ISSUE 78

focus

ON COMMERCIAL AVIATION SAFETY

SPRING 10

The official publication of the United Kingdom Flight Safety Committee

ISSN 1355-1523

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The Official Publication of THE UNITED KINGDOM FLIGHT SAFETY COMMITTEE ISSN: 1355-1523 SPRING 2010

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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Web Site: www.ukfsc.co.uk
Office Hours: 0900 - 1630 Monday - Friday

Printed by:
Woking Print & Publicity Ltd
The Print Works, St. Johns Lye, St. Johns, Woking, Surrey GU21 1RS
Tel: 01483 884884 Fax: 01483 884880
e-mail: sales@wokingprint.com
Web: www.wokingprint.com

Front Cover Picture: B757-200 in the livery of Titan Airways

Lessons from winter operations – Let's not have to learn them again next winter!

In his column in the last Winter edition of FOCUS, the Chairman provided a timely reminder on the aviation industry's need to focus on Winter operations; he had clearly had an uncanny premonition about the weather to come in January, which appears set to continue into February as I write. His exhortation to everyone who contributes towards the safe delivery of commercial air transport system to spend time in re-familiarising and preparing themselves for poor weather operations appears to have been heeded. Indeed, the AAIB Representative at the last UKFSC Information Exchange expressed her satisfaction and surprise that the recent period of ice and snow had not been accompanied by an increase in serious incidents.

But do we always learn the lessons of past seasons? Through my regular visits to the AAIB hosting our Flight Safety Officers Course delegates, I have grown well aware of the dangers of inadequate aircraft de-icing procedures and poor pilot judgement on the need for it; the Birmingham CRJ accident in 2002 is the focus of the video which regularly shown as an introduction to the AAIB's work. Just a few minutes of research on the web reveals the same causes and circumstances surrounded two accidents in 2004, two more in 2007, and yet another in 2008. Even the photographs of the crash sites are disturbingly familiar.

Another major winter operations issue to regain momentum and attention in the past few months is runway surface friction measurement and reporting. Commercial pilots know well that there are significant variations in the standards of runway condition assessments and in the format used to report them across the globe, which is obviously unwelcome and potentially confusing. However, it could also be said that any report, be it airport, air traffic or pilot derived, has some value since regular visitors to a specific airport are able to build up experience and trends from which better decisions can be made on the flight deck.

But the opportunity to build at least some understanding of local conditions amongst the pilot community is totally denied when airports refuse to provide any runway condition information, whether sourced from airport operations or other pilots. The danger in these cases is that an assumption is invited that no information means a clear runway with good braking action when, in fact, this may not be accurate.

The bad news is that the need for global harmonisation and common standards was widely recognised over 15 years ago but without any effective action being taken to address the problem. The good news is that the need to establish a global standard for runway condition reporting and surface friction measurement may be moving from an annual winter dream which is quickly forgotten as spring turns into summer, into positive and co-ordinated action by the regulators across the world.

ICAO has established an International Friction Task Force to address the methodology and equipment standards by which a harmonised global solution for friction measurement can be established. In parallel work under an initiative known as the FAA Takeoff/Landing Performance Assessment Aviation Rulemaking Committee (TALPA ARC), the FAA has produced a draft Paved Runway Surface Assessment Table for each stated contaminant, type and depth which is based on aircraft performance data supplied by aircraft manufacturers. In the meantime, EASA has let a contract for a major report to be produced on friction measurement of runway surface methodology and aircraft braking performance around the globe.

The better news is that all three of these work strands are being brought together in a workshop in Paris in March. Maybe this is the end of the beginning for the longstanding issue of surface friction assessment and reporting.

Nonetheless, there are numerous other seasonal safety lessons to be learnt and re-learnt right across commercial air transport. It should go without saying that these must shared a widely as possible, in order that the necessary education and preparation can be undertaken in good time before next winter.

In light of the exceptional weather conditions in the UK and Europe, the UK CAA intent is to hold a winter operations safety review to capture the resultant lessons. In support of this initiative, it would be invaluable if UKFSC Members and others from all the professional sectors of the industry could relay their safety findings from this winter operations to the UKFSC Office at Fairoaks where they can be consolidated and offered up as part of the CAA process.

focus ON COMMERCIAL AVIATION SAFETY

A New World with Old Problems

by Capt. Tony Wride, Monarch Airlines

When I wrote the last Chairman's column, talking about Winter Operations and the associated hazards, I had no idea that the UK was about to get some of the most severe winter weather for over 30 years. Fortunately, although there was severe disruption to the flying programme, the aviation community in the UK succeeded in keeping safe and to my knowledge there was only one incident where an aircraft departed a taxiway. Everybody, from the people in Operations trying to sort out what could be flown to the airfield staff desperately trying to keep the runways and taxiways clear, played a part in maintaining the safe operation. So if you were involved and working during all the bad weather then thank you for being professional and playing your part. However, before we all go off and celebrate, the severe weather also gives an opportunity to look at what went well and what could have been done better so that perhaps we are better prepared to cope for the next time Mother Nature decides to test us.

Based on what happened last time I did think that if I started talking about the challenges that face us during the summer we would end up getting one of the best summers in the UK for 30 years! Alas, judging by what has been happening during the previous few summers, I suspect that will not be the case and we will experience the usual excess of H2O! Summer does present us with different threats to our operation with the skies, and the airports, getting noticeably busier. To cope with the increased traffic various parts of the industry end up with a lot of new and inexperienced staff so there is a period, while the 'newbie's' find their feet, that the Risk is increased. It is vital that all of the new staff, and indeed even the 'old hands', appreciate how important it is for them to put Safety at the top of the pile and how it could be them that prevents a serious accident. In this time of recession the industry must not loose sight of the fact that a robust Safety Culture with adequate training is vital and not try to make savings by reducing training or cutting the Safety staff.

Apart from the awful weather several other noteworthy things have happened recently that I would like to comment on and perhaps leave you with some food for thought. The first is the release of the final report on the Heathrow B777 crash. The other is that the long overdue "It's all a dream liner" has finally flown and begun its flight testing. Before I start I must stress that what follows are my thoughts based on the information I have available. Whilst I try and ensure my facts are correct if there are errors they should not detract from the overall purpose of the exercise which is to make you think!

The final report into the Heathrow B777 crash ended up pointing to the icing up of the fuel in the supply pipes to the engines which caused a restricted flow and therefore limited the power available. To be more correct it was the water, (H2O again!), in the fuel that formed ice in the supply lines. The aircraft had spent a considerable time at a high cruising level with very low ambient temperatures cooling the fuel. Only the other day I watched the fuel in the outer tanks of the A330 I was flying getting to -41°C with the OAT of -70°C at FL400 and the B777 crash came to mind! These very low temperatures are not uncommon in various parts of the world and you hope that the aircraft and engine designers have done a thorough risk assessment to ensure that the risk is mitigated. In the B777 case there have been a number of recommendations made which include some redesigning of the engine fuel supply architecture to prevent the icing and restricted fuel flow. In this case it could be argued that the redesign is reactive because the accident, and several other similar engine 'roll back' incidents, have already occurred. In an ideal world the risk of the fuel icing would have been identified and the mitigation done in advance of the crash!

Another aspect of the B777 crash is how well the crew coped with the problem in the final stages of a very long flight. If the Captain had not raised the flap one stage and reduced the drag the aircraft apparently would not have made it over the road and the outcome could have been significantly worse. It is interesting to note that this scenario had never been trained for so the crew were relying on their experience to save the day. I wonder, in this era of 'cheap' low experience pilots being the flavour with the airlines, what the outcome would have been if the aircraft had been flown by a much less experienced crew!

The Boeing 787 'Dreamliner' is flying at last and is hailed as the next generation of super efficient air travel with a very large order book as a result. The aircraft has some new technology, particularly in terms of the airframe construction, but has also clung on to old technology in terms of flight controls. The composite fuselage construction is by all accounts very strong but I wait with interest to see how resilient the structure is after it has been hit by steps and hi-loaders, a not uncommon occurrence! Certainly it is a hazard that should be risk assessed because apparently one of the problems with composite materials, highlighted by the AAIB, is that they sometimes don't show ground damage in the same way that the traditional metal construction does. As I highlighted earlier we all rely on the designers to have considered the various hazards and taken suitable mitigating action so I'm sure the ground damage scenario has been more than adequately covered.

I have mentioned risk and risk assessments a number of times in this article and under the new Safety Management System requirements risk assessments are a key part in the pro-active management of safety in the aviation industry. The problem is where do you stop or for that matter begin? Taking the things I've already talked about as an example, for Winter Operations there are a whole host of hazards that should be considered and mitigated not only in terms of the aircraft operation but also in terms of the risks to the staff. In aircraft and engine design I would suspect that a vast team has spent a long time considering the hazards and mitigating those hazards at the design stage rather than waiting for the incident. In terms of crew actions for a failure all the classic scenarios are practiced and considered at length but what about the 'odd balls' like the double engine failure at 500ft on finals or at 700ft on take-off? The problem is just where do you stop without being totally unrealistic and requiring a vast army of people doing the assessments?

The UK Flight Safety Committee has always tried to be a centre for the promotion of Safety in the aviation industry and we have just released a Generic Hazard register for the membership to start the risk assessment process. The register is by no means complete but it is a starting point and hopefully by sharing information all the major hazards can be identified and risk assessed correctly. Will it change the world? Well if by identifying that there is a hazard of fuel icing causing a restricted fuel flow to the engines results in a redesign to prevent the problem then I would argue yes.

Accident investigation: the EU tightens its grip

by Edward Spencer & Charlotte Marfleet – BLG

In October 2009, the European Commission proposed an overhaul of civil aviation accident investigation in the Community by replacing Directive 94/56/EC with a Regulation. Under the proposed legal revisions intended to streamline accident investigations, European civil aviation safety authorities (including the UK's Air Accidents Investigation Branch) could be legally mandated to investigate accidents jointly, share information and report to the EU.

The current Directive, 94/56/EC, transposes into Community legislation a number of fundamental principles contained in Annex 13 to the Chicago Convention. Under the Directive, Member States are obliged to ensure that every accident or serious incident in civil aviation is subject to an investigation by an independent body and that the only purpose of the investigation is to prevent future accidents and not to apportion blame or liability. Member States must also produce a report and, where appropriate, safety recommendations in relation to every accident or serious incident.

Although Directive 94/56/EC has significantly contributed to the harmonisation of air accident investigation in the EU, the Commission now feels that the 15-year-old regulatory framework should be updated.

In its recent proposal, the Commission says that the current rules in Europe on investigating civil aviation accidents no longer reflect the realities of the aviation market and the complexity of the global aviation industry. More specifically, the Commission emphasises that the investigation of accidents requires considerably more diversified expertise and resources than a decade ago. Change is also said to be required in order to answer a substantial evolution of the EU's institutional and legal framework, notably the emergence of the European Aviation Safety Agency (EASA) and its wide-ranging remit throughout the EU.

The draft text of the proposal points out current deficiencies such as a general lack of uniform investigating capacity, tensions between safety investigations and other proceedings, the unclear division of responsibilities in investigations, problems with the implementation of existing safety recommendations and resource issues in providing assistance to air accident victims.

The proposal aims to cure these problems by creating a modern regulatory framework for air accident investigation, the centrepiece being the establishment of a European network of civil aviation safety investigation authorities. The aim of this will be to coordinate and strengthen cooperation between Member States, the Commission and EASA, and implement a number of central functions such as coordinating training activities or sharing investigation resources available in the EU.

