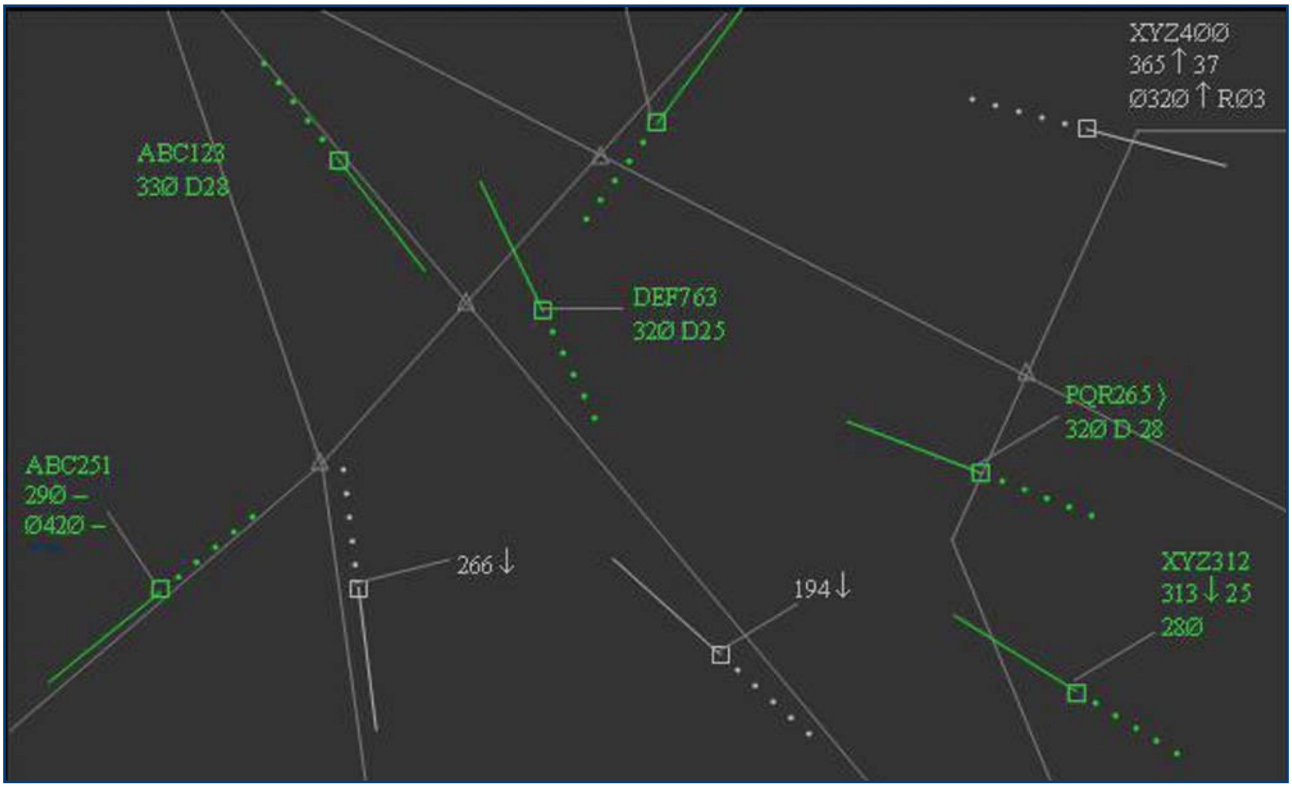


Figure 1 - For ABC123 - the controller spots both PQR265 and XYZ312 but overlooks DEF763

