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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: Bruce Dickinson: Captain with Astraeus, Iron Maiden Lead Singer and Presenter in "Safety in the Balance" DVD. See page 11.
Photographer John McMurtie / © Iron Maiden Holdings 2011

UK Flight Safety Committee - 50 Years in Aviation Safety Reflections of a Past Chairman

by Rich Jones, Chief Executive UKFSC

In the Spring edition of FOCUS, the opportunity was taken to remind our readership that 2011 is the 50th anniversary year of the UK Flight Safety Committee. From our early beginnings under the Department of Transport and Civil Aviation, we became an independent association of aviation safety professionals in September 1961, with the specific aim of promoting flight safety across the commercial air transport sector. In response, we were delighted to receive the following reflections from Harry Hopkins, who was Chairman of the Committee between 1982 and 1986.

I belatedly congratulate the UKFSC and its Chairman on its 50th anniversary. Over that time membership has steadily widened, so that views on safety can be contributed over a spectrum of professions within the industry and from an ever wider range of geographical areas of operation.

Might I now exploit the privilege of being a past Chairman by offering some personal comments.

I have often found myself returning to three principles as lying at the root of aviation safety, which I feel should form the groundwork of any safety philosophy, on which detailed guidance and regulation can then be planted. I believe that these basics can never change:

Safety is the survival of error; design, construction and operation are all inescapable sources of error.

Safety gives weight to the risk that an incident could have been an accident, at another time or place.

Safety depends on identifying and quitting a degrading situation at a prudently early stage. In any field of human activity mistakes will be made, in spite of all attempts to avoid them; the final line of flight safety defence must lie with the operatives – aircrew, controllers and others. Any dismissal of an incident as 'no actual risk' may then lead to a failure to take serious action and the very real prospect of a similar situation occurring in the future, with far graver consequences. The companion to this is the finding of 'an isolated incident'. Aren't they all, the first time?

One sensitive situation is where the captain is PNF, when the link between command and action is indirect and the monitoring role reversed. Accidents have revealed situations where co-pilots have been over-deferential to captains – but also where captains have allowed co-pilots PF excessive latitude. I will always treasure one anecdote from a friend, who became concerned at his co-pilot PF's late dive at the threshold with idle thrust; he said 'I have control' – before he himself could no longer have been so confident at making a smooth recovery. On clearing the runway the aggrieved co-pilot demanded 'why did you do that captain'; my laconic friend was economical in his reply: 'because I wanted to live!' It is not a bad basic command philosophy. The BA chief maintenance engineer once spoke up at a company safety meeting at which I was present. The matter of hurt feelings and sensitivities was being bandied about. He said, with some exasperation: 'some of us sometimes have to be nasty to some of us.'

In the Chairman's column in Focus of Autumn 11 is titled 'The Right Attitude'. Tony Wride starts with comment on the fundamental issues, which can never be re-emphasised enough, and then refers to the AF447accident to an Airbus A330.

My mind goes back to arguments which were running through BALPA and IFALPA many decades back: 'Why are airliner cockpits not provided with clear angle of attack information?' The question still largely remains, yet angle of attack sensors are widely fitted.

Over nearly fifteen years, when I was conducting air tests for Flight International, I very rarely found this information to be missing as a supplementary fit in the flight deck of a test aircraft. Of course certification test pilots have to explore well beyond the normal flight envelope, but history shows that line pilots not infrequently find themselves in that situation too.

Awareness of attitude is not fully serviced by the primary flight instruments: do they display to the necessary precision? For example, the width of the target on the PFD of the A330 is about one degree, over a 2.5 degree scale, which equates to a variation in vertical speed of the order of 1,000ft/min in the cruise. (The Concorde ADI was graduated in single degrees between 20 degrees nose-up and 10 degrees nose-down.)

But the Report on the AF447 accident has not yet fully addressed two important issues, which relate in turn to pilot experience and training: the extreme final position of the horizontal stabiliser and the aerodynamic configuration which allowed the aircraft to enter a deep stall. Was it that the crew did not select Direct Law – to be able to use the trim wheels, and was it that the deep stall was not recognised? I am not in the position to pursue these questions, but what is the general potential for mishap on aircraft with a powerful stabiliser?

As ever, aviation safety is full of questions.

AN APOLOGY AND A CLARIFICATION FOCUS EDITION NO 84

Apology - Ryanair

The Editor wishes to apologise to Ryanair and its pilots for any distress or concern that may have been caused through the views expressed by the authors in relation to the Ciampino incident in their article 'Bird Strike Mitigation – Beyond the Airport', which was published in FOCUS Magazine Issue 84. The Executive Board of the UK Flight Safety Committee acknowledges that any comment on the actions of the crew involved prior to the publication of the final accident investigation report was premature and recognises that certain phraseology in the article could be interpreted as implied criticism of actions taken by the crew involved, which was not the intention of the Editor in publishing the article.

Clarification - The Increasing Risks and Dangers of Portable Electronic Devices on Commercial Aircraft

From my Editorial on lithium battery fires in portable electronic devices, I am grateful to Captain John Goodyer from Thomson Airways for pointing out that my comment that 'lithium and water do not mix well together' could be misleading. The CAA and FAA advice recommends the use of water extinguishers or, where these are not available, copious amounts of water, after the use of a Halon type extinguisher to put out a lithium battery fire in the passenger cabin when airborne. Although lithium metal from any split battery cells will react with water to cause bright flashes and small explosions, it is essential that any remaining lithium batteries are cooled down to prevent thermal runaway and further serious cell explosions and fire.

Rich Jones
Chief Executive and Editor
UK Flight Safety Committee

Mishaps and fuel for thought!

by Capt. Tony Wride, Monarch Airlines

Over 100 years ago the Wright brothers took to the air for the first time and so started the Aviation Industry. It wasn't long before they had their first 'mishap' and learned some valuable lessons which they subsequently applied to ensure a greater chance of success, and survival! As time passed improvements in aircraft design continued but 'mishaps' still occurred which invariably led to some major lessons being learned. Those lessons have been applied in order to make more improvements. Given that we have had over 100 years to learn the lessons from our predecessors 'mishaps' you would think that as an industry we would have learned everything by now and that 'mishaps' wouldn't happen anymore.

Unfortunately, as has been seen recently with the B767 wheels up landing, despite all the best efforts sometimes things just don't work and s**t happens! If we look back through history at the number of 'wheels up' landings that have occurred, due to mechanical failure rather than hostile fire, we would see that once aircraft began to be fitted with a retractable undercarriage initially the numbers were high until the engineers learned to design in backup systems, like gravity extension, so that the likelihood of a 'wheels up' landing, and therefore the risk, was reduced. If a Safety Manager was doing a Risk Assessment on the likelihood of one of the Company's aircraft ever having to do a wheels up landing he or she would most likely have put it in the Very Unlikely category therefore requiring no action. Equally of they had looked at the likely consequences of a 'wheels up' landing they would most likely have said extensive aircraft damage but no injuries.

Having watched the video of the B767 landing, and I have to say that the crew of that particular flight did an excellent job, there might be a temptation to reassess the likelihood and spend an inordinate amount of time and resources coming up with mitigations should the gear become stuck. However, this is where a realistic view has to be taken. How many other incidents, in relation to the thousands of commercial flights that happen every day, have occurred? To my knowledge this B767 incident was the first for a long time of an aircraft having to do a total 'wheels up' landing.

In this time of increased financial pressure, and Safety Departments having limited resources, the Safety Managers have to 'target' their activity to achieve as much as they can with the resources they have. But let's consider this. If on landing, the B767 had landed hard, broken up and caught fire killing a large number of the passengers, the lawyers would have been after the airline for huge amounts of compensation and one of the first things that would be asked is had a Risk Assessment been carried out! Therefore, can an airline afford not to do thorough Risk Assessments on just about every possible 'mishap'? A difficult argument could ensue but until the Airline Board realise just how exposed the Company could be and resource the Safety Department appropriately they are taking a Risk!

Whilst on the subject of Risk and the effect of the current financial situation on the industry, I have watched how Airlines have taken some quite drastic measures to reduce fuel costs. Just about every airline now has a fairly rigid 'Fuel Policy', has changed SOPs to try and minimise fuel burn including such things as having a lower Acceleration Altitude and a reduction in the contingency from 5% to 3%. Aircraft now arrive at their destination with very little, in fact almost no, extra fuel should any 'mishaps' occur. I fully understand the rationale behind introducing a fuel policy, it could be argued that if the industry is going to survive then such measures are vital, but I do wonder if by doing this we are setting up a section of the 'James Reason Cheese' that will be a factor in a future accident!

Let me explain my rationale. It is well known that there are Captains who would always carry some extra fuel above what the Flight Plan required, in fact some would take unrealistic extra amounts given the prevailing conditions at the destination with an associated additional cost for carrying that fuel. On the flip side we now have a breed of 'fuel saving' Captains who are actively 'shaving' the required figure back as much as possible which means that they arrive at destination on 'finals' with diversion fuel and not much more! What does this mean in terms of safety? Well my concern is that what this 'shaving' is doing is giving the crew even more pressure to land off the approach regardless, or face an immediate diversion. As the saying goes "There is no greater pressure than a lack of fuel pressure!" So what happens to that crew when at just above 1000ft they select the gear down and the extremely unlikely 'mishap' occurs? They have no spare fuel, they have to declare an emergency, go around to have time to try the alternate extension system but they are already eating into their diversion fuel. And what about the other aircraft expecting no delay to their arrival with more 'fuel shaving' captains who will have no option but to divert immediately?

Let me make one thing clear. I'm not advocating everybody carrying lots of extra fuel, just applying some caution to the practice of trying to cut back too much. We all have a duty to be realistic with how much fuel we carry if the industry is going to survive and if I was to point a finger at anybody it would be those Captains that have always taken the excessive amounts of extra on a regular basis. They are the ones who have wasted the most and almost forced Airlines to introduce strict fuel policies. Arguably fuel saving is not just the remit of pilots. Have you ever wondered as you look at the sky over Heathrow at several very large aircraft 'holding', how much fuel is being wasted?

In other news, although not a 'mishap' it is a safety event! Our excellent Chief Executive, Rich Jones, has decided to move on to greener pastures, if you can call the CAA that! Rich has been the driving force behind updating and progressing the UKFSC and we all owe him a debt of gratitude. I would like to thank him on behalf of the membership for all his hard work and wish him all the best for the future.

Cabin Crew Fire Training

by N J Butcher

In November 2006, the Royal Aeronautical Society and the Guild of Air Pilots and Air Navigators published a paper entitled: 'Smoke, Fire and Fumes in Transport Aircraft – Past History, Current Risk and Recommended Mitigations'

The Royal Aeronautical Society is now considering updating this paper to include a section regarding how the European Requirements for cabin crew fire training should be achieved.

Many of the issues to be addressed in this second edition are equally applicable to flight crew fire training. The aim is to provide guidance to operators, third party training organisations and instructors, and to identify advisory material. Recommendations made by Aviation Authorities and other safety related organisations will also be included.

The second edition of this paper will also identify the several initiatives conducting by Aviation Authorities and other aviation safety organisations.

The European requirements (EU-OPS 1) are not very specific as to how compliance with the requirements for fire training should be achieved. Little additional information is issued by EASA in respect of cabin crew fire training, although the UK CAA and the US FAA have both issued advisory material.

There are omissions in the requirements of EU-EU-OPS 1 Subpart 'O'. For example 'hidden' fires and restrictions on the use of circuit breakers are not specifically mentioned, although these are both critical issues and need to be addressed in cabin crew training.

