focus

ON COMMERCIAL AVIATION SAFETY

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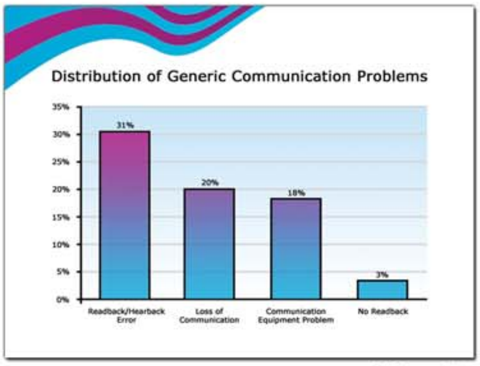
Communication Error

40% of runway incursions and 25% of level busts involve communication error.
So what is Communication Error?

Clear and unambiguous communication has long been recognised as an important factor in assisting safe and expeditious aircraft operations. On busy sectors, poor standards in RT phraseology and technique can often be heard and regularly leads to misunderstandings and read-back errors. Take the case of the aircraft which got airborne and its first call was "xxx airborne to six". Immediately the controller took this to mean that it was climbing to 6000ft and as the aircraft should only have been climbing to 5000ft took action. In fact the pilot meant that he was airborne from runway "two six".



screen grab from DVD

By using standard phraseology communication errors can be reduced which in turn allows:

- Prevention of misunderstandings or language difficulties
- Aircrew to build up good situational awareness
- A reduction in workload and a decrease in frequency congestion
- Errors by either ATC or aircrew to be more easily detected

A Communication Error DVD has been produced as a follow up to the Top Ten Tips leaflet which gave guidance on how to avoid communication error. It is split into five modules:

Module 1 is the introduction, providing background information and an overview of the key problem areas and statistics.

Modules 2, 3 and 4 focus on the specific environments of Aerodrome, Approach and En-route operations and contain verbatim reconstructions of incidents and their consequences. There is also an opportunity to interactively test your knowledge of correct phraseology.

Module 5 contains a summary of the key learning points and gives the Top Ten Tips for avoiding communication error.

If you have any comments or suggestions regarding communication error
or would like to receive a copy of the DVD, please e-mail karen.skinner@nats.co.uk

Karen Skinner
Operational Safety Expert
NATS

NATS UKFSC Civil Aviation Authority Civil Aviation Authority UK AIRPROX BOARD CHIRP GATCO

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__FOCUS__ is a quarterly subscription journal devoted to the promotion of best practises in aviation safety. It includes articles, either original or reprinted from other sources, related to safety issues throughout all areas of air transport operations. Besides providing information on safety related matters, __FOCUS__ aims to promote debate and improve networking within the industry. It must be emphasised that __FOCUS__ is not intended as a substitute for regulatory information or company publications and procedures.

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Front Cover Picture: Eurocopter AS 332L2 operating in Marseilles

Communication Error

During 2006 Communication Error was identified as one of the major threats to aviation safety.

An industry working group made up of pilots and air traffic controllers was set up to try to find ways of tackling this problem. The group included participants from NATS, British Airline Pilots Association, The UK Civil Aviation Authority, UK Airprox Board, CHIRP, The Guild of Air Traffic Control Officers and the UK Flight Safety Committee. The output of this working group has been the production of a DVD that can be used by pilots to improve both their radio phraseology and methodology. The DVD is easy to use and is put together in modular form so that it may be used as and when pilots have time available.

The DVD is divided into five modules: The Introduction gives an overview of the problem, Aerodrome, Approach, En Route and a Summary of the key learning points.

Humour is used to illustrate just how big the problem of communication is. However the overall message is very serious indeed.

Included in some of the modules are questions with multiple choice answers. If you are not sure of the answer the available choices really make you think. By the end of these questions you should have a much better understanding of the answers.

Actual case studies of incidents with commentary illustrate each of the points very clearly and it soon becomes apparent that poor communication leads to most of the difficulties and subsequent incidents.

An examination of 700 communication events recorded, revealed that 105 resulted in a level bust, 40 in runway incursions and 73 in loss of separation between aircraft. It is no wonder that everyone involved in the working group were anxious to try to assist in improving communication.

The differences between the ICAO RTF terminology and the terminology used in the United Kingdom are covered in detail and the reasons for the differences clearly explained. Pilots that fly internationally need to be able to understand both sets of terminology.

Call-sign confusion is illustrated in a number of incidents and it is important for pilots to make sure that they do not act on an ATC instruction that is not intended for them because they were not paying enough attention to the RT. The old adage "if in doubt ask" certainly applied here. The Flight Operations Departments also need to ensure that they do not compound the issue when planning their call-signs.

So what can the industry do to improve the situation?

Firstly, the air operators should encourage, if not insist, their pilots use the Communications Error training disk. If this can in some way be built into the recurrent training programme so much the better.

Secondly, simulator and line training instructors could tighten up on the way the RT is used both in the simulator and during line training.

Thirdly, all pilots, assuming that they value their status as professionals, could make a real effort to use the training disk (not once but several times) to get their radio telephony (RT) performance up to standard.

Fourthly, aircraft Captains could insist that each and every aircrew member that they fly with makes a concerted effort to use the correct terminology and methodology to improve their RT.

Currently the standard of use of the RT is not very good at all. We all need to be making an effort to improve the performance of ourselves and of those we fly with. Only if we all make an effort is the situation likely to improve.

For those pilots who's first language is not English we appreciate that it may be more difficult for you. However, it is not possible to make exceptions based on whether or not you are proficient in English if you fly in domestic international airspace that you share with other users then you must make an even greater effort to improve your RT performance.

Lastly, we should be grateful to NATS and other air traffic service providers for monitoring the situation and bringing these shortcomings to our notice. We should also join together in asking them to continue to monitor the situation so that we may see the overall improvement as we all make an effort to hone our personal performance.

What Lies Beneath

by Ian Crowe, Willis Ltd

Firstly, may I wish everyone a very happy and safe new year. Part of my role at Willis is to provide an international aviation insurance training course.

With the exception of one individual, a lawyer, all of the 22 speakers are Willis employees. Each course attracts over 20 different nationalities, a truly multi role operation! In addition to risk, safety and insurance related topics the 2 week course includes a section on aircraft and how they fly. During this phase we review the multitude of aircraft systems explaining how these have developed in sophistication and reliability over the last hundred years of powered flight. To complete the training session we visit the RAF Museum at Hendon and there we see some of the systems "in the flesh" as it were. Seeing aircraft and engines exposed displaying their internal workings is always a complete surprise to the course delegates. Many of them have no concept or understanding of what lies beneath the fabric, skin or casings of an aircraft and its engine.

It struck me how we often view safety in much the same way. We do take it for granted forgetting all the hard lesson that life in the aviation business can throw at us. To us, the safety professionals, we know that aircraft and supporting systems including, operations, air traffic control, engineering and maintenance develop procedures to control, maintain and operate extremely complicated and sophisticated systems at times under difficult circumstances. The traveling public sees safety and safe operation in a completely benign way, taking it all very much for granted and this is of course rightly so. However, the work both in terms of systems and procedural development is unknown much like the delegates when seeing the inner workings of an aircraft.

Aircraft operate in a very hostile environment flying 6 miles high at 500 mph with an outside air temperature of – 50 Celsius, and doing this 20 hours a day for at least 25 years; well, its no wonder we all take safety for granted.

In my very first column for FOCUS, I touched on the topic of complacency and I still feel this is one of the biggest risks that we face in our business of safety. Records show that in 2006 there were some 96 accidents killing over 1200 people at a cost of many millions of dollars. It's true that in the majority of these cases the accidents were low profile, involving older aircraft in remote locations.

The current start for 2007 in respect of accidents has not been particularly good to say the least. In January alone there have been some 9 accidents killing 134 people at a cost in the region of USD 300 million.

Looking at these figures it seems we are headed for a similar statistic as we had in 2006.

As much as the course delegates do not see the systems that lie beneath the aircraft exterior, we too must not be lapsed into a false sense of security believing our own statistics and industry propaganda that all is well.

Looking at systems it is easy for us to hand over safety to aircraft and system designers. Arguably, we could say that the improvement in operational safety is a function of modern engines and to a lesser extent system reliability coupled with improvements in air traffic management.

Commercial pressure continues to drive our industry but it's true we need to make money so we can spend it on safety, training, retention and retaining of valuable staff.

Data indicates, however, that in the majority of cases accidents say 90%, are due to human error with this figure on the rise.

Data collection, therefore, seems to be our next challenge, for without data we cannot manage the risk. This data is in many respects "invisible". The complexities of human nature do not allow us to challenge every report to find out the true nature of the incident or accident. This is where a fully functioning and experienced safety department is so valuable. Having the ability to ask questions that a reporting form cannot cover is a skill that is in danger of being lost.

Just below the surface there is always an accident waiting to happen, the old expression there are no new accidents only new people is as true as ever.

So let's make sure for 2007 safety is not just skin deep.

UK FLIGHT SAFETY COMMITTEE OBJECTIVES

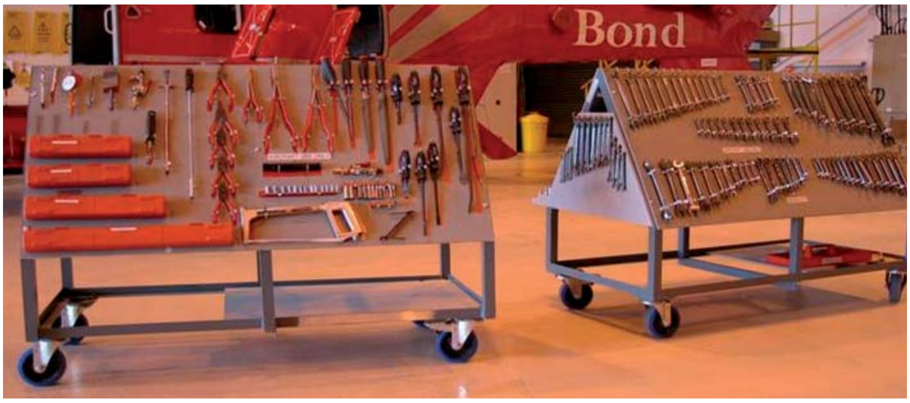
- **To pursue the highest standards of aviation safety.**
- **To constitute a body of experienced aviation flight safety personnel available for consultation.**
- **To facilitate the free exchange of aviation safety data.**
- **To maintain an appropriate liaison with other bodies concerned with aviation safety.**
- **To provide assistance to operators establishing and maintaining a flight safety organisation.**

Bond Offshore Helicopters

Bond Offshore Helicopters (Bond) was established by brothers Stephen and Peter Bond in the autumn of 2002 in response to approaches from the major Oil companies in the North Sea. It was well known that many oil companies were concerned at the limited number of helicopter operators in the UK sector.