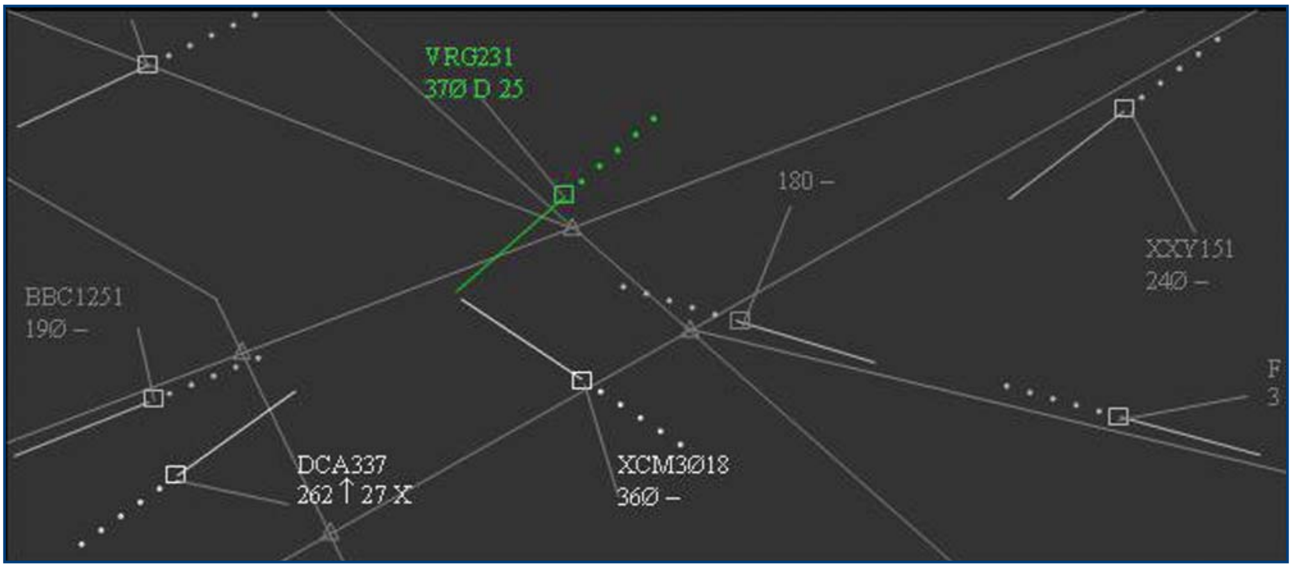


Figure 2 - VRG231 is on the sector frequency and requests descent. Taking DCA337 into account, the controller overlooks XCM3018