Some of the more specific measures proposed will:-

- attempt to clarify the role of all parties involved;
- better protect safety information and guarantee the independence of investigations;
- strengthen the implementation of safety recommendations by requiring that every recommendation resulting from an accident will be acted upon if justified;
- create a European database of safety recommendations;
- strengthen the rights of victims of air accidents through common rules requiring the provision of rapid and organised assistance in the case of an accident. Victims and their families will be guaranteed the right to reliable information about the progress of an ongoing investigation.

The plan stops short of recommending a fully institutionalised and single European air accident investigation authority. However, recognition that such a step would be premature suggests that it may only be a matter of time before each Member State's investigative authority is subsumed into one, central pan-European body. Clearly the logistics of this would need to be carefully considered given that any investigation would need to observe the local laws of the Member State concerned.

The proposal is now with the EU Council of Ministers and Parliament who must consider the proposal and agree any binding Regulation. The proposal is likely to come into effect at some point in 2011.

Safety Management System (SMS) Preparedness of UK Air Operators

By Mara A. Estefani - RTI

"As we approach the twenty-first century, many challenges face the safety, engineering, and management communities. Risks and the potential for catastrophic loss are dramatically increasing as technology advances at an ever-increasing rate. The public demands a high level of safety in products and services, yet, in the face of world competition, the safety effort must be timely and cost-effective" (System Safety, 1999: pp.xiii, cited by Lewis & Haug, 2009).

It is this intrinsic gap between the requirements of safety and the resources available for organizations that it has been the focus of my research. As widely known in the industry, international organizations and regulators are currently in the process of creating a consolidated Safety Management System (SMS) with the ultimate aim of uniting the safety standards in the global aviation industry. Hence, changes introduced by ICAO in the form of standards and recommended practices (SARPs) will become regulation, and therefore mandatory for all air operators, when EASA and the CAA issue new legislation by 2012. In my view, and based on my research on organisations' ability to effectively identify hazards, assess risk and establish mitigation processes as part of their safety management systems, the industry is not ready to accommodate SMS requirements in the next 2 years. Furthermore, results show that implementing a consolidated SMS is highly resource intensive as it will require not only more personnel, but more importantly, a wide range of subject expertise in different fields, e.g. safety training, investigation skills, etc. In essence, meeting ICAO's SARPs will engage air operators in the organizational change of manpower and operational functions in order to fund the compliance with the new safety measures. These changes will represent the recognition of becoming safety-conscious at every level of the organisation, i.e. creating a safety culture.

With this in mind, I carried out a study and conducted both primary and secondary research in order to assess, firstly, the requirements involved in ICAO's recommendations, and secondly, the level of preparedness of air operators to comply with them, i.e. *How prepared are Air Operators in the UK to meet the requirements of ICAO's proposed Standard and Recommended Practices for Safety Management Systems and comply with EASA regulation when it becomes mandatory in 2012?*

As all AOC holders in the UK will be liable of compliance for SMS changes in safety standards by 2012, primary research targeted the entire census in the UK. However, from the 155 companies approached only 20% participated in the survey. From this sample, a representative rate of helicopters (45.2%) and commercial airlines (35%) responded. However, the response rate for cargo aircraft and corporate jets was not representative so conclusions cannot be generalized to the entire industry.

Primary research has showed that 92.9% of operators have schemes in place to identify hazards. However, a small percentage of companies (7.1%) admit not to have any. This reveals that there are organisations that operate without any schemes for identifying hazards which, as we all well know, is extremely high-risk. Added to this, some organisations that do operate a hazard identification scheme have made known that they perform it very poorly. This indicates that these companies are currently not capable of complying with the new safety standards, and steps need to be taken by these organisations to introduce a hazard identification scheme that complies with the new recommendations.

Primary research revealed that reactive approaches are currently favoured by the majority of respondents (average of 91.98%). Thus, collecting data from accidents and incidents, flight data monitoring, and incident investigation are the most common practices currently employed by air operators. This shows that most organisations prefer to use reactive data capture systems rather than proactives ones. This decision might be cost and/or time related as carrying out measures before an event has occurred, as well as to after every incident, represents added costs and time for organisations. Lack of awareness about the potential damage of not identifying hazards in advance could also be playing a part in the decision to opt out making use of proactive systems. However, the results show a general level of support for more proactive schemes to be in place by 2012. Hence, it seems that operators intend to adopt company reporting systems, confidential reporting schemes, and conduct safety surveys, operational audits, and safety assessments more often, i.e. an average of 85.66% respondents aim to adopt some or all of these proactive practices by 2012.

Effective safety management is data driven. Thus, information collected through hazard identification schemes, then forms the pillars for analysing and assessing the risks in those identified hazards, and establishing mitigation processes to eradicate such hazards. Primary research shows that most operators have schemes in place to assess risks and create mitigation processes (Chart 1). However, a percentage of companies (11.1%) admit not to have any. This is not surprising as 7.1% of

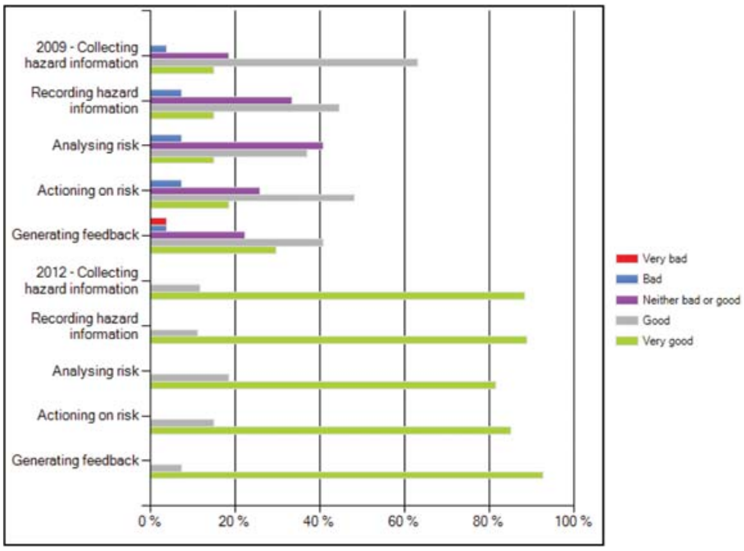


Chart 1 – Hazard Identification:

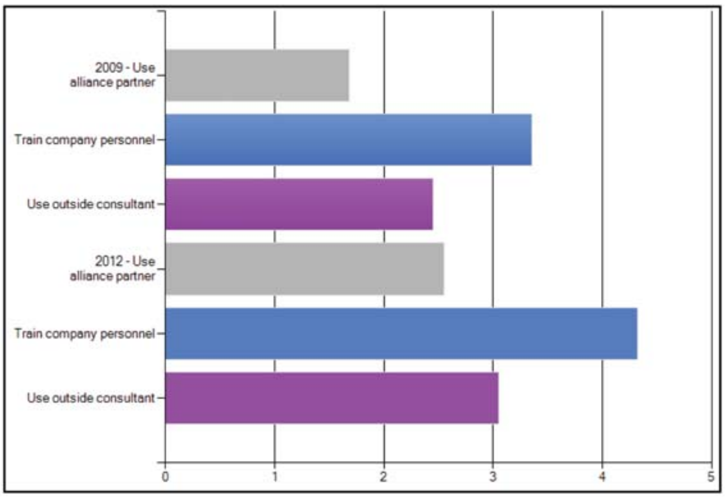


Chart 2 – Resourcing Safety Studies:

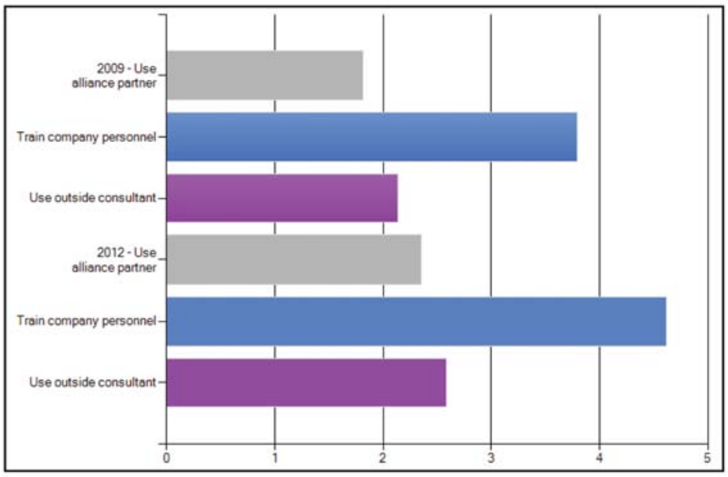


Chart 3 – Resourcing Safety Studies:

organisations admitted not having any schemes for identifying hazards in the first place, and it is an expected consequence that organisations that cannot identify hazards will not be able to assess the risks in those hazards either. Therefore, hazard identification appears to be the base-stone from where a chain of procedures follow to establish the consolidated safety system. Thus, if organisations fail to follow the first step, a chain of malfunctions in their safety system unleashes. In addition to these organisations that fail to meet SMS requirements from the start, there are a further 4% of respondents who do have schemes in place to indentify hazards, but are not assessing their risks and mitigating them. This decision might also be cost and/or time related. Similarly to the hazard identification schemes, setting up measures to assess every risk and to establish a process to mitigate that risk represents added costs and time for organisations. Lack of expertise within organisations to carry out these tasks could also be playing a part in the decision of not making use of risk assessment and mitigation processes. All in all, this indicates that some companies in the industry are currently not capable of complying with the new safety standards.

Furthermore, variables used to assess operators' capabilities to assess the potential for harm include considering the probability of the hazard causing adverse consequences, and the severity of the potential adverse consequences. Primary research showed that around 64% of operators consider both the probability and the severity of the potential adverse consequences at present. This figures show that a number of the organisations questioned are not measuring any of these two variables. This means that those operators are operating unaware of how often and how severe the hazards involved in their operations and its consequences can be. Therefore, it can be argued that these operators will struggle to prevent such hazards more so than an organisation that has identified the probability and severity of their hazards, and as a result has been able to prioritise them and establish mitigation processes to eliminate them. Added to this, there are 4% of respondents who admit not even planning on improving in the future. This decision might be linked to lack of awareness or care about the importance of taking into consideration these two elements, and the potential damage of disregarding them. On a positive note, 84% of operators aim to consider both the probability of hazards and the severity of the potential consequences by 2012.

The industry opinion is that core competencies are currently not well developed and that, whilst it is reasonable to expect organisations to develop these competencies, it is unlikely to happen without the pressure from regulators. Dr. Simon Mitchell, Course Director for SMS training at Cranfield University, Safety and Accident Investigation Centre, also recognizes the importance of a number of conditions for organisations to conduct incident investigations and safety studies effectively. Thus, *"trained and qualified people are a must" and "analyst should at least be trained to a level to be aware of the potential problems of bias and of the need to validate the findings"*. However, a total of 14.8% of operators admit not to have any trained personnel for conducting incident investigations, and even a higher percentage (37%) of operators claim not to have trained personnel for conducting safety surveys either. These percentages are directly correlated to the level of reactive and proactive schemes adopted by organisations. Hence, once more it seems organisations opt to use reactive data capture systems rather than proactives ones. This decision might be cost, time, or skills related as carrying out safety surveys as well as investigations represent a substantial investment in resources for organisations. Overall, this indicates that some companies in the industry are currently not capable of complying with the new safety standards.