In December 2002, BP awarded Bond a 10 year contract with a five year option, to provide crew change services from Aberdeen to its Central and Northern North Sea and West of Shetland installations. To facilitate this Bond invested £55 million in five Eurocopter AS332L2 aircraft. A further £2 million was invested in upgrading an existing engineering building on the east side of Aberdeen airport. Benefiting from previous experience, the layout of the building was carefully planned to both adhere to regulatory requirements and allow the smooth flow of passengers from check-in to the departing aircraft. In addition, this provides a well organised base for the Bond staff to carry out their various functions with the best equipment available.

The management team recruited were chosen from various fields for their knowledge and experience and set about laying the foundations of the Company. The benefits of starting with a "blank sheet of paper" were quickly realised and best practice could be readily adopted into the formation of the Company policy. For example the Safety Management System (SMS) was specifically built around CAP 712 with an electronic 'Alert' database implemented to track and control all documents within the company. In addition all engineering tools are supplied by the Company and placed on purpose built shadow boards to effect tool control.



After 10 months of planning, selection of staff and writing the various manuals required to gain an AOC the company took delivery of the first aircraft in May of 2004. All Engineers, licenced and unlicenced, attended factory type courses and aircrew were trained on the simulator at Marignane in France. Immediately on delivery flying training on the actual aircraft was undertaken.

The original plan was to commence operations for BP on 1 August 2004, however due to the early arrival of the first aircraft in May the company was able to bring this forward to the beginning of June. The second aircraft arrived in June followed by two more in July with the final aircraft arriving in August. By that time Bond had 30 pilots and 25 engineers as well as support staff working in Aberdeen.

Additionally, in May of 2004, BP announced that the Jigsaw SAR contract (valued at £100 million) had also been awarded to Bond for 10 years, again with a five year option. This heralded the arrival of two further AS332L2 aircraft, this time in a Search and Rescue (SAR) configuration. The recruitment of SAR crews and further engineers commenced, followed by a rigorous training programme.

Presently the company has 52 pilots, 18 aircrewmen, 33 engineers and 43 support staff.

Crewchange

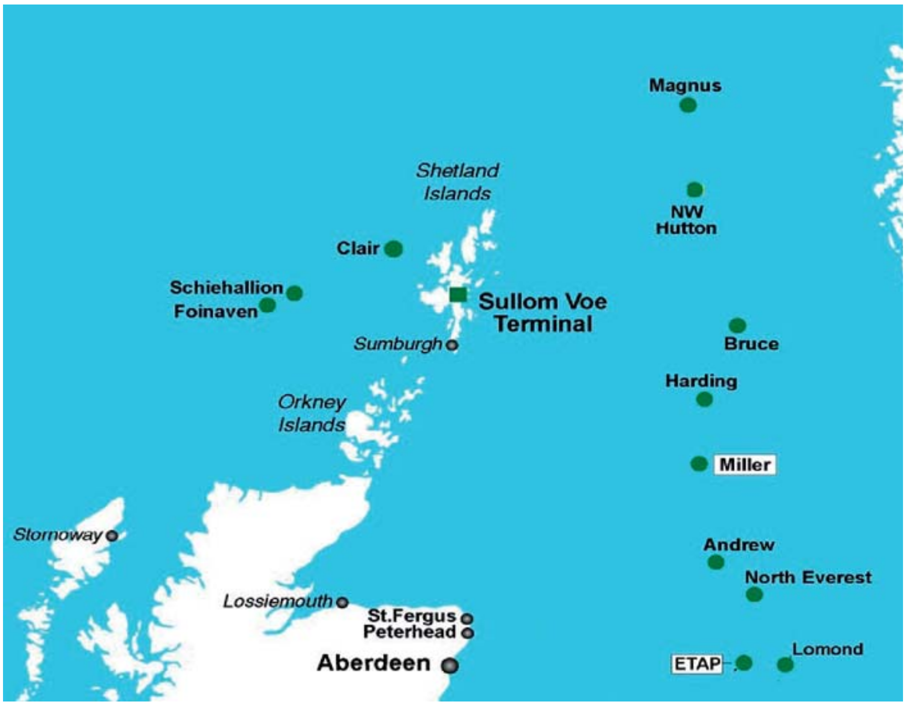
The five aircraft utilised on crew change (the movement of BP and contract personnel to and from BP platforms) to December 2006 have flown 19,984 flying hours. This equates to 6498 flights (16,314 sectors), with an on time departure rate of 98.3%, transporting 214,752 passengers to platforms, rigs and vessels in the North Sea.

The AS332L2 can carry 19 passengers and two crew, with an all up mass of 9300KG. Capable of cruising at 145 kts, the L2 is equipped with a fully coupled four axis auto pilot with a glass cockpit.

Crew change pilots have recently adopted a new fixed roster which entails working 5 days on, followed by 2 days off, 7 days on and 7 days off. This equates to 191 working days a year, including leave.

The typical flying day starts with the early crews coming on shift at 0600 for a 0700 take off, and the late crews often working to 2200-2230. Crews will arrive one hour before the scheduled take off time, to enable them to plan the flight and provide payload details for check-in staff.

Passengers arrive at Check-in and are weighed along with their baggage. All details are logged and recorded through the Vantage POB System which is used



BP installations Serviced by Bond

by the majority of oil companies to track all UKOOA (United Kingdom Offshore Operators Association) passengers. The system prints off the manifest which is handed to the crew.

Once checked-in, passengers await their flight in the lounge and approximately 30 minutes prior to take off are called forward through security to a briefing lounge. Here they are issued with survival suits, Personal Locator Beacon (PLB) watches and then view a safety video. Having started the aircraft, one of the pilots will then personally brief the passengers on flight times, weather and routing (often flights can go to more than one destination) in the Departure Gate.

The average round trip flight time is 3:30 with the longest scheduled flight being approximately 4:25.

One location to the West of Shetland is the Schiehallion FPSO, where Bond are currently conducting a trial based on using the Norwegian landing limits, using Rate of Heave as opposed to Amplitude as a limiting factor for landing.

Current practice within the UK sector is to use a 5 metre heave (with a max of 3° Pitch and Roll) as the limit for landing. The trial involves using the same pitch and roll limits but using a 1.3 m/s (day) 1.0 m/s (night) rate of heave. This has seen an increase in the number of landings carried out to the vessel with one landing at 6.9 metres. The trial has increased landings on this vessel by in excess of 20 in the last 12 month period.

SAR

Deemed to be among the worlds most sophisticated Civilian SAR aircraft, two AS332L2 aircraft are utilised as part of JIGSAW, a BP initiative integrating marine and aviation assets in an innovative programme. The aircraft are substantially modified with FLIR (Ultra Force 2) linked to a VCR, Autohover (also controllable, with limited authority, from the Winch Operators position) , Spectrolab SX16 Nightsun, Dual Hydraulic and electric hoist installation with a hoist line video camera linked to VCR and vertical light to aid hoist operations, HF, Homer, Skyshout, Medical Storage, Iridium Sat Phone, additional despatcher harness points and a steerable scanner light.

One aircraft is based offshore on a BP Platform and the other in a purpose built hanger at Sumburgh in the Shetland Islands. The aircraft are rotated between the bases on a weekly basis to facilitate maintenance and in order to carefully monitor for corrosion due to exposure to the salt laden environment of the platform.

The crew on the platform have to carefully monitor weather conditions and will relocate the aircraft to Aberdeen if the wind speed offshore is forecast to be excessive and out of limits i.a.w. the manufacturers specifications for starting rotors. When at Aberdeen they remain on standby and available for SAR operations.

Passenger Lounge

Check-In Desk

The aircraft are utilised only in the Offshore SAR role and are regularly called out by the Coastguard, with the one on the Platform supplying coverage to other platforms in the Norwegian sector and carrying out inter-field Civil Air Transport (CAT) flights when possible. The Sumburgh aircraft is also utilised to provide Inter Island Patient transfer around the Shetland Isles.

The crews have a rigorous and carefully monitored training programme and carry out day and night training sorties on a daily basis when possible. Their roster is two weeks on, two weeks off, (one week on days the other on nights) alternating between Sumburgh and the Miller.

Between going live in February 2006 up to the end of December 2006 36 callouts have been undertaken by the two SAR helicopters.

Engineering

The Engineers working on Crew Change aircraft have a three shift pattern on a

Miller Platform

Schiehallion FPSO

Some of the weather problems on the platform

three month rotation which enables them to maintain experience in all aspects of Engineering Maintenance. The roster is 6 days on and 3 days off.

Early shift Engineers work from 0630 to 1530 and carry out pre-flight inspections, turn-rounds and manage any defects that occur through the day-to day flying programme.

The Team Leader will also plan the scheduled maintenance for the late shift.

Late shift Engineers work from 1500 to 2400 and rectify any deferred defects as well as carrying out after flight inspections and routine scheduled maintenance planned by the early shift. They also ensure that the aircraft scheduled for a T check is available for the night shift. Running from 2100 to 0600 night shift Engineers carry out the T checks on the aircraft without any distractions.

The SAR bases always have an airframe/engine and an avionic engineer available at all times.

Looking to the future Bond currently have four engineering apprentices going through a four year training course and are seriously considering abnitio pilot training.

Support Staff

As in any company, the support staff, often behind the scenes, are vital to the business. The movement of aircraft, baggage and passengers is well orchestrated with Security Staff, Accounts, Tech records, HSE and Quality, Check-in, Ramp, Ops and Management all contributing to the smooth and safe operation of the daily functions of the Company.

The Company has two Eurocopter EC225 aircraft on order with delivery expected June 2008. Options on a further three EC225's are available to Bond.