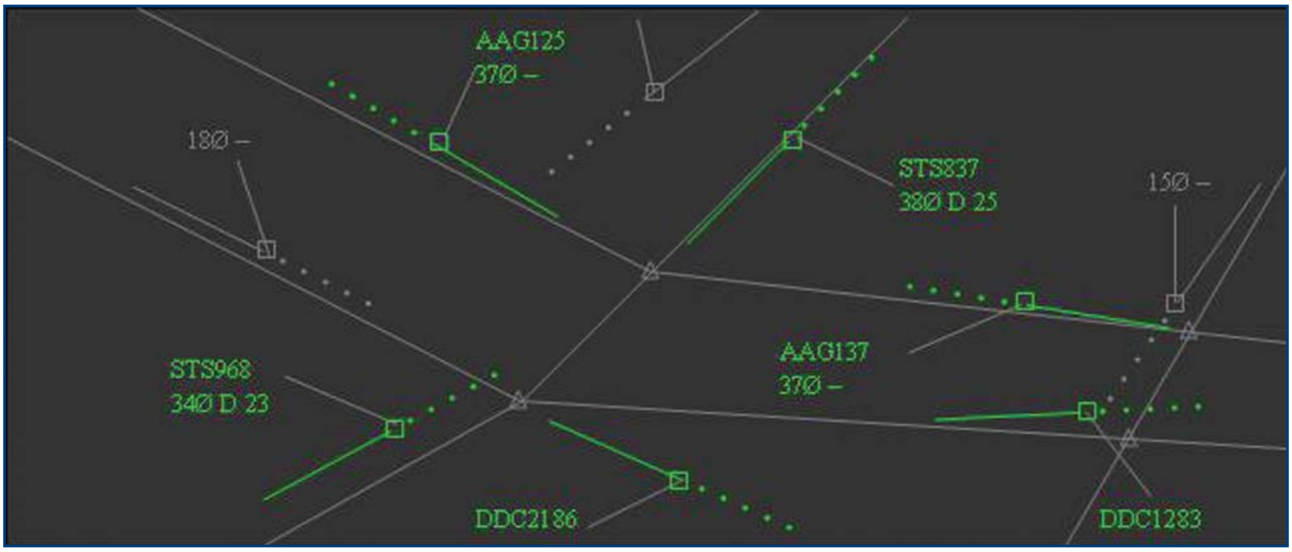


Figure 3 - Controller focuses on making a restriction for STS837 and overlooks AAG125

LESSONS LEARNED

From the many lessons learned from this and other incidents concerning all members of the aviation community, the following relate particularly to Air Traffic Controllers:

- Re-scan the situation immediately after you've given a clearance.

- Ensure correct brightness settings don't obscure aircraft not under your control.

- Avoid transferring aircraft to the next sector very early, especially in places where a lot of vertical movements are necessary.

- After peak periods, exchange positions on the sector in order to refocus and maintain a high concentration level.

- Wearing a headset can help the coordinator to follow the actual traffic situation closer. As an Executive, don't assume that your coordinator hears and cross-checks absolutely everything you do. Even when you're not very busy, your coordinator may be.

- Don't be afraid to tell a pilot to stand-by while you evaluate his/her request.

- Get a release from your adjacent sector. If possible, ensure that aircraft is free of conflictions before you pass them to adjacent centres, so no unexpected manoeuvre will affect your traffic. Try and do this for internal transfers as well.

RUNWAY INCURSIONS - IT WILL NEVER HAPPEN TO ME ...

By Bengt Collin

Bengt Collin is an ATC Operational Expert at EUROCONTROL Brussels. Previously he spend some 25 years as an TWR & APP controller at Stockholm-Arlanda airport, including four years as the Tower Operational Manager.

It will never happen to me. Well, like many other people - that is just what I thought. This article is about just that; it is about runway incursions I never expected to happen. But they did. And they can happen again. What can we do to prevent them in the future?

Let's make it perfectly clear: Stockholm-Arlanda is a safe airport. The airport layout is, if not perfect, very good for the prevention of runway incursions. All terminals and aprons are located in the centre of the airport and no runways need be crossed by aircraft.

The first incursion happened during the relatively quite hours at midday. It is not unusual that incidents happen at off-peak hours; perhaps you relax more and perhaps focus on things outside your normal procedures.

I was working at the ground controller position, the traffic was low and only one ground position was open. We used runway 26 for landing and runway 19 (today 19R) for departure. The weather was nice as always; in Sweden most days are sunny, blue sky is standard and the visibility unlimited.

The aircraft involved was parked at gate 15 on Terminal 5. Following pushback, the aircraft requested and received taxi instructions for the holding point of runway 19. The aircraft should taxi out on the south side of the terminal, turn 90 degrees right for taxiway Yankee and finally straight ahead for around one and a half kilometres (see green line on the diagram). Not complicated at all; in addition this was a standard taxi route, an instruction you give day in and day out.

The tower at Arlanda is centrally located (very convenient for the lunch break and the restaurants in nearby Sky City) with good views in all directions. Another aircraft just vacating runway 26 called; I turned to the right and looked north, away from the aircraft from gate 15 west of the tower, in order to monitor a conflict with a towed aircraft.