Additionally, evidence suggests that not many UK operators have full-time investigators or assigned safety manager, let alone a safety department. As a result, organisations have had to use external sources to investigate accidents and to carry out safety studies (Charts 2 and 3). Primary research shows that companies are occasionally outsourcing to acquire the personnel with the required skills to conduct investigation and safety studies, including use of alliance partners and use of outside consultants. Nevertheless, training company personnel was selected by all respondents as the most likely practice to improve their safety studies and investigations in the future. Moreover, almost 60% of operators would also like to use outside consultants by 2012. This might be due to outsourcing being a cost-cutting strategy against the investment needed to acquire full-time safety personnel. Thus, there seems to be a persistent trend in operators opting for the most cost-efficient measures rather than, maybe, the most recommended by ICAO and the CAA. If this is the case, it might be that the resources they are being asked to invest are excessive, or that company priorities need to change from financially-orientated to safety-orientated.

Secondary research suggests that training plays an essential role in creating and promoting a safety culture throughout the company. However, primary sources reveal that 11.1% of respondents do not carry out any training for safety personnel. This exposes operators with bad practices, as research shows that even for *"the smallest company, the safety manager needs to be as a minimum trained in the core principles of hazard awareness and risk management, reporting procedures and just culture"* (Dr. Mitchell). Additionally, those operators that do train their safety personnel prefer sending away their workforce on external courses than carrying out on-the-job training with consultants. Dr. Mitchell recognizes that *"there is a role for both; sending personnel away on external courses and on-the-job training with consultants, but neither will be fully effective before senior management have made real commitments to lead and back the process"*. Hence, the importance of training for senior management appears as crucial in the successful implementation of safety standards. Unfortunately, over 22% of respondents claim that they do not carry out any training for senior management. Why? This decision might be also cost or time, and the issue of allocation of finite resources. In any case, the lack of training for safety personnel as well as specifically for senior management indicates that some companies in the industry are currently not capable of complying with the new safety standards.

Which Air Operators Will Need Help Incorporating SMS and In Which Areas?

Contrary to initial assumptions, primary research showed no distinctive trends based on the type or size of operator that could help identify which organisations might need help incorporating SMS. However, Dr. Mitchell suggests that it is likely that *"large, well established airlines already have well developed systems"*, as well as large offshore helicopters and some large cargo carriers. He adds that *"the problem lies with small to medium size operators"* as very few of them *"have any form of formal hazard identification process in place at all"*. Similarly, when analysing the level of capability of air operators in the UK to assess risks and implement mitigation processes, Dr. Mitchell believes that *"the largest of operators (airlines) are adopting principles of Enterprise Risk Management"* and that *"these large companies tend to have a Group or Chief Risk Officer, responsible for harmonising and coordinating the process and standards of risk management in all departments"*. Accordingly, it is difficult to identify precisely which air operators will need help incorporating SMS. Nevertheless, it can be argued that in fact it is not essential to determine whether they are, for instance, medium or small operators having difficulties with SMS, or large offshore helicopter companies. The truth is that the likelihood of any of these organisations already following exhaustively the entire list of ICAO's safety standards and recommendations is very improbable. In each of these groups there are organisations that at some level or another will need to make exceptional efforts to meet all safety standards and comply with them by 2012.

Similarly, primary research showed no distinctive trends based on the type or size of operator that could outline in which specific areas they are lacking resources, i.e. subject expertise. Thus, operators of different sizes and operating different aircraft have shown that at some level or another they lack expertise and enough allocation of resources in all five core competencies: hazard identification, risk assessment and mitigation process, safety studies, incident investigations, and safety training. For these reasons, it can be argued that most organisations (if not all) will not be capable of complying with the new safety standards at all levels.

On a positive note, however, the majority of organisations do have the intention to improve and they seem to recognize their reliance upon safety to remain in operation. However, there is also some cynicism in the industry towards the "good will" of businesses which, as such, always aim to ultimately make a profit. Some operators feel that in order to SMS to work, the industry needs regulators and legislative bodies to penalize if safety standards are not followed. Thus, organisations must prove to regulators and society that they do everything in their power to prevent incidents and accidents. For this purpose, Dr. Mitchell recognises the importance of clearly stating performance indicators and some level of acceptable safety that organisations can be tested against. Furthermore, he believes that such measures will lead to greater pressures on operators to improve safety *"because the previous official stance that safety is 'an absolute priority' is both immeasurable and unaccountable"*.

Future sustainability of the air transport industry will depend on the ability to maintain the public's perception of safety so air operators should feel forced to develop and invest in their reputation as trustworthy organisations, and not just as legally compliant. The introduction of SMS is, therefore, changing the focus of safety management from enforcement-centred to a more proactive approach, and special emphasis has been placed on creating a culture of safety throughout organisations across the global aviation industry.

However, implementing SMS is not a simple task and it seems to be a challenge for many organisations in the UK. Research shows that the allocation of limited resources to meet both safety standards as well as financial goals represents a managerial dilemma difficult to resolve for air operators. Lack of resources, therefore, has been identified as the main reason for some air operators' insufficient safety personnel and procedures in place to identify hazards, assess risk and implement mitigation processes.

This research study was conducted as part of an MBA Programme in 2009 with the support of the UKFSC and its members.

Anatomy of an Accident

by Dr Simon Bennett, MRAeS, FICDDS

Lions led by donkeys?

The aviation industry underpins today's globalised world. It creates wealth and by providing cheap, convenient transport for the public, brings nations closer together. Aviation's technical achievements are legion. Yet, as the 12 February 2009 crash of a commuter aircraft at Buffalo, New York State, demonstrates, this is an industry in crisis. Let me explain.

The Buffalo accident

On 12 February 2009, a twin turboprop piloted by a tired crew crashed onto a residential neighbourhood. Fifty people died. Continental Connection Flight 3407 was operated by regional carrier Colgan Air (a subsidiary of holding company Pinnacle). Although both pilots were based at Newark (EWR) neither had accommodation near the airport. The Captain commuted from Tampa, Florida, and the First Officer from Seattle (on the Pacific Seaboard). The Captain spent the night of 11/12 February in EWR's Operations Room. The First Officer spent the night dead-heading to EWR via Memphis on FedEx flights. The Captain logged into Colgan's computer system at 03:10 and 07:26. He can't have slept well. The First Officer arrived at EWR at 06:30 on 12 February, some 33 hours after waking in Seattle. Although she slept on her FedEx flights, and in the Crew Room, these sleeps amounted to no more than six hours in total. The crew's first two sectors were cancelled. They were not cleared for take-off until 21:18. During taxi-out the First Officer complained of feeling unwell. Here is the CVR transcript:

First Officer: "I'm ready to be in the hotel room... This is one of those times that if I felt like this when I was at home, there's no way I would have come all the way out here. But now that I'm out here..."

Captain: "You might as well"

First Officer: "I mean, if I call in sick now, I've got to put myself in a hotel room until I feel better... We'll see how it feels flying. If the pressure is just too much I... could always call in [sick] tomorrow. At least I'm in a hotel on the company's buck..."

The conversation hints at the parlous state of the US regional airline sector. First Officer

Rebecca Shaw says"... If I call in sick now, I've got to put myself in a hotel room." She concludes: "I could always call in [sick] tomorrow. At least I'm in a hotel on the company's buck." Colgan paid Shaw, a university graduate with a degree in Flight Technology, less than $24,000 per annum. She had flown 500 hours in the previous six months. When she started at Colgan she was paid less than $17,000. She had to wait on tables in a cafe to make ends meet. Pilots at regional carriers which operate around 50% of North America's internal flights, are often paid significantly less than pilots at major carriers like Continental and American. This differential is justified on the basis that the regional sector is a 'stepping stone' to a career with the majors. While superficially plausible, this rationalisation does not stand up to scrutiny. Given that all commercial pilots occupy a position of trust, the fact that some fly turboprops on regional routes while others fly jets on intercontinental routes should make no difference to their remuneration.

Remuneration should reflect not the number of persons for whom one is responsible but the fact of responsibility. The nature of a pilot's responsibilities does not vary with the type of aircraft s/he flies or service s/he operates. Commercial pilots' responsibilities are invariable. All pilots must deliver a safe and efficient service, regardless of the type of aircraft they fly, or routes or schedules they operate. On a moral level the loss of 50 lives (as happened in the Colgan Air accident) is as regrettable as the loss of three hundred lives. Let me put it this way: there is no moral or professional disequivalence between the job performed by, say, a Saab 340 pilot operating an east coast shuttle service and that performed by an Airbus A380 pilot. So on what grounds is the former paid less than the latter? Could it be that the 'regionals' are exploiting an apparent (but not substantive) difference between different types of operation for their own selfish ends? And could it be that the majors tolerate this practice because it helps keep their costs down?

Aviation's traps

Commercial aviation has always been a volatile and uncertain industry. Even in good years there are acquisitions, rationalisations and failures. Surplus pilots are made redundant or furloughed. While some are able to move to take up new positions, many, especially those with family responsibilities, are obliged to commute long distances to work. The Colgan Air accident has foregrounded US commercial aviation's 'commuting culture'. During its investigations, the National Transportation Safety Board (NTSB) discovered that 36% of Colgan's Newark-based pilots lived more than 400 miles from base (some lived more than 1,000 miles from base). Long-distance commuting is stressful. Pilots can go for long periods without sleep and food, especially if they are jumpseating on freighters. To save money, pilots may sleep in crew rooms. Crew rooms are not designed as dormitories. Crew room sleep is often broken, partial sleep—hardly an ideal preparation for a four or six-sector day. As Colgan Air's vp, flight operations told the National Transportation Safety Board's inquiry team: "lt's not quality rest. There's a lot of activity in our crew rooms."

Neither the Captain nor First Officer of Flight 3407 had accommodation at Newark. As mentioned above, the Captain spent the night in the Operations Room, while the First Officer slept on her overnight FedEx flights, then slept in the crew room. Some pilots eschew noisy crew rooms for beds in 'crash-pads'. The crash-pad phenomenon, for so long hidden from public gaze, evidences the dysfunctionality–if not squalor–of the US regional airline sector. Following the NTSB's three-day Hearing into the accident John Boccieri, a member of the House of Representatives Transportation Committee and a pilot in the United States Air Force Reserve said: "The committee I serve on has to seriously address what's happening to commercial aviation in this country." A relative of one of the victims of the Flight 3407 accident said; "There seems to be truly an indifference to commuting, to pay, to fatigue." The 18 May 2009 edition of The Buffalo News noted: "Regional airlines now run nearly half of the nation's commercial flights. But those airlines... have been responsible for all of the nation's multiple-fatality commercial plane crashes since 2002."

Crash-pads or flop-houses?

On 4 August 2009, *The Washington Post* published an article on crashpads. There are between 500 and 1,000 crash-pad houses in the United States. Renting a bed (often a space in a bunk-bed) costs from $200 per month. Beds can also be rented by the night ('hot-sheeting'). Sometimes the bed turns out to be an air mattress. One of the houses visited by *The Washington Post* contained 30 bed spaces, 16 of which were in the basement. Crash-pads can be depressing places. As the article noted: "The interior is nondescript. The faded carpets, brownish wallpaper and secondhand furniture give rooms the feel of a low-budget motel." Thirty living in one suburban house. Is this any way for professional people with critical safety responsibilities to live? Come to think of it, is this how anybody should live? Surely we can find a better way of doing things in the 21st century? If this is what is happening in one of the richest nations on earth, what might be happening elsewhere?

There has been significant reaction to the circumstances of the Buffalo accident. Board member Kathryn O. Higgins commented: "When you put together the commuting patterns, the pay levels, the fact that your crew rooms that aren't supposed to be used, are being used, I think it's a recipe for an accident." The chairman of a Senate hearing into the accident, Senator Byron L. Dorgan, said: "The disclosures about crew rest, compensation [wages], training and many other issues demonstrate the urgent need for Congress and the FAA to take actions to make certain the same standards exist for both commuter airlines and the major carriers. *The New York Times* addressed the Buffalo accident in its editorial of 17 June 2009: "Reports have emerged of poorly paid commuter pilots who hopscotch across the country to work and sleep wherever they can. They sometimes sack-out in lounge chairs in airports or on the floors of planes or even in their cars... Commuter pilots are flying too much, sleeping too little and placing passengers at risk." The web site About.com carried this statement from an airline employee: "What many people don't realise is how many airline employees do commute Not just pilots but flight attendants, airport agents... I certainly know what it's like to... sleep on a couch in an employee lounge and live off caffeine... Commuting crosscountry is not something that is without impact on one's body."