A conscious decision has been made by the Bond Senior Management to grow at a pace which enables the core structure to sustain the high standard of all aspects of the operation that the Company aspires to.

Conditional ILS Clearance phraseology within the London Terminal Manoeuvring Area

by Stuart Lindsey, Head of TC Operations, London Terminal Control Centre, West Drayton

Within the UK Air Traffic Control do not use the phraseology **"(callsign) Cleared ILS"** due to implications of using this phraseology and aircraft descending before becoming localiser established. This is of particular concern for the London airports within the London Terminal Manoeuvring Area (TMA) because of the number of routes, mainly helicopter routes that pass close to or under final approach tracks.

The standard phraseology used by approach controllers is **"(callsign) turn left/right heading (3 digits) report established on the localiser"**. Once the pilot reports established the controller will then give the clearance **"(callsign) descend on the ILS"**.

During periods of high frequency loading – especially within the London TMA - it can often difficult for a pilot to get back on the frequency in a timely manner to report established. This can have the undesirable effect of the aircraft been left high and potentially leading to a rushed approach or go-around. Being able to a give a conditional clearance to establish then descend in a single transmission would help alleviate this problem.

Within the current Civil Aviation Authority Manual of Air Traffic Services Part 1 phraseology does exist which allows conditional ILS descent clearances to be given. It is not, however, widely utilised within the London TMA because this existing phraseology requires the inclusion of QNH and aerodrome elevation.

After consultation with the Civil Aviation Authority Safety Regulation Group a trial was undertaken within the London TMA (at Heathrow, Gatwick, Stansted and Luton airports only) to promote the use of this conditional ILS descent phraseology, but omitting the QNH and aerodrome elevation. The justification for omitting these is based on the fact that the QNH will already have been passed on descent to an altitude, and a mandatory read back will have been received. The aerodrome elevation is omitted on the basis that pilots have this information available on the approach charts, and that it is not passed currently.

Controllers could then use the following phraseology: **"(callsign) turn left/right heading (3 digits), when established on the localiser, descend on the ILS"**. This helps to ensure that during periods of high frequency occupancy, pilots are able to start the descent without having to actually report established. This abbreviated phraseology is only approved for use by Heathrow, Gatwick, Stansted and Luton approach controllers.

After six months of monitoring, by both NATS and CAA SRG, the trial of the phraseology became permanent for Heathrow, Gatwick, Stansted and Luton airports in the autumn of 2006. It is now possible for London TMA Approach Controllers to use either form of the phraseology for establishing / descending aircraft on the ILS at Heathrow, Gatwick, Stansted or Luton.

During periods of high frequency occupancy especially when controllers anticipate that pilots will intercept the ILS glide path before being able to report to ATC that they are established on the localiser they can use the conditional clearance. However its use has been slightly undermined by pilots still reporting established even though they have been given the conditional clearance. This has led to controllers using the conditional clearance less than they otherwise would because they are still having to make two transmissions!

We have managed to move some way to reducing frequency occupancy levels within the London TMA during the approach; pilots can help ATC make better use of this change by not reporting established when they have been issued with the conditional establish then descend clearance.

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To Err is Human, Or So They Say, But Why?

by Group Captain Andy Ebdon, Programme Manager for the MOD's Harrier GR9 Upgrade and Chairman of the Engineering and Maintenance Standing Group (EMSG) within the Royal Aeronautical Society's Human Factors Group.

Whenever anything goes wrong these days the first question that always seems to be raised by the media is 'Whose fault was it?', followed rapidly by 'and when can we expect them to lose their job/go to court/or generally be subjected to some form of retribution'. In many aspects of society the 'me culture' is becoming more and more predominant and I find it increasingly disappointing that the desire for instant gratification is finding its way into the analysis of human failing, at least as far as the populist media is concerned. As all those involved will know, progress with human factors understanding in the aviation industry has been a long and hard fought road, but the long-term evidence of accident reduction is a very clear sign of success. Open and honest reporting of issues and incidents in an environment where a Just Culture is demonstrated by actions rather than merely words in a 'Mission Statement' has paved the way for improvements across the board. Unfortunately, in a highly competitive market in which security, cost of travel and punctuality are more to the front of the customer's mind it is easy to believe we are safe enough and the balance of investment should swing elsewhere. While I would hesitate to suggest there is any growing complacency over accidents generated through human error, I am convinced that the combination of media and commercial pressures has the potential to not only stifle further progress, but to harden attitudes, which could ultimately lead to a reverse in human factors behaviour.

When human activity leads to the wrong outcome, be it an accident, a delay, or some expensive rework, there is almost always a significant chain of events leading to the final failing. Frequently there is more than one person involved and there is usually a mixture of conscious and unconscious acts. Discounting the terrorist condition, it is very rare indeed to encounter someone who deliberately wants to cause harm. In my experience the vast majority of people come to work intent on doing a good job. It is certainly far too easy to label individuals involved in an incident as negligent without fully understanding the circumstances. That does, of course, take time to find out, which gets us back to instant media gratification and a commercial reluctance to commit hard pressed funds. With this in mind, it seemed like a reasonable time to refresh some of the 'whys' of human error and, given my background, I hope you will forgive me for doing so from an engineering and maintenance perspective.

The Human Machine is immensely impressive and well beyond anything Man has yet been able to devise. While it is adaptable, flexible and resilient it is also vulnerable to misinterpretation of data. Human physiology is such that sensory inputs to the brain are not absolute, but require decoding and interpretation. Here the brain can be its own worst enemy because we often see or hear what we expect or want to, rather than what is actually there. Any number of illusions or party tricks prove this and if you put this into a maintenance context then add physical problems that can further degrade performance, such as poor lighting, tiredness, cramped conditions or poor tooling and it is not to difficult to understand why mistakes can happen. Complacency can be induced, especially in the more experienced personnel, but the 'can do' attitude that we all know is vital when the pressure is on can be equally vulnerable in such circumstances. Fatigue is a particular worry with very clear research to show the degradation of performance that can be expected when people get tired. Shift working, particularly long periods of night work, can be cumulative and there seems to be a growing culture of long hours in the maintenance arena. Furthermore, many live long distances from work and have stressful commutes, which only exacerbate the situation. The greater the fatigue, the less an individual is able to interpret a problem and the more easily they can be distracted. Distraction at a crucial moment can mean a vital step in a process is missed, or a fault is not seen. In terms of an individual's capability it is not unreasonable to expect a technician or mechanic to be adequately trained to carry out the tasks given, but this is not always the case. Training is expensive and may often be a distant memory for a long serving individual. Refresher courses are vital, but not just in strictly technical activity. Human factors training is now also mandated and should not be taken lightly or as a one off.

As well as physiological impacts, humans are similarly vulnerable psychologically. It requires a particularly strong character to resist the norms of an environment, even though he or she may be particularly uncomfortable with a given situation where they are expected to follow the unwritten rules and behaviour of the majority of their group. Even in less overtly pressured areas, a lack of individual assertiveness in putting forward doubts, opinions or beliefs has the potential for disaster.
Management pressure to cut corners and get the aircraft back into service may not be that overt, but it takes very little for an individual to feel they are being pressured. Indeed, many pressurise themselves because they think that is what is required, even if it is not supervisory or management intent. Such pressure leads to rushed thinking and 'bending' of the rules. How often is the threat of 'working to rule' seen as a potentially business crippling threat and the perception of rules (and procedures?) is that they are for the guidance of wise men rather than adherence by rote? Difficult and complex tasks can illicit good concentration for long periods, even when someone is fatigued, because of the stimulation of the challenge. It is often the mundane, simple tasks where things can go wrong because of boredom and low arousal. The mind wanders onto more interesting topics and the body works on autopilot with little attention being paid to sensory input.

It is almost always the case that in the analysis of any human error incident the individual concerned has been in 2 or more of the conditions described above. Maybe they were not trained for the task, so why were they doing it? Pressure to get the job done – why? No one else available – why? Perhaps they just missed something, but why? Tired – why? Distracted – why?

If there is a genuine desire to prevent the repeat of an incident the full depth of the circumstances have to be understood and this cannot be achieved by a cursory examination. Asking 'Why?' 5 times is likely to get you somewhere near to the root cause, but it requires persistence and trust. People are not going to talk about personal issues in an adversarial, blame-seeking environment and yet it may well be personal issues that have been at the heart of the problem. Unfortunately, dealing with this and setting the right tone takes time, which means money, and leadership. But it is the right thing to do.

I hope that this has given you some food for thought. Next time you see someone on the 'who is to blame' bandwagon try getting them to ask why someone might have done something first before passing judgement. After all, one day it might be them in the spotlight for an unintentional mistake.

Improving our understanding of Vortex Wake

Introduction

Wake vortices are the tightly spinning tornadoes of air that are generated at an aircraft's wing tip. Wind speeds in the core of the vortex can reach over 300km/h and, if a strong vortex is encountered, the vortices can have a dramatic affect on a following aircraft. Wake vortices are an unavoidable by-product of the generation of lift; hence, the potential danger of wake vortex turbulence is currently one of the most limiting factors for the take-off and landing frequencies at airports.

Monitoring and analysis of reported wake vortex encounters is one of the most important tasks of the NATS Wake Vortex Team, within the Operational Analysis Department The analysis performed on the data aims to identify any trends, in particular any increase, in the underlying risk of a wake vortex encounter. The majority of reported encounters (63% over the past ten years) occur at Heathrow leading to the bulk of our analysis being focused on this airport. Daily runway logs for the airport also allow us to take into account any changes in traffic levels. In addition to monitoring the number of reported wake vortex encounters, other aspects of the encounters are collected and analysed, for example, the height at which the encounter occurred, the separation between the affected aircraft and generating aircraft, and the aircraft pair that was involved. This provides an invaluable data set which is used to support theoretical hypotheses on wake vortex behaviour and ensures that any changes to airspace or procedures does not increase the risk posed by wake vortices.

In November 2006, the NATS Wake Vortex Team produced a questionnaire to be completed by pilots concerning aspects of wake vortex encounters. The motivation behind the Wake Vortex questionnaire was the desire to better understand under which circumstances a pilot will report an encounter. It would also provide us with information on pilots' perceptions of the risks posed by wake vortices, thus allowing us to more accurately assess the reports that we receive.

