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

Editorial Office:
The Graham Suite, Fairoaks Airport, Chobham, Woking, Surrey. GU24 8HU
Tel: 01276 855193 Fax: 01276 855195
e-mail: admin@ukfsc.co.uk
Web Site: www.ukfsc.co.uk
Office Hours: 0900 - 1630 Monday - Friday

Advertisement Sales Office:
UKFSC
The Graham Suite, Fairoaks Airport, Chobham, Woking, Surrey GU24 8HU
Tel: 01276 855193 Fax: 01276 855195
email: admin@ukfsc.co.uk
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The Increasing Risks and Dangers of Portable Electronic Devices On Commercial Aircraft

by Rich Jones, Chief Executive UKFSC

Whilst there is no specific evidence at this stage that lithium batteries were the cause of the recent Asiana B747 accident off South Korea, the potential risk of lithium batteries to aviation safety is, at least among the cargo carriers, starting to rise up the agenda. The Dubai B747 accident last September, in which a significant numbers of batteries were being carried, did nudge ICAO and some National Aviation Authorities to remind those operators carrying lithium batteries in bulk to ensure that they abided with the relevant Technical Instructions and also to consider the positioning of these loads in those hold areas with fire suppression systems.

It is, therefore, reasonable to assume that the air cargo carriers are well aware of the issue, all be that they may not know the precise whereabouts of every small battery pack in a 300 ton cargo. Nonetheless, the growing trend on economic grounds for there to be just two pilots on the aircraft, both of whom would be tied to the flight deck during airborne emergencies, leaves no flexibility for intervention to reduce or impair fire and smoke generation to win more time for a successful diversion or return to base.

However, the dangers of personal devices such as computers, tablets and mobile phones which all contain lithium batteries appear to being disregarded by many airline operators. Whether in the passenger cabin, where it is not unusual to see a hundred or more passengers charging their laptops as the aircraft speeds its way across the Atlantic or on the flight deck, where personal devices of all kinds are being routinely used for legitimate business, information and entertainment purposes, these equipments invariably rely on chargers, approved or not, which are plugged into flight deck power points during the cruise phase of the flight.

Let's consider the passenger cabin, and the ever-increasing level of risk created by the widespread availability and usage of lithium powered devices being charged by the aircraft system. Two concerns come immediately to mind; the possibility of thermal overrun and a subsequent fire or explosion, or the shorting of spare batteries in hand luggage. On the latter, we are aware of at least one example of a small mobile phone battery having slipped from a bag onboard an aircraft which has subsequently shorted out behind a seat cushion and caused a fire.

It is unrealistic to think that the presence and use of all such powered devices can be banned from the cabin. However, it essential that passengers are made aware of the potential risks; not only for careful spare battery stowage but also of the actions they must take, should they sense overheating of the device or its associated charger. Equally, the cabin crew must be adequately trained to deal with lithium battery fires. For a start, they must know which type of extinguisher to use and, of course, which not to use; lithium and water do not mix well together! There are reports of cabin crews being unaware of the mechanisms which trigger fire extinguishers and also of excessive and ineffective use of the wrong extinguisher types on electrical and galley fires.

Turning to the flight deck and, as was alluded to earlier in this editorial, the presence and widespread use of personal electronic devices in the cockpit, both official and private, which is now well established. It is immediately accepted that these are making a valuable contribution to operational efficiency and safety. Nonetheless, the same risks identified for the passenger cabin exist on the flight deck too, and could have even more catastrophic consequences. Such dangers as thermal runaway and loose batteries are obvious, but something as simple as a charger cable strewn across the cockpit could cause inadvertent switch selections in turbulence or, as has already happened, the cable may be accidentally trapped and the charger shorted with unwelcome effects on aircraft electrics and avionics. In addition, there is evidence that the Wifi and mobile phone technology routinely featured in these devices, whether radiating deliberately or accidentally, can interfere with aircraft systems.

Where do we go from here? The inevitable and relentless increase in the availability and utilisation of lithium battery powered devices is, for all practical purposes, unstoppable. But having accepted the positive contribution that such devices can make operationally, it is essential that regulators and the airline operators ensure that flight crews, cabin crews and passengers alike are fully aware of the risks that such devices and their associated hardware, and that pilots and cabin staff are appropriately equipped and trained to deal with device and battery fires in an effective and timely fashion. If there are doubters amongst you, take a look at the informative FAA video on You Tube which provides useful demonstrations on laptop fires and the methods to fight them.

'Airstairs Vigilance' Article – CAA Actions In Response To The Risks

The UK CAA has undertaken the following actions to mitigate the risks highlighted in the article entitled 'Airstair Vigilance' on Page 83 of the Summer edition of FOCUS:

As well as considering operations with the B737, the CAA has also considered the risks with the operation of other types of aircraft fitted with airstairs. Accordingly, the CAA has published Safety Notice SN 2011/02 in which operators are directed to draw passengers attention to the risks with airstairs and the need to maintain close supervision of children, immediately prior to boarding or disembarking.

The CAA has also considered action to be taken by operators from other States arriving in and departing from the UK. For EU Member States, EASA has been alerted to the publication of the SN and, in view of Ryanair's extensive operations in the UK, the Irish Aviation Authority has been alerted. Lastly, the CAA has advised the UK Department for Transport so that they could advise any third country (non-EU Member State) operators of aircraft fitted with airstairs likely to operate to/from the UK.