The passenger's role

While the outcry is understandable, it is important to remember where some of the downward pressure on wage levels comes from - the travelling public. Pilots' depressed wage levels reflect many factors, including passengers' expectations that air travel should be as cheap as–if not cheaper than–any other mode of transportation. The result? Ever lower ticket prices and ever more aggressive cost-cutting at first and second-level carriers. Speaking in August 2009, William Swelbar, a researcher at the International Centre for Air Transportation at the Massachusetts Institute of Technology, said: "When adjusted for inflation over the last 30 years, fares are down some 50-plus percent. And that just does not make for a sustainable business model. It doesn't make a model that allows them [the airlines] to compensate their people well, like they have in the past." While the public's disquiet is understandable, air passengers need to be mindful of the impact their demands are having on wage levels... and safety. The more that travellers focus on price, the easier it is for airlines to justify cost-cutting. It's a vicious–and potentially dangerous–spiral.

Basement-level pay

In recent years the airline industry has made a determined effort to reduce its wage bill. The 11 September terrorist attacks and current recession have strengthened the cost-cutters hand. As a result, many regional airline pilots earn between $20,000 and $30,000. In May 2009 first and second year First Officers at US regional carrier Pinnacle Airlines earned less than $22,000 a year. Speaking in May 2009, Pinnacle Airlines Captain Amy Kotzer claimed: "Almost half our pilots earn less than $30,000 a year." The result of this downward pressure can be gauged from the following table. The May 2008 wage-level data was obtained from the US Bureau of Labour Statistics:

Occupation	Mean annual wage $US
Dishwasher	17,700
Short order cook	20,200
Baggage porter/bellhop	23,200
Filing clerk	25,300
Construction labourer	32,200
Bus driver	35,700
Carpet installer	41,300
Carpenter	42,900
Brickmason	47,700

When Rebecca Shaw applied to join Colgan Air in November 2007 she was offered a salary of less than $17,000 — about the same as a dishwasher. At the time of the accident she was earning about the same as a baggage porter. How might one describe a world in which a degree holding, highly trained and highly motivated professional with safety responsibilities is paid the same as a baggage porter?

Missing the point

Asked to address the subject of pay, Phil Trenary, Pinnacle's Chief Executive Officer told the Senate Commerce subcommittee on Aviation: "I urge you, please do not ever equate professionalism and competence with pay.... Some [pilots] make over $100,000, some make less than that. They are all professionals". Trenary is missing the point. The issue is not low pay and professionalism but low pay and lifestyle. If pilots cannot afford to live near their work, they have no choice but to commute–sometimes, as in Shaw's case, over very long distances. Colgan Air expected it's Newark based pilots to buy or rent accommodation in New Jersey but did not recognise the cost of doing this in wage levels. Colgan Air's managers made no attempt to understand the wider socio-economic environment. They divorced themselves from the lived reality of the flight crew lifestyle. They lived in a bubble.

Questioned about his pilots' lifestyle, Daniel Morgan, vp, safety and regulatory performance at Colgan Air, told the NTSB: "You're adults, you're professionals use the time we've given you to rest." Morgan's statement is a prime example of Colgan Air's 'bubble' mentality–the belief that, so long as minimum requirements are met, the rest will take care of itself. But, as evidenced by long-distance commutes, nights spent sleeping on crew room sofas and the crash-pad (flop-house) phenomenon, things are not taking care of themselves. The US regional airline sector is an industry in crisis. Many pilots are overworked and underpaid and some managers are in denial. Something has to change.

A socially responsible industry?

Low pay levels, long-distance commutes to work, nights spent in crew rooms or cars, or in seedy crash-pads with crewmembers coming and going at all hours constitute latent errors (resident pathogens) in the US national airspace system. Practices like these increase the risk of accident. The industry does have a way out, however. Its called Corporate Social Responsibility (CSR). Management experts Kathryn Bartol and David Martin define CSR as: "The obligation of an organisation to seek actions that protect and improve the welfare of society along with its own interests." The following table describes three different perspectives or 'readlngs' of CSR:

Perspective	Objectives and outcomes
The invisible hand	To maximise profitability and shareholder value by legal means
The hand of government	To maximise social benefit by passing enlightened laws (like the Equal Pay Act)
The hand of management	To maximise profitability and shareholder value by legal means in a way that benefits the whole of society (i.e. not just the elites)

It could be argued that the current behaviour of first and second-level carriers reflects the first reading of CSR. Airlines seem determined to maximise shareholder value regardless of social outcomes. To maintain public confidence and their licence to operate, it is imperative that airlines action the third reading of CSR. For all sorts of reasons (passenger safety, public relations, insurance premiums) they can no longer afford to dismiss the social outcomes of boardroom decisions. Decision-making processes must factor in social costs and benefits. Managements can no longer act as though the world beyond the boardroom or dealing floor is nothing to do with them. If airline managers expect itinerant pilots to rent accommodation close to their base, they must recognise the extra burden in pay levels. It is the responsible thing to do. It is also what the public expects. A 1996 Business Week poll found that most Americans believed that companies "owe something to their workers and the communities in which they operate."

On 30 July 2009, the US House of Representatives approved the 'Airline Safety and Pilot Training Improvement Act' (HR3371). The Act directs the Federal Aviation Administration to investigate long-distance commutes to work. HR3371 is underwritten by the most enlightened reading of corporate social responsibility. It is predicated on the assumption that airlines' responsibilities extend beyond the board room and dealing floor. It assumes they extend into the wider society. If the airline industry wishes to regain public confidence it, too, must embrace the most enlightened reading of corporate social responsibility.

Dr Simon Bennett, MRAeS, FICDDS, is a consultant member of the Flight Operations Group. He works at the University of Leicester's Civil Safety and Security Unit (CSSU) where he directs the MSc in Risk Management. His latest book, A Sociology of Commercial Flight Crew, is published by Ashgate.

Originally printed in Aerospace Magazine.

Laser Illumination

by Capt. Dick Hornby, Deputy Chief Pilot – Greater Manchester Police Air Support Unit

I can remember quite vividly the first time I ever fell victim to a laser illumination. In a split second my world went from a scenic view over Manchester, to a sensation of the being hit (without feeling a physical blow) as green shards appeared to fly around the cockpit and then back to a (still) scenic but less detailed view of Manchester. I was shaking my head and blinking in an effort to sort out my vision when the second strike occurred. Only then did I react with a control movement that instinctively placed the rear of the aircraft between the crew, and where I thought the source had been.

Having no SOP for such an incident and with the perpetrator happy enough with his work that he did not 'show' again we returned to our base, to discuss what had happened. Since that night a lot of work has gone into working closely with the CAA as members of the Laser Steering Group, briefing our crews on the effects of laser illumination, educating the industry on mitigating the effects of an attack, educating the public of the seriousness of such an act and locking up those who have decided not to heed the warnings.

Laser illumination has been on the increase over the past 5 years which may be attributable to a number of factors such as the expansion of the Internet leading to greater (and relatively anonymous) access to laser pointers, their unit price falling and also an increased awareness (by aircrew) of the need to report illuminations.

The majority of offenders caught by myself and my colleagues around the UK are individuals who, despite the stupidity and dangerousness of the act, did not set out with intent to cause an accident (though this does not lessen the impact of the act). They come from a wide range of educational, social and economic backgrounds. Age has ranged from children aged 10yrs to an old lady of 70yrs (if you believe the only other occupant of the house, which was her 40yr old son).

Laser Steering Group

The Laser Steering Group is chaired by the CAA and was set up to consider the operational and safety impact of laser illuminations on aviation and to explore and implement a response to the threat. The group is made up of representatives from the CAA (SRG, Medical, Flight Ops, SDD & Regulation Enforcement), Home Office, NATS, and ourselves from the Police.

Work by the steering group led to a media campaign in early 2009 warning the public of the danger of laser illuminations and also the fact that they were unlawful and carried the risk of a custodial sentence. A new offence (more easy to prove) has been introduced to the ANO in record time as a result of lobbying at the Department for Transport (DfT). Collated information is being shared with other National & International organisations as the problem is not restricted to UK airspace.

Lasers

LASER is an acronym for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation. It is an optical device that produces a very highly concentrated beam of light in a single colour by means of synchronised, narrow light waves within a low convergence beam. Modern laser technology produces laser beams in the X-ray, ultra-violet (UV), visible, near infra-red (NIR) and longer wavebands. Only visible (Blue, Green, Yellow/Orange and Red) and NIR lasers are likely to be seen outside of special environments such as laboratories.

The most prevalent laser in connection with our current problems is the Green lasers, which fall into the 495-570nm (nano-metre) range. As can be seen in **Fig 1** this wavelength spread has within it the peak relative sensitivity for both light adapted and dark adapted eyes. Due to this fact, green lasers can appear to be 2 - 10 times more effective when compared to an equal powered red or blue laser.

Medical Aspects

Temporary Visual Impairment

The temporary effects of laser illumination currently experienced by aircrew fall into 3 main categories:

- Distraction – interferes momentarily with task concentration
- Glare – the beginning of disrupted vision (inability to see beyond the laser light). Becomes more severe with increased power levels
- Flash blindness – vision is blocked during the exposure and hindered after it by after images that result from the saturation of photoreceptors at the image site of the retina. Recovery time will differ between individuals.

Retinal Damage

- Whilst it is extremely unlikely (in relation to the current threat), permanent damage

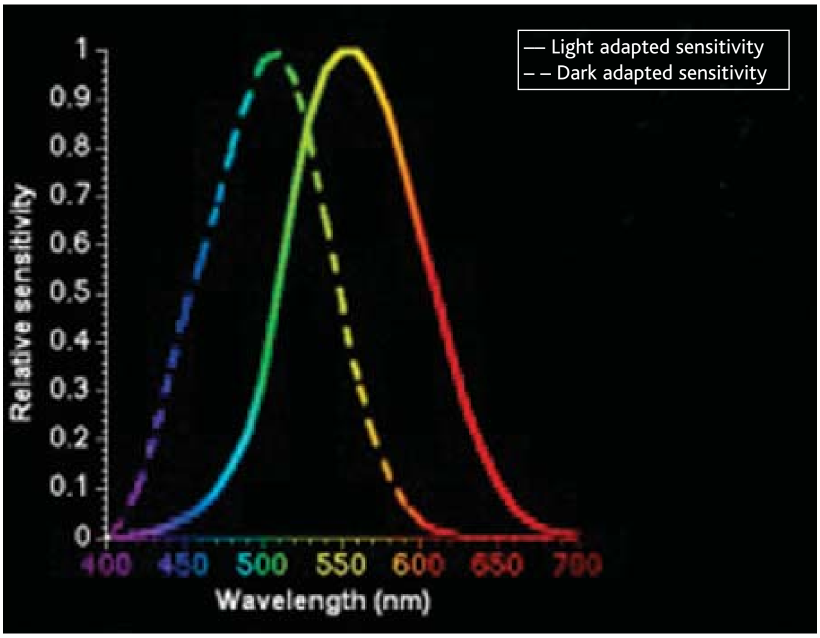


Figure 1

Laser Effect in Relation to Altitude

Figure 2 is a graphical representation of the expected hazard levels.