Results

The questionnaire was distributed through UKFSC on 1st November 2006 and the deadline for returning completed questionnaires was 6th December. Over 100 replies were received in this time period, and this is a summary of the feedback.

There were several issues raised by the analysis of the questionnaire. These included concerns over the current wake vortex separation minima behind a B757, the action that pilots are taking to avoid encountering wake vortices and the phase of flight on which encounters are most common. The remainder of this article deals with these subjects in more detail.

B757

When asked if they felt that there was a particular aircraft which caused wake vortex encounters, 30% of pilots highlighted their concern over the B757 family. The B757 has been synonymous with wake vortex encounters ever since the late 1980s and early 1990s when there were a series of wake related accidents in the US. All of the accidents occurred to aircraft following B757-type aircraft on approach whilst under visual separations. The accidents prompted many states (including the UK), but not ICAO, to revisit their wake vortex separations and led many to introduce increased separations for aircraft landing after B757-type aircraft. The extra separation was, in most cases, restricted to the approach phase of flight.

Recently, it has become apparent that there is some concern amongst the pilot community over whether or not there is a requirement for extra separation for aircraft departing after B757 aircraft. Research suggests that the B757 should not generate vortices inconsistent with aircraft of its weight on departure and therefore should not be treated differently to other Medium category aircraft. Briefly, the reason for the increased propensity for B757's to cause hazardous wake vortex encounters is thought to be a combination of the characteristic wing design (in particular, the continuous trailing edge) and the fact that they are relatively slow over the last stage of the approach path, meaning that following aircraft are more likely to catch them up. Neither of these factors are particularly relevant to the departure phase of flight (the wing design is most influential when the B757 is in it's landing configuration) – hence the lack of extra separation on departure.

To support this theory, the reported encounter rate of aircraft following B757s on departure was analysed and compared to aircraft of a similar size. The NATS Wake Vortex Database, where all received reports are stored, was queried to determine the number of encounters where the leader was a B757 on departure from Heathrow. The data was normalised to give a rate of encounter – this is the number of encounters per 100,000 queued departures (a queued departure is where the separation is less than 150 seconds). This was then compared to data for the A321 (a similar medium aircraft), and for encounters involving Medium-Medium and Heavy-Heavy pairs. The data was taken over the seven year period 1999-2005.

- The rate of encounter for a B757 leading on departure was approximately 40 encounters per 100,000 queued pairs
- The rate for an A321 leading on departure was approximately 25 encounters per 100,000 queued pairs
- The rate for Medium-Medium pairs on departure was approximately 20 encounters per 100,000 queued pairs
- The rate for Heavy-Heavy pairs on departure was approximately 90 encounters per 100,000 queued pairs

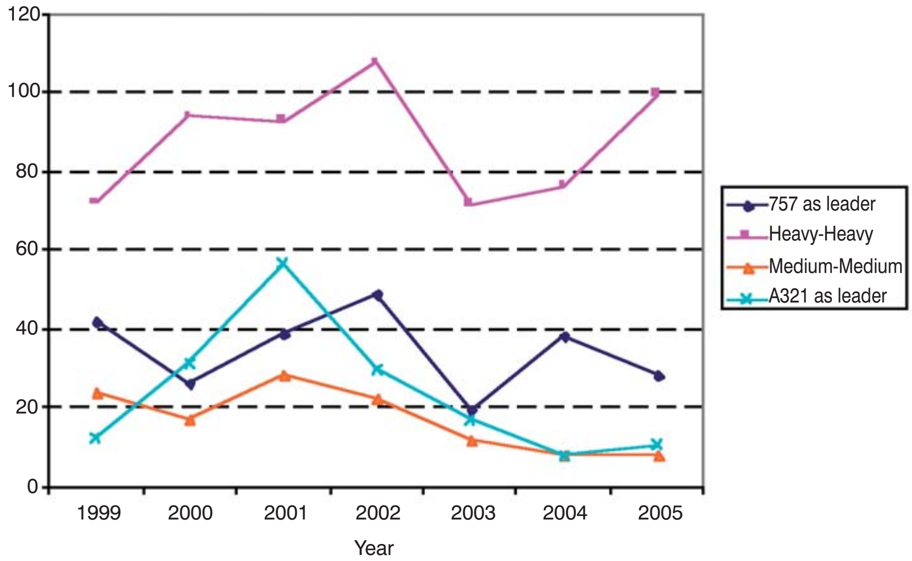


Figure 1: Rate of encounter for various aircraft pair combinations on departure from Heathrow

This shows that although the rate of encounter for a B757-Medium is higher than average, it is not as high as the rate of encounter for Heavy-Heavy pairs, and is not significantly outside the typical rates seen for other aircraft pair combinations. It should be remembered that these results are based on the rate of reported encounter and as such is subject to fluctuations in reporting rates.

Avoidance Action

It has become apparent from the analysis of responses to the questionnaire, that pilots are regularly taking action, ranging from increasing separations and staying high of the glide path, to increasing departure spacing and flying offset en-route, to avoid wake vortices. In response to the question of whether or not pilots take action to avoid encountering wake vortices only 17% of pilots reported that they do not take any action. This is potentially concerning as any action that an aircraft takes to avoid vortices can have knock-on effects for successive aircraft. Flying high on the glide path, flying upwind of the previous aircraft and reducing speed on approach can all have consequences as following traffic becomes more susceptible to encounter the vortices of the aircraft performing the avoidance action. There have been a number of encounters reported that have been the direct result of the previous aircraft taking avoidance action. The un-instructed reduction of speed on approach can cause subsequent aircraft to 'catch up' and can lead to the following aircraft having to undertake a go-around, resulting in increased delays. In the en-route arena, pilots choosing to climb or descend, or fly off-sets (in domestic airspace) without permission from ATC, risk coming into conflict with other aircraft.

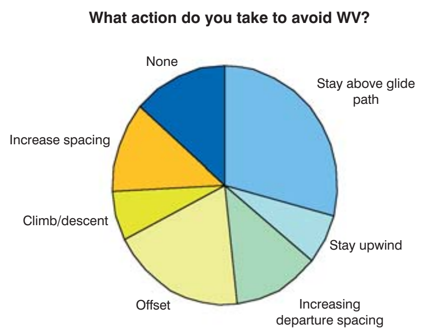
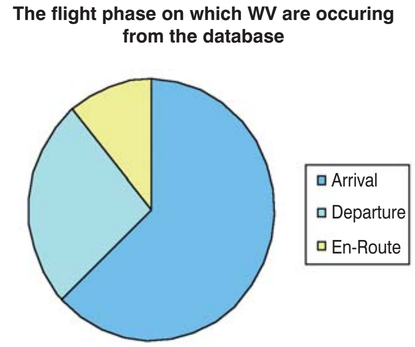


Figure 2: Questionnaire results to the question: What action do you take, if any, to avoid wake vortices?

En-Route Encounters

The questionnaire revealed an approximately equal split between the likelihood of a wake vortex encounter on approach, departure and en-route phases of flight. However, only 11% of our received wake vortex reports took place en-route compared to 63% inbound and 26% outbound. This discrepancy is likely to be due to the fact that wake vortex encounters in en-route carry less risk than those closer to the ground where the pilot has less recovery time. As a result of this we are only receiving the more severe encounters occurring in en-route airspace. With the introduction of the A380 on the horizon, and in the light of recent incidents that have resulted in significant rolls in en-route airspace, NATS are keen to receive as much information as possible about en-route encounters. If there is anything that could make it more convenient for pilots to record and report en-route encounters we would be happy to hear about it.



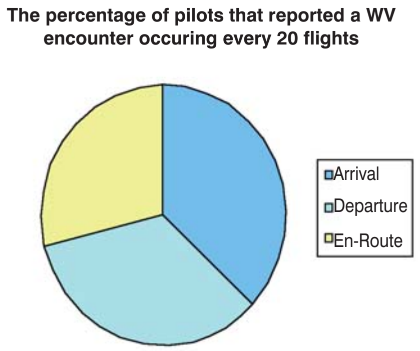


Figure 3: Questionnaire answers compared to information from the Wake Vortex Database

Encounter Report Forms

The issue of the time consuming nature of the reporting process was also drawn to our attention. Several pilots expressed concern at the high volumes of paper work already involved with flying and felt that they would not report a wake vortex encounter unless absolutely necessary. The lack of awareness of the NATS Wake Vortex Report Form (previously named CA1695) was highlighted with only 1% of questioned pilots employing this method of reporting. This has prompted the redesign of the NATS Wake Vortex report form and alerted us to the need for its promotion. The Wake Vortex team are currently investigating ways in which to better publicise and promulgate the NATS Wake Vortex Encounter form.

However, the form can currently be found on the www.customer.nats.co.uk site or obtained by emailing waketurbulence@NATS.co.uk.

Summary

Thank you to all those pilots that took the time to complete the questionnaire. The impressive response to the questionnaire has enabled us to improve our understanding of pilot's perception of wake vortex encounters. It has alerted us to issues that we were unaware of, such as the scale of the perceived problem with the B757 and the action regularly undertaken by pilots to avoid encountering wake vortices. The low reporting rate for en-route encounters has also been brought to our attention as an issue that needs to be addressed, especially with the imminent introduction of the A380. The fact that we received so many completed questionnaires shows that pilots consider wake vortices to be an important safety issue that concerns them.

The Wake Vortex Operational Monitoring Team
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4000 Parkway
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London TMA Speed Restriction Trial

by Capt. Jim Snee & Capt. Ian Mattimoe - bmi

(Max speed 250kts below FL100 on departure – NOTAM XXXX refers)

You will be aware that a departure speed limit of 250kts below FL100 has been trialled since April this year within the London TMA (AIC 39/2006). This trial has now been extended until January 2007, with the probability of making it a permanent feature thereafter.
This notice is intended to explain the rationale behind the trial, to give you some feedback on results to date and to exhort you to ensure compliance from here on in.