Cabin crew fire training is usually delivered in full compliance with the requirements of EU-OPS 1 Subpart 'O'. However, it is possible that some operators and third party training organisations might be achieving less than is required, possibly due to a lack of understanding of how to implement the mandatory requirements.

Case studies are a useful tool in the training of in-flight fires and should be incorporated into cabin crew training whenever relevant.

Note: The requirements of EU-OPS 1 will in time be overtaken by the transition to EASA Part-OPS. However, the actual cabin crew fire training requirements in EASA Part-OPS are anticipated to be essentially the same.

Background

In the Bradford City football stadium disaster in May 1985, a fire totally destroyed one large spectator area. The fire, although quite small to start with, spread rapidly along the length of the spectator stand. It took less than four minutes for the entire stand to be engulfed in flames. There were 56 fatalities. The cause of the fire was probably a match or cigarette being dropped on debris that then ignited.

Bradford City Stadium fire – May 1985

If a fire on the ground with the potential for several different means of escape can be so devastating and with so many fatalities, how effectively would an aircraft crew deal with a serious in-flight fire?

An in-flight fire is one of the most significant and potentially catastrophic emergency scenarios that the crew will face. Prompt assessments and actions by flight crew and cabin crew will determine the outcome of the emergency. Failure to act immediately to a fire threat is likely to have fatal consequences.

If a fire does occur in any area of the aircraft accessible to the cabin crew during flight, the cabin crew will have to fight the fire whilst keeping the flight crew fully aware of what is happening.

DC-9 accident – Cincinnati June 1983

The flight crew will have to make rapid assessments of the situation and a decision regarding diversion to the nearest suitable aerodrome, or if flying over water, may as an absolute last option, have to decide on ditching the aeroplane.

According to the FAA, delaying the aeroplane's descent by only two minutes is likely to make the difference between a successful landing and evacuation, and a complete loss of the aircraft and its occupants.

Cabin crew must be able to deal with a fire/smoke situation immediately and aggressively, and locate the source of the smoke and/or fire as quickly as possible. Cabin crew will need to initiate fire fighting action immediately. Every second lost is likely to bring the situation nearer to disaster.

The flight crew will need to have accurate and concise information from the cabin crew as the situation develops, and cabin crew will need to be aware that the flight crew will at this time have a very high work-load. Cabin crew should be trained to communicate the essential information to the flight crew regarding an in-flight fire, so that the flight crew can make objective decisions as to an emergency descent and/or diversion. This should be reflected in both theoretical and practical training and specific procedures should be included in the operator's CCOM.

In recent years several initiatives have been undertaken by Aviation Authorities and other aviation safety organisations, and these include:

- US National Transportation Safety Board Review and Recommendations on In-flight Fires (2002);
- US Federal Aviation Administration Advisory Circular 120-80 (2004);
- UK Civil Aviation Authority Safety Plan of 2006/2007;
- Royal Aeronautical Society and the Guild of Air Pilots and Air Navigators Paper – Smoke, Fire and Fumes in Transport Aircraft (2006);
- UK Civil Aviation Authority Cabin Crew Fire Training Analysis (2009).

The time available to successfully deal with an in-flight fire is extremely limited – perhaps a fact that some cabin crew and flight crew are not fully aware of. This should be stressed during crew training and case study examples should be included to demonstrate the importance of the need for urgent action.

In AC 120-08, the FAA identified that the time for the situation to become non-survivable was as little as seven minutes, and that only 33% of events with 'hidden fires' would reach an aerodrome before the fire became uncontrollable. This issue is not addressed in any EU-OPS 1 requirement or in any EASA advisory material.

It is obvious that the speed and effectiveness of both flight crew and cabin crew actions are vital to a successful outcome of an in-flight fire event, although the importance of this is not always reflected in flight crew or cabin crew training.

Problems with achieving realistic fire training

It is widely recognised that the provision of realistic cabin crew and flight crew fire training presents many practical and logistical difficulties.

The Montreal Protocol prohibits the discharge of halon during fire-fighting training and removes the opportunity for crew to experience the discharge of halon on a live fire.

The size of a fire to be extinguished in practical training and the level of difficulty in extinguishing the fire are critical to achieving requirements for crew proficiency. A fire that is easily extinguished is likely to lead to a sense of false security and may not prepare the crew member for dealing with an actual in-flight fire event. Therefore, the size of the fire should present the cabin crew with an actual challenge in terms of extinguishing the fire, and also that fire re-ignition should be addressed in practical training.

Additionally, the type of fire extinguisher used in training may not adequately replicate the type of fire extinguisher carried in the operators' aeroplane. Also, the difficulty of initiation of discharge of the extinguishing agent is very often not included in practical training, and in many cases is not achieved by cabin crew as a demonstration of individual proficiency.

Some 25 years ago, during training, crew usually fought fires outside. These fires were usually quite large, and often visually challenging, as well as being difficult to extinguish with re-ignition being a major issue. However, it was decided that since such fires were not realistic to a cabin fire situation and the requirement was changed to crew fighting a fire representative of an interior aircraft fire. This has resulted in cabin crew now fighting fires of such a small size that extinguishing the fire provides little difficulty or challenge, and with no real degree of proficiency being demonstrated.

Training in the use of Protective Breathing Equipment (PBE) during practical training also presents problems. The vast majority of cabin crew will never remove PBE from its container or remove it from its sealed packaging, other than during an actual in-flight fire emergency. Most cabin crew will never don PBE which has a neck seal that fully replicates a live unit and therefore difficulty in donning such equipment is not effectively experienced.

Practical fire training - 25 years ago

The differing fire scenarios that cabin crew may encounter during flight is not always adequately addressed in theoretical and practical fire training. One major concern is the increase in the use of Passenger Electronic Devices (PED's) which are mainly powered by lithium batteries. Dealing with a lithium battery fire on board an aircraft presents several difficulties and it might be that cabin crew will be unaware of how to deal with such an in-flight fire event due to the lack of specific operational procedures and associated training.

Many operators and training organisations achieve the requirements for cabin crew fire fighting in separate training scenarios, with cabin crew extinguishing a fire without the use of PBE, and the use of PBE by cabin crew when not extinguishing a fire. This appears to be meeting the mandatory requirements with little consideration as to the probability of a serious in-flight smoke or fire event when both fire extinguishers and PBE will need to be used simultaneously, perhaps in conjunction with the use of other equipment such as fire gloves.

Logistically combining fire extinguisher training with PBE training is certainly feasible

Combining practical fire extinguisher training with practical PBE training since some operators and training organisations do combine both elements of practical fire training. It would seem entirely logical for the mandatory requirements to reflect the likelihood of an in-flight fire event when different items of fire safety equipment will need to be used at the same time.

Gas-powered fire training rigs are now quite commonly used. Usually the actual fire is controlled by the instructor. In the case of some fire training rigs, it is the instructor who actually turns off the gas supply thereby extinguishing the fire, rather than the individual cabin crew member achieving this. Therefore the standards applied by the instructor(s) must be consistent with the procedures and will need to be specifically defined in the Operations Manual. An additional consideration is the acceptability and legality of such a procedure whereby the cabin crew member has not actually extinguished the fire as required by EU-OPS 1 Subpart 'O'.

Items also to be addressed in the second edition of this paper will include:

- Effectiveness of cabin crew fire fighting procedures
- Hidden fires
- Electrical fires and lithium battery fires
- Communication and coordination
- Instructors
- Third party training
- 'Combi' Aircraft
- The cabin crew training requirements of EU-OPS 1 Subpart 'O'
- The US National Transportation Safety Board Review and Recommendations
- The US Federal Aviation Administration Advisory Circular – Number 120-80
- The UK Civil Aviation Authority – Safety Plan of 2006/2007
- The UK Civil Aviation Authority – Cabin Crew Fire Training Analysis
- Guidance on meeting the fire training requirements of EU-OPS 1 Subpart 'O'
- Case studies of catastrophic in-flight fires
- Case studies of non-catastrophic in-flight fires and smoke events
- Additional reference material

UK FLIGHT SAFETY COMMITTEE

APPLICATION FOR THE POST OF CHIEF EXECUTIVE

Applications are invited from experienced safety professionals for the immediate appointment to this post. The successful applicant will have a substantial career in aviation safety.

The UK Flight Safety Committee is an independent not-for-profit association of aviation safety professionals dedicated to the improvement of flight safety in the commercial aviation sector. The office is located at Fairoaks Airport near Woking in Surrey.

The Committee promotes and facilitates safety information exchange among our 100 Members through regular meetings, a dedicated website, a quarterly magazine and a Flight Safety Officers Familiarisation Course.

The successful applicant will be required to:

- Manage and motivate a small team and manage the annual budget
- Demonstrate a broad knowledge of all aspects of aviation safety
- Represent the UKFSC at aviation safety forums in the UK and worldwide

The successful applicant will also need to have:

- Strong people skills and confidence in speaking to large groups
- A command of the English language
- Sound writing skills with the ability to edit our FOCUS magazine
- The ability to plan and manage meetings, events and seminars
- A working knowledge of IT

Interested parties are invited to e-mail their application together with their Curriculum Vitae by **16 DECEMBER 2011** to: The Chairman, UK Flight Safety Committee at **admin@ukfsc.co.uk**. The final selection interviews will be notified and held at Fairoaks Airport in early January 2012.

TCAS RAs How to fly them and why it matters

by Alex Fisher, GAPAN

The last (at the time of writing) Eurocontrol ACAS Bulletin reported that in a recent study, only 55% of TCAS RAs occurring in the TMA were correctly flown, and the figure for en route was little better at 65%. This doesn't sound encouraging, but only 10 years ago, a similar study showed that none of them were flown right (see fig 1 from the 2002 ECASA study), so maybe the trend was encouraging. But maybe not, as the earlier study was looking at not only the vertical speed achieved, but the time it took to get there, I'm not sure the more recent study did.

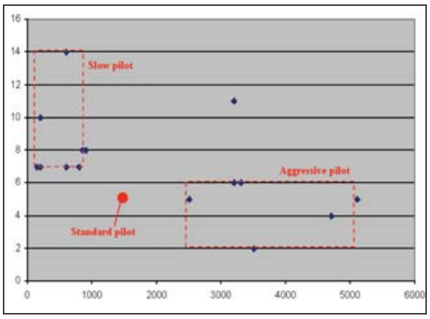


Figure 1: Delay (s) vs. Vertical speed (fpm)

As you can see, an admittedly small sample of pilots fell into two groups, aggressive and slow, straddling and missing what the TCAS designers were looking for in terms of response.

TCAS assumes:

- for a corrective advisory:
  – 5 seconds reaction time, followed by
  – 1/4g acceleration to satisfy demand.

- For enhanced advisories ('Increase...Or '...NOW'):
  – 2 seconds reaction time
  – 1/3g acceleration.

But does anyone know what 'x' g feels like and how to achieve it? Probably not, not even the test pilots, but there is a very simple way to achieve the right acceleration. Not only does this ensure that TCAS is used to its full potential, the right technique should give pilots who apply it the confidence to manoeuvre the aircraft secure in the knowledge that they won't ever plaster the passengers on the ceiling.