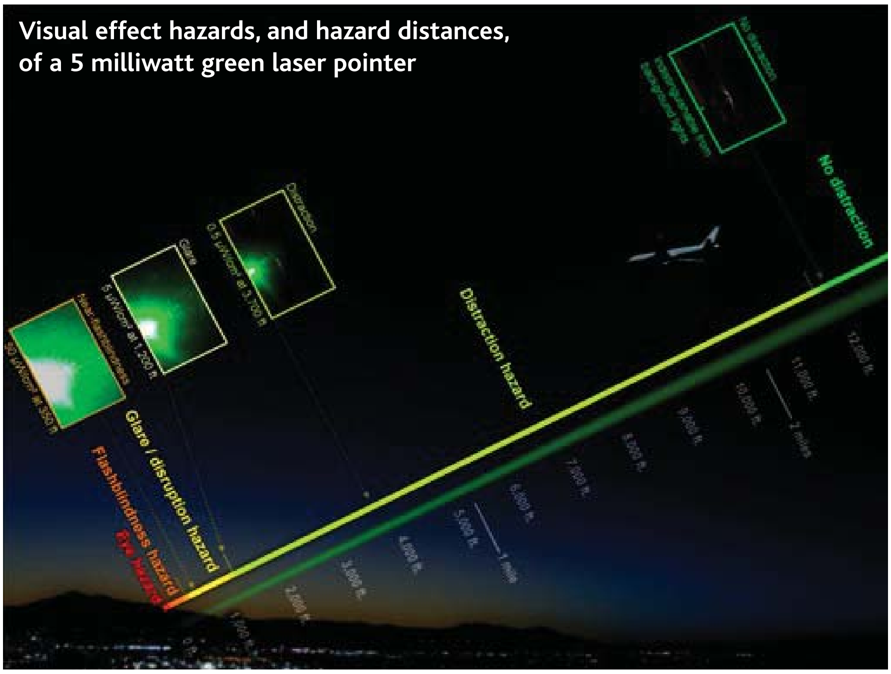


Figure 2

could occur from a deliberately targeted high power laser should the exposure be of sufficient duration. Any member of crew who feels the affect of a laser illumination after the initial attack should seek medical advice before returning to flying duties.

Mitigating the Effect

There are a number of things that can be done by airlines and aircrew to help mitigate the effects of a laser illumination on the safe operation of their flights.

- Warning – warn the other members of the crew should you become aware of laser activity, expect an impending laser illumination or actually experience one.

- Avoidance – avoid looking directly at the laser. Whilst it would be helpful to accurately locate the source it is of secondary importance to the safe conduct of the flight so do not risk further after effects by attempting to nail the source location.

- Fly the aircraft - Whilst an illumination can be severely distracting it does not affect the flight characteristics or airworthiness of the aircraft. There is greater danger of damage from overreaction and mishandling.

- Report – a timely report of any laser illumination will allow ATC to inform other traffic, consider traffic patterns (if incidents are numerous) and liaise with Police Air Support Units. Verbal reports should be followed up with an MOR containing as much information as possible as per table 1 with the caveat of the advice given above concerning Avoidance.

- Education – the education of aircrew into the effects of laser illumination can go a long way to dispel myths such as "certain retinal damage" that still exist within the industry. Understanding the very low, direct, risk to health will help in avoiding possible over reaction to an illumination and any anxiety that may be invoked.

- Experience – despite the increasing number of reports there are still a large number of aircrew out there who have never experienced a laser illumination. By introducing the experience, as part of routine simulator training, the inexperienced members of the industry can be quickly be brought into the fold.

- Cockpit SOP's - should be developed and practiced during routine training and best practice shared between airlines/type users.

- Awareness – be aware of any laser activity in and around your airfield of departure and arrival as you will be more susceptible to the effects of laser illumination during critical phases of flight (take off and landing).

- Medical – avoid rubbing your eyes after an illumination. Seek medical advice should you feel unwell following an incident (either physical or mental) and prior to reporting for further flying duties.

The Current Threat

The current weapon of choice of most illuminators appears to be a hand held 5mW (milli-Watt), 532nm (nano-metre) green laser pointer though more powerful laser sources are readily available via the internet and, whilst their current cost is prohibitive to general members of the public, the prices are falling.

The Future

Despite our best efforts to eradicate the problem, incidents of laser illumination are still on the increase. There were 739 reported incidents of laser illumination in the UK in 2009 and a further 127 reported by UK aircrew that had been experienced whilst operating in foreign airspace.

A further media campaign is being considered with a change of emphasis on the target audience and a change in emphasis of the perceived victims.

Police Air Support Units continue to respond to reports of laser activity reported by local ATCU's and, if the perpetrators are detected and detained, prosecution is applied whenever the law allows (please understand that under UK law certain individuals, dependant on circumstances, are entitled to receive a Police Caution as opposed to being prosecuted in a Court of Law).

What should be reported?

Table 1

Position	Position of aircraft and source of illumination with reference to that position, unless you can identify a geographical location
Colour	What colour was the laser? Red, Green, Blue (white would normally indicate a powerful torch)
Duration	What was the duration of the illumination?
Type	Was it a continuous beam or pulsed? Single or multiple sources? If multiple was it considered a co-ordinated attack?
Intent	Was the laser just waving in the sky, or deliberately targeting the aircraft?

Hazard Distance for Differing Laser Power

Table 2

Power (mW)	Damage Range	Flash-blindness Range	Glare Range	Distraction Range
5	16	80	400	3600
50	50	250	1200	11000
125	80	400	1800	18000
250	100	560	2600	25000
500	160	800	3700	36000

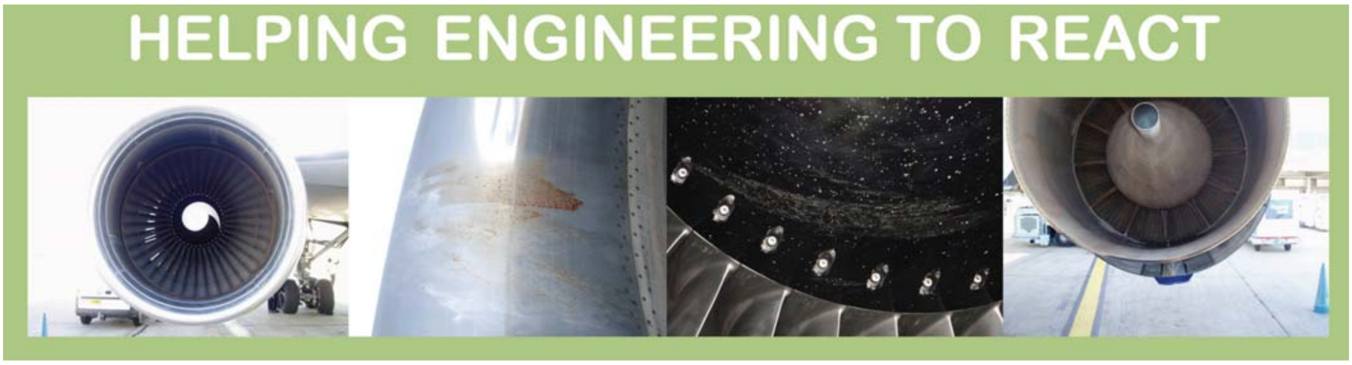
Distances given in metres assuming illumination by green (532nm) lasers of indicated powers

Reports are filtering through from overseas about co-ordinated laser illuminations from multiple sites. This is a worrying trend that, thankfully, we haven't seen in the UK to date. National Authorities in the countries where these attacks have been reported have been lobbied by the UK authorities to act robustly. You may, in future, find reports of such laser activity within NOTAM information as part of your pre flight briefing package.

Our future (certainly in the short term) would be one of managing and policing the threat, as opposed to eradicating it. In the long term the imposition of a ban on the importation of laser pointers into the UK with the exception of legitimate users (similar to that introduced in Australia) would help to reduce the flow of laser pointers into the UK but it will not stop the flow completely. Likewise, the robust and consistent prosecution and sentencing of perpetrators may eventually help to reduce the number of offences but there will always be an element who will have no time or consideration for the danger they cause or the consequences of their actions.

Birdstrike Investigation

by Jason Digance IEng, AMRAeS



Every year throughout the aviation world 1000's of aircraft are in collision with flying objects of the feathery kind. The impact inevitably leads to catastrophic damage to our intrepid feathery flyers but what damage is caused to the aluminum assailant ?

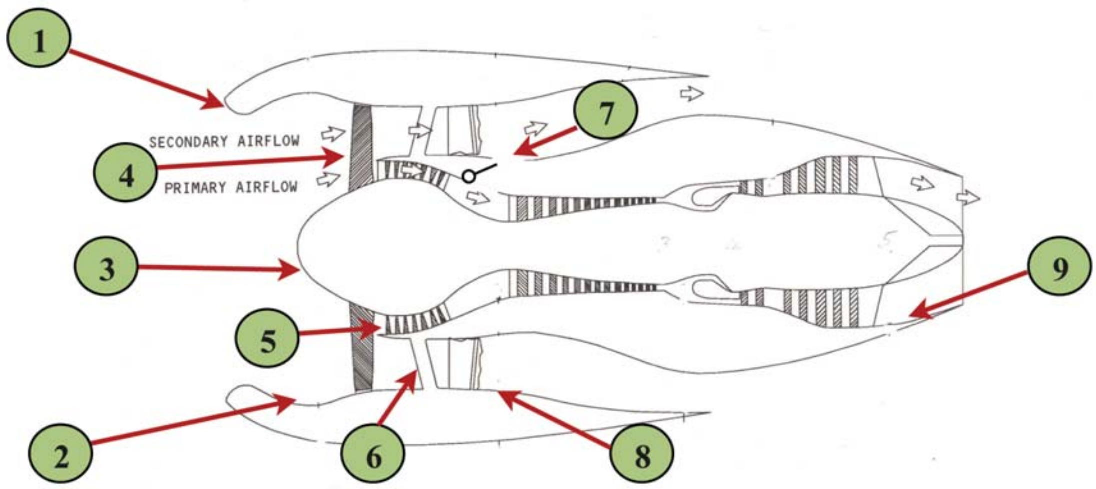
The most common areas of damage are the radome, windshields, slats, flaps, undercarriage and of course when you are landing down-route miles from engineering support, the engines. This article is a pictorial guide designed to help with the initial identification of any engine damage.

The article is designed to give Flight Crew a more practical level of knowledge regarding the type of information required by their Maintenance Control (Maintrol) prior to deploying an engineer.

The following questions from the manufacturers Fault Isolation/Troubleshoot manuals will always be asked by Maintrol following a suspected engine birdstrike:

- Did an engine stall occur?
- Was engine operation normal after the stall? (Vib's, EGT, etc)
- Were engine parameters cross checked at the same EPR /N1?
- Did it require the engine to be prematurely shutdown?
- Was there a burning smell in the light deck and/or cabin?

Visual Aid



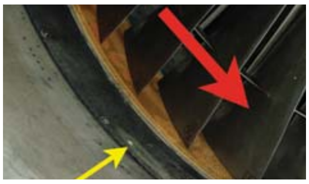
This diagram is numbered front to rear. In reality following a suspected birdstrike the initial inspection areas will be (1) Intake Lip (4) Fan Blade (5) Core Inlet (9) Turbine Exhaust. If damage and debris are found in these areas engineering assistance will be required.