CAA Cabin Safety Inspectors will be paying particular attention to operations with airstairs during their continuing oversight programme.

The Right Attitude!!

by Capt. Tony Wride, Monarch Airlines

Just when I thought I had written my last Chairman's Column it all changed and I'm still in the Chair for another year so unfortunately you will have the pleasure of my thoughts for another 4 issues!

I had a nostalgic moment, as you do occasionally at my age, a few weeks ago remembering back to the early 80s teaching baby Navy pilots at the Royal Navy Elementary Flying Training Squadron (RNEFTS). In particular, I remember the early lessons on effects of controls, apart from the effects of the controls themselves, instilled the basic principles of having the correct aircraft attitude into the minds of the students. In fact one of the important requirements to do this initial training was to have a defined horizon so that the aircraft attitude could be clearly seen and remembered.

Those of you that have flown an aircraft will, I'm sure, remember to your dying day, Power, ATTITUDE, Trim (PAT) and ATTITUDE, Power, Trim (APT) being taught to you by your instructor. For any given stage of flight the students were taught the "Right Attitude" to set and having learnt that important principal in visual conditions it was relatively easy, for most pilots, to then apply the same principal using an Artificial Horizon when learning to fly on instruments.

In another early lesson the student pilots were also taught all about stalling including the fact that it was to do with angle of attack (AOA) and that to recover from a stall, or the stall onset, you had to reduce the angle of attack by pushing forwards on the control. The very first exercise was to enter a stall in level flight where you set idle power and gradually increased the attitude to maintain level flight until the stall warning. At the point of the stall the attitude was invariably very high and well away from the normal level flight attitude. Talk to any military fast jet pilot, particularly ex Phantom ones, and they will tell you that they flew the aircraft watching the AOA like a hawk. If they went to too high an AOA figure the aircraft would depart violently and the only option was the Martin Baker 1 recovery, i.e. EJECT!! Remember Maverick in "Top Gun"?

Despite the vast technological leap from a Bulldog to an Airbus A330, the basic principles with regard to attitude and stalling still apply and for any given flight phase there is a correct attitude. For example in the cruise at high altitude the A330-200 flies level with an attitude of about 2.5 degrees nose up and with about 80% N1 (Fan speed). As another example, the initial descent from high level is about 0 degrees to 1 degree nose up and idle thrust. In the Quick Reference Handbook (QRH) for the A330 there is a procedure to be used in the event of Unreliable Speed Indications where the attitudes and power settings for the various stages of flight are tabled. It is a procedure practiced in the simulator but, even if it wasn't, the basics of flying dictate that getting the attitude right is vital and in the aircraft that you fly you should know the right attitude for normal cruise at least. In fact, Airbus have 3 "memory items" attitudes to set, depending on the height, along with power settings until the QRH has been opened and level off table figures obtained.

In the last Chairman's Column, I said that now they have recovered the Flight Recorders and Cockpit Voice Recorders from the Air France AF 447 we might finally discover what caused the tragic accident. The French BEA have now released an updated report, available in English at http://www.skybrary.aero/bookshelf/books/1554.pdf, which is well worth a read. The report and the recommendations made by the BEA will no doubt be the subject of much discussion and debate within the industry.

Whilst it could be argued that such a modern commercial airliner should have sufficiently robust systems so that airspeed should always be available, in this particular case the somewhat freak atmospheric conditions, possibly combined with a pitot system that could have been better, meant that the crew lost airspeed indications. At this point, the "basics" from way back when they were learning to fly, would have saved them, but unfortunately rather than setting a reliable and proven attitude between 0 and 2.5 degrees the pilot flying ended up letting the attitude reach 10 degrees nose up with a resultant vertical speed of 7,000 ft/min before initially pushing the side stick briefly forward. Not surprisingly having a high nose attitude at high level, which gave the rocket like vertical speed, meant that the airspeed (although not indicated) decreased rapidly toward the stall speed. Unbelievably when the Stall warning activated, rather than pushing forward and setting a nose down attitude, thereby reducing the all important angle of attack, the PF kept making nose up inputs! The aircraft ended up in a deep stall descending at over 10,000 ft/min until finally crashing into the sea after a 3 minute descent and killing everybody on board.

In another tragic accident that happened a few years ago an aircraft crashed into the Black Sea following a badly handled go around. In the final stages the attitude indication was showing over 10 degrees nose down with lots of brown showing! Not a picture you want to see in an airliner close to the ground!

So what are the lessons to be learned? There has been much discussion in the Commercial Aviation world about pilots losing their manual flying skills because of the extensive use of automatics and the reliance on automation. Pilots learn to manage the aircraft rather than fly it and the Flight Director or Flight Path Vector is the focus of a pilot's attention most of the time rather than the aircraft attitude. Maybe a slight rethink of the training during type conversion should focus on an initial exercise where the basics of flying the aircraft without a Flight Director or a Flight Path Vector are practiced emphasising the correct attitudes to be flown.

The skill of flying an aircraft on attitudes has, to some extent, been eroded and perhaps if there is a big lesson to be learnt from the tragedy of the AF447 crash it's that when the chips are down the "Right Attitude" will keep you alive!