What do these acceleration numbers actually mean in terms we can understand? First, a little bit of arithmetic and school physics:

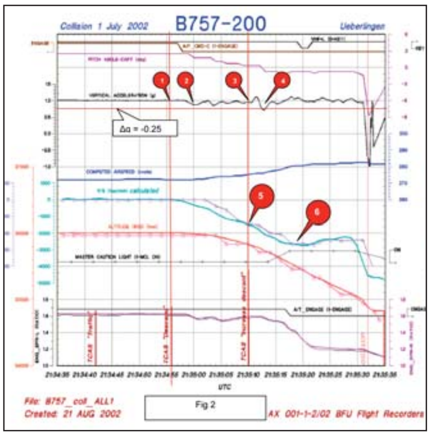
- 1g = 32 ft/sec/sec...so.
- 1/4g = 8ft/sec/sec = 480 ft/min/sec (i.e for every second you maintain 1/4g, your vertical speed will increase by nearly 500 ft/min).
- 1/3g = 10ft/sec/sec = 600ft/min/sec.
- To achieve +/- 1500 ft/min takes 3.3 seconds at normal rate.
- To achieve +/- 2500ft at enhanced rate takes 2 secs more.
- To achieve a 3000 ft/min reversal at enhanced rate takes 5 secs.

The last three figures are the important results, they tell you how long you have to reach the advisory rate. A few of you may have seen and remember the advice given in JAA TGL11, or the CAP it replaced, which were just about the only public documents to mention reaction times. Both are no longer current. They gave a figure of 5 seconds for the time to achieve the vertical rate. This was a deliberate simplification as it was felt that a 5 second reaction time to an RA was overgenerous given that there was a warning through the preceding TA, so we could 'borrow' a couple of seconds and assign them to the acceleration phase. As I hope will become clear, precision isn't important, a ball park figure is. Just how important is shown by a case study that must surely be familiar to everyone by now.

The Uberlingen Accident

At 2 am in clear night conditions, a Tu 154 and a B757 were converging at roughly right angles at FL360 in the Zurich FIR. Due to distraction, the single controller on duty noticed the conflict late, issued a descent clearance to the Tu 154 to FL350, and then returned to working another arrival into Friedrichshafen. The descent clearance coincided with the TCAS Climb RA to the Tu 154, which was coordinated with a Descend RA to the B757. Unbelievably (but sadly not by any means uniquely) the Russian crew elected to follow the ATC clearance opposite to the RA. Both aircraft started to descend at roughly the same rate. The fact that this was a coordinated RA is important; at the time this meant that TCAS was inhibited from issuing a reversal, telling the 757 to climb (the latest change to TCAS, 7.1, corrects this wrinkle). All it could do was to tell the 757 to increase descent, which it did, but not soon enough and the two aircraft collided at just below FL 350, the Tu 154's left wing hitting the 757's fin (An Enhanced Advisory, Increase climb, was also given to the Tu 154, but they were clearly not in listening mode).

FDR data (extracts) of the B757-200 (last minute)



Referring to Fig 2, the 757 recorder data:

1. TCAS Descend RA is received.
2. After a 2 second pause a modest decrease in g of about 0.15g is seen briefly. The average g decrement is less than 0.1g.
3. An Increase Descent RA is received.

4. There is an odd wobble in the g trace but it is clear than no sustained 0,33g is applied; the results are:-

5. 1500 ft/min is achieved 14 seconds after the start of the RA, and 12 seconds after the advisory is complied with.

6. The increased of 2500 ft/min rate is reached about 7 seconds later.

Clearly this reaction was a lot less than TCAS was expecting, and yet the Accident Investigators despite correctly listing the TCAS assumptions declared 'the crew had reacted correctly to the RA'. I beg to differ. This is not meant as criticism of the 757 crew; they performed as fig 1 showed, pretty much like many crews do, especially when asked to accelerate down (doubtless partly through concern about the safety of anyone not strapped in 'down the back'; in this case the flight was all cargo, but the co-pilot was not back in his seat at the start, so similar thoughts may have occurred to the handling pilot).

Altitude Deviation and Acceleration

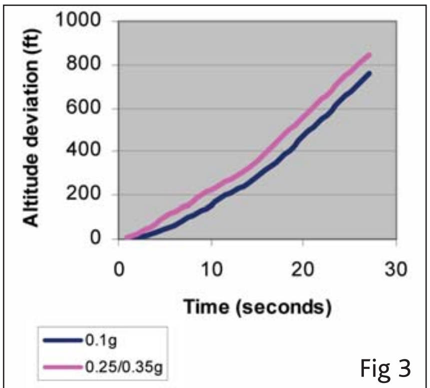


Fig 3

Does this matter? For an answer refer to fig 3. I have plotted altitude against time for two cases;

1. 0.1g acceleration to 1500 ft/min followed by 0.1g acceleration to 2500ft/min after the enhanced RA (approximates to the B757 reaction at Uberlingen).

2. 0.25g acceleration to 1500 ft/min followed by 0.33g acceleration to 2500 ft/min after the enhanced RA (what TCAS is expecting).

The results are not dramatic at first sight; the more aggressive response results in about 80ft more altitude change in the first stage, increasing to about 100ft after the strengthening of the RA. But just consider, TCAS is only 'shooting' for 400ft clearance, slow reaction wastes a quarter of it. And the Tu154 only clipped the 757's fin, the effect of that extra 100ft would have been no accident. Of course extra clearance could have been achieved if the 757 crew had the ability to instantly work out what was happening and gone for an increased vertical rate at any time, preferably early on, but this misses the point, slow reactions risk miss distance. Period.

But what if your aircraft doesn't have such a display but is equipped with a 'TA/RAVSI', or is a current Airbus without an EFIS presentation of required attitude to comply? A little more thought is needed. You could simply try to 'drive' the VSI to the right value, but this isn't ideal, there are lags even in an 'instantaneous' VSI, and in some aircraft the scale is less than ideal.

The answer is to think

TA = Traffic Advisory = **Think Ahead** = Think Attitude

In other words, to react to any subsequent RA, think what attitude change will be appropriate, and the time to do that thinking ahead when the TA is announced.

In cruise, the most an initial RA will demand is a climb or descent of 1500ft/min; the attitude change in degrees, $\triangle$p, to achieve that is given by: $\triangle p° = 1000/TAS(kt)$

You don't need to be wizz calculator, if you prefer, think of the following table:

To achieve 1500ft/ min change in V/S:

Condition	TAS kt	$\triangle$ pitch°
Cruise	500	2
Hold	230	4-5
Final	150	7

Use this as the target initial attitude change, and then adjust to get the vertical speed right. The sequence is shown in the next figures.

Proper Reaction to RAs

The preceding section has shown the time available to achieve the RA and the consequences of not doing it. But that still doesn't tell us how to achieve those rates reliably and with confidence.

If you are flying an aircraft with an RA display such as the Boeing/Honeywell one shown in fig 4, nothing could be simpler. When the RA appears, start the indicated adjustment and count slowly up to 4 or 5; at the end of that time you should be looking at the picture on the right and you will have achieved around 0.25g in the process.

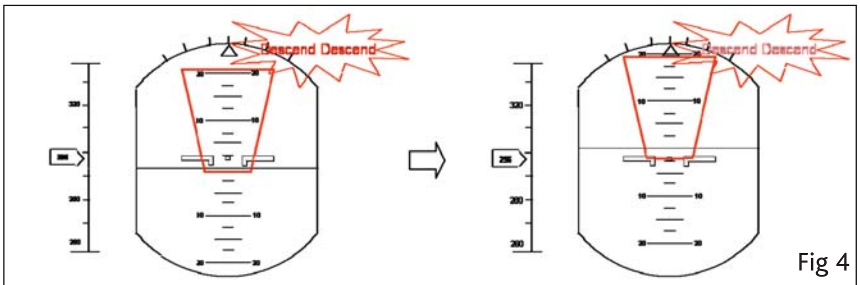
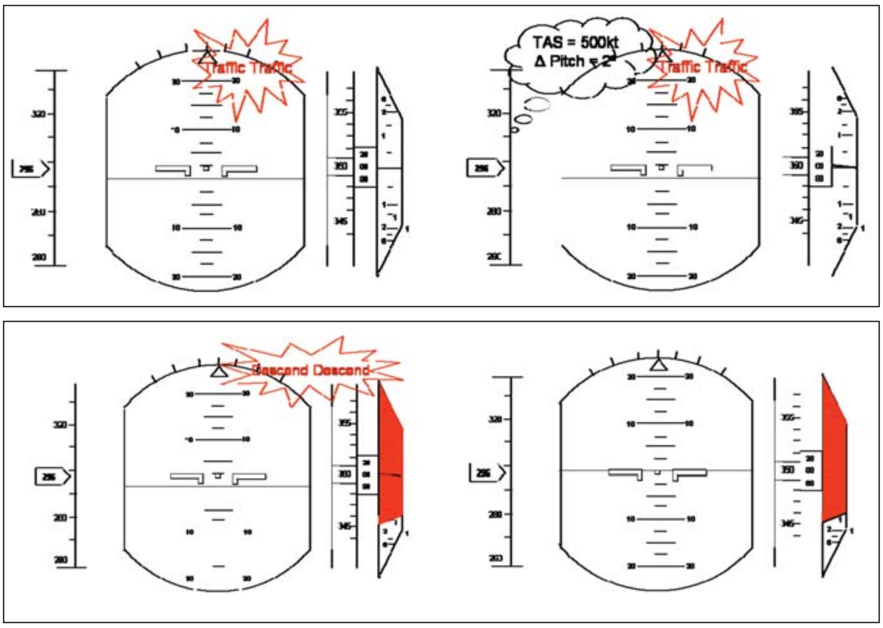


Fig 4



Conclusion

Proper reaction to an RA is important. Getting the right vertical speed in the right time gives TCAS the best chance of a successful resolution, while minimising the chance of disturbance in the cabin.

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Sliding Away

by David Thomas

Despite wet snow on the runway, the A321 crew expected normal winter landing conditions.

On the evening of March 26, 2006, an Airbus A321 operated by My Travel Scandinavia was involved in a serious landing incident at Sandefjord Airport Torp in southern Norway. Although damage was minimal, the aircraft stopped about 65 degrees off the runway heading with the nose-wheel against the concrete base of an antenna and the right main wheel approximately 2m (7 ft) from the end of the runway.

This crew's experience illustrates the problem of detecting and describing braking action on contaminated runways that has become the subject of significant discussion.

During the preflight preparation for the midday departure from Tenerife, Canary Islands, Spain, crew members had received a company briefing pack containing a snow notice to airmen (SNOWTAM) indicating that the runway at Torp was wet with good braking action, and a terminal area forecast calling for snow with deteriorating visibility as the afternoon progressed.

Just before descent, the automatic terminal information service indicated that the runway was dry with pod braking action and visibility was 2.5 km (1.6 mi) in light snow. There was broken cloud at 500 ft, the temperature was minus 2 degrees C (28 degrees F), and the dew point was minus 3 degrees C (27 degrees F). Although the wind, from 030 degrees at 6 kt, marginally favored the nonprecision approach to Runway 36, the instrument landing system approach to Runway 18 was in use. On descending through Flight Level 100 (approximately 10,000 ft), an additional 5 kt was added to the approach speed based on a formula that took into account the icing conditions.

As the aircraft descended, snow began to settle on the runway. Three minutes before landing, the air traffic control tower informed the crew that the runway was contaminated with 8.0 mm (0.3 in) of wet snow and the friction coefficients indicated medium braking. A glance at the actual landing distance (ALD) figures in the quick reference handbook indicated that the 72-tonne (158,733-lb) aircraft would require an ALD of 1,812 m (5,945 ft), with maximum manual braking after touchdown. The landing distance available (LDA) was 2,569 m (8,429 ft).