1 Engine Inlet Cowl

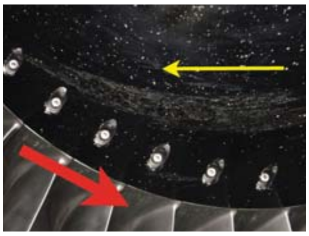
The first visual clue will often be bird remains on the engine inlet cowl. Directional staining of the blood and remnants will often show whether the remains have passed through the engine or gone around the outside. If it is suspected that the bird has passed down the outside remember to look at the surrounding structures, bird remains have been found wedged in slats, flaps and undercarriages after impact with the engine inlet. But what else should we be looking for ? In this photograph it is easy to see that no structural damage has occurred. Please look closely at the impact point for signs of damage such as scratches, dents, missing rivets and puncture marks. **Report any damage to Maintrol**.

2 Intake Cowl

Engine intakes are home to various engine probes. The CF6-80 houses two Fan Inlet Temperature sensors (yellow arrows) which input directly into the Electronic Engine Control. Other engines types may contain an Engine Pressure Ratio probe, these all need to be visually examined for damage and blockage. **If it looks like any of these probes/sensors are damaged or blocked please relay that information to Maintrol**. NEVER TRY TO UNBLOCK PROBES OR SENSORS AS SEVERE DAMAGE CAN BE CAUSED TO AIRCRAFT SYSTEMS.

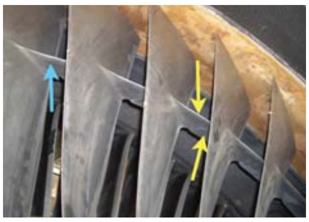


Take time to inspect all of the intakes Acoustic Lining looking for signs of impact damage, tears, cuts and delamination. Taking note of the direction of engine rotation (English and American engines turn in opposite directions), look at the initial impact point on the inlet cowl in this case the 9-10 o'clock position. The bird may have its first point of impact with the fan blades approximately in line with this. Dependent on its size, not all of the bird may be instantly shredded by the blades. Sections of the carcass may be thrown in the direction of fan rotation (red arrow). In this case a small hole containing feathers was discovered at the 7 o'clock position (yellow arrow). **Please report any damage to the acoustic lining**.



3 Spinner

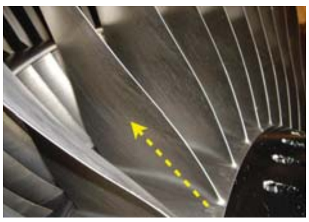
The spinner can be a major indicator as to whether or not the bird has passed through the core of the engine. In this photograph a large stain is plainly visible. Bearing in mind the direction of fan rotation (red arrow) and the suction created by the engine, it can be determined that the bird remains were sucked into and across the spinner. The remains were then sucked into the core of the engine as shown by the direction of the yellow arrow. If a bird has only passed down the cold-stream fan duct there is unlikely to be any significant marking to the spinner. Please take time to examine the spinner for any signs of damage.



4 Fan Blade

The Fan Blades are the area that we tend to pay most attention too after the birdstrike. It is not uncommon to see bent or torn blades after an impact with a bird. **Report any damaged blades to Maintrol**, they can check the aircraft records to determine if the damage was previously recorded. Please note some fan blades may have a number written on them in indelible marker pen please relay the number to Maintrol if it is present. Engines with a Mid-Span Shroud (blue arrow) may also experience 'shingling' where the shrouds from each blade no longer line up as shown in the picture. When this occurs one mid-span shroud rides up over the other at the location shown by the yellow arrows. This prevents the blades from taking up their natural position when the engine is running resulting in excessive fan vibration. **Any signs of shingling must be reported to Maintrol**.

Feathers can give an indication of which blades were in contact with the bird, but look at the general condition of all of the blades. If there are only visible signs of feathers on the outboard half of the fan blades, it may indicate that the bird has passed down the cold-stream duct. This can only be confirmed after the blade roots and engine core inlet (5) have been inspected. It can be seen in the photograph that there are small feathers and blood stains radiating out from the fan blade roots. Not all blade roots will exhibit this staining but inspect them all, in this case 6 consecutive blades demonstrated this pattern, starting in the area of the spinner staining.



This photograph shows a distinct pattern of blood staining on the back of the fan blades emanating from the blade root. If there is no sign of blood staining near the root look at the reverse of the blades further outboard. If similar patterns are only found on the reverse of the outer half of the fan blades it is likely that the bird has passed through the cold-stream duct. Further inspection will be required to confirm this but it is a good first indicator. DO NOT TOUCH ANY BIRD REMAINS WITHOUT WEARING GLOVES.

5 Core Inlet Guide Vanes

In this example with feathers and blood staining on both the spinner and blade roots signs of core ingestion were inevitable. The photograph shows feathers and carcass stuck to the core inlet guide vanes. **Once this has been identified the engine will require a borescope inspection before further flight**. Please note that not all licensed engineers have the required certification to carry out this inspection, so if you are in any doubt about core ingestion ***please tell Maintrol you are unsure***. A suitably qualified engineer will then be sent with the required equipment to carry out this task if it is required.

6 Outlet Guide Vanes

Visual inspection of additional areas can help to prove or disprove your suspicions. The Outlet Guide Vanes (OGV's) direct the flow of air through the cold-stream duct and can be viewed from either the front of the engine through the fan blades or from the rear by looking up the cold-stream duct. In this case large amounts of feathers were found on the OGV's between the 9 o'clock and 7 o'clock positions. This proves that some of the bird passed down the cold-stream duct. Feathers were also found on the OGV's at the 6-5 o'clock position. Please inspect both the OGV's and acoustic lining around them for any signs of damage.

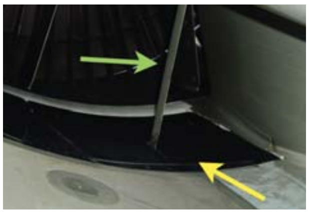
7 Variable Bypass Valve Outlet

Most engines have a compressor airflow control system that vents compressor air into the cold-stream duct during engine surging or low power settings. On some models of engine such as the CF6-80 the outlet to these valves can be seen from the rear of the engine. If bird remains can be seen emanating from the slot highlighted by the yellow arrows on this particular engine type, it is proof that some of the bird has been ingested by the core of the engine and a borescope inspection will be required.

Debris in the cold-stream duct is inevitable if portions of the bird have passed down it. Feathers and carcass will undoubtably be found, but what else should you look for ? Initially, any signs of impact damage, delamination, holes or tears to the acoustic linings. Any damaged areas should be measured and if possible photographed. The damage limits in some of these areas are quite generous and if this is the only area of damage found after confirmation that the bird has passed through the cold-stream duct you may be on your way home sooner than you first anticipated.

8 Reverser Doors

If a reverser door is completely saturated in bird debris it can be an indication that the birdstrike happened during reverser operation. **If you suspect that the birdstrike happened during reverse thrust please inform Maintrol as an inspection of the reverser cascade vanes will be required**. The cascade vanes can only be inspected with the thrust reverser deployed and are not visible with the engine in its normal configuration. Please take time to look at the reverser doors (yellow arrow) and stays (green arrow) to inspect for damage, a broken stay requires the removal of the thrust reverser door before further flight.



9 Turbine Exhaust

The Turbine Exhaust may be last on the diagram but in reality it will be one of the initial four places you inspect if you suspect severe damage. If you experienced any engine stalling, abnormal engine parameters or could smell 'Fried' chicken then you can be pretty certain that the bird has gone through the core. Tell Maintrol asap if you experienced any or all of these symptoms as it is likely that the engine will require at least a borescope inspection. If there are any metal particles in the tailpipe the chances are we will need to replace the engine. Initially, leave the metal particles where they are and if possible send Maintrol a photograph. Do not remove the particles unless specifically requested to do so. ***Any removed debris must be safely stored for future analysis.*** A pool of oil in the tail pipe does not necessarily spell disaster once again inform your Maintrol who will check to see if there is a current defect referring to high oil consumption. **"IF IN DOUBT CALL ENGINEERING OUT"**

Finally a word of warning!

Avian Flu – You should avoid skin contact with the bird remains at all times. Cabin crew have a spill kit onboard the aircraft which contains disposable gloves. **http://www.hse.gov.uk/biosafety/diseases/ avianflu.htm**

CAA Requirement – It is a requirement to complete a Birdstrike Occurrence Form – CA 1282. For all birdstrikes, whether or not damage has occurred whilst in UK airspace. **http://www.caa.co.uk/birdstrikereporting**

Maintenance Test Flying – Where can you get Effective Training?

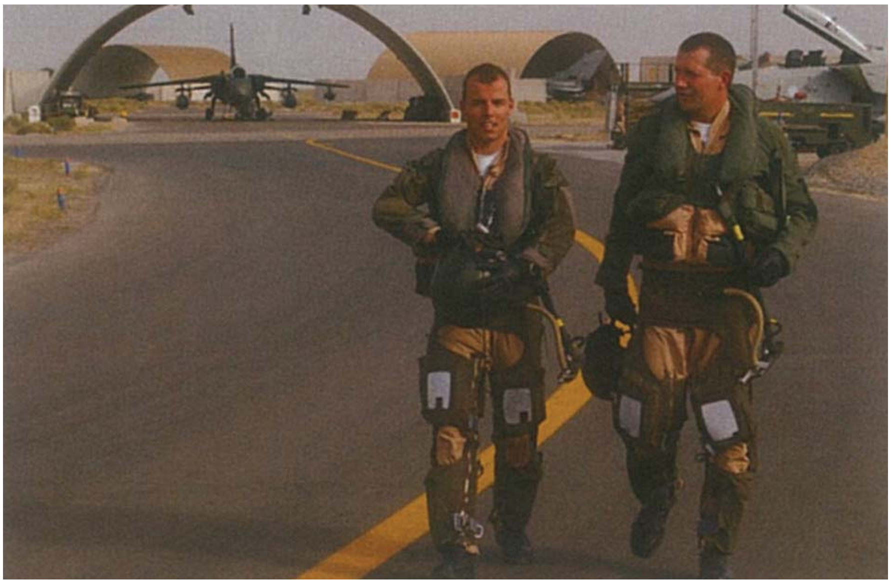
by Mr Steve Daniels, Chief Instructor Empire Test Pilots' School

The Empire Test Pilots' School (ETPS) based at MOD Boscombe Down in Wiltshire takes operational pilots from both the UK and other countries and turns them into some of the world's top Test Pilots after a gruelling and demanding year of training. In the 'old days' pilots applied for the course and, following graduation, were dispatched to join the development test squadrons at Boscombe Down or the research and development squadrons at the Royal Aircraft Establishments (RAE) at Farnborough and Bedford.

But a lot has changed in recent years and ETPS is now a military school, run in close partnership with QinetiQ under the terms of a Long Term Partnering Agreement (LTPA). It is based at Boscombe Down which QinetiQ also operates and manages on behalf of the MOD. Diversification of the syllabus has led to ETPS providing a much broader training schedule and these days, it also trains Flight Test Engineers (FTE) in addition to Test Pilots on its 12-month graduate course. ETPS has also developed a varied range of additional 'Short Courses' aimed at training a wide spectrum of personnel involved in the Air Test and Evaluation (AT&E) environment, and one of these courses is the Post Maintenance Flight Test (PMFT) course.

The ETPS PMFT course was developed following publication of the Radley Report (see the previous article written by Director DARS) to provide training in PMFT philosophy and techniques. It is aimed at all aircrew and engineering managers involved in this type of test flying and the course fills the gap in competencies which was identified in the Radley Report, enabling practitioners to be trained specifically for maintenance test flying. The course has proved to be a popular success since its implementation.

Recently the media has reported numerous alarming stories of post-maintenance flight tests which have gone wrong, predominantly in the civil aviation arena. Some have ended in tragedy, with lives lost, and some have ended embarrassingly, with egg on faces and lessons learned. In the light of such events, does the ETPS PMFT course have a bigger role to play in UK military aviation?