Then it happened. The outbound aircraft did not turn 90 degrees to the right, it only turned 60 degrees to a Rapid Exit Taxiway leading out to the runway (see the red line on the diagram) where another opposite aircraft was about to depart. It took less than three seconds. This time everything went well, the pilot understood he was wrong and stopped before the runway. The signs were in accordance with ICAO standards and Stop Bars are used H24. As a bonus, another controller, just released, observed the incursion and alerted me, but I guess there is no guarantee that that would happen again...

The second incursion happened a long time ago; this was before Surface Movement Radar and Stop Bars were introduced at Arlanda, probably just after World War II ended. In dark and foggy weather (the sun does not shine when it is dark) a lot of interesting things happen; being new at the job the controller used slightly different language when describing the incident. The old international terminal had a bomb threat so it was decided to tow aircraft to Ramp South instead. At the same time, the controller was busy with an aircraft returning with severe vibrations. Tug 12 received instructions to tow west via taxiway X-ray and south onto Yankee. Suddenly the tower was contacted via the radio from the Follow Me (on the "aircraft" frequency), asking the controller if she was aware that Tug 12 and the towed aircraft were on runway 19. The controller instructed Tug 12 to vacate and the Follow Me confirmed when the runway was free. Instead of turning south on Yankee the tug had mistakenly continued straight ahead on YF! (see Figure 2).

The inbound aircraft (yes, the one with vibrations) on one mile finals landed without problem; the controller aged by a couple of years.

What can we learn from these runway incursions? Use the Action Plan for the Prevention of Runway Incursions*! Make people aware of the recommendations. Follow them! Many of the recommendations are things that you can do right here, right now. Others may take longer, but if your Human-

* A copy of the European Action Plan for the Prevention of Runway Incursions can be obtained from the following e-mail address: runway.safety@eurocontrol.int