The aircraft touched down softly 357 m (1,171 ft) beyond the touchdown point, and both the reversers and spoilers were promptly deployed. The captain thought that the autobrake had disarmed because of the lack of braking action. Eight seconds later, the first officer applied full manual braking and shortly afterward, when they still were unable to feel any braking action, the captain took control and applied the parking brake. The aircraft was still decelerating as it approached the end of the runway. The first officer indicated that the terrain looked more even to the left of the runway, and the captain responded by turning the nosewheel steering toward the left.

The first assumption one might make after reading this brief account is, considering that the crew touched down 357 m down the runway, the incident must have been the result of a mishandled approach and landing. Case closed or not?

The aircraft had been slightly above the glideslope below 250 ft, crossing the runway threshold 10 ft high and carrying an extra 5 kt for icing; the extra speed might not have been necessary. These deviations can be easily understood considering the short notice to the crew about the change in runway condition and the crew's mindset of medium braking action. In normal line operations on a dry runway, both the extra height and the extra speed would have been insignificant.

The flight data recorder indicates that the autobrake was armed but may have been disengaged accidentally. Aerodynamic braking and engine reverse produced a deceleration of 0.16 g, increasing to 0.20 g when manual braking was applied at 110 kt.

In calculating landing performance using Airbus tables, 8 mm of wet snow was considered equivalent to 1/4 in of slush. Airbus takes into account contaminant drag and uses varying effective Mu[1] (friction) values that are groundspeed-dependent for fluid contaminants. It is, therefore, difficult to establish an equivalent average aircraft braking coefficient (ABC) value.

In contrast, Boeing does not consider contaminant drag and uses an average (groundspeed-independent) ABC value for each contaminant.

Below 110 kt, the ABC was approximately 0.05; this reduced to 0.04 after the parking brake was set at 70 kt and the wheels locked. If Airbus used the same methodology as Boeing, the crew would have been aware before touchdown that 8 mm of wet snow corresponds to an average (groundspeed-independent) ABC value of 0.05 - associated with poor braking action. Why did such a recently completed runway friction test suggest the braking action was medium?

After landing on a snow-covered runway in Torp, Norway, the A321 stopped with its nosewheel against an antenna's concrete base.

The airport's winter regulations in 2006 said that it was a priority to offer a runway free of snow and ice and that when runway friction decreased below poor, the affected areas were to be dosed until satisfactory braking action could be re-established.

Both Airbus and Boeing support the view that friction readings from ground friction-measuring devices may not represent actual ABC. In a number of countries, friction-measuring devices can only be used on compacted snow and ice or on a bare runway. The Accident Investigation Board Norway (AIBN) has highlighted the uncertainty of friction measurements from friction measuring devices. Their findings suggest tolerances on fluid contaminants of plus or minus 0.20; on dry contaminants, tolerances are plus or minus 0.10. The friction-measuring device used at Torp was certified for use only in up to 3.0 mm (0.1 in) of wet snow. However, considering the fluid contaminant tolerances, this was not seen as a contributory factor.

The unreliability of ground friction-measuring devices is not the sole reason for the incorrect braking action report. Other factors are the air temperature and dew point. The AIBN has investigated 30 incidents and accidents that occurred on contaminated runways over the last 10 years and has highlighted a number of coinciding factors. The most common - evident in 21 of the 30 occurrences - was a difference of 3 degrees or less between the air temperature and the dew point.

The narrow temperature-dew point split indicates that the relative humidity of the air mass will be at least 80 percent. Given these conditions, with an air temperature at or below freezing, the air mass immediately above the runway surface is close to, or at, saturation, causing freezing on contact with the runway surface.[2] This phenomenon was derived from findings by the AIBN and is referred to as the 3-Kelvin- Spread Rule. The AIBN has concluded that poor braking action often is associated with moist low-level atmospheric conditions. Although the rule is not an absolute, it is a good indicator of hazardous conditions. It is likely that at Torp, the lower layers of wet snow had frozen to form ice on the runway.

Four years after the accident, have things changed?

As a result of a Dec. 8, 2005, runway excursion accident involving a Southwest Airlines 737-700 at Chicago Midway International Airport (ASW, 2/08, p. 28),[3] the U.S. Federal Aviation Administration issued Safety Alert for Operators 06012 and a related advisory circular. The agency also formed the Takeoff and Landing Performance Assessment (TALPA) Aviation Rule-Making Committee. Although the committee's recommendations have not been adopted, a primary provision is the runway safety matrix, designed to produce a standardized reporting method, developed from different types of surface condition reports and aircraft data.

Airbus released a letter in mid- 2010 advising operators to add safety margins to its ALDs, in line with the committee's proposals. As an interim solution, Airbus has settled on a plan to factor its ALDs to calculate an operation landing distance (OLD), which is designed to reflect the actual performance achieved by a line pilot.

If the TALPA matrix had been available for use on the evening of the Torp runway incident, the crew would have factored their 1,812 m ALD to obtain an OLD of 2,563 m (8,409 ft) - 6 m (20 ft) less than the LDA. 9

David Thomas is a captain with a major U.K. airline.

Notes

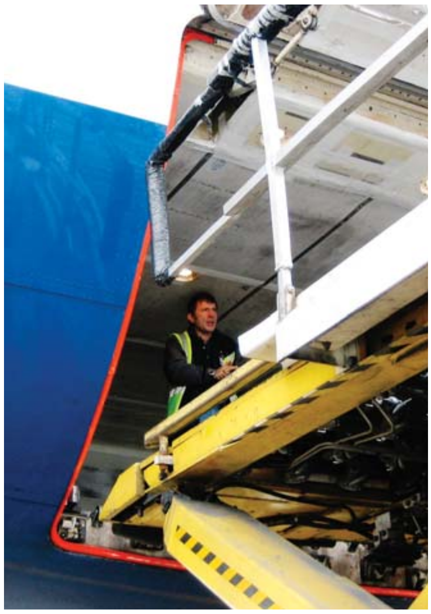
1 Airbus uses the term effective Mu, while other manufacturers, including Boeing, use ABC, referring to the percentage of the airplane's weight on the wheels (W-L), which is converted into an effective stopping force. For example, an airplane with a W-L of 100,000 lb (45,360 kg) would create 20,000 lb (9,072 kg) of stopping force for an ABC of 0.20. ABC depends on tire pressure, tire wear, aircraft speed, aircraft weight and anti-skid system efficiency.

2 Water vapor can change to ice without becoming liquid. This is likely if the air is saturated and is cooled below the freezing point. The process is known as sublimation.

3 As it skidded off the runway, through an airport fence and onto a road, the 737 struck two cars, killing one passenger. Another occupant of a vehicle received serious injuries, and three others received minor injuries. Of 103 people in the airplane, 18 received minor injuries. The U.S. National Transportation Safety Board said the probable cause of the accident was the flight crew's failure to promptly apply reverse thrust. The pilots were distracted by the airplane autobrake system, which they had not used before, the NTSB said.

Heavy Metal Front Man Ramps Up Industry Loading Awareness

by UKFSC Focus Magazine Article – Winter 2011



Astraeus Airlines Captain and legendary Iron Maiden front man, Bruce Dickinson, is the presenter of a brand new flight safety production. *Safety in the Balance*, which is available free of charge, is part of a joint initiative by the Civil Aviation Authority (CAA) and the UK aviation industry to highlight the importance of safe and accurate aircraft loading.

The DVD, which was released during the summer of 2011, was commissioned by the Ground Handling Operations Safety Team (GHOST), a CAA/ industry group committed to develop strategies to mitigate the safety risks from aircraft ground handling and ground support activities. The group is made up of representatives from UK airlines and airport operators.

Jason Sandever, the CAA's Aircraft Loading Inspector, was the focal point of the project. "It was clear we needed to make something that was not only engaging but also related directly to the target audience. Having worked within the ramp environment, I knew we had to do something a bit different." When it came to deciding who would be asked to present the film, Bruce was the obvious choice. "Having seen him in action in another aviation mini-series and knowing that he was a keen enthusiast, I could think of no-one better." In addition to his line flying, Bruce is also a qualified Crew Resource Management Instructor.

The team then secured the services of some enthusiastic film tutors and students from Exeter College, who throughout 2010, shot scenes at a number of locations including London Heathrow, East Midlands and at Oxford Aviation's Crawley Simulator. Jason said: "The footage jumps deliberately from various locations and aircraft as we wanted to involve as many airlines, ground handling agents and airports as we could. So, viewers shouldn't get cynical when they see Bruce go up the stairs of an Airbus A340, through a Boeing 747, down the steps of a Boeing 757 and into the cargo hold of an Airbus A321. It was meant to happen like that!"

The film is not intended to replace the need for formal training, rather to compliment it. the general consensus of the GHOST team was that whilst the majority of current training does cover what to do and how to do it, the reason why is often missed.

For Jason, as an ex-Loadmaster, the importance of accurate aircraft loading was brought home in no uncertain terms in the late 1990s, when he was involved with an accident that was the direct result of a gross loading error. Both the crew members on board were killed in the accident. "Once you have experienced that kind of thing, you are left in no doubt that the worst case scenario can and does happen. Sometimes the challenge can be trying to make others believe that the outcome can be more than a paperwork error. It is so important that everyone involved is aware of the potential consequences," he said.

All who watch the film should indeed get an overview of just why it is so important that aircraft are loaded according to a plan, both for cargo, baggage and passengers. Any changes to the load must be reported to the appropriate person and all loads must be restrained. Whilst new and existing ramp

personnel are the obvious target audience for the film, it is hoped airlines and airports will screen it for other staff including, dispatch personnel; local and centralised load planners; airline and agent representatives; cargo warehouse employees; commercial departments; airline management; and of course flight deck and cabin crew.

Since the release of Safety in the Balance in mid June, there have been requests for copies of the DVD from various Training, Safety and Standards Departments around the globe. That's in addition to the worldwide distribution provided by UK based Airlines and Ground Handling Agents. Some of the more interesting requests came from locations such as Hawaii, El Salvador, Greenland, Alberta and Airbus Flight Operations.

Feedback received has shown that Bruce and the team have managed to successfully complete a product that is not only educational but also enjoyable to watch. However, all involved are very aware that the DVD alone will not change an industry wide problem overnight - so will no doubt remain busy!

As well as the benefit the DVD will bring to those involved in the loading process, the project also brought together many people from different organisations, in many cases forging strong working relationships which the CAA hope will help to improve safety standards in the future.

Safety in the Balance was only made possible with the assistance and continued support of the organisations and individuals involved. It is available on DVD, please contact jason.sandever@caa.co.uk for details.

Photographer John McMurtrie / © Iron Maiden Holdings 2011

Preventing Landings Without Clearance

A great many reports to NASA's Aviation Safety Reporting System identify pilots' failure to obtain clearances prior to landing. How to prevent Landings without Clearance ?

This reporter's experience is typical:

I was the pilot flying on an IFR approach into MEM for runway 36R. My Captain was in communication with Memphis approach control. They told him to contact the tower at the outer marker. The weather was IMC and when we arrived at the marker, we were in the process of making final landing configuration of our aircraft. The Captain forgot to call the tower, and we landed the aircraft safely and without a conflict with another aircraft, on runway 36R.

Fortunately, most incidents like the above do not result in traffic conflicts or other hazardous consequences. However, their potential for a breach of safety is high. So that we could better assess the factors contributing to landing-without-clearance events, we analyzed a small number (37) of ASRS reports and identified areas where safety improvements might be possible.