The Rationale

The trial was initiated as a consequence of the growing volume of traffic within the London TMA and the complexities that this increase has generated, not least the wide variation in climb speeds used (210kts – 355kts) which gave controllers an additional - and unpredictable - challenge that they didn't want. Whilst the aim of the trial is obviously to 'smooth' the traffic flows, maintain separations, and take the unpredictability out of the process for controllers, there is also an additional dimension. The continued growth in traffic volumes requires evolution in the controlling process also. We are moving toward a more strategically managed process and need to develop procedures that encompass P-RNAV to handle the increasing number of movements. Greater predictability in traffic flow will also help reduce r/t congestion and should maintain a smooth handover of traffic from the TMA to En-Route Control. This consistent speed flow is the first move toward the more strategic management process that ATC need to cater for future demand.

Feedback

- The trial to date has produced some good results with a 65% compliance rate (of which more later).
- Although it is very difficult to make a direct link with safety, there are some positive indicators such as a reduction of the number and severity of loss of separation incidents reported and level busts in TC
- Overall, the TMA has been 'slowed down' and this has achieved the systemised flows required although sector occupancy times have increased slightly.
- The slowing of traffic has improved the effectiveness of avoiding action when it has been required and there have been no loss of separation incidents below FL100 where aircraft have been complying with the restriction.
- The systemisation has reduced r/t clutter.
- There are some indications that a further benefit has been a reduction in the number of sector regulations applied.
- There has been a reduction in noise from aircraft accelerating on SIDs.

Compliance

As mentioned above, a compliance rate of 65% has so far been achieved, with some airlines performing better than others in this respect. The question here is what about the remaining 35%, why not those pilots too?

There are essentially two answers to this question; the first is lack of knowledge. The crews haven't read the AIC/Notam, or have ignored it, and/or have not been advised by their management that the trial is in place.

The second is that some controllers have been over keen to 'be kind to pilots' and have released aircraft from the speed constraint when, in their view, the traffic pattern has warranted it.

One of the conditions of the trial – for obvious reasons – is that controllers are allowed to remove the speed restriction only for over-riding safety reasons, or when the pilot requests it due to aircraft configuration and the request can be accommodated. The key elements of this alleviation are 'when the pilot requests it' which should be 'due to aircraft configuration', and then only if the request 'can be accommodated'. This caveat has perhaps been too liberally applied.
One of the consequences of the alleviation of the speed control limitation has undoubtedly been confusion, with several airlines receiving queries from their pilots as to whether or not the trial was still in place.

Conclusion

- The trial has now been extended until January 2007 in order to confirm that the initial positive indications of success are maintained and verified. It is anticipated that the trial will then translate to a permanent feature within the London TMA.
- There have been some very positive safety benefit trends during the trial as well as ATC handling benefits.
- The remaining challenge is to now ensure that all pilots – and all controllers – apply the speed control process for the rest of the duration of the trial.
- Remember, if you need more than 250kts to optimise climb and minimise drag you can ask. For the rest, 250kts clean below FL100 is the way to go.

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Letters

2 January 2007

Dear Sir,

The first point to make is that Focus appears not to have a ‘Letters’ section; I wonder if such a facility might elicit some good ideas. So, let me start the ball rolling - - I'm not so sure about the 'good ideas' bit!

BRISTOL. SIDS –'LEVEL BUSTS'

Your ‘Winter 2006’ FOCUS back page, which highlights ‘level busts' on departures from Bristol, captured my attention. As a humble - but reasonably experienced - ex-RAF pilot and (probably more important in this instance) ex-staff officer - the little bells started ringing. When a number of people get something wrong, overlook something or don't understand fully what they are supposed to do, it is often because of a failure in communication. The instruction or guidance may be poorly worded, contradictory or just wrong, and there are of course shades of grey caused by other factors such as – in this case – pilot discipline. airmanship, or a reluctance to deviate into the 'too difficult', 'unknown' or 'inconvenient' categories. As a typical 'ex-pert' I couldn't resist the temptation to try to figure out what was wrong and propose a solution.

FOCUS seems to have **an** answer the red warning boxes are 'eye-catching'; however. unless the AIP has been amended recently, I notice that they do not appear on the chart. Perhaps AC&D and AIS will not countenance such vulgarity! However, on the Brecon SID, placing the current 'warning' box nearer to the point of application might help.

What did I find misleading or confusing? Select any from the following! The word 'maintain' (in the General Information notes) implies that you keep doing something that you are already doing (dictionary: 'keep going'). In the Brecon case one needs to determine whether one can maintain a climb gradient to achieve FL 80 by BCN DI0. One had been climbing but was directed (by implication on the SID chart) to level at 6000 ft at BCN DI5. Could one maintain the climb gradient and achieve FL 80 by DI0? Yes, if one **'kept going'**. Is one permitted to do so? No, not without ATC clearance. When will clearance be given? Don't know. Will one still be able to make FL 80 when cleared to climb? Don't know. How much further along track will one be when cleared? Is the QNH against one – altitude v FL – does one have more than 2000ft to climb? What is one's TAS? Does one have a significant head/tail wind? What is one's G/S? I could go on.

It seems to me (a mere spectator) that the 'Warning' box contradicts the procedure that is laid down in the SID.

In the boxed guidance notes for BCN 1 X/RWY 27 and BCN 1Z /RWY 09 it clearly states 'cross BCN 15 at 6000 to BCN VOR'. Nothing about levelling off, although the annotated altitude indicates 'not above' and ‘not below'. One might infer (and clearly some do) that as long as one is over D15 at 6000 it is OK. It also refers one to Note 6: 'Pilots of aircraft which are unable to maintain (keep going) climb gradients to achieve FL 80 by BCN D10 etc, etc'. which again implies that it is OK to keep climbing.

Human (pilot) nature tells one that seeking 'alternative clearance' from ATC (Note 6) will be tedious to say the least, and who wants to go via some circuitous route when a straight line is easier and more efficient. So, one makes the assumption - based on performance data - that one can make FL 80 by D I0, and the mind is set. The over-riding aim is FL 80 by DI0 because (presumably) it has something to do with safety. A not unreasonable thought process!

The solution would appear to be a combination of two actions. The first is to review the written guidance and instructions on the SID Chart with the aim of eliminating any possible anomalies, confusion and inconsistencies. The second, I assume pilots and ATC do actually speak to each other during the departure procedure; therefore, the suggestion is for ATC to instruct the pilot what to do when he gets to D15. I would be surprised if this does not already happen, but perhaps a review of **what** is said and **when** might be timely. If communication is to be effective it must be clear, concise and accurate. It would appear that the Bristol SID does not satisfy those criteria. This letter probably doesn't either - but I've tried!

Yours Sincerely,
Martyn Redmore

Dear Editor,

LEVEL BUSTS ON DEPARTURE FROM BRISTOL AIRPORT

Thank you for forwarding me the letter addressed to you from Martyn Redmore which was prompted by the poster on the final page of the winter 2006 edition of the UKFSC magazine FOCUS. I think it would be useful to provide some background to the publication of the poster.

Standard instrument departures (SIDs) were introduced from Bristol on the 31st of August following airspace changes. The new SIDs were published in the UK AIP with a plan view of the route and with explanatory text which includes information on the vertical profile. All of the SIDs have a final altitude of 6000 feet and some have a warning in the notes in the UK AIP that the aircraft must achieve FL80 by a specified DME range, this is to ensure that the aircraft remain inside controlled airspace. The chart also includes a warning that crews should not climb above 6000 feet until instructed by ATC, by implication climb above 6000 feet can only be after an ATC instruction. Commercial third party companies take this information from the AIP and produce charts to their own design and specification.

In the two week period immediately after the introduction of the SIDs there were a number of actual level busts on the BCN, BADIM and WOTAM SIDs and a number of occasions when ATC intervened to prevent level busts. On all of these occasions the crews involved climbed to FL80 rather than the correct SID level of 6000 feet. When these events were investigated by NATS we discovered that all of the crews involved in the events were using the same chart which had been produced by the same third party. These charts had included the warning about the minimum climb gradient on the plan view of the route which gave the impression, incorrectly, that the final level of the SID was FL80. There was no supporting text explaining the vertical profile so the crews has to rely on the information provided on the plan view although the warning about not climbing above 6000 feet was included. In the circumstances it was not surprising that some crews misinterpreted the final SID level and climbed to FL80.

As soon as we became aware of the situation we wrote to the chart producer highlighting the number of level busts on the SIDs, that all of the crews had been using charts produced by this one manufacturer and illustrating the incorrect interpretation of the information from the AIP. We requested that the manufacturer acknowledge the errors, warn its customers about the errors and publish new charts. All of the requested actions were carried out but we didn't know how long they would take so we took the decision to publish a poster, based on the AIP SID plates, to warn operators and pilots about the problem. This poster was produced and disseminated by the 28th of September. We took the decision to add the red warning box to the UK AIP SID plates in the poster to highlight the existing warning box and that the note about the minimum climb gradient did not constitute clearance to climb. In the warning box which we added we use the phrase 'You MUST maintain 6000' until cleared by ATC.' We used the word maintain in the context explained by CAP413 Radiotelephony Manual 'continue in accordance with the condition(s) specified'.

Martyn believes that the AIP SID chart used in the poster is potentially confusing. There have been no level busts by crews using the chart from the UK AIP or any of the other third party manufacturers but this does not mean that Martyn is incorrect. The source of the potential confusion appears to be the inclusion of the note about the minimum climb gradient to reach FL80. In the operational environment controllers know that they must climb aircraft above the SID level to ensure that aircraft remain inside controlled airspace and have been doing this successfully since the routes were introduced. The note about the minimum climb gradient was added at the request of the Directorate of Airspace Policy to ensure that every possible mitigation was put in place to cover worst case scenarios; RTF failure, the ATCO forgetting to climb the aircraft or a very heavy aircraft which struggles to make the appropriate levels.

We are in discussion with the Directorate of Airspace Policy to determine if, in the light of operational experience and of the number of level busts on the routes, it is still appropriate to have the potentially confusing warning included about the minimum climb gradient. We are also still in discussion with the chart producer who did correct the original incorrect chart but we still have some concerns about the style and content of their chart.

Richard Schofield
Division of Safety - NATS

Tail Strikes: Prevention

By Capt. Dave Carbaugh, Chief Pilot, Flight Operations Safety

Tail strikes can cause significant damage and cost operators millions of dollars in repairs and lost revenue. In the most extreme scenario, a tail strike can cause pressure bulkhead failure, which can ultimately lead to structural failure; however, long shallow scratches that are not repaired correctly can also result in increased risks. Yet tail strikes can be prevented when flight crews understand their causes and follow certain standard procedures.