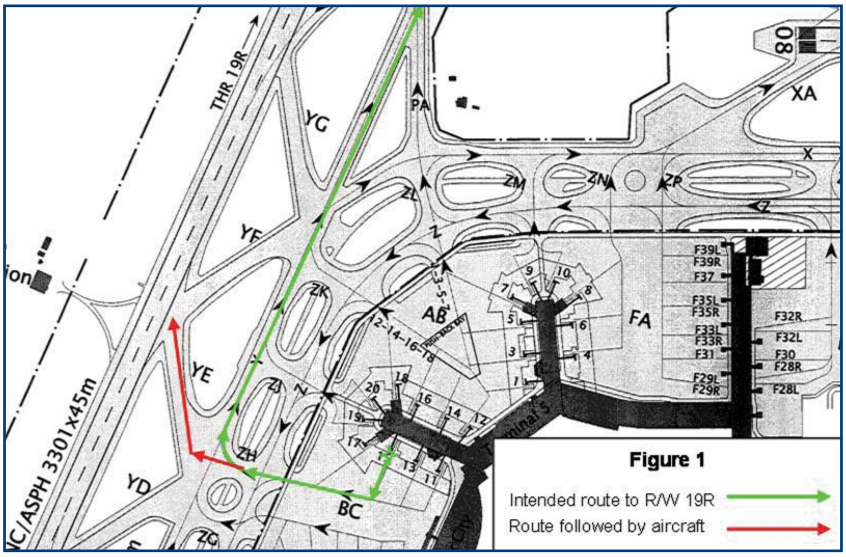


Figure 1
Intended route to R/W 19R
Route followed by aircraft

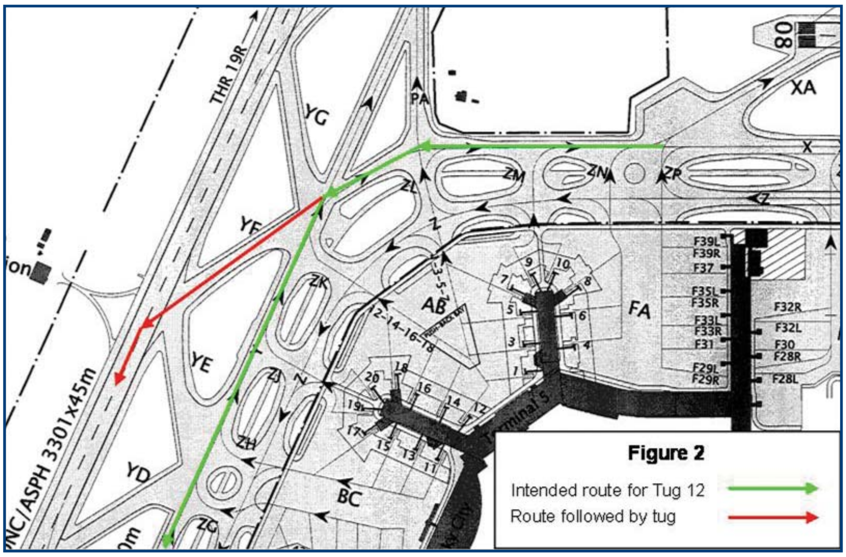


Figure 2
Intended route for Tug 12
Route followed by tug

Machine Interface (HMI) for example prevents you from using the Stop Bars, change the HMI rather than not using an excellent accident-prevention tool. Stay alert to the recommendations; safety work just goes on and on - like the Swedish sunshine.

LESSONS LEARNED

From several safety occurrences we recommend (paragraph numbers relate to Action Plan Recommendations; although not all of them are related directly to controllers, they are relevant for the local Runway Safety Teams):

- 4.1.3. Confirm that all infrastructure, practices and procedures relating to runway operations are in compliance with ICAO provisions.
- 4.2.1. Verify the implementation of ICAO Annex 14 provisions and implement maintenance programmes relating to Runway operations e.g. markings, lighting, signage. Ensure that signs and markings are clearly visible, adequate and unambiguous in all relevant conditions.
- 4.3.5. Improve situational awareness, when practicable, by conducting all communications associated with runway operations on a common frequency. (note - aerodromes with multiple runways may use a different frequency for each runway.)
- 4.5.7. Ensure that ATC procedures contain a requirement for explicit clearances to cross any runway.
- 4.5.9. Use standard taxi routes when practical to minimise the potential for pilot confusion, on or near the runway.
- 4.5.10. Where applicable use progressive taxi instructions to reduce pilot workload and the potential for confusion.

MISUNDERSTANDINGS - WRONG QNH SETTING

A C9, operated by the US military, was approaching a civil airport. The approach controller guided the aircraft to the ILS during descent to an altitude of 3000 FT.

APP: "C9 descend altitude 3000 FT QNH 996"
C9: "Descending 3000 FT 996 C9"

The pilot reported reaching 3000 FT but the Mode C indication on the radar display said "A2400 FT". The pilot confirmed being at A3000 FT, so a Mode C inaccuracy was assumed. After the aircraft had been cleared for ILS and had intercepted the LLZ, it was transferred to the TWR frequency.

When the pilot confirmed the QNH after having been transferred from APP to TWR, the cause of the presumed "Mode C inaccuracy" became apparent. The pilot had misunderstood the QNH. He had confused 996 hPa with 29.96 inches. The Mode C indication was indeed correct; the aircraft was at an altitude of 2400 FT. The difference amounted to 19hPa, which corresponds to approximately 570 FT (29.96 inches corresponds to 1015 hPa).

The glide path was intercepted at A2400 FT. The ILS guided the aircraft safely to the airport despite the wrong altitude. It does, however, raise the question as to what could have happened as a result of the wrong altimeter setting if the ILS had not been available but if an NDB approach had to be performed instead, with a low ceiling in IMC. The OCA for an NDB approach to that airport is approximately 600 FT above aerodrome level; with an error of 570 FT, this would have only left 30 FT or about 10m - with a considerable distance to cover before reaching the runway!

Conclusion drawn by the air traffic controller:

If the correct QNH value is set for the radar display, the actual altitude is shown on the radar screen.