Safe Winter Operations

by Haruhiko (Harley) Oda, Flight Operations Engineer; Philip Adrian, 737 Chief Technical Pilot; Michael Arriaga, Service Engineer; Lynn Davies, Aerodynamics Engineer; Joel Hille, Service Engineer; Terry Sheehan, 737 Technical Pilot; and E.T. (Tom) Suter, Service Engineer

Airline engineering, maintenance, and flight personnel, as well as contracted airplane deicing service providers, need to be aware of the recent developments and recommendations for operating airplanes in winter weather conditions.

Safe winter operations require special procedures by airline maintenance, engineering, flight, and deicing personnel. These procedures include deicing, anti-icing, cold weather maintenance, and flight operations.

This article discusses recent developments for winter operations intended for both maintenance and flight crews, it provides operators with guidance for reviewing and updating cold weather operations procedures. This article also outlines general concepts and tips on safe winter operations.

Airlines need to be aware of recent developments in winter operations and regularly update their cold weather operations procedures.

The clean-airplane concept

The "clean-airplane" concept is derived from U.S. Federal Aviation Administration (FAA) Federal Aviation regulation (FAR) 121.629, which states, "no person may take off an aircraft when frost, ice or snow is adhering to the wings, control surfaces, propellers, engine inlets, or other critical surfaces of the aircraft or when the takeoff would not be in compliance with paragraph (c) of this section. Takeoffs with frost under the wing in the area of the fuel tanks may be authorized by the Administrator."

The FAR also prohibits dispatch or takeoff any time conditions are such that frost, ice, or snow may reasonably be expected to adhere to the airplane, unless the certificate holder has an approved ground deicing/anti-icing program in its operations specifications that includes holdover time (HOT) tables.

The European Aviation Safety Agency (EASA), Transport Canada Civil Aviation (TCCA), and other regulatory authorities have requirements similar to FAR 121.629.

The clean-airplane concept describes an airplane that is aerodynamically clean — that is, free of frozen contaminants. The clean-airplane concept is important because airplane takeoff performance is based upon clean surfaces until liftoff.

An airplane is designed using the predictable effects of airflow over clean wings contaminants such as frost, ice, or snow adhering to the wings disturb this airflow, resulting in reduced lift, increased drag, increased stall speed, potentially severe roll problems due to uneven lift, and possible abnormal pitch characteristics.

Considerations for maintenance and ground crews

Airplane operation in cold weather conditions can cause special problems because of the effects of frost, ice, snow, slush, and low temperature. The airplane maintenance manual (AMM) provides procedures for removal of contaminants from the airplane and the prevention of subsequent accumulation of frost, ice, snow, or slush. In addition, the operator must ensure that the maintenance procedures for winter operations are appropriate for the weather conditions.

Boeing recommends that maintenance and ground crew personnel and contracted airplane deicing service providers acquaint themselves with these recent developments in the area of airplane deicing and anti-icing: When thickened airplane deicing/anti-icing fluids (i.e., SAE International Types II, III, and IV fluids) dry, they may leave a very fine, powdery residue in critical areas in wings and

Figure 1: *Elevator control maintenance and ground crews should establish an inspection and cleaning schedule for deicing/anti-icing fluid residue to help ensure that no flight control restrictions will occur.*

stabilizers. This residue can rehydrate and expand into gel-like materials that can freeze during flight and cause restrictions in the flight control systems (see Fig. 1). (For more information, see AERO first-quarter 2007.) As a result, operators should:

- Be aware of how frequently airplanes are being deiced/anti-iced.
- Be aware of whether a one- or two-step application process is being employed. While recognizing that it is not possible at some locations, boeing recommends using a two-step process, preferably with Type I fluid and/or hot water as the first step. The application of hot water or heated Type I fluid as the first step of a two-step process has been shown to minimize the formation of residue gels.
- Ensure that proper procedures, including storage, handling, and application of fluids, are being followed by airline personnel or contracted deicing service providers.
- Establish an inspection and cleaning schedule for thickened fluid residue to help ensure that no flight control restrictions will occur. Examine areas such as wing rear spar, wing leading edge devices, horizontal stabilizer rear spar, vertical stabilizer, auxiliary power unit bay, control tabs and linkages (when applicable), and the bilge area of the tail cone. Visually inspect for dry or rehydrated residues in these areas. This inspection and cleaning should be performed in accordance with the recommendations found in the AMM for the specific airplane model involved.
- Apply lubricants and corrosion inhibitors as necessary to the areas where residue cleaning occurs.

Airplane deicing/anti-icing fluids and many runway deicing fluids are not compatible — interaction between the two may contribute to the formation of gel residues. When these fluids combine, the salts in some runway fluids enhance the separation of the polymers contained in thickened airplane fluids, leading to a more rapid formation of gel residues.

When runway deicing fluid contaminates thickened airplane anti-icing fluid, there can be significant degradation of the fluid's performance. HOT values can be reduced and adherence or unacceptable flow-off may result. Runway deicing fluid can get onto the wings and tails by various means, such as spray from the nose gear, spray kicked up by the engine exhaust of other airplanes, or from activation of the engine thrust reversers. Runway deicing fluids are hydroscopic fluids, so they don't dry out very quickly, causing them to leave a thin wet layer on the wing that can be difficult to see. This implies that the use of hot water or Type I fluid to clean the wing prior to the application of thickened anti-icing fluid (i.e., Type II, III, or IV) is even more important than previously thought. On September 14, 2010, EASA issued Safety information bulletin 2010-26 on this subject, recommending the use of the two-step application process.