Two vital keys to prevention are raising awareness of tail strikes among flight crews and including tail strike prevention in standard training procedures. It's also important to promote discussion about tail strikes among members of the flight crew as part of takeoff and landing briefings, particularly when strong wind conditions are present.

This article:

- Provides an overview of tail strikes and how Boeing is addressing them.
- Examines tail strike causes and prevention.
- Discusses operations in strong gusty winds.
- Reviews training recommendations and preventive measures.

Tail Strikes: An Overview

A tail strike occurs when the tail of an airplane strikes the ground during takeoff or landing. Although many tail strikes occur on takeoff, most occur on landing. Tail strikes are often due to human error.

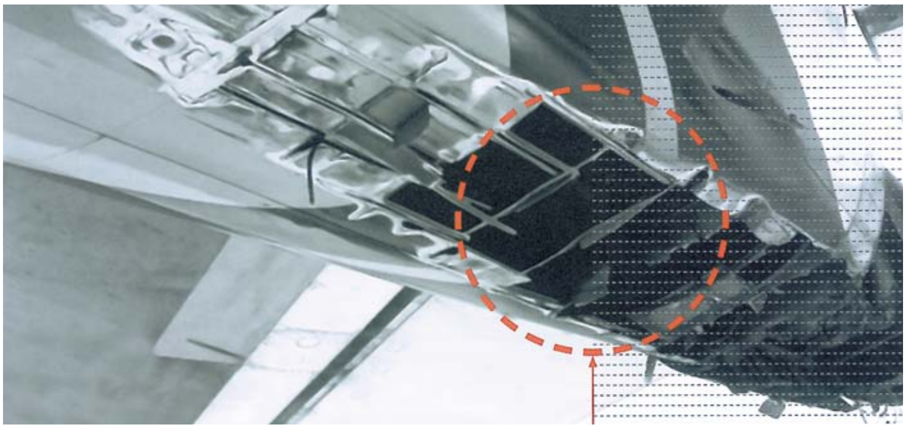
Tail strikes can cause significant damage to the pressure bulkhead. Failure of the pressure bulkhead during flight can cause a catastrophic event if the flight continues while pressurised.

Tail strikes are expensive, too. During a safety investigation, one airline reported that a single tail strike cost its company $12 million in repair cost and loss of revenue during the repair.

Boeing has done design work to reduce tail strikes, including implementing an improved elevator feel system in some airplanes. For example, the 747-100/-200/-300 has varied feel (column forces) throughout the center of gravity (CG) and weight envelope. The newer 747-400's elevator feel system design provides a constant feel elevator pressure, which has reduced the potential of varied feel pressure on the yoke contributing to a tail strike. The 747-400 has a lower rate of tail strikes than the 747-100/-200/-300.

In addition, some 777 models incorporate a tail strike protection system that uses a combination of software and hardware to protect the airplane. And some models of the 737,767, and 777 have a tail skid that prevents damage from most takeoff tail strikes. However, these devices do not guarantee protection for landing tail strikes and some takeoff tail strikes. They also reduce tail clearance distances. Many of the longer-bodied Boeing airplanes use relatively higher speeds than their shorter-bodied major models (e.g., the 757-300 versus the 757-200). The subsequent higher V_1, V_r and V_2 speeds, or approach speeds, are designed to improve the tail clearance. Higher speeds make the tail clearance equivalent to the shorter-bodied equipment of the same model.

Regardless of airplane model, tail strikes can have a number of causes including gustywinds and strong crosswinds. But environmental factors such as these can often be overcome by a well-trained and knowledgeable flight crew following prescribed procedures. Boeing conducts extensive research into the causes of tail strikes and continually looks for design solutions to prevent them, such as an improved elevator feel system. Enhanced preventive measures, such as the tail strike protection feature in some Boeing 777 models, further reduce the probability of incidents.

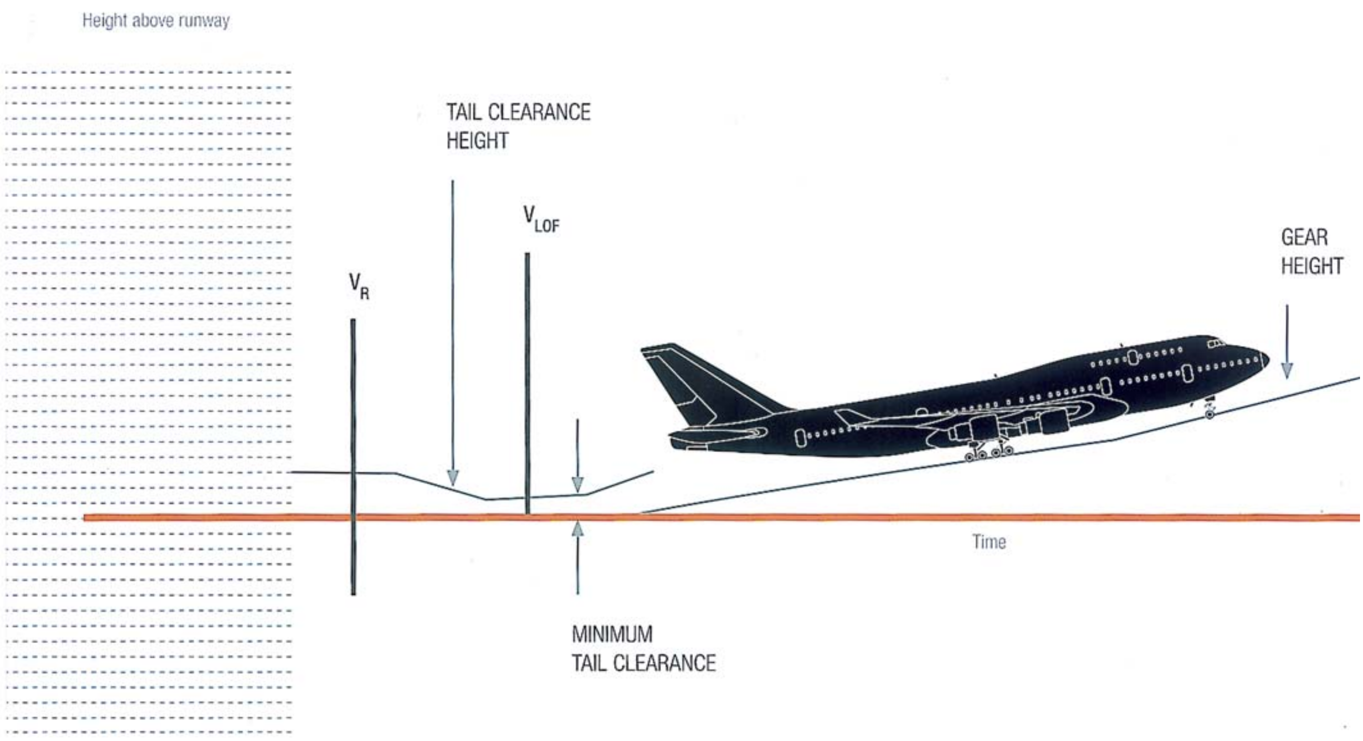


Most tailstrikes occur when the tail of an airplane strikes the ground during landing and are preventable. In this incident, the crew made an error and calculated takeoff data incorrectly. This resulted in an early rotation.

Typical Tail Clearance for Takeoff

Model	Flap	Liftoff Attitude (deg)	Minimum Tail Clearance [inches (cm)]	Tail Strike Pitch Attitude (deg)
747-400	10	10.1	39 (99)	12.5
747-400	20	10.0	40 (102)	12.5

Figure 1.
This diagram indicates the effect of flap position on liftoff pitch attitude as well as minimum tail clearance during takeoff. The minimum tail clearance depicted is predicted on a no-wind, no-crosswind control, and constant rate of 2 to 3 degrees per second rate of rotation.



Typical Tail Clearance for Engines-Out Takeoff

Model	Flap	Liftoff Attitude (deg)	Minimum Tail Clearance [inches (cm)]	Tail Strike Pitch Attitude (deg)
747-400	10, 20	10.6	34 (86)	12.5

Figure 2.
When an operating engine failed at V_1 with only 75 percent of thrust available for a four-engine airplane or 50 percent of thrust available for a two engine airplane, minimum tail clearance is reduced. If there is a crosswind, the aileron/spoiler displacement will further reduce minimum tail clearance. In all cases, whether operating in one-engine or two-engine configuration during the rotation, a high average rate of rotation above what is recommended will further reduce minimum tail clearance.

Boeing also works to reduce tail strikes through exhaustive takeoff testing, which is a part of certification for any new airplane program. During flight testing, takeoff test conditions are specifically designed to investigate the impact of early rotation, rapid rotation, no flare during landing, and long flare. During this testing, an acceptable margin per certification criteria is established for the design operational use of the airplane. In all cases, Boeing commercial airplanes meet or exceed the design certification criteria for takeoffs and landings, as well as for crosswind takeoffs and landings (see fig.1). Criteria for engine-out takeoffs and landings are also evaluated (see fig.2).

Causes and Prevention

Takeoffs. A number of factors increase the chance of a tail strike during takeoff, including:

- Mistrimmed stabilizer.
- Improper rotation techniques.
- Improper use of the flight director.
- Rotation prior to V_r:
    - Early rotation: Too aggressive, misinterpretion.
    - Early rotation: Incorrect takeoff speeds.
    - Early rotations: Especially when there is a significant difference between the V_1 and V_r.
- Excessive initial pitch attitude.
- Strong gusty winds and/or strong crosswinds may cause loss of airspeed and/or a requirement for lateral flight control inputs that can deploy some flight spoilers, reducing the amount of lift on the airplane.

These factors can be mitigated by using proper takeoff techniques (refer to your operations manual for specific model information), including:

- *Normal takeoff rotation technique.* For current production airplanes, the feel pressure should be the same as long as the CG/weight and balance are done correctly. For most cases, there is no reason to be aggressive during rotation.
- *Rotating at the appropriate time.* Rotating early means less lift and less aft tail clearance.
- *Rotating at the proper rate.* Do not rotate at an excessive rate or to an excessive attitude.
- *Using correct takeoff V speeds.* Be sure to adjust for actual thrust used and be familiar with quick reference handbook and airplane operations manual procedures for takeoff speed calculations.
- *Consider use of greater flap setting* to provide additional tail clearance on some models.
- *Use the proper amount of aileron* to maintain wings level on takeoff roll.