Contributing Factors

Procedural, workload, and memory factors appeared to be the main contributors to the group of ASRS landing-without-clearance incidents.

Pilot Not on Tower Frequency

Pilots landing without clearance were often on a frequency other than the tower frequency.

Of the 34 pilot reporters who mentioned the frequency they were using when they landed, 25 said they were on approach frequency, while only eight were on tower frequency. Of the eight reporters who did change to tower frequency, five made initial contact with the tower but did not receive landing clearance. Nine of the 37 reporters stated they had never received a frequency change.

This finding has important safety implications. If an aircraft is not on tower frequency, the tower will not be able to contact it directly should a go-around or other safety-related action be necessary.

Also, pilots who land without changing to tower frequency, as instructed, could be in violation of a Federal Airworthiness Requirement (FAR), which requires aircraft operating into airports with an operating control tower to establish two-way radio communications with the control tower (unless aircraft are not equipped for two-way communications).

High Workload

Twenty-one reporters implied that their workload was high during approach. The reporters' sources of workload were varied - some were in a training situation, and some were busy coping with weather conditions, as on this approach:

During approach to CLE we were on vectors to intercept ILS 28 at 3000 feet, which we did. We began to encounter precipitation, freezing rain and snow. We were cleared for the approach and to contact tower at PARMA. As we approached PARMA we were told to keep 170 knots to PARMA. Our bug speed was 121 knots. Approaching PARMA LOM we began to experience light turbulence. Our airspeed dropped by 20 knots and gained 30 knots maximum. The glide slope intercept moved very fast to center of bull'seye with over 1000 fpm descent to stay on glide slope. There was also 20 degrees of crab and fluctuation to stay on localizer. This was very distracting to us and to other aircraft on approach. We placed a lot of concentration on maneuvering the aircraft on the glide slope and localizer and failed to change over to tower at the marker ... After we touched down we realized we did not switch to tower frequency for landing clearance.

The large number of incidents citing workload factors suggests that when workload is high, pilots should exercise additional caution to verify that landing clearance has been received.

Forgetting to "Contact the Tower at the Marker"

Another pattern in the 37 reports was the likelihood of pilots' forgetting to contact the tower if they were told to do so in advance. Nine reporters indicated they were told to "contact the tower at the marker", sometimes as far as 20 miles out. Seven of these never switched to tower frequency (in the other two reports it was not stated whether a frequency change occurred).

The following example was typical:

My First Officer and I were returning from Harlingen, Texas to Austin, Texas on our tenth and final leg of the day. We logged eight hours that day of flight time in rough weather (thunderstorms, turbulence, and occasional windshear). Austin approach control cleared us for the ILS 31L approach to Austin Mueller Airport while we were approximately 10 miles outside the marker and instructed us to contact tower at the OM... After landing and turning off the runway, I noticed that we were still on approach control frequency and had forgotten to contact tower at the marker.

Confusion Over Phraseology

Pilots' confusion over phraseology may be an additional factor in their failure to contact the tower. Some pilots may mistakenly believe that the instruction "contact the tower at the marker" means they are supposed to change frequency immediately, but not call the tower until they reach the marker. This misunderstanding may result in their leaving the approach frequency prematurely and being unavailable for contact if the approach controller needs to issue other instructions.

The Airman's Information Manual explains the proper procedures for complying with frequency changes:

"When instructed by ATC to change frequencies, select the new frequency as soon as possible **unless instructed to make the change at a specific time, fix, or altitude**. If you are instructed to make the frequency change at a specific time, fix, or altitude, **monitor the frequency you are on until reaching** the specified time, fix, or altitude unless instructed otherwise by ATC". [ASRS emphasis in bold type.]

SOME ATC CONSIDERATIONS. One suggestion for decreasing the number of landings without clearance came through loud and clear in the ASRS reports we reviewed. Pilots suggested that controllers not give the change to tower frequency until they want it to occur.

These reports were typical:

Landed on runway 26R in A TL without clearance. Cleared visual 20 miles out told to contact tower at marker. It seems this is the only phase of flight in which you are passed to another controller and told to contact them at a different time... If approach control wants you to contact tower then it should be at the time of transmission or the flight crew should be told to switch by the approach controller when it is required.

In summary, I feel we were led into a trap by giving us an automatic change-over to tower at marker, which reduced approach controller's workload, but also increases the pilots, especially in those types of conditions [dark and stormy night].

Approach controllers we talked to while preparing this article told us they have several reasons for giving the instruction to "contact tower at the marker". One is to maintain an optimal arrival traffic flow. If the change to tower occurs too early (prior to the marker or final approach fix), tower controllers may slow incoming traffic or issue other instructions that disrupt the approach facility's arrival spacing, especially in busy terminal areas.

Also, if the approach controller delays issuing the frequency change to tower until an aircraft actually reaches the marker, frequency congestion may make it impossible to complete the change to tower in a timely way.

For many controllers, then, the phraseology "contact tower at the marker" accurately represents the point at which they need the frequency change to occur.

Techniques for Prevention

Our analysis of ASRS incidents led us to the conclusion that the best safeguard against landing without a clearance is to develop procedures to ensure that a frequency change has taken place and landing clearance has been received. As these reports show, it is not advisable during a busy approach for pilots to rely on memory to determine whether they have been cleared to land.

Create a Visual Reminder - and Check It

Some pilots have developed an effective technique of performing a positive action that creates a visual reminder that is checked as part of their landing procedure. All three of these elements reduce the likelihood of landing without a clearance. For example, some pilots leave one of the taxi lights off until landing clearance is received. They put the light on when the clearance is received, giving them a visual reminder, the switch position. They then visually check that the light is on as part of the landing checklist.

Another technique is to combine a visual reminder with an audible confirmation of tower frequency. When the landing checklist calls for "cleared to land", the pilot-not-flying (PNF) visually checks the communications radio to ensure that the correct tower frequency has been set, then verbalizes, "cleared to land [specific tower frequency]".

In order for any reminder to work, that final check has to be performed. Several reporters learned this the hard way:

Since the incident I have adopted the technique of mentioning "cleared to land" on final gear and altitude call out.

I flew the ILS to 26L and all checklists were completed normally. At 500 feet I called "30 flaps, final setting (normal procedure), cleared to land?" The First Officer and Second Officer verified 30 degrees flaps and said nothing more. I thought I had heard a clearance to land so did not question the First Officer again. I landed... Approach control answered and we realized that the First Officer had not switched to the tower at the OM... Switching to the tower at the marker is so routine it never dawned on me that the First Officer might not have done it... In the future I will say "are we cleared to land?" instead of merely saying "cleared to land?" Since the incident the company has added a "cleared to land" check on the 1000 foot call out.

Change to Tower at a Fixed Point

Another way for pilots to stack the deck in their favor is to develop a habit of always checking that they are on tower frequency at a fixed point, such as at the outer marker or when completing the landing checklist. A fixed altitude may also be the landing clearance reminder, as this reporter notes: "In future I will check at 1000 foot AGL that we are on tower frequency". If a pilot reaches this pre-determined fixed point and has not yet been instructed to change to the tower frequency, a request to approach control to change frequency is recommended.

Even pilots who routinely use this technique can forget to change frequency if they allow distraction or complacency to interfere.

I always go to tower and call at the final approach fix, but was still doing checklists and then became too pre-occupied with the approach. I missed that part of my approach habit pattern.

Conclusion

There are no fool-proof techniques we know of to prevent landings without clearance. But fewer of these events are likely to occur if pilots adopt techniques that will help them remember during busy approaches to "tune in" to the tower and verify that they have received landing clearance.

Reprinted with kind acknowledgement to Smart Cockpit.com/Ludovic Andre

A Dark and Stormy Night - and 90 Seconds to Disaster

by Macarthur Job

Shortly after taking off at night in rain and thunderstorm conditions from Douala, on the Cameroon coast in West Africa, a Boeing 737 entered an increasing, uncorrected bank. Responding erratically when the bank angle warning sounded, the captain precipitated a spiral dive. Both pilots were still wrestling the controls when the 737 plunged into a swamp and disintegrated, killing all 114 aboard.

The flight

(Reconstructed from flight data and cockpit voice recordings)

Operated by Kenya Airways, the Boeing 737-800, registration 5Y-KYA, was making a scheduled flight from Abidjan on the Ivory Coast to Nairobi, Kenya, on the night of 5 May 2007, with a one hour en route stop at Douala, Republic of Cameroon. The departure from Douala was scheduled for midnight local time, but because of heavy rain, was delayed. Just before 0100 hours, the aircraft was cleared to taxi for Douala's Runway 12. Its airways clearance, passed while taxiing, was direct to Nairobi at Flight Level 370. The first officer was conducting communications with the tower, but when ready for take-off, the captain intervened to request the tower's approval to maintain an initial heading slightly to the right of the runway heading because of rain and thunderstorms ahead.

Without waiting for the first officer to obtain a clearance to do so, the captain began the take-off with five degrees of flap set. The undercarriage was retracted after lift-off, and with the aircraft showing a tendency to roll to the right, the captain maintained a wings level attitude with left aileron. At 1000ft the captain called 'Heading select', and the first officer responded, 'Select checked,' indicating the captain performed the selection himself.

Over the next 55 seconds, there was no control input at all. The crew's attention could have been on the weather radar display because of their proximity to thunderstorms, but at this stage the autopilot was not engaged. With the aircraft still tending to roll to the right, its heading increased in that direction, which happened to be the captain's initial intention.

Although deviations in pitch and speed were also increasing, the first officer made no monitoring calls, confining his efforts to adjusting the heading selector knob to accompany the uncontrolled heading changes.

The captain, wanting his autopilot engaged, then called 'OK, command.' Although its engagement was not confirmed by the first officer, or by the flight mode annunciator, or by the behaviour of the aircraft itself, he assumed it had engaged. It is possible that activation of the aircraft's speed trim as the airspeed increased, could have reinforced this impression. The Flight Data Recorder indicated a slight control column pressure just as the captain called 'OK, command', so it was possible the selection was made, but that pressure on the column interfered with the autopilot's engagement.

As the aircraft climbed through 2400ft at 180kt, both pilots carried out the required change in altimeter setting, still not noticing the deteriorating flight parameters. Yet these were plainly visible on their electronic attitude director indicators, from which they were both reading the altimeter settings.

The captain still seemed unaware of the aircraft's changing attitude but as the bank angle passed 35 degrees he uttered an expression of surprise just before the bank angle warning sounded. Grabbing the controls, he mistakenly applied right aileron, further aggravating the bank.

The flight data recorder showed the 'Command A' autopilot (i.e. the captain's autopilot) was then selected, probably by the captain himself, engaging the control wheel steering roll and level change modes. Over the next five seconds, the confused movements of the control wheel diminished and the bank angle stabilised at 50 degrees.

But the captain was evidently not comprehending the autopilot's correction, for he resumed his confused control manipulation, forcing the autopilot to switch to control wheel steering pitch mode. His inputs were mostly to the right on both control wheel and rudder pedals, further aggravating the situation, and he cried out in alarm, 'We are crashing!' This was echoed by the first officer, the captain exacerbating the situation with a prolonged input of right rudder.

As the aircraft's angle of bank passed 90 degrees, it suddenly pitched down and entered a spiral dive. The first officer called to the captain to level the wings to the right then, hastily correcting himself, insisted desperately, 'Left, left, left, Captain!

At this point the flight data recorder showed confliction in the controls, with the captain applying right aileron and nose-up elevator, while the first officer was correctly trying to apply left aileron and nose-down elevator.