Catalytic oxidation of carbon brakes may result from exposure of the brakes to alkali metal (i.e., organic salt)-based runway deicers. This may cause severe damage to the brakes and drastically shorten their service life. These runway deicers have also caused corrosion of electrical connectors and hydraulic system components.

In the 1990s, runway deicing materials containing potassium and sodium acetate were introduced (potassium and sodium formate were introduced later) as an alternative to urea and glycol runway deicers. Urea and glycol runway deicers contribute to an increase in the biological and chemical oxygen demand of water systems surrounding airports and are more toxic to aquatic life than the alkali metalbased runway deicers.

Following the introduction of the new runway deicers, some operators reported that their airplanes equipped with carbon brakes began experiencing catalytic oxidation of the carbon brake heat-sink disks (see Fig. 2). In order to help operators of airplanes equipped with carbon brakes comply with FAA Special Airworthiness information bulletin NM-08-27 and EASA Safety information notice 2008-19R1, the main gear wheel removal/installation sections of applicable AMMs have been revised to recommend inspection of the carbon brake assembly for signs of catalytic oxidation damage whenever a wheel and tire assembly is removed.

Boeing has released several service letters regarding the corrosion caused by alkali metal-based runway deicers on various airplane parts, including hydraulic tubes and cadmium-plated electrical connectors.

Considerations for flight crews

Winter or cold weather operations are generally associated with a combination of low temperatures and frost, ice, slush, or snow on the airplane, ramps, taxiways, and runways.

The airplane flight manual (AFM) defines icing conditions as when the outside air temperature (OAT) on the ground or total air temperature (TAT) in flight is 50 degrees F (10 degrees C) or less and any of the following exist:

- Visible moisture (e.g., clouds, fog with visibility of one statute mile [1,600 meters] or less, rain, snow, sleet, or ice crystals).
- Ice, snow, slush, or standing water on the ramps, taxiways, or runways.

On runways contaminated by slush, snow, standing water, or ice, the use of fixed derate reduced thrust is permitted, provided that airplane-takeoff-performance planning accounts for the runway surface condition. Use of the assumed temperature reduced thrust method, alone or in combination with a fixed derate, is not permitted on contaminated runways. Boeing does not recommend takeoffs when slush, wet snow, or standing water depth is more than 0.5 inch (13 millimeters) or dry snow depth is more than 4 inches (102 millimeters).

Boeing recommends that flight crews make themselves aware of the following recent developments in the area of winter operations:

Starting with the 2010 winter season, HOT guidelines for Type I fluids include a new set of times to be used when the fluids have been applied to composite surfaces. Testing performed during the last three winter seasons has shown that HOT values for Type I fluids on composite surfaces are significantly shorter (on the order of 30 percent) than for aluminum surfaces.

Although this topic has been discussed in the FAA notice of its "FAA-Aproved Deicing Program Updates" for the last two winter seasons, this year both the FAA and TCCA are publishing separate HOT guidelines for composite surfaces. In addition to extensive use of composites on newer models, many older models also have numerous composite surfaces (e.g., spoilers, ailerons, flaps, slats, etc.).

During taxi-out, avoid using reverse thrust on snow-or slush-covered runways, taxiways, or ramps unless absolutely necessary. Using reverse thrust on snow or slush-covered ground can cause slush, water, and runway deicers to become airborne and adhere to wing surfaces.

The use of hot water or Type I fluid to clean the wing prior to the application of thickened anti-icing fluid (i.e., Type II, III, or IV) is even more important than previously thought.

Airplane performance

Boeing currently provides two different landing-distance data sets to operators: dispatch data and in-flight operational data. Dispatch landing data is used during flight planning to determine the maximum landing weight at which the airplane can land within the available landing distance at the destination or alternate airport. This data, referred to as certified data in the AFM, is based on standard-day temperature and accounts for airport pressure altitude and runway wind. However, it does not account for the effect of thrust reversers or runway slopes. Non-dry runway conditions are accounted for by factoring the dry runway dispatch landing-distance data.

In-flight operational data is published as advisory normal-configuration landing distance data in the performance in-flight section of a quick reference handbook (QRH). The data is provided as unfactored data for operators who use FAA requirements. The advisory data in the QRH for operators who use Joint Aviation Authorities or EASA requirements includes a 1.15 factor for non-dry runway conditions. The advisory data

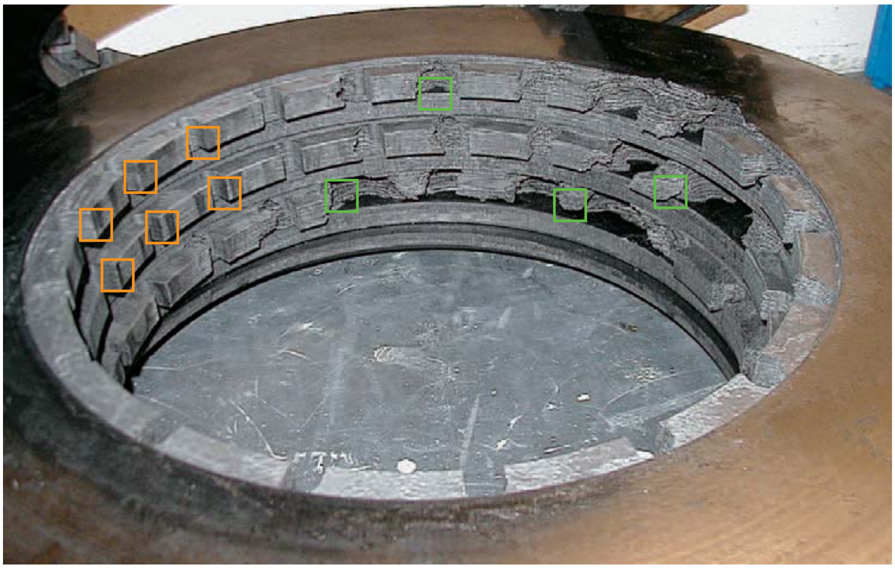


Figure 2: *Damage to carbon brake disks caused by runway deicers The damaged stator disk drive lugs on this carbon heat-sink demonstrate the type of damage alkali metal-based runway deicers can cause to carbon brake disks.*