Landings. Tail strikes on landing generally cause more damage than takeoff tail strikes because the tail may strike the runway before the main gear, damaging the aft pressure bulkhead. These factors increase the chance of a tail strike during landing:

- Unstabilized approach.
- Holding airplane off the runway in the flare.
- Mishandling of crosswinds.
- Overrotation during go-around.

Techniques that can reduce the chance of a tail strike during landing include:

- Maintain an airspeed of V_{ref} + 5 knot minimum to start of flare and fly the approach at the "specified target airspeed."
- The airplane should be in trim at start of flare; do not trim in the flare or after touchdown.
- Do not "hold the airplane off" in an attempt to make an excessively smooth landing.
- Use only the appropriate amount of rudder/aileron during crosswind approaches and landing.
- Immediately after main landing gear touchdown, release the back pressure on the control wheel and fly the nose wheel onto the runway.
- Do not allow pitch attitude to increase after touchdown.
- Do not attempt to use aerodynamic braking by holding the nose off the ground.

Sometimes the best option for the approach is a go-around. It is important that the culture within the airline promote go-arounds when needed without punitive measures.

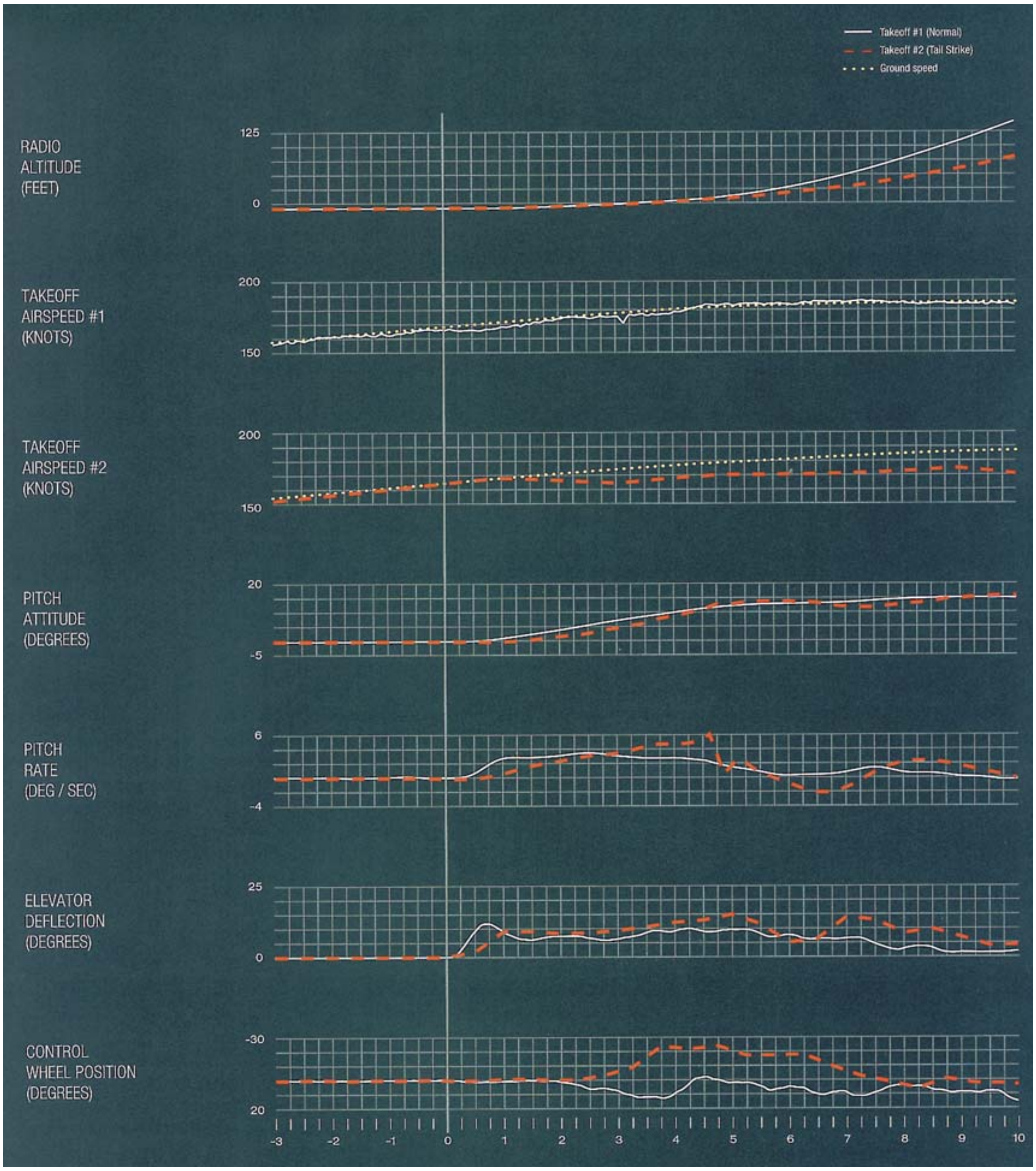
Operations in Strong, Gusty Winds

Tail clearance is reduced during takeoffs performed in strong gusty winds and crosswinds because of the lift loss incurred by flight control inputs, primarily spoilers. With very large inputs, this loss can be significant (see figs. 3 and 4).

Approximately two years ago, Boeing revised wording in all production model flight crew training manuals (FCTM) to incorporate input from industry and safety professionals regarding tail strikes during strong and gusty winds. The Boeing FCTM recommends that crews use thrust settings higher than the minimum required. The use of a higher takeoff thrust setting reduces the required runway length and minimizes the airplane exposure to gusty conditions during takeoff roll, rotation, liftoff, and initial climb.

Pilots can take a number of steps to reduce the possibility of tail strikes during takeoff in gusty winds or strong crosswinds, including:

- Momentarily delaying rotation during the gust. As airspeed fluctuates back and forth (what is sometimes referred to as "bounce"), ensure that the airplane starts rotation at a speed that averages above rotate speed.
- Using a normal rate of rotation, but not a greater rate of rotation than normal. This faster rate may be a tendency if the airplane is slow to liftoff due to airspeed stagnation.
- Limiting wheel input to that necessary to maintain wings level. Pre-setting too much aileron increases drag and reduces lift with higher probability of cross control and reduced tail clearance margins. When safely airborne, smoothly transition from the slip by slowly releasing the rudder while maintaining desired track.
- Avoiding the tendency to quickly



Tailstrike Comparison. Figure 3.
This is a comparison of a normal takeoff and a tail strike takeoff in gusty wind conditions. Note that takeoff #2 suffers a 9- to 10-knot airspeed loss during the rotation. The pitch attitude increases at an increasingly at an increasing rate until the tail strike. This is primarily due to the continued elevator increased deflection during rotation.

Aft Body Clearance Breakdown. Figure 4.

Guidelines that relate to Boeing airplanes show that airspeed loss, lateral control deflection, a greater than average pitch rate, and a maximum pitch rate in excess of 4 degrees per second all contribute to reduced tail clearance margins. The numbers change, but the concepts hold true for other models.

Factor		Incremental Difference From Nominal	Reduction in Aft Body Clearance
Airspeed loss		Each 1 knot below the nominal liftoff speed	=2.8 inches†
-Δ CL from lateral controls		Each 0.1 of (-Δ CL) from lateral controls	=14 inches
Pitch rate*	Average pitch rate to 10 degrees pitch attitude	Each 0.1 deg/sec in the average pitch rate above 2.5 deg/sec	=2.8 inches†
Either/Or	Maximum pitch rate	Each 0.1 deg/sec above 4.0 deg/sec	=1.3 inches

* *If the maximum pitch rate up to the point of contact was less than 4.0 deg/sec, the average pitch rate corrections are used. If the maximum pitch rate up to the point of contact was above 4.0 deg/sec, then the maximum pitch rate correction should be used. In all cases, only one method or the other is employed.*

† *For these increments, the relationship holds for both positive and negative contributions, i.e., an* increase *in* lift off *speed by 1 knot would* increase *the aft body clearance by 2.8 inches, and each 0.1 deg/sec of average pitch rate* below *2.5 deg/sec would* increase *the aft body clearance by 2.8 inches.*

rotate the airplane off the ground during rotation in these wind conditions. Gusts up to 20 knots have been noted in the review of tail strike incidents.

- Rotating on the conservative side of gusts. Use normal rate of rotation a bit on the side of a slower versus faster rotation, similar to the engine-out case noted earlier.

If, after reaching the normal takeoff attitude, the airplane is not airborne, avoid the tendency to increase rotation rate. Either slow or momentarily stop rotation rate. Many tail strikes on takeoff occur when or just after the main gear is airborne.

Training Recommendations and Preventive Measures

Tail strikes can be prevented. The most effective means of prevention is a training program that reinforces proper takeoff and landing procedures. There are a number of steps both management and flight crews can take to help prevent tail strikes.

Management:

- Ensure instructors and evaluators stress proper landing and takeoff techniques during all training and evaluations.
- Make "tail strike prevention" part of the safety program through posters, briefings, videos, computer-based training, and other elements which are available from Boeing Field Service representatives.
- Make tail clearance measuring tools available in the simulator for all takeoffs and landings during simulator training and evaluations and provide feedback to crews.
- Use a self-measuring tail strike operational tool in the airline's fleet (see "Crew" section).
- Ensure that flight operational quality assurance programs are not used as a punitive device.

Crew:

- Adhere to proper takeoff and landing techniques
- Never assume—double-check the takeoff data, especially if something doesn't look right. Coordinate insertion of the zero fuel weight (ZFW) in the Flight Management Computer with another crew member. Double-check data with the load sheet. Inaccurate (low) ZFW entries have caused significant tail strikes.

- Know your airplane—have an idea about the approximate takeoff and approach speeds.

- When setting airspeed bugs, always do a "reasonable check."

- Be aware of the differences between models and types, especially when transitioning from other equipment.

- If a tail strike occurs, follow the checklist.