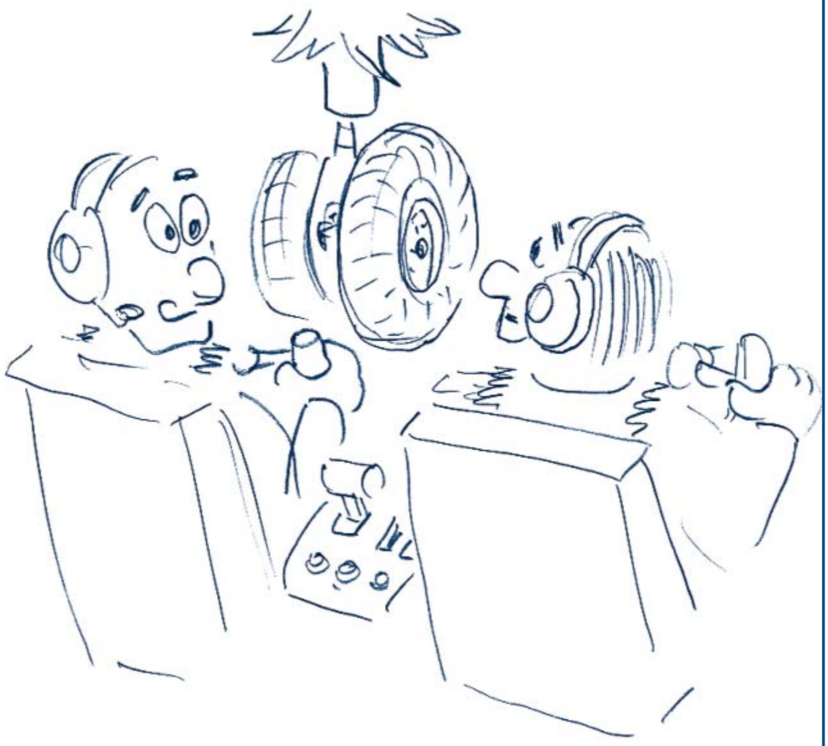
Statement by the DFS Safety Management Department:

The conclusion drawn by the ATCO is correct since both the altimeter and radar data processing use 1013 hPa as the reference value. For altitudes below the transition level, on-board as well as ground-based systems make a correction according to the QNH set. In the incident described above, the altimeter of the C9 had the wrong correction value (which the pilot cannot see!!) while the radar used the right correction value and thus showed the actual altitude of the aircraft.

For values above 1000 hPa, the "1" clearly indicates that the air traffic controller has given the value as hPa. For QNH values below 1000 hPa, there is a risk that (mainly US or military) pilots who are used to QNH values expressed in inches confuse the hPa QNH values within the range of 900 with the QNH values expressed in inches starting with 29. The pilots appear to be used to the missing "2". This could perhaps be the result of negligent phraseology applied by foreign colleagues ...

According to present German radiotelephony procedures, it is not mandatory to explicitly mention the measurement unit of the QNH. In order to avoid misunderstandings, however, the following solutions might be advisable for QNH < 1000 hPa.

- to add a preceding "0" (e.g. QNH 0996), or
- to add "hPa" (e.g. QNH 996 hPa).



Joe ... are you sure that we've stopped climbing at the right level?!

THE LEVEL BUST TOOLKIT

The European Action Plan for the Prevention of Level Busts* includes the Level Bust Toolkit, which contains a number of Briefing Notes dealing with a range of subjects connected with the cause and prevention of level busts. Section 7 of Briefing Note ATM 1 - Understanding the Causes of Level Busts - deals with altimeter pressure settings and features the error described above as well as some others. Briefing Note Ops 2 gives a fuller explanation of this and related errors. The recommendations which follow are taken from Briefing Note ATM1.