Stator Disk Drive lugs *Stator Disk Drive lugs missing (oxidized)* provided by boeing is based on the use of reverse thrust and a 1,000-foot (305-meter) flare distance.

The FAA has chartered an aviation rulemaking committee (ARC) on takeoff and landing performance assessment (TALPA) to ensure that industry practices have adequate guidance and regulation for operation on non-dry, non-wet runways (i.e., contaminated runways). Based on the recommendations made by the ARC, the advisory normal-configuration landing-distance data for the 747-8 and 787 will include the following:

- Braking action and runway surface condition descriptions.
- 7-second air (flare) distance.
- A 1.15 factor for operators that use FAA requirements.

The 787 and 747-8 QRH advisory data will be based on the TALPA ARC recommendations. changes to the QRH advisory data for other models, such as the 777 and the next-generation 737, will await final rulemaking. However, boeing can provide guidance on how existing QRH normal configuration landing data can be adjusted to meet the intention of the TALPA ARC recommendations.

Summary

Airlines need to be aware of recent developments in winter operations and review and update their cold weather operations procedures accordingly.

For more information, please contact Harley Oda at haruhiko.oda@boeing.com.

The basics of deicing and anti-icing

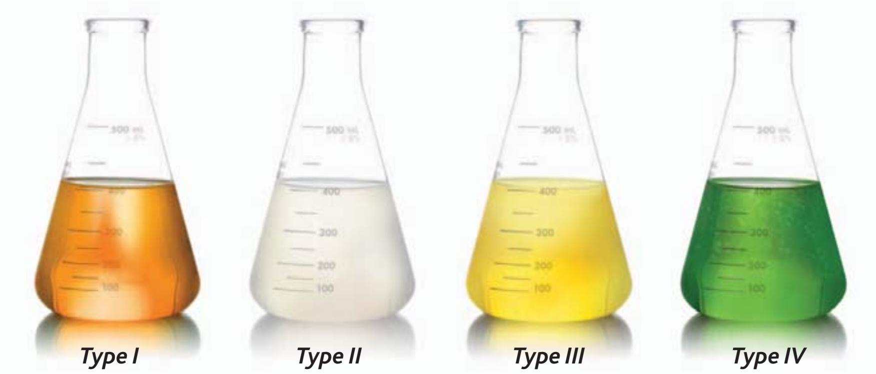


Figure A: *identifying deicing and anti-icing fluids by color The four types of deicing/anti-icing fluids can be readily identified by their color.*

For each winter season, the FAA publishes an annual Approved Deicing Program Update in an 8900.xx notice (where the "xx" changes each year) that includes HOT guidelines for all commercially available deicing/anti-icing fluids that are currently qualified. Similarly, TCCA annually publishes tables of HOT values in its Transport Canada Holdover Time Guidelines.

Deicing removes accumulated frost, ice, or snow from an airplane, typically through the application of hot water or a hot mixture of water and deicing fluid. Although there are other approved methods for deicing—such as infrared heat or hot air—the primary method worldwide is the use of fluids.

Anti-icing prevents the adherence of frost, ice, or snow to airplane surfaces for a certain period of time (i.e., the HOT values). While the same fluids used for deicing are also used for anti-icing, SAE Types II, III, and IV fluids are more typically used for anti-icing because they are thickened to stay on the airplane and thus provide longer HOT protection. They are most effective when applied unheated and undiluted to a clean airplane surface.

Whether used for deicing or anti-icing, the fluids must be transported, stored, and handled properly to be effective. operators must ensure that the fluid manufacturer's guidelines are followed for the entire deicing/anti-icing process.

Deicing and anti-icing fluids

The SAE standards define four types of deicing and anti-icing fluids. These fluids are acceptable for use on all boeing airplanes (see fig. A):

- Type I fluids are unthickened and typically have a minimum of 80 percent glycol and a relatively low viscosity, except at very cold temperatures. These fluids provide some anti-icing protection, primarily due to the heat required for deicing, but have a relatively short HOT. Standards for Type I fluids are published in SAE Aerospace Material Specification (AMS) 1424.
- Type II, III, and IV fluids typically contain a minimum of 50 percent glycol in addition to polymer thickening agents. The thickening agents delay the flow-off of the fluids from the airplane surfaces. As a result, Type II, III, and IV fluids provide longer HOT values than Type I fluids. The flow-off characteristics of Type III fluids make them more suit able for commuter airplanes with relatively low takeoff rotation speeds. Type IV fluids provide longer HOTS than Type II fluids. Standards for Type II, III, and IV fluids are published in SAE AMS 1428.