- Crew resource management should be an integral part of training. Crews can get complacent during routine operations, yet a real threat exists during operations in strong gusty crosswinds. How the crew plans for and mitigates the threat can make the difference between a safe takeoff or landing and one that results in a tail strike. Every crew should have a plan for identifying and discussing the threat. For example:

  - The entire crew should review appropriate crosswind takeoff procedures and techniques for operating in strong gusty winds.

  - The pilot flying (PF) should review threat strategy for the takeoff or landing with the pilot monitoring (PM).

  - The PM should monitor airspeed versus rotation callout to the PF and identify airspeed stagnation during the rotation phase to takeoff target pitch attitude.

  - If the first officer is making the takeoff, the captain should monitor pitch rate and attitude and call out any deviations and be prepared to intervene.

Other approaches include a self monitoring tail strike analysis tool that provides a pitch report for every takeoff and landing. If the tail gets within 2 degrees of a potential tail strike, an auto printout is provided to the crew after the respective takeoff or landing. Airlines that have adopted this program have had significant drops in tail strike rates.

Preventative measures. Boeing is actively developing tail strike preventive measures. Some 777s have two additional features that help prevent tail strikes: the semi-levered main gear and tail strike protection.

Boeing 777 semi-levered main gear. Because the vast majority of the weight of the airplane is borne by the lift of the wings at the time of rotation, the semi-levered gear acts as if it were "pushing" down like a longer gear. This allows a higher pitch attitude for the same tail clearance or more clearance for the same pitch attitude. A hydraulic strut provides the energy to provide this increased takeoff performance. Although designed to increase takeoff capability, the system provides increased tail clearance for the same weight and thrust as nonequipped airplanes.

Boeing 777 tail strike protection. Timely elevator input can help avoid tail strikes on both takeoff and landing. The tail strike protection command (TSP CMD) is summed with the pilot's input to form a total elevator command. The TSP CMD is limited in size to 10 degrees, which allows the pilot to overcome its effects, if desired, by pulling the column farther aft. The size of the TSP CMD is controlled by excessive tailskid rate relative to a nominal threshold of tailskid rate, and by excessive nearness of the skid to the runway, relative to a nearness threshold. Different thresholds are used for takeoff and landing. The TSP CMD is limited to commanding nose down increments only. Tailskid height and rate are computed from radio altimeter signals, pitch attitude, pitch rate, vertical speed, and the length between the radio altimeter location and the tailskid location. A complementary filter is used to provide acceptably smooth rate and height signals. Provisions are included to account for the bending of the forward fuselage when the nose wheel gear lifts off the ground.

Summary

Tail strikes are preventable. If standard recommendations are followed for all Boeing models, the chance of tail strikes is greatly reduced. There are additional challenges and solutions when operating during strong crosswinds and gusty winds. Training is the key to preventing tail strikes. Technology enhancements can also contribute to solutions for Boeing production airplanes.

For more information, contact Capt. Dave Carbaugh at dave.c.carbaugh@boeing.com.

EU Air Carrier Blacklist Update

By Keith Richardson, Barlow Lyde & Gilbert

Bulgarian carriers are under threat of being added to the latest blacklist of carriers banned from operating in the EU when the updated list is published shortly. In the meantime, the experience of at least one carrier suggests some potential flaws in the Commission's decision-making processes for adding carriers to the blacklist and in its notification process to carriers who are being considered for inclusion on the list.

In February of this year the European Commission ("EC") will publish the latest version of the list of carriers which are banned from operating within the EU or are subject to operating restrictions - otherwise known as the EU Aviation Blacklist.

Whilst the publication of this list will be keenly awaited by those operators who are either seeking to challenge existing bans or which have been subject to investigation by the EC, the latest version will be of particular interest as there is the possibility that, for the first time, an EU state could see its carriers added to the blacklist.

Bulgaria, one of the two countries which became EU member states as from 1 January 2007, potentially faces a ban following European Aviation Safety Agency ("EASA") reviews of the Bulgarian CAA conducted in 2005 and 2006. EASA reported serious deficiencies in the administrative capacity of the Bulgarian CAA but, as at January 2007, no detailed corrective plan had been received by EASA.

Political embarrassment as well as the economic implications for Bulgarian carriers may mitigate against an outright ban (which would effectively ground all Bulgarian carriers) and so some restriction on their operations and/or non-recognition of certificates and approvals issued by the Bulgarian CAA is perhaps more likely. However, the EC has been adamant in the past that its decisions are motivated by concern for the safety of the travelling EU public which may override political or economic considerations.

A further issue which has been expressed by one of the carriers which has already been subject to a ban, is the process by which carriers might be added to the blacklist. The criteria for addition focus on the use of antiquated, poorly maintained or obsolete aircraft; the results of ramp inspections carried out at EU airports; and the ability of an airline to rectify shortcomings identified during such inspections.

In practice, there appear to be some significant flaws in the system. Blacklisting decisions can be made on the basis of Safety of Foreign Aircraft Assessment ("SAFA") reports prepared following ramp inspections. However, it has been reported that the carrier's response to an adverse ramp inspection is not passed on automatically to the EC, so the risk is that the EC may only see one side of the story when assessing the SAFA reports. This can mean that a carrier is at the whim of the competence and/or qualifications of the relevant SAFA inspectors. One carrier who has expressed concerns was effectively powerless to correct the inappropriate categorisation of defects in a series of SAFA reports which ultimately led to that carrier's addition to the blacklist. That carrier's situation was made even worse by the lack of notice provided by the EC. EU legislation requires carriers to be notified if they are being considered for inclusion on the blacklist and given the opportunity to make representations. Nevertheless, in this case, no such notice was received either by the carrier or its regulatory authority and the first that the carrier knew of the situation was the grounding of its aircraft upon arrival in the EU. Of course, the list is only updated at approximately three month intervals which, in the case of the carrier concerned, was enough to bring it to the brink of insolvency.

Certain stories emerging suggests that the manner in which some SAFA inspections are conducted, as well as the qualifications of the personnel conducting those inspections within some EU Member States, would benefit from review given the potentially serious financial consequences for carriers. As from 1 January this year responsibility for the coordination of the SAFA programme passes to EASA. Whilst the maintenance of the highest aviation safety standards must remain the overriding objective for EASA, the use of EU-wide bans is a draconian sanction and, therefore, should be applied following a balanced and informed assessment of all of the evidence available.

UK FLIGHT SAFETY COMMITTEE

TECHNICAL INNOVATION AND HUMAN ERROR REDUCTION

Annual Seminar 2007

1st/2nd October 2007
The Radisson Edwardian Hotel Heathrow

SEMINAR OBJECTIVE

The continuing growth in technical innovation has without doubt helped to reduce the number of accidents. However, some of these developments have introduced unexpected challenges for the operators. The formulation of good procedures helps to mitigate these challenges, but there is a consensus within the industry that major difficulties still exist. This Seminar will highlight the problems encountered and propose strategies for the future.

PROVISIONAL PROGRAMME

1st October 2007

2000hrs Seminar Dinner
After Dinner Speaker - TBA

2nd October 2007

0800 - 0900	Registration
Session Chairman - TBA	
0900 - 0910	Welcoming Introduction - Chairman – UKFSC
0910 - 0945	Keynote Speech - Dr Kathy Abbott - FAA
0945 - 1020	Future ATM/Single European Sky - Mark Green - IFATCO
1020 - 1040	Refreshment Break
1040 - 1115	R-NAV, B-RNAV, P-RNAV - Andy Shand – British Airways
1115 - 1150	Passenger Entertainment in the 21st Century - Panasonic Avionics Corp - TBA
1150 - 1225	Flying the Emb195 - Capt. Bob Horton – Emb195 Fleet General Manager – flybe.
1225 - 1255	Questions
1255 - 1400	Lunch
1400 - 1435	The Complexity of Unmanned Aerial Vehicles (UAVs) - Cdr Paul Brundle, RN Defence Aviation Safety Centre
1435 - 1450	Comfort Break
1450 - 1525	Airbus - The Way Forward- TBA
1525 - 1600	Maintenance Human Factors - Howard Leach - RAeS
1600 - 1630	Questions
1630 - 1645	Closing Speech - Chairman - UKFSC

National Aerospace FOD Prevention Inc and BAe Systems Present

THE 3RD INTERNATIONAL FOD PREVENTION CONFERENCE

FOD PREVETION CULTURE – THE HUMAN ELEMENT

www.nafpi.com

9-10 October 2007 at the Hilton Hotel, Blackpool, UK

Conference Description:

The 3rd International FOD Prevention conference objective is to make the wider aerospace industry aware of the need to prevent foreign object debris/ damage from our aircraft, airports, runways, manufacturing facilities, flight lines and all aspects of aerospace operations. The conference provides an effective forum for the exchange of ideas, solutions, expertise.

Who should Attend:

Anyone who has an interest in flight safety. This conference attracts major industry representatives from: Airlines, Airports, Cargo Haulers, Aircraft Manufacturing & Repair, Military, Space, Support Industries, and many others from Aviation organizations.

Who should Exhibit:

Anyone who's products or services increase flight safety & FOD prevention. Examples: borescopes, cameras, lights, tools, tool kits/ tool control, FOD detection systems, aircraft protective devices, personal protective equipment, wildlife control, runway sweepers, vacuums, etc... Companies also exhibit to showcase their FOD prevention programs, products and services.

Conference Program:

NAFPI and this year's co-host invite everyone to come to Blackpool and take part in the 3rd International Aerospace FOD Prevention Conference to see the latest FOD prevention techniques, equipment, and technological advancements used in the industry to prevent FOD, promote awareness, and combat a common enemy. Experience two days of facilitated panel discussions, keynote presentations and exhibits. Share proven methods and best practices of preventing FOD throughout the aviation/aerospace industry. FOD can come in many different forms, and produce disastrous effects if not identified and corrected.

Registration Fee = $350.00 per person   Exhibit Registration Fee = $750.00 (Per Booth)   **Rates increase after 15 Sep 2007**

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Hotel Reservations

It is your responsibility to make your own hotel reservations. Please quote NAFPI FOD Prevention Conference for special rate

Hilton Hotel
North Promenade, Blackpool, Lancashire FY1 2JQ
Tel : 01253 623434
Fax : 01253 294371

Room Cost - £90.00 per night

BAE SYSTEMS