LESSONS LEARNED

From the many lessons learned from this and other incidents concerning all members of the aviation community, the following relate particularly to Air Traffic Controllers:

The controller can reduce the likelihood of error by paying close attention to the use of standard phraseology and by insisting on the correct read-back procedure.

Standard phraseology is especially important when:

- Passing a clearance to pilots whose familiarity with the English language is limited.
- Specifying the altitude reference when this changes (e.g. "descend to 3,000 feet QNH" or "set QNH 993 hPa and descend to 3,000 feet").
- Passing the pressure setting to the pilot of a North American aircraft. In the USA and Canada, pressure settings are always expressed in in.Hg.; the pressure setting reference should therefore be stressed (e.g. "set QNH 993 hPa," not, "set 993").
- Passing an altitude or flight level clearance to a pilot accustomed to using metres as altitude reference. When passing a new altitude or level clearance the altitude reference should be stressed.
- Pilots from the USA and Canada are accustomed to a standard TA of 18,000 feet. There is therefore an enhanced risk of error when clearing them to a flight level below 18,000 feet. This risk may be reduced by repeating the clearance (e.g. descend to flight level one two zero I say again flight level one two zero).

* The EUROCONTROL Level Bust Toolkit has been developed as a result of the EUROCONTROL Level Bust Initiative. It contains much important information and advice to help combat the level bust threat. The EUROCONTROL Level Bust Toolkit may be obtained on CD ROM by contacting the Coordinator Safety Improvements Initiative, Mr Tzvetomir Blajev, on tel.: +32 (02) 729 3965 fax: +32 (02) 729 9082 tzvetomir.blajev@eurocontrol.int

DESCENT BELOW THE GLIDESLOPE

Recently, several serious incidents have been reported to UK NATS that have occurred when aircraft on final approach have descended significantly below the glide-path. UK AAIB is investigating these incidents, the most recent of which has attracted the attention of the media. None of these incidents were in any way attributable to NATS; however, we are working to identify methods of assisting in the detection and resolution of this type of event. Brief summaries of two of the incidents are outlined below:

Incident 1:

An A310 was being vectored for an ILS Localiser/DME approach (the glide-path was not available). The aircraft had been turned onto a base leg heading and instructed to descend to 2000 FT QNH. The pilot was then given a closing heading to establish on the localiser. After reporting established on the localiser at 10 NM, the aircraft was released for descent with the procedure and transferred to the Tower frequency. Almost immediately following transfer to Tower, the Radar 2 controller noticed that the aircraft had begun to make a left turn, deviating from the final approach track. Radar 2 then contacted Tower to confirm the aircraft's intentions. The pilot reported "affirm, we're turning to the right" but by the time the aircraft reached an 8NM final, the Radar 2 controller recognised that the aircraft was now descending rapidly and, again, alerted the Tower controller, who instructed the aircraft to climb immediately. The lowest altitude observed on radar was 600 FT (approx 2-300 ft AGL) approximately 7 miles from touchdown. The Radar controller then directed the aircraft for a further approach from which the aircraft made a safe landing.

Incident 2:

A B747 was being vectored for an ILS approach and reported established on the localiser at 15 NM, maintaining 4000 FT QNH. The pilot was given clearance to descend further on the ILS, and descent commenced when the aircraft was at 13 NM. Shortly after commencing descent the pilot asked "do you have a problem with the glideslope?" - although the only clearly readable part of this transmission was the callsign and "glideslope". As the aircraft approached 9 NM, the controller realised that it was now indicating Mode C 1800 FT and descending. The controller immediately instructed the pilot to climb to 2000 FT, although the aircraft actually descended further to 1300 FT before levelling out and then commencing climb. Investigation has shown that the aircraft was descending at a rate of 2500 fpm.

Both of these serious incidents were resolved through the prompt action of the controllers on duty, following early recognition that the aircraft were dangerously positioned. The controllers involved should be commended for their swift action in resolving the situation. Work is ongoing to enable better understanding of the full extent and nature of this incident type. In the meantime, controllers should be aware of the potential for this type of event and be prepared to take immediate action should an aircraft be seen to be dangerously positioned, particularly when on final approach.