In accordance with AMS 1424 and 1428, all fluids must pass an Aerodynamic Acceptance

Test to be considered qualified fluids that can be used on airplanes. All fluids must be requalified every two years.

Military (MIL) specifications for deicing/anti-icing fluids (such as MIL-A-8243D Type 1 and 2) are no longer kept up to date. Boeing recommends updating service documents to reference SAE standards if they currently reference MIL specifications.

Holdover Time

HOT is the length of time that anti-icing fluid will prevent ice and snow from adhering to and frost from forming on the treated surfaces of an airplane. These times are only guidelines; a number of variables can reduce protection time, including:

- The heavier the precipitation, the shorter the HOT.
- High winds or jet blast that cause the fluid to flow off, decreasing the protection afforded by the fluid layer.
- Wet snow, which causes fluids to dilute and fail more quickly than dry snow.
- An airplane skin temperature lower than outside air temperature.
- Direct sunlight followed by precipitation.
- The use of incorrect equipment to apply fluids.

Applying deicing/anti-icing fluids

There are two methods for applying deicing and anti-icing fluids.

One-step process: This process accomplishes both the deicing and anti-icing steps with a single fluid application. Typically a heated mixture of thickened fluid and water is applied.

Two-step process: This process involves deicing with heated Type I fluid, a heated mixture of Type I fluid and water, or a heated mixture of water and thickened (Type II, III, or IV) fluid, followed by a separate application of thickened fluid for anti-icing protection.

Experience and testing have shown that deicing with heated Type I fluid or a heated mixture of water and Type I fluid will help remove residue from previous anti-icing fluid treatments. Deicing with heated thickened fluid may contribute to residue formation.

General precautions during winter operations

FOR MAINTENANCE CREWS

These are general guidelines; refer to the AMM for definitive information.

- Ice that has accumulated on the fan blades while the airplane has been on the ground for a prolonged stop is called "ground-accumulated ice" and must be removed before engine start.
- Ice that has accumulated on the fan blades while the engine is at idle speed is called "operational ice" and is allowed to remain on the fan blades before taxi because the ice will be removed by engine run-ups prior to takeoff.
- The right and left sides of the wing and horizontal stabilizer (including the elevator) must receive the same fluid treatment, and both sides of the vertical stabilizer must receive the same fluid treatment.
- Treat the wings and tails from leading edge to trailing edge and outboard to inboard.
- Treat the fuselage from the nose and work aft. Spray at the top centerline and work outboard.
- Do not point a solid flow of fluid directly at the surfaces, gaps in airframe structure, or antennas. Instead, apply the fluid at a low angle to prevent damage, while pointing aft for proper drainage.
- Make sure that all of the ice is removed during deicing. There may be clear ice below a layer of snow or slush that is not easy to see. As a consequence, it may be necessary to feel the surface to adequately inspect for ice.
- Do not spray deicing/anti-icing fluids directly into auxiliary power unit (APU) or engine inlets, exhausts, static ports, pitot-static probes, pitot probes, or TAT probes.
- Do not spray hot deicing/anti-icing fluid or hot water directly on windows as it may cause damage.
- Ensure that ice or snow is not forced into areas around flight controls during deicing.
- Remove all ice and snow from passenger doors and girt bar areas before closing.
- Cargo doors should be opened only when necessary. Remove the ice and snow from the cargo containers before putting them on the airplane.
- If SAE Type II, III, or IV fluids are used, remove all of the deicing/anti-icing fluid from the cockpit windows prior to departure to ensure visibility.
- Deicing/anti-icing fluid storage tanks must be constructed of a compatible material. For thickened fluids, the tanks must be of a material that is not susceptible to corrosion (e.g., stainless steel or fiberglass). This is particularly important for thickened fluids because their viscosity can be permanently decreased if they are contaminated or exposed to excessive heat or mechanical shear during handling and application.

- When there is ice, slush, snow, or standing water on the runways or taxiways during taxi-in, examine the airplane when it gets to the ramp. Look for any damage to the airplane surfaces and for contamination that may have collected on the airplane. carefully remove the contamination.

- Proper maintenance procedures for landing gear during cold weather opera tion as defined in the AMM can help reduce degradation of the structural joints and ensure optimal shock strut performance.

- Operating during cold weather can adversely affect the ability to properly lubricate the landing gear joints. Where possible, perform scheduled lubrication at maintenance bases where the temperature is above freezing. A heated hangar is the next most effective means of ensuring proper lubrication. If lubrication must be accomplished outside a heated hangar in temperature below freezing, the landing gear structure itself should be heated by blowing hot air directly onto the structure or into an enclosure around the structure.

- The temperature surrounding the airplane has a direct effect on both the volume of the gas and the viscosity of the oil in the shock strut. Boeing multi-model service letters provide procedures to ensure optimum strut performance if an airplane operates between two different regions with significantly different temperatures.

- Do not point a spray of deicing/anti-icing fluid directly onto wheels or brake assemblies.

- Remove contamination (e.g., frost, ice, slush, or snow) from the area where the main and nose gear tires will be positioned when the airplane is parked at the gate. If tires are frozen to the ramp, the airplane should not be moved until they are free.

FOR FLIGHT CREWS

These are general guidelines; refer to the boeing flight crew operations manuals (FCOM) for definitive information.