But the first officer's belated attempts to recover the situation came much too late. Spiralling down steeply, the Boeing plunged violently into the mangrove swamp to the south-east of Douala Airport, exploding on impact.

Investigation

The site of the crash, a relatively short distance southeast of the end of Runway 12, was located at 0730 next morning in an extensive low-lying mangrove swamp on the northern side of the Dibamba River, close to a wide inlet on the Gulf of Guinea. Because of the inaccessible nature of the swamp, it proved extremely difficult for investigators to examine the wreckage.

The aircraft had impacted at a descent angle of about 50 degrees while steeply banked to the right, forming a crater five metres deep. Trees were knocked down and mud flung in all directions for up to 30m. None of the pilots' remains could be identified, but 86 of the other victims were identified by DNA analysis and another four by fingerprinting.

With the exception of the flight data and cockpit voice recorders, none of the recovered wreckage was subjected to detailed technical examination.

The flight data recorder was found on the surface of the swamp with only slight external damage, but with its underwater locator beacon units torn off. Finding the cockpit voice recorder posed a more complex problem.

Pumps were used to drain the water-filled crater, and with the aid of an acoustic pinger receiver flown from Boeing in the USA, the recorder's motherboard, battery pack, underwater locator beacon, and finally memory module were progressively found. No major difficulty was encountered in reading out either of the recordings.

The Airport

Douala International Airport, elevation 10 metres, lies just over two nautical miles south-east of the city. Its single Runway 12-30 is 2950m long and equipped with highintensity lighting, approach lighting, a VOR DME, and a Category 1 instrument landing system. The airport also has an NDB.

The Aircraft

The Boeing 737-800 was less than a year old, had flown only a little over 2000 hours, and was fully serviceable for the flight. Its weight at the time was 10,000kg less than the maximum permissible, and its centre of gravity was within the correct range. Its maintenance had been carried out in conformity with an approved maintenance programme.

Some differences existed between the B737-700 and B737-800 flight instrument displays. Because company pilots were flying the 700 and 800 concurrently, the differences could possibly affect interpretation during an instrument scan. The position of the autopilot command (CMD) indication in the 700 was also different from that in the 800.

The Crew

The captain, aged 52 years, had a total of 8682 hours flying experience, of which 3464 hours were command time, including 823 hours as a 737 captain. As well as Boeing 800s, he was qualified to fly Boeing 737-300s and 700s, and the Airbus A310-300. He was familiar with the air route, and properly rested beforehand.

The captain flew as a first officer on B737-300s for two years before being assessed in 2002 for command. The check pilot considered the assessment unsatisfactory because of poor knowledge of systems, including the autopilot, and insufficient monitoring of the flight mode annunciator. Training reports mentioned difficulties in adherence to procedures and cockpit scanning. His initial B737-300 command check was inconclusive, calling for a second flight. He passed a final command check by a different check pilot.

After he received his initial B737 rating in 1997, he demonstrated 'recurring shortcomings' – deficiencies in crew resource management, knowledge of aircraft systems, operating procedures, cockpit scanning, situational awareness, and decision making. His performance was found to be unsatisfactory during proficiency checks, and he was required to undergo further training.

During later recurrent training, an instructor urged him to be more attentive to checklists and aircraft limitations, be systematic in responding to system failures, and more consistent in briefings and adherence to standard operating procedures. A 2004 training session resulted in recommendations that he take time to analyse system failures and to discuss them with his first officer.

A 2005 line proficiency check cited deficiencies in the captain's command ability and teamwork and knowledge of aircraft systems. He also tended to be 'overbearing'. A 2006 line check found the captain's performance below standard, requiring a further line check.

A proficiency check only three months before the accident revealed deficiencies similar to those found in earlier checks. He nevertheless passed the check. The captain had undergone CRM training courses, but his proficiency checks repeatedly revealed he had difficulty in crew coordination.

The first officer, aged 23, had held a Kenyan commercial pilot's licence for 18 months and had a total of 830 hours flying experience, including 170 hours on type. Trained in South Africa, where he obtained his commercial licence, he failed his initial instrument rating test, but was successful on his second attempt. The same thing occurred during his radio telephony tests.

Assessments during his training as a 737 first officer in 2006 included requirements for improvement in crew coordination. Progress reports showed he was not monitoring and calling out deviations by the pilot flying; not monitoring the autopilot when engaged, and 'lagging behind the aircraft'. His situational awareness and radiotelephony procedures also needed to be improved and he needed to be less tense in carrying out procedures. His overall performance during training and subsequent checks was nevertheless considered satisfactory. He had logged 113 hours on the Boeing 737-700 and 57 hours on the 737-800, and had flown into Douala twice before.

Operational Procedures

Before starting, the captain used a wrong aircraft call sign. The aerodrome controller clarified the confusion after about 15 minutes. Communications with ATC were then conducted by the first officer up to the point where he read back the airways clearance and said he would call back for a take-off clearance. But just before takeoff the captain intervened to request a modified airways clearance because of the meteorological conditions ahead, and the aircraft took off without a clearance.

Weather conditions at the time of the take-off were stormy, with numerous thunderstorms, heavy rain showers, a low ceiling, and little wind. The night was completely dark, with no external visual references available once the runway was left behind. In the face of these disquieting conditions, a special weather briefing was required before take-off.

The Boeing crew had received a meteorological forecast, but did not request any verbal briefing. Preoccupied by the adverse conditions, they used the aircraft's radar while on the apron and during taxiing to analyse the meteorological situation on their departure route.

Once aligned on the runway, they again used the radar, choosing a trajectory that would avoid the worst of the weather after becoming airborne. They were therefore aware of the meteorological situation, and from available data it was obvious the weather had improved sufficiently for a safe departure that met company and airport departure minimums.

The procedure for engaging the autopilot, set out in the company's standard operating procedures, was less precise than in the Boeing B737 manual. The procedure in use at time of the accident recommended that the pilot flying do the engaging, with the other pilot confirming the flight mode annunciator indication. When the captain made the call 'command', the first officer did not respond. He might not have heard the captain's call, or heard the captain's call but not crosschecked the flight mode annunciator, or seen no changes in the flight mode annunciator and not told the captain because standard operating procedures did not make confirmation mandatory.

The variations in procedures from those recommended by Boeing, the lack of a required confirmatory announcement by the monitoring pilot, and the lack of standards generally, confused the engaging of the autopilot. The confusion was accentuated by the response of the aircraft's speed trim to deteriorating manual control.

No call-out was heard from the first officer while variations were taking place in pitch and speed, with roll increasing beyond 25 degrees. One single announcement by the first officer of the variations on the flight mode annunciator,

or of the excessively changing flight parameters, would have alerted the captain to the deteriorating situation long before the bank angle warning sounded. Probably 'lagging behind the aircraft', the first officer failed to discern that the uncontrolled flying was the result of the captain's confusion.

The captain's reaction was another example of spatial disorientation, resulting from a long slow turn on a dark night, with no exterior visual reference, without monitoring the attitude indicator. The consequences of the disorientation were further aggravated by his failure to follow the recovery procedures prescribed by the company. The investigation recommended that all the company's flight crew should receive formalised training in upset recovery.

The captain had a strong character – authoritative and domineering, which at times manifested itself as overconfidence and arrogance. In contrast, the first officer was reserved and not assertive. He seemed intimidated by the meteorological situation and his announcement to the cabin crew just before take-off betrayed his anxiety about the weather. He also appeared subdued by the strong personality of the captain. Although he had undergone CRM training several months before, he failed to monitor the obvious and vital lapses in the handling of the aircraft during the accident flight, seemingly placing his entire confidence in the captain's flying ability.

In the light of the findings of the investigation, the airline's management should have taken measures to avoid pairing these pilots because of the deficiencies found during their training, and because of their psychological traits. The company's system for addressing the handling of weak pilots appeared adequate, but its application to the captain's performance was not sufficiently aggressive. As a result, the captain's skills were deemed to be acceptable, despite that fact that his examiners regularly reported his weaknesses. The Kenyan Civil Aviation Agency should have identified the problem during its oversight inspections of the airline, and should have acted on the recommendations of the airline's examiners for appropriate action.

Comment

This tragedy bears a marked similarity to the Flash Airlines Boeing 737-300 accident that followed a night take-off from Egypt's Sharm el-Sheikh Airport on 3 January 2004, which was reviewed in the March-April 2010 issue of Flight Safety Australia.

It seems incredible that in both cases, the experienced captains concerned did not know how to recover on instruments from unusual attitudes. Both accidents emphasise again the importance of maintaining basic manipulative flying skills, rather than relying entirely and blindly on today's highly sophisticated aircraft automation systems for consistently safe operations.

Reprinted with kind acknowledgement to Flight Safety Australia

Runway Incursions

by Adrian Leonard, Senior First Officer - Virgin Atlantic Airways Boeing Fleet Safety Officer

The CAA has compiled a "Significant Seven" list of risks to aviation, one of which is runway incursions.

ICAO Definition:

- "Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing and take-off of aircraft".

Runway incursions statistics are broken down into the following categories:

- CAT A – serious incident in which a collision was narrowly avoided **HIGH RISK**
- CAT B – incident in which separation decreases and there is a significant potential for collision **HIGH RISK**
- CAT C – ample time to avoid a collision
- CAT D – little or no risk of a collision

(In the UK there were no CAT A or B incidents in 2009; however, there were two CAT B incidents in 2010 and one CAT B in Q1 2011.

One would expect runway incursions to occur more frequently during periods of low visibility eg. Tenerife 1977, Milan Linate 2001, but this is not the case. Main cause factors include: poor taxiway markings, complex R/T procedures, language barriers, callsign confusion, out-of-date/inaccurate Notams, poor aircraft lighting and poorly educated airport staff. When analysing the human factors involved in runway incursions, the most common cause is "pilot failed to follow clearances". The remaining factors apply to pilots, ATC and drivers and include failure to follow procedures, failure to follow instructions/signals, lack of situational awareness, lack of experience/familiarisation, poor/lack of ability/airmanship, poor/lack of pre-flight planning, poor R/T contact, erroneous expectation and a lack of management oversight.

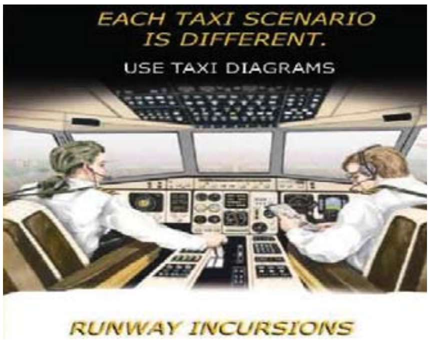
In addition to the CAA, the National Transport Safety Board (NTSB) has recognised the dangers of runway incursions and has put them on their "Most Wanted" list. Following a FAA Runway Safety "Call to Action" meeting, serious runway incursions have reduced by 50% (Year 2009 compared to 2008). This reduction was achieved by introducing pilot and controller education programmes to improve situational awareness, workshop forums, pamphlets, websites, controlled access to airports, improved airport surface markings and explicit ATC clearance for all runway crossings. The Royal Air Force has also set up a runway incursions steering group within their MAA.

The CAA has introduced the following preventative measures:

- Identified an Action Plan to reduce CAT A and B incidents to zero and reduce C and D incidents significantly.
- Promoting a greater understanding by industry of the risk associated with runway incursions.
- Local Runway Safety Teams (LRSTs).
- Providing a greater oversight of AAIB recommendations.
- Distributed coffee mug coasters to publicise runway incursions.
- Ensuring runway/taxiway/holding position signage compliant with CAP 168.
- Ensuring runway safety is maintained during "work in progress".