The course is designed to give students ground-based instruction in the discipline of PMFT of aircraft. It consists of a series of classroom lectures, discussion forums and role-playing exercises over three days. It also draws on the shared experiences of the students in the forum and is designed to help build upon their academic background. Indeed, a primary aim of the course is to encourage a frank exchange of views and experiences in both the classroom environment and the social environment – a curry night is included in the syllabus!

The PMFT course studies in depth the documentation used for PMFT; why, when and how the tests are effectively and efficiently performed. Importantly, it provides students with an understanding of the responsibilities of PMFT flight crews, their selection, training and supervision. It examines the conditions relevant to air test sorties, such as weather, external stores configurations, centre of gravity (cg) position etc. The course also aims to help students consider all aspects of pre-flight preparation and planning, the risk analysis of test points, the importance of understanding the aircraft and its systems and the need to be fully aware of the requirements of the Flight Test Schedule (FTS).

The course teaches students to adopt a critical and analytical approach to the in-flight conduct of PMFT, emphasizing the need to use an incremental build-up technique for critical tests, how best to achieve consistent results, and the most effective strategies to use for observation and recording of results. It also explores the understanding of limits, the analysis of unexpected events which may occur during a flight and the 'best practice' test techniques required to complete the FTS in the most efficient manner, with special emphasis on flight test safety.

The major elements of the course are broken down as follows:

Engineering and Documentation – This topic covers the higher-level responsibilities for PMFT, the generation and control of PMFT sorties at station level and a study of all documentation relating to the air tests, including the derivation and amendment of the FTS. The philosophy of partial air tests is also explored.

Sortie Conduct – This covers the general aspects of planning, flying and reporting a PMFT sortie. The selection, training, supervision and responsibilities of air test crews, the weather conditions needed for PMFT sorties and the fundamentals of risk analysis are all discussed in some detail. The need for a thorough understanding of the aircraft, its systems and the flight test schedule is debated, with particular emphasis placed on the effect of cg position and external stores carriage. Such topics as choice of airspace, order of flying tests, consistency/repeatability of test results, observation and recording of data, observance of limits and in-flight analysis of unexpected events are all covered. Post-flight requirements, including accurate, honest and clear reporting are emphasized. The experimental accuracy of the data gathered is also explored.

Applied Theory – This part of the course reviews the terminology associated with engine system and automatic flight control system theory which is relevant to PMFT procedures. A case study is used to demonstrate the importance of aircraft system knowledge and understanding in the planning and preparation of this specialist type of flying.

Test Techniques and Test Safety – This section comprises the major part of the course and provides instruction on precisely how to perform the tests required within the FTS. Safety aspects especially are emphasized here. Depending on the discipline of the students involved (the course is designed for fixed wing and rotary wing aircrew, and engineering managers, with some lessons combined to ensure lots of 'cross pollination'), specialist subjects include ground handling, ground resonance, engine ground runs, low speed handling, spinning, stalling, autorotation, flight control systems, avionic systems, engine testing and much more besides.

Forum Discussions – The forums comprise a number of discussions where the ETPS staff and external presenters introduce and lead debates on UK military accidents that have occurred during PMFT activity in the past. Maintenance Test Pilots (some of whom are also qualified experimental Test Pilots) with significant flight test experience on a multitude of aircraft types discuss their own experiences, and if there is a student majority in the class operating a specific aircraft type, then their particular flight test schedule will be examined in detail.

In all cases, students are encouraged to discuss their own maintenance test flying experiences and share the lessons that they have learned with their fellow students and the staff presenters.

Students are encouraged to bring with them their relevant FTS and it is especially helpful if they have a basic working knowledge of the document before the course begins in order to get the maximum benefit from three days of training. There is no formal assessment during the PMFT course, as the emphasis is on sharing experience and learning best practice from others rather than undertaking formal learning in a classroom environment. Think of it as three days of the enjoyable syndicate-type work which you might have undertaken during military staff courses – with the curry night thrown in for more interaction and further debate!

Students who have attended the course have certainly enjoyed the learning experience and this message has spread through word of mouth across squadrons, with increasing numbers of students applying to attend the course. Typical comments from recent PMFT course attendees include;

- 'excellent course which has changed the way I think about doing PMFTs...'
- 'a highly thought-provoking course'
- 'a good heads-up on a document I didn't even know existed!'
- 'the content was spot on'
- 'very relevant and provided valuable knowledge'
- 'great to hear the stories and experiences of such an experienced pilot!'
- 'amplified the message to expect the un-expected...'

The Radley Report highlighted that those involved in PMFT should be trained and competent in its implementation and, as a consequence, the RAF Search and Rescue (SAR) Force (for example) ensures through policy that all newly qualified Sea King aircraft captains attend the ETPS PMFT course. Thereafter, if a PMFT sortie is required on their 'watch' they have received appropriate competency training in order to conduct the activity. While it is acknowledged that there are many methods of proving competency in any field of aviation, and in this case the ETPS course is but one method of gaining competence, here is an example of the positive consequences emanating from the Radley report. This is particularly pertinent given the current civil aviation focus on PMFT activity following a number of incidents and accidents during civil regulated maintenance test flights.

To summarize, the ETPS PMFT course is highly recommended for any aircrew and engineering managers who are involved in post-maintenance flight test activity for both fixed and rotary wing aircraft. Indeed any aircrew who conduct this type of flying need to be able to prove competence and this course is one method of achieving that aim. In just three days, it provides attendees with a much greater understanding of the skills they need to prepare, conduct and report the results of a maintenance test flight in a safe, efficient and effective manner. This training can help to minimize the risk of mistakes being made and mishaps occurring so, if you are involved in PMFT and would like to learn more about your skill set, please do consider applying. Previous students have found it great fun and have enjoyed the shared learning experience.

The long-term benefits of the course could save lives or at the very least reduce the risk of damaging expensive machinery in the future.

For more information please phone ETPS on 01980 662656 or email etpssales@qinetiq.com

go on... ask your boss for approval to apply!

Post Maintenance Test Flying

by Cdr K A Fox RN, DARS

So what is Post Maintenance Test Flying (PMTF) and why is it an issue? In 1999 the test flight of a Harrier resulted in the loss of the aircraft and whilst this was of course not the first ever crash during PMTF it did result in the Radley study to look at the conduct of PMTF.

Military aircraft are flown within the parameters of the release to service and in a manner that aircrew are used to, following considerable training. However during PMTF the pilot is trying to prove the aircraft in a specific flight regime in which the pilot may not be that familiar. For example you do not routinely fly a multi-engine helicopter on one engine at the engines' limit to prove it can produce the power, and record the parameters. You do not routinely fly a fast jet at maximum angle of attack, as per the ODM etc. Whilst these evolutions are not in themselves any more dangerous than other flying, squadron aircrew are not usually as practiced in their execution. The key to successful PMTF is proper briefing, planning, understanding what you are actually testing and having a plan if it all goes wrong, if at the limits the aircraft does not behave as you expect. If you had not night-flown or been on the range for some time you would work up to it so why is PMTF often taken on too lightly?

This is not just a military issue; below are two recent examples of PMTF in the civilian airline world. Both went wrong but proper briefing, adherence to procedures and a fundamental understanding of how to recover the situation resulted in one aircraft being recovered with lessons learnt and the other crashing with the loss of life.

Flight International, 3-9 March gives a detailed resume of the A 320 accident at Perpignan in November 2008. While not wishing to repeat the complete article, the pertinent points are that by trying to conduct a low-speed performance check at an inappropriate height and phase in a rushed manner, the crew failed to understand or identify that an indication system had failed, until it was too late. Had the test been correctly briefed and conducted at a suitable height and phase of flight it is highly likely that the error, which had in fact been evident since take off, would have been identified. Even if it had not, sufficient height would have been available to have recovered from the resultant manoeuvre.

An experienced easyJet Captain conducted a test flight on a Boeing 737 which included a test of the trim setup (Flight International 10-16 March 2009). Due to a maintenance misunderstanding the elevator trim balance tabs were adjusted in the opposite sense to that intended. This resulted in an unexpected and potentially uncontrollable response during the manual reversion phase of the subsequent test flight. The same captain who carried out the PMTF had delivered the aircraft to the maintenance provider the month before. During the delivery flight he had identified that a trim adjustment was required. When informally briefing the crew chief on arrival that an adjustment should be made, he did not enter the defect in the technical log.

The AAIB report comments: ***'The absence of a formal post-flight debrief and formal written record resulted in the (elevator) balance tabs being adjusted in the opposite sense to that identified as necessary by the flight test'***. However in this incident, the experienced Captain had fully briefed the test, covering just such an event, resulting in him having a pre-discussed plan to recover the aircraft. Despite fully considering all eventualities, it appears that a misunderstanding in the cockpit did not result in the briefed actions being fully actioned, but fortunately this did not preclude recovery. Due to a well-briefed sortie, conducted at a suitable height and with all eventualities briefed, the aircraft was recovered successfully. Likewise, if the original defect had been entered in the maintenance log it is highly likely that this incident would not have happened. **Paperwork does matter**.

So how do we avoid this sort of incident in the future?

Well, training is the most obvious first step. The Radley Report identified that some operating fleets do not fully understand the importance of treating PMTF with the correct level of importance. PMTFs are flown **because** the system may not work, and they are being flown to check that the system behaves as it should. An unusual failure should be anticipated.

Some fleets treat it very seriously, requiring authorized pilots to fly profiles in the simulator and indeed fly practice profiles for the key exercises with an experienced PMTF pilot before they are authorized to carry out such flights.

In the military, PMTF is made a lot easier as we publish the 5M or Flight Test Schedule which tells you how to fly PMTFs, what to notice and what to measure.

This is where judgement is needed. Obviously a PMTF for a radio change does not require the same level of preparation as a single engine performance test or an angle of attack check where things can go very wrong very quickly.

As stated above, PMTF is carried out to establish whether the aircraft, or a system, is working correctly. Most of the time it will, but sometimes it will not. It may be another system that is not working correctly that has an influence on how the aircraft performs at what is often the edge of the normal flight envelope. On occasions the aircraft will be flown in a configuration not normally flown, ie outside the 'normal' operating envelope but within the 'cleared' area of flight. Ultimately do not forget the basics. Fly the aircraft and understand what the indications really mean.

Below is a reproduction of the Summary of the Radley Report after the 1999 Harrier PMTF accident. While much has moved on, there is always a danger of forgetting the lessons of history. This was an RAF study into the conduct of PMTF, but the findings are still relevant to the other services and indeed the civilian world, as highlighted by the two examples above. This leading article is aimed at getting all involved with PMTF to think carefully about what is being carried out. That involves the engineers calling up the test, which must be articulated correctly and briefed to the pilot, the authorizer who nominates the pilot, and ultimately the pilot to ensure he understands what is needed, and who feels confident enough to do it.

Following this article is a piece by ETPS covering the background and content to the 3 day course developed in the light of the Radley Report. This is a very pertinent and comprehensive course that looks at all the issues and I commend it to all those involved in flying PMTF.

Summary Of The Study Into RAF In-Service Flight Testing Of Aircraft; The Radley Report 1999

1. The Study into In-Service Flight Testing in the Royal Air Force considered the creation, approval, dissemination, use, control and amendment of flight test schedules employed both for post-scheduled maintenance as well as for post-rectification work. The role of both engineering staff and of aircrew in the proper conduct of day-to-day aircraft testing was reviewed. The responsibility of Support, Engineering and Design Authorities for the Flight Test Schedule (Topic 5M) was examined as was the place of the Air Staff responsible for the operational airworthiness of aircraft.