Prior to Taxi

- Carefully inspect areas where surface snow, ice, or frost could change or affect normal system operations. Perform a normal exterior inspection with increased emphasis on checking surfaces, pitot probes and static ports, air-conditioning inlets and exits, engine inlets, fuel-tank vents, landing-gear doors, landing-gear truck beam, brake assemblies, and APU air inlets. Takeoff with a light coating of frost (up to 1/8 inch [3 millimeters] thick) on lower wing surfaces caused by cold fuel is allowable. However, all leadingedge devices, all control surfaces, the horizontal tail, vertical tail, and upper surface of the wing must be free of snow, ice, and frost.

- Perform the normal engine start procedures, but note that oil pressure may be slow to rise. Displays may require additional warm-up time before engine indications accurately show changing values. Displays may appear less bright than normal.

- Engine anti-ice must be selected on immediately after both engines are started, and it must remain on during all ground operations when icing conditions exist or are anticipated. Do not rely on airframe visual icing cues before activating engine anti-ice. Use the temperature and visible moisture criteria.

- Operate the APU only when necessary during deicing/anti-icing treatment.

- Do not operate the wing anti-ice system on the ground when thickened fluids (e.g., SAE Type II, III, or IV) have been applied. Do not use the wing anti-ice system as an alternative method of ground deicing/anti-icing.
- If the taxi route is through ice, snow, slush, or standing water, or if precipitation is falling with temperatures below freezing, taxi out with the flaps up. Taxiing with the flaps extended subjects flaps and flap devices to contamination.

- Check the flight controls and flaps to ensure freedom of movement.

- If there are any questions as to whether the airplane has frozen contamination, request deicing or proceed to a deicing facility. Never assume that snow will blow off; there could be a layer of ice under it. In rainy conditions with OAT near freezing, do not assume that rain drops on surfaces have remained liquid and will flow off; they could have frozen onto the surface. A similar issue can occur due to cold-soaked fuel in the wing tanks.

- Ice that has accumulated on the fan blades while the airplane has been on the ground for a prolonged stop is called "ground-accumulated ice" and must be removed before engine start.

- Ice that has accumulated on the fan blades while the engine is at idle speed is called "operational ice" and is allowed to remain on the fan blades before taxi because the ice will be removed by engine run-ups prior to takeoff.

During taxi

This guidance is applicable for normal operations using all engines during taxi.

- Allowing greater than normal distances between airplanes while taxiing will aid in stopping and turning in slippery conditions. This will also reduce the potential for snow and slush being blown and adhering onto the airplane or engine inlets.

- Taxi at a reduced speed. Taxiing on slippery taxiways or runways at excessive speed or with strong crosswinds may cause the airplane to skid. Use smaller nose-wheel steering and rudder inputs. Limit thrust to the minimum required.

- Use of differential engine thrust assists in maintaining airplane momentum through a turn. When nearing turn completion, placing both engines at idle thrust reduces the potential for nose-wheel skidding. Differential braking may be more effective than nose-wheel steering on slippery or contaminated surfaces.

- Nose-wheel steering should be exercised in both directions during taxi. This circulates warm hydraulic fluid through the steering cylinders and minimizes the steering lag caused by low temperatures.

- During prolonged ground operations, periodic engine run-ups should be performed per the Boeing FCOM to shed the accreted ice.

Before/during Takeoff

- Do the normal before Takeoff Procedure. Extend the flaps to the takeoff setting at this time if they have not been extended because of slush, standing water, icing conditions, or because of deicing/anti-icing.

- Verify that airplane surfaces are free of ice, snow, and frost before moving into position for takeoff.

- In icing conditions, refer to the boeing FCOM for guidance regarding static engine run-up before takeoff.

- Before brake release, check for stable engine operation. After setting takeoff engine pressure ratio (EPR), or N1, check that engine indications are normal, in agreement, and in the expected range. Check that other flight deck indications are also normal.

- Rotate smoothly and normally at V_R. Do not rotate aggressively when operating with deicing/anti-icing fluid.

- Retract flaps at the normal flap retraction altitude and on the normal speed schedule.

- A larger temperature difference from International Standard Atmosphere (ISA) results in larger altimeter errors. When the temperature is colder than ISA, true altitude is lower than indicated altitude. Consider applying the Boeing FCOM cold Temperature Altitude corrections, especially where high terrain and/or obstacles exist near airports in combination with very cold temperatures (-22 degrees F/-30 degrees C or colder).

Operator coordination with local and en-route air traffic control facilities is recommended.

Descent

- Unless the airplane has fully automatic activation of ice protection systems, anticipate the need for activating the engine and/or wing anti-ice systems at all times, especially during a descent through instrument meteorological conditions or through precipitation.

- When anti-ice systems are used during descent, be sure to observe Boeing FCOM minimum EPR/N1 limits (if applicable).

Landing

- The flight crew must be aware of the condition of the runway with respect to ice, snow, slush, or other contamination.

- Follow the normal procedures for approach and landing. Use the normal reference speeds unless otherwise directed by the Boeing FCOM.

- ARM the autobrake and autospoiler systems, if available, before landing.

- The airplane should be firmly flown onto the runway at the aiming point.

- Immediately after main-gear contact with the runway, deploy the speed brakes if not already deployed by the automatic system.

- Without delay, lower the nose-wheel to the runway to gain nose-wheel directional control. Do not hold the nose gear off the runway when operating on slippery or icy runways.