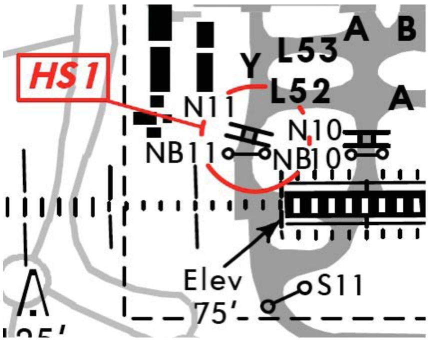
The likelihood of a runway incursion is further reduced by strict adherence to SOPs, maintaining aircraft to a high standard (eg. lighting), good command of the English language, accurate Notams and sterile cockpit procedures.

On the subject of language, would you know what to do if you were given the instruction, "annuler le décollage"? This instruction was given to an Air France aircraft at CDG airport during low visibility procedures as a BA aircraft was crossing the runway further upfield. The AF aircraft rejected the takeoff as instructed; however, the BA aircraft continued to cross the runway oblivious to what was happening. ATC speaking in a foreign language adversely affects the situational awareness of other crews; however, this practice continues eg. Cuba (Spanish), some Caribbean islands (French).



An example of a recent runway incursion at LHR is as follows: Pilots were cleared to hold point N11 but proceeded to NB11. LVPs were in force at the time, meaning that the airfield was safeguarded and aircraft were required to hold at the CAT 2/3 holding point (in this case N11) before being cleared to enter the runway. Hence, by exceeding this holding point it was a runway incursion rather than just exceeding the cleared holding point/taxi clearance.

LHR has recently published "Hotspots", one of which is the holding points referred to in this incident.

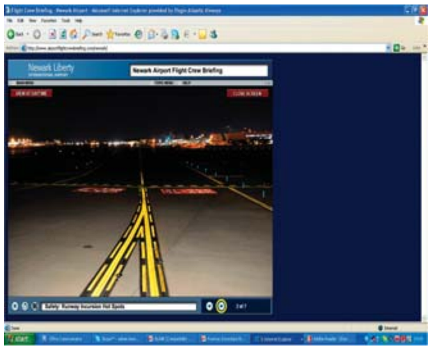


The following runway incursions preventative measures are available at LGW: Vehicles have transponders (SQUIDS) which means that they are easier to track during LVPs. In the tower is a system called "RIMCAS" (Runway Incursion Monitoring and Collision Avoidance System). If two a/c are on the runway then there is an amber warning in ATC. If two a/c are on the runway and accelerating towards each other, then there is a red warning and audio alert. There is also an "Approach Monitoring Aid" which gives an alert if an a/c is aiming for the wrong runway or a taxiway. If the a/c is "outside the funnel" within 4nm then it is issued a go around instruction.

In addition to the technologies present at LGW, LHR has split ground frequencies to reduce R/T congestion, Hotspots on AERAD/Jeppesen plates and "RUNWAY AHEAD" markings at some intersections/ holding points.

MAN ATC also has RIMCAS and at runway intersections there are small grey boxes on either side of the taxiway with a laser beam between. If the beam is crossed then ATC will get a tone. Recently a GPS trial that warns drivers if they are entering the runway has proved very successful.

There is also some useful information online eg. Newark (www.airportflightcrewbriefing.com/newark):



Some Other Technologies:

- Rumble Strips

These were set up near runway entrances at Southampton but the trial was unsuccessful because they were too rough for light aircraft and were not felt by larger aircraft.

- RIPCAS - Runway Incursion Prevention Collision Avoidance System

This system is used in Malpensa and involves flashing red lights to indicate that red stop bars have been crossed.

- FAROS – Final Approach Runway Occupancy System

On approach, if the PAPI lights flash then the runway is occupied.

- OANS - Onboard Airport Navigation System

This is on board the A380 aircraft and shows the position to the pilots of the aircraft at the airport. Obviously very useful during LVPs.

One particular technology which is being introduced an increasing number of airports in the USA is: Runway Status Lights (RWSLs) **RED MEANS STOP!**

This is a "Smart system" and uses surface radar data. It is fully automatic in that no inputs are required either from ATC or pilots. Lights on the runways and taxiways inform pilots and ground vehicle operators when a runway is unsafe to enter/cross or to begin take-off.

There are also "Take off hold lights"

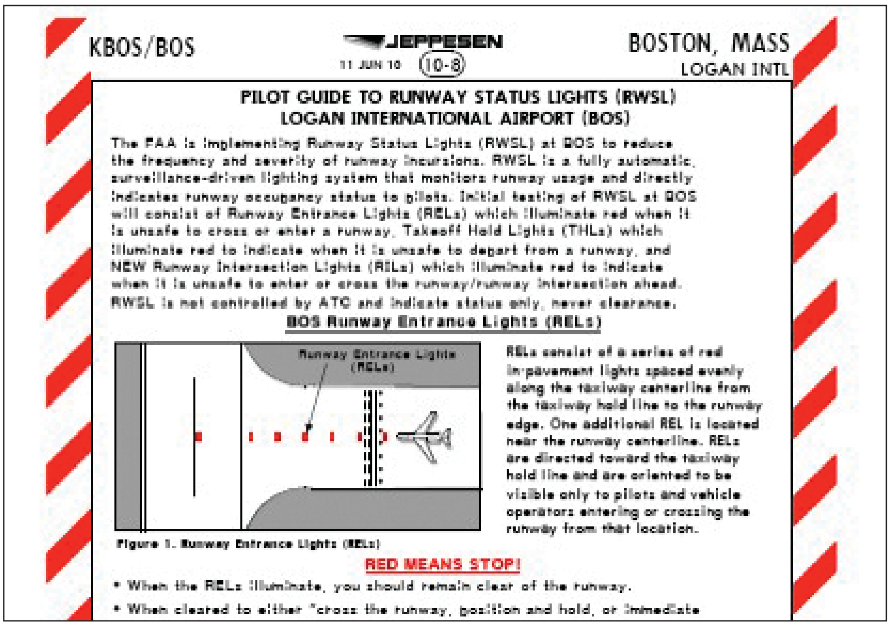
The following example details RWSLs at Boston, Logan International.

Another technology which has been installed by some long haul carriers is the Honeywell system, "SmartRunway".

SmartRunway is a "low cost" modification to the Enhanced Ground Proximity Warning System (EGPWS) and it provides situational awareness to pilots as an audio warning and (for extra cost) a visual warning in the flight deck. Amongst other things, it can help prevent pilots taking off from taxiways, the wrong runway, without flaps or from too short a runway. It also complies with the NTSB recommendation following the attempted takeoff from the wrong runway of Comair Flight 5191 in Lexington, Kentucky in 2006.

NTSB recommendation AAR 07-045 "operators install on their aircraft cockpit moving map displays or an automatic system that alerts pilots when a takeoff is attempted on a taxiway or a runway other than the one intended".

In summary, aside from the multitude of technologies available, runway incursions can be reduced by addressing callsign confusion,



KBOS/BOS JEPPESEN 11 JUN 10 (10-8) BOSTON, MASS LOGAN INTL

PILOT GUIDE TO RUNWAY STATUS LIGHTS (RWSL)
LOGAN INTERNATIONAL AIRPORT (BOS)

The FAA is implementing Runway Status Lights (RWSL) at BOS to reduce the frequency and severity of runway incursions. RWSL is a fully automatic, surveillance-driven lighting system that monitors runway usage and directly indicates runway occupancy status to pilots. Initial testing of RWSL at BOS will consist of Runway Entrance Lights (RELs) which illuminate red when it is unsafe to cross or enter a runway, Takeoff Hold Lights (THLs) which illuminate red to indicate when it is unsafe to depart from a runway, and NEW Runway Intersection Lights (RILs) which illuminate red to indicate when it is unsafe to enter or cross the runway/runway intersection ahead. RWSL is not controlled by ATC and indicate status only, never clearance.

BOS Runway Entrance Lights (RELs)

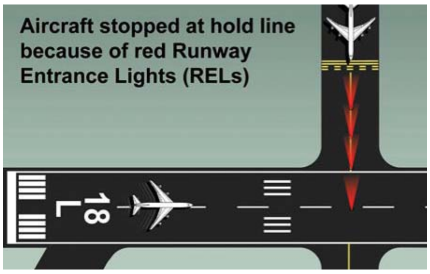
Runway Entrance Lights (RELs)

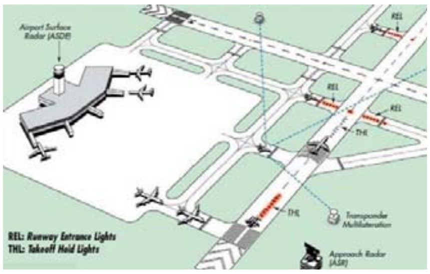
RELs consist of a series of red in-pavement lights spaced evenly along the taxiway centerline from the taxiway hold line to the runway edge. One additional REL is located near the runway centerline. RELs are directed toward the taxiway hold line and are oriented to be visible only to pilots and vehicle operators entering or crossing the runway from that location.

Figure 1. Runway Entrance Lights (RELs)

RED MEANS STOP!

- When the RELs illuminate, you should remain clear of the runway.
- When cleared to either "cross the runway, position and hold, or immediate





using standard RTF, using a common language, adopting a Sterile Flight Deck procedure, effective LVPs, courses to educate personnel, LRSTs, accurate Notams, stopbars and aircraft lighting. Pilots can familiarise themselves with RWSLs by reading the relevant section in the Jeppesen booklets for LAX, and BOS, and look out for RWSLs being fitted in the coming years to MCO, LAS, ORD, IAD, NEW and SFO (bear in mind that LAX and SFO are in the top ten list for runway incursions).

Lastly, runway safety is a shared responsibility among pilots, controllers, vehicle drivers and airports. Automated warning systems enhance runway safety, but education and situational awareness are the keys to preventing incursions.

References:

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Better Safe Than Sorry – Speak up if you see safety problem

by Staff writers

In these days of locked cockpit doors, communication between flight and cabin crew has never been so important. With most contact between the flight deck and cabin via the interphone, CASA cabin safety inspector Susan Rice says pilots and cabin crew should consider the effectiveness of how they are communicating which each other.

"Being mindful of each spoken word and how it may be interpreted is something that must be recognised as a vital component of crew coordination and effectiveness," she says.

"Most airline operators in Australia have implemented their own crew resource management (CRM) programs in recent years. A vital tool in building these sessions is to utilise the findings that have resulted from incidents that have occurred within their companies.

This can provide valuable lessons for all aircrew and highlight any problems that are impeding communication."

CASE STUDY 1: A commercial flight was taking off in the early morning in a cold climate. From the cabin, a flight attendant noticed heavy snow build-up on the wings.

However, the flight attendant did not speak to the pilot-in-command about her observation because on previous occasions when she'd brought concerns to flight crew in the same company, she had been rebuffed and made to feel stupid.

When the aircraft took off, it was unable to gain altitude and crashed into trees near the runway killing 24 of the 69 people on board.

CASE STUDY 2: Two flight attendants travelling at the back of an aircraft realised there was something wrong on takeoff and decided to go to the front (to respect interphone silence) to see whether it had been noticed. When they got there the purser was already in contact with the captain who informed them there were some problems on the flight deck and he would let cabin crew know as soon as possible what was happening.