NATS have in this context issued the following message:

"NATS KEY MESSAGE

- Controllers are reminded to ensure that standard phraseology is used when clearing aircraft to descend for final approach.
- These incidents are not caused by ATC error, but ATC can be very effective in preventing a serious incident from becoming a fatal accident by taking prompt action when it is recognised that an aircraft is dangerously positioned on final approach.
- If such an occurrence happens on final approach, consider issuing climb instructions immediately, before clarifying intentions or pressure setting.
- If such an occurrence is noticed by the Tower controller, be prepared to issue immediate missed approach instructions.
- If such an occurrence is noticed by the Radar controller, following transfer of the aircraft to the Tower frequency, alert the Tower immediately.
- File a safety report. We can only do something about these incidents if we know about them."

PROVISIONS IN ICAO PANS-ATM (DOC 4444) RELEVANT TO THIS TYPE OF INCIDENT, INCLUDE THE FOLLOWING:

8.9.3.6 Aircraft vectored for final approach should be given a heading or a series of headings calculated to close with the final approach track. The final vector shall enable the aircraft to be established in level flight on the final approach track prior to intercepting the specified or nominal glide path if an MLS, ILS or radar approach is to be made, and should provide an intercept angle with the final approach track of 45 degrees or less.

15.7.4.2 In the event an MSAW is generated in respect of a controlled flight, the following action shall be taken without delay:

a) if the aircraft is being provided with radar vectors, the aircraft shall be instructed to climb immediately to the applicable safe level and, if necessary to avoid terrain, be given a new radar heading;

b) in other cases, the flight crew shall immediately be advised that a minimum safe altitude warning has been generated and be instructed to check the level of the aircraft.

N° 1 HindSight

January 2005

Putting Safety First in Air Traffic Management

HINDSIGHT IS A WONDERFUL THING

By Tzvetomir Blajev
Coordinator - Safety Improvement Initiatives, and Editor in Chief of HindSight.

"Hindsight"
The ability or opportunity to understand and judge an event or experience after it has occured.

"With the benefit of hindsight I would have done it differently".

How often do we hear responsible people saying these words? Often, it is an attempt to disguise the fact that they had not prepared themselves for some unusual situation. Yet hindsight is a wonderful thing and can be of great benefit if used intelligently to prepare ourselves for the unexpected. There is much to be learnt from a study of other peoples' actions - good and bad.

If we learn the right lessons we will stand a much better chance of reacting correctly when we are faced with new situations where a quick, correct decision is essential. This magazine is intended for you, the controller on the front line, to make you know of these lessons. It contains many examples of actual incidents which raise some interesting questions for discussion. Read them carefully - talk about them with your colleagues - think what you would do if you had a similar experience. We hope that you too will join in this information sharing experience. Let us know about any unusual experiences you have had – we promise to preserve your confidentiality if that is what you wish. Working together with the benefit of HindSight we can make a real contribution to improved aviation safety.

European Air Traffic Management - EATM

EUROCONTROL

EUROCONTROL DAP/SAF January 2005

First edition of Hindsight, order your copy by sending an e-mail to *tzvetomir.blajev@eurocontrol.int*

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CONTACT US

The success of this publication depends very much on you. We need to know what you think of HindSight. Do you find the contents interesting or boring? Are the incident descriptions easy to follow or hard to understand? Did they make you think about something you hadn't thought of before? Are you looking forward to the next edition? Are there some improvements you would like to see in its content or layout?

Please tell us what you think - and even more important, please share your difficult experiences with us!

We hope that you will join us in making this publication a success. Please send your message - rude or polite - to:

tzvetomir.blajev@eurocontrol.int

Or to the postal address:
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Putting Safety First in
Air Traffic Management