2. The routine conduct of in-Service flight testing by engineering and flying staff was good. Procedures for the day-to-day application of the Flight Test Schedule were well established in engineering orders and the interface between engineering and flying staff was sound. Crew selection for air testing was tight with either dedicated crews (UTPs) or carefully selected, experienced squadron or wing staff. Two main areas of concern over the higher-level ownership of RAF in-Service flight testing emerged. First was the proper husbandry of the Flight Test Schedule document and the second was the investment in the people responsible for the conduct of air testing.

3. The Flight Test Schedule was unique in that it sat astride the two disciplines of engineering and flying. There was clear uncertainty over the ownership of the contents of the Flight Test Schedule. Engineering staff believed that the ultimate responsibility lay with those who flew the schedule while the flying staff believed that they were merely completing an engineering process which was dictated by Engineering staff. Inevitably, the husbandry of the Flight Test Schedule suffered. Responsibility should be placed firmly with the Support Authority for type with a clear attendant, auditable remit to coordinate Design and Engineering Authority approval and Air Staff agreement to the Flight Test Schedule contents. Air Staff responsibilities should be placed with Director Air Operations, the current owner of the Release to Service. Given their place in the Airworthiness Documentation Set, responsibility for other documents such as the Aircrew Manual and Flight Reference Cards should be placed formally with the Air Staff but should be approved by the Support Authority for engineering content. All documents in the Aircraft Documentation Set should be brought under the MOD Form 765 procedure for amendment, including the Flight Test Schedule, Aircrew Manual and FRC/FCC. RAF Handling Squadron should continue to act as agent, but under a new name to reflect the Squadron's actual role. To remove the potential conflict of interest, the ownership of the Squadron should moved from IFS(RAF) and be placed with Director Air Operations.

4. The RAF needs to take proper ownership of in-Service flight testing. Behind those responsible for the day-to-day duty lay no culture, structure or ethos of proper flight testing practice. No training was given, other than exposure to schedule content and well-intentioned ad hoc briefing/practice. No basic reference training manuals for engineers or aircrew covered the subject, no orders or regulations required any minimum competencies to be defined. Guidance to all users of the Flight Test Schedule was minimal. The RAF should learn from procedures common elsewhere and introduce a revised Flight Test Schedule document that contains comprehensive advice to users. Air testers should be formally trained and examined. Proper supporting guidance should be available throughout professional reference documents such as AP3456.

5. A number of other recommendations were identified to address weaknesses of detail in controlling engineering publications and procedures, in guidance to schedule users, to suggest a periodic flight testing regime and to improve orders and instructions.

Upset Recovery Training Aid, Revision 2

by Larry Rockliff – V.P. Training and Flt. Ops Support, Customers Services, Airbus Americas

Introduction

The original industry upset recovery training was delivered to the aviation community ten years ago. The genesis of this reference was a discovery that many pilots had progressed along their career and had never been educated in recognition and recover from upsets or unusual attitudes. Ten years later, the accident/incident rate due to failure to recover from an upset, remains among the top statistics to work on. There are various reasons for this, not the least of which is a regulatory base that allows to add training modules to an operator's program, but is less agreeable to remove modules that have much less significance in the operating environment of today.

In recent years, there have been several accidents and incidents that have occurred in the high altitude environment. Odd as it may seem, causal factors from several investigations have been a lack of understanding of phenomena associated with operating a jet aircraft in the high altitude environment. To respond to this shortfall in a pilot education, the FAA asked Airbus and Boeing to convene an industry group to define a training aid specific to high altitude operations. The result has been a collaborative effort that consisted of manufacturer, airline, safety, regulatory, industry trade, and educational organizational representatives both domestic, within the United States, and international in scope to arrive at a document that addresses the problem.

Consensus from the group was to amplify information and guidance vis a vis high altitude already embedded in the existing Industry Upset Recovery Training Aid and deliver it as Revision 2. This is now available to operators on *http://w3.airbusworld.com*.

In addition, because the FAA requested a specific reference for high altitude to respond to NTSB recommendations, it was decided to also provide a separate stand alone supplement to specifically address high altitude phenomena. This is a separate appendix, which is contained in the back of the Training Aid.

Goal

The goal of Revision 2 is to focus on specific education for pilots so they have the knowledge and skill to adequately operate their airplanes and prevent upsets in a high altitude environment. This includes educating pilots so they can develop the ability to recognize and prevent an impending high altitude problem and increase the likelihood of a successful recovery from a high altitude upset situation should it occur.

As surprised as regulators and industry was to discover in the 1990s that many pilots did not have the knowledge and skills to recognize and recover from any upset or unusual attitude, it came equally as baffling to learn that pilots had exceedingly limited knowledge and abilities to handle their airplanes in the high altitude environment in spite of the fact they operate in this area over 98% of their flight time experience. Indeed, many pilots have never had the opportunity (or requirement) to operate their aircraft in the high altitude environment with an Auto Pilot off to experience the differences.

Take Away

There is considerable content within the Training Aid Revision 2 and Airbus recommends that operators refresh their knowledge and skills with a view to introduce primary and/or refresher training for their crews. With all the information available to the training departments, the take away to each and every pilot has been distilled into three simple guidelines:

- Contain The Startle Factor
- Recognize and Confirm the Situation
- Very Small Control Inputs

Containing the startle factor applies to every situation a pilot may encounter, regardless of high altitude or sea level operating environment. It is a natural reaction; perhaps even reflex action, to want to do something when one is startled. Reactively, disconnecting an Auto Pilot and making un-calibrated open loop rudder and/or control yoke or sidestick inputs will never be the correct reaction and will almost always lead to an amplified abnormal situation. It is in this area that pilots must develop skills to discipline themselves from putting their hands and/or feet into motion, without first understanding what is going on and what the potential consequences of their actions will be. Disconnecting the Auto Pilot under effort in a reflex action is particularly significant as it generally results in a large control input. Indeed, many high altitude upsets would never have become upsets had pilots contained the startle factor. This is a critical area of human factor development that cannot be overstated.

Recognize and confirm the situation is essential for the pilot to determine what recovery action is necessary. Some situations develop quite slowly in which case, the crew will have ample time to assess and decide upon a course of action. However, some may occur nearly instantly, and in these cases the pilot/crew must determine what is happening to their energy state and what is happening to their trajectory. It may not be easy, but it is critical in order for the crew to decide what response they will need to take. In the same way that many engines have been un-necessarily shutdown before sufficient information had been considered, so too, have high altitude upsets been created, due to reacting to only part of the available information. This is a broad area that cannot be distilled into the scope of this article, but sufficient to say that a corrective action can not be contemplated without consideration of what the pilot/crew is responding to. The link between containing the startle factor, recognizing and confirming the situation, can be fused together to allow the pilot to apply the third and always essential take away point.

Very small control inputs cannot be overstated. Open loop, or arbitrary large scale deflections must be avoided at any altitude. The relationship between control surface deflection and trajectory change is amplified at high altitude.

- The airspeed at high altitude is generally higher than the one pilots are used to fly at manually. Therefore, a reflex action giving the same control surface deflection will result in a much higher load factor than initially expected.

- For the same control surface movement at constant airspeed, an airplane at 35,000 ft experiences a higher pitch change than an airplane at 5,000 ft because there is less aerodynamic damping. Therefore, the change in angle of attack is greater, creating more lift and a higher load factor.

- Moreover, if the input is large enough, pitch up may happen, amplifying the formerly described effect and buffeting may occur, creating a second startle factor that may trigger another large reaction in the opposite direction.

If the control system is designed to provide a fixed ratio of control force to elevator deflection, it will take less force to generate the same load factor as altitude increases.

On many modern airplanes with classical, non reversible flight controls, the control force to elevator ratio is varying with airspeed so as to give roughly a constant force for the same load factor all over the flight envelope. This is even more true for fly-by-wire airplanes flying with C* pitch control law where sidestick deflection is actually a load factor demand.

A similar discussion could be held for the yaw axis with rudder inputs.

Nevertheless, and whatever the flight control system, an additional effect is that, for a given attitude change, the change in rate of climb is proportional to the true airspeed. Thus, for an attitude change for 500 ft per minute (fpm) at 290 knots indicated air speed (KIAS) at sea level, the same change in attitude at 290 KIAS (490 knots true air speed) at 35,000 ft would be almost 900 fpm. This characteristic is essentially true for small attitude changes, such as the kind used to hold altitude. It is also why smooth and small control inputs are required at high altitude, particularly when disconnecting the Auto Pilot (an Auto Pilot disconnection by overriding it on the yoke or sidestick controller will very likely cause large and excessive control inputs). Put in fundamental piloting terms, inappropriate control inputs due to uncontained startle factor without consideration for what is actually occurring, can almost certainly cause an upset to become exaggerated, or indeed precipitate one that didn't exist in the first place. Simply stated, all control inputs must be in the form of control pressures versus control deflections. Incidentally, this is identical to the relationship in the larger movements on an automobile steering wheel when nearly stopped as opposed to the tiny pressures warranted while at high speeds. Imagine the result of a large steering wheel deflection highway speeds…

Airbus Policy towards Upset Recovery Training

Airbus policy has been consistent since the original Industry Upset Recovery Training Aid was offered in 1998. Airbus believes it is practical and encouraged to educate all pilots to understand the principles of airplane upsets and how to avoid them. The dynamics of airplane upsets at low altitude or high altitude are so broad that defining simplistic procedures or techniques are not appropriate. To that end, upset recovery training is encouraged in the context of awareness training versus procedure training.

Moreover, Airbus does not support the use of full flight simulators to conduct upset recovery training. Although excellent training tools within the normal operating environment and envelope the pilot/crew experiences in his/her duties, simulators have many limitations that create enormous opportunities for negative training. Airbus believes the risk of producing significant negative training far outweighs the possible benefit that might be achieved.

High altitude exercises as proposed in the most recent Revision 2 of the Industry aid, is consistent with Airbus training policy. Because the scenarios recommended are focused towards recognizing a developing situation so the pilot/crew can arrive at a solution prior to entering an upset, the use of simulators in these scenarios are appropriate.

Some operators may still decide to use simulators to conduct upset recovery training. In these cases, Airbus recommends to only use the simulators with the motion systems selected off. This is not to protect the serviceability of the equipment due to large motion movements toward the stops. Rather, it is an attempt to minimize the likelihood of negative training due to incorrect motion cues and lack of accelerations. Indeed, positive reinforcement derived from negative training, is the most difficult situation to manage. A pilot/crew should walk away from a training event with positive re-enforcement. However, if similar conditions taught in a simulator are experienced in an airplane, there could be large differences in how the airplane responds to the pilot inputs and consequences can be severe and unrecoverable. Finally, Airbus does not support intentionally suppressing normal law in order to facilitate upset conditions.

Summary

Airbus has been a supporter of educating pilots to recognize and avoid airplane upsets. Though this knowledge and associated skills should have been acquired during earlier pilot training and not airplane type rating training, it is important to recognize that a knowledge gap exists within the pilot community and Airbus has been a leader in working with industry to arrive at a solution.

Contain the startle factor, recognize and confirm the situation and correct making the smallest control inputs/pressures possible to arrest any divergence in order to recover. These three points are powerful, positive "take aways"…

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TAM Brazilian Airlines
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Thomas Cook Airlines
Kenny Blair

Thomson Airways
Martin Ring

Titan Airways
Pavan Johal

Virgin Atlantic Airways
Rob Holliday

Vistair
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GROUP MEMBERS

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Graham Rourke - Airworthiness
Simon Williams - Flight Operations Policy
Garth Gray – Flight Operations

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Telling us it was a 'big bird' isn't enough!

40% of all birdstrikes reported to the CAA contain no bird species information.

This hampers the ability to accurately assess and mitigate the birdstrike risk and also masks potential underlying problematic changes to bird populations and strike trends.

For more information go to www.caa.co.uk/birdstrikes

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