In the ensuing five minutes the flight attendants focused on staying relaxed and alert and revised their emergency procedures.

The passengers became aware that the aircraft was going around in circles so the purser made an announcement informing that the captain would speak as soon as he could, which he did straight away.

In a clear and reassuring way he told passengers there was a problem and the flight would need to return to the airport. He then asked cabin crew to prepare the cabin for a heavy landing.

The aircraft landed safely and engineers fixed the problem.

Cabin crew were given an extensive debriefing so they understood what had happened and had the opportunity to share their own views.

To the crew involved, this was a clear example of a professional, united team with excellent communication between all sections. There was an open, honest and professional approach by each person in their specific role and this naturally led to good teamwork.

As one flight attendant said: "We were happy about the decision of the flight crew to turn back and we tried to help those passengers who became grumpy to understand why. It's better to be on the ground wishing to be in the air than the other way around!"

Communication and teamwork are the backbone of flight safety and an essential component of airline training.

But sometimes issues can impede communication between cabin and cockpit. In CRM Advocate, Lucy Young from US Air says they can include: "complacency, distraction, confusion, fatigue, peer pressure, poor situational awareness, 'significant others', stress or supervisory pressure."

Young calls these problems "barriers" because "they can distort or block information transfer, or cause communication not to be initiated at all."

However, she has a solution. "Any of these can be overcome by interaction with other crew members who can, through teamwork, bring the original crew member back into the loop or help them advocate their concern to the captain."

The captain's reaction to the cabin crew's approach is important, as can be seen with case study 1. In this incident, the flight attendant decided not to tell flight crew about snow on the wings because of bad experiences in the past when she had approached pilots with her concerns.

Young says the best captain is "authoritative enough to command the flight effectively, yet seeks input from other crew members."

She recommends crew briefings as an effective way to establish clear leadership and authority, while giving cabin crew the opportunity to participate in the discussion.

"Assertiveness with respect, not insubordination, is the goal for the 'followers' in the crew," Young says.

In their paper "Shall We Tell the Pilots?" published in The International Journal of Aviation Psychology, Rebecca Chute and Earl Weiner quoted from an aviation safety reporting system report filed by a flight attendant following an incident in the United States:

"After being on the ground in Denver approximately 1/2 hour, passengers and flight attendants began to notice snow and ice mounting on the wings. The captain was asked three times about deicing. He claimed it was not necessary. More time passed and more snow and ice became visible on the wings." Eventually the captain listened to the concerns and commenced de-icing.

While this incident shows that certain personalities can make it hard to forge a working relationship, cabin crew need to be sure of their own abilities and judgement and feel confident to raise concerns either with their supervisor or the pilots if they ever have doubts about something.

A tragic crash at Kegworth in 1989 occurred when the pilots shut down the wrong engine before their emergency landing. The No. 1 (left) engine had failed, but the pilots mistakenly throttled back and then shut down No. 2. By the time the mistake was discovered, it was too late to restart the operational engine.

The Boeing 737-400 crashed into a field, then onto the M1 motorway. Forty-seven people died and 74 were severely injured.

Investigators found that three cabin attendants and several passengers had observed flames coming from the No. 1 engine but did not inform the flight crew. The accident report recommended the introduction of training exercises for flight and cabin crew to improve coordination between them in the event of an emergency.

In "Shall We Tell the Pilots?" Chute and Weiner note that the improvements in aircraft technology and design that have made flight engineers redundant have contributed to changes in cabin and flight crew interaction. The flight engineer often acted as a filter, deciding whether the information was important enough to disturb the pilots.

"The flight attendant probably found it easier to communicate with the flight engineer, whom she might expect to be less judgmental, owing to his relatively lower status in a highly hierarchical cockpit," they wrote. "Furthermore, his physical proximity to the cockpit door made communication easier. Interrupting his duties was not seen as a problem."

Knowing when it is acceptable to disturb a pilot is an important judgement call and one that is particularly crucial during the sterile cockpit periods of takeoff and landing. Although all 'nonessential' communications between the cabin and cockpit crew are banned, if the cabin crew knows of anything that could affect flight operations, they must inform the pilots.

An example of this was an incident near Orlando, Florida. The commercial airliner had encountered severe turbulence but the rest of the flight and the landing were normal. However, when the aircraft landed, a flight attendant told the pilots that both cabin attendants and some passengers had been injured in the turbulence. But because the pilots were in a sterile cockpit, the attendants thought they shouldn't disturb them.

The problem was if any emergency had developed during approach and landing, the pilots wouldn't have been aware that the flight attendants might have been too injured to perform their usual emergency functions.

In a paper published in CRM Advocate, Tom Chidester and Laura Vaughn of American Airlines had some suggested guidelines for communicating with the sterile cockpit either in person or on the intercom.

Incidents when it was acceptable to breach the sterile cockpit rule were:

- Fire in the cabin
- Exit door ajar
- Burning odour in the cabin
- Medical emergency
- Cart stowage problem
- APU torching
- Fuel spilling from the aircraft
- Passengers moving or standing
- Extreme temperature change
- De-ice problem
- Suspicious, unclaimed bag, package
- When aircraft is moving on the ground, call cockpit if emergency conditions exist such as unusual bangs, scraping sounds, smoke, fire etc.

Incidents when it was not acceptable to breach the sterile cockpit rule included:

- Non-safety related logbook duties
- Temperature (i.e. too hot/cold)
- Entrée preferences
- Gates information
- Misconnected baggage
- "How much time do we have?"
- Catering problems
- Obnoxious but not dangerous passengers

"Bear in mind that this extract is taken from an American situation and there may be some cultural differences involving language and interpretation. You will make your own assessment as to suitability and effectiveness," Sue Rices advises.

It's always worth telling your company when you have any concerns or observe something that could be a potential problem as training and procedures are developed from people's reactions to reallife incidents.

"The industry is constantly challenging and raising its standards to improve procedures. Nothing is ever static in the arena of training and education, for operational personnel, inclusive of maintenance engineers, ground staff and aircrew."

Cabin crew should use this training as well as their experience to guide them on whether they should alert other cabin crew or the pilots to a potential problem. As aviation professionals, their knowledge is invaluable and a vital cog in the systems safety machine.

Reprinted with kind acknowledgement to Flight Safety Australia

Monitoring Flight Levels

New more stringent ICAO height monitoring requirements are effective from November 2010.

It goes without saying that accurate altitude keeping is vital in commercial aviation, particularly in the thin cold air where altitudes become flight levels.

The reduced vertical separation minimum (RVSM) has been one of the success stories of international air transport since its introduction in the 1990s. It has been progressively introduced globally; nearly all the world's airspace will be operating with RVSM by the end of 2011. With RVSM the minimum altitude gap between aircraft flying between flight levels 290 and 410 is 1000 feet. Flight level 290 is approximately 29,000 feet, based on a standardised altimeter QNH setting of 1013.25 mbar. After RVSM was introduced in Europe delays to scheduled flights fell by 40 per cent. The system frees up airspace by increasing the number of usable flight levels between FL290 and FL410 from seven to 13. It has also been found to reduce fuel consumption – and therefore greenhouse gas emission – by more than one per cent. That may not sound like much but it's a big deal over years of operating aircraft whose fuel capacities are measured in tonnes rather than litres.

But there is a cost involved. The technical requirements for operating in RVSM airspace are stringent. To conduct regular operations there an aircraft must have:

1) Two independent altitude measurement systems;
2) An altitude alerting system;
3) An automatic altitude control system; and
4) A secondary surveillance radar transponder with altitude reporting system that can be connected to the altitude measurement system in use for altitude keeping.

Typically, RVSM airspace is managed on an exclusive basis, with aircraft only being able to flight plan and operate in the airspace if they hold state-issued RVSM airworthiness and operational approval. Australian airspace is managed on a nonexclusive basis where the 1000ft minimum will only be applied between aircraft holding the required RVSM approvals. However, clearance at RVSM levels for non-RVSM approved aircraft is subject to disposition of traffic and RVSM aircraft priority.

The International Civil Aviation Organization (ICAO) has introduced a requirement that aircraft operating in RVSM airspace be monitored to ensure the continued accuracy of altimeter systems.

While no accidents have been attributed to the introduction of RVSM (the system was developed to a safety standard of 2.5 accidents per billion flying hours) extensive monitoring in North America and Europe has revealed a loss of accuracy of hundreds of feet in the altimetry systems of some aircraft. In a recent example, one aircraft had a measured error of minus 800ft. Because of the nature of types of altimetry errors, pilots of these aircraft would be unaware that they were flying higher or lower than other aircraft reporting the same flight level. Additionally ATC is unable to observe the error.

While it's tempting to quip that if this aircraft were to encounter another with a comparable altimetry system error the respective crews would be close enough to wave to each other, the reality of a 900kt-plus closing speed makes this a very serious situation, with only traffic collision avoidance system (TCAS) as the last line of defence. Unfortunately, the commonly-used TCAS II bases its altitude calculations on reported flight level and so would not recognise even a very large altimetry system error.

To ensure accuracy of altimeters in RVSM aircraft, ICAO's more stringent global longterm height monitoring requirements become effective from November 2010. At a minimum they require two of each aircraft type that an operator flies to have their height-keeping performance monitored, at least once every two years or every 1000 flight hours per aircraft, whichever period is longer. However, within the Asia/Pacific Region, as in other regions, some aircraft types will require up to 60 per cent of an operator's fleet to be monitored. ICAO requirements will require monitoring of 143 aircraft on the Australian register.

Monitoring can be done in three ways: aircraft can fly over a height monitoring unit (HMU, also known as an aircraft geometric measurement height measurement or AGHME) that accurately determines its height; or it can be temporarily fitted with a portable GPS monitoring unit (GMU). The main advantage of a GMU is the ability to monitor an individual aircraft during normal operations without the need to fly over a height monitoring unit. There are no height monitoring units in Australia anyway.

For the small proportion of the monitored fleet that flies internationally, this is not a huge problem – they can fly over HMUs in Europe or the US and be checked by them.

A third way conducted by the Australian Airspace Monitoring Agency (AAMA), an ICAO designated agency operated by Airservices Australia, monitors using automatic dependent surveillance - broadcast (ADS-B). The system broadcasts an aircraft's call sign, GPS-derived position and altitude, velocity and other data, more than once a second. Australia leads the world as the first country to have full ADS-B coverage for FL300 and above. The national network of ADS-B ground stations became fully operational on 23 December 2009.

As a GNSS satellite-based system, ADS-B calculates altitude geometrically, like a GMU. The ADS-B transmissions contain aircraft flight level measured from barometric pressure. By converting the flight level to a geometric height using meteorological data, the AAMA can compare the two heights and calculate an altimetry system error. The AAMA is collaborating with the US Federal Aviation Administration to make this data processing as accurate and efficient as possible.

The AAMA will be able to retrieve data for any flight of an ADS-B-approved aircraft in RVSM airspace since 23 December 2009, and derive an altimetry system error for the airframe. Aircraft not equipped with ADS-B will need to be monitored with a portable GMU. As ADS-B equipped aircraft replace older types in RVSM operations ahead of the 2013 mandate for ADS-B carriage in RVSM airspace, the ability of the AAMA to efficiently monitor altimetry systems increases. With increased data processing power the future will be a safer one of seamless and frequent checking of altimetry systems for commercial aircraft that ply their trade high in the thin cold air.

For more information
www.airservicesaustralia.com/.../RVSM_minimum_monitoring_requirements.pdf

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