- Use of autobrakes is recommended. They will allow the pilot to better concentrate on directional control of the airplane. If manual braking is used, apply moderate to firm steady pedal pressure symmetrically until a safe stop is assured.

- Let the anti-skid system do its work. Do not pump the brake pedals.

- Do not use asymmetric reverse thrust on an icy or slippery runway unless necessary to arrest a skid.

- When using reverse thrust, be prepared for a possible downwind drift on a slippery runway with a crosswind.

- During winter operations, it is even more important than usual that the flight crew not attempt to turn off the runway until the airplane has slowed to taxi speed.

- Taxi at a reduced speed. Taxiing on slippery taxiways or runways at excessive speed or with strong crosswinds may cause the airplane to skid.

- The cold Weather Operations Supplementary Procedure in the Boeing FCOM specifies how far the flaps may be retracted after landing in conditions where ice, snow, or slush may have contaminated the flap areas. If the flap areas are found to be contaminated, flaps should not be retracted until maintenance has removed the contaminants.

- Use the engine anti-ice system during all ground operations when icing conditions exist or are anticipated.

Reprinted from AERO magazine, courtesy of The Boeing Company.

Bird Strike Mitigation – *beyond the airport*

Pilots must be prepared for bird strike avoidance and damage control

by Paul Eschenfelder and Russ Defusco

Between November 2007 and January 2009, U.S. civil aviation experienced four major accidents caused by bird strikes. The accidents demonstrated the range of aircraft categories and types affected by this threat, and served as a reminder that the entire aviation community is challenged. A Piper Seneca, a transport helicopter, a Cessna Citation business jet and an Airbus A320 were all destroyed, and 17 people died. [1-4]

Three months prior to the US Airways A320 bird strike accident, a similar accident occurred at Rome Ciampino Airport. A Ryanair Boeing 737-800 encountered a large flock of starlings during its approach. The flight crew attempted a go-around, but birds were ingested into both engines, and both lost thrust. The crew landed the aircraft on the runway, but the left main landing gear collapsed. Although no one was killed, there was 10 injuries and the airplane was damaged beyond repair.

Before the Ryanair accident, an A320 operated by Balkan Holidays encountered a flock of gulls while departing the seaside resort of Bourgas, Bulgaria. Both engines were damaged by bird ingestion and lost thrust. The crew had pre-briefed an immediate return plan and successfully executed their plan. The airplane was landed safely, but a total of 32 fan blades on both engines had to be changed.

Turboprops are likewise at risk, but for different reasons. Propellers with composite material tend to shatter when struck. A de Havilland DHC-8, on landing at Toronto City Airport, struck geese just at touchdown. Both propellers lost large chunks of the blades and vibrated so severley that the crew had to shut down the engines on the runway. The airport management had been tolerating the geese on the field until this incident.

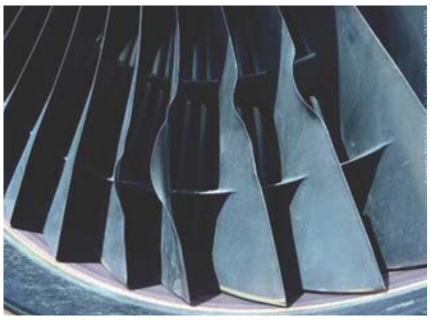
While general aviation airplanes typically do not have the same engine ingestion concerns as transport category jets, their overall design and certification make them much less available to resist damage from bird strikes. Mid-size to large birds can penetrate the windshields and cause pilot incapacitation or disorientation, resulting in loss of control. The drag caused by the loss of the windshield has also resulted in accidents because enough thrust is not always available to overcome the huge drag increase. Likewise, collision-caused deformation of wing or tail surfaces can increase stall speed considerably and affect handling qualities, especially at slower speeds.

Other aspects of the problem have received concentrated attention and reduced hazards on airports. While not always properley implemented, well-developed and documented standards exist for airport habitat management, means for deterring wildlife from entering airfields, active dispersal of birds and other wildlife, and even lethal methods when population control must be employed.

Such efforts must continue and be constantly monitored, but these strategies will not solve the problems of off-airport hazards, communication failures, inadequate pilot training and procedures, or lack of operational guidelines by aircraft owners and regulators that led to the primary causes of the accidents cited.

What is missing is a comprehensive, integrated plan that involves all parties: airports, aircraft operators, air traffic controllers, aircraft and engine manufacturers, regulators and others.

What would an effective bird strike mitigation policy look like? In the US Airways accident, the New York area airports were well known for the large bird populations affecting them La Guardia Airport has had a problem with resident Canada geese for some time. John F. Kennedy International Airport is located across the fence line from a U.S. government wildlife refuge with a very large gull colony, protected by federal law.



Damage to left-engine fan blades of Boeing 767-432-ER following the ingestion of gulls after takeoff at Rome Fiumicino Airport, July 2007.

An Air Berlin Boeing 737-700 windshield after encountering a flock of white-fronted geese at about 2,150 ft and 226 kt indicated airspeed.

The U.S. Air Force Bird Avoidance Model (BAM) had shown the risk of high bird concentrations in the New York area during the A320 accident period.[3] The presence of large numbers of birds in the area should have been cause for action by aircraft operators, but was not.

No aviation hazard today is successfully mitigated without effective policy guidance for the flight crews and adherence to that policy.

In the Ryanair 737 accident, the crew response was incorrect in our view. In many low-altitude scenarios, the commonly used response is to increase thrust and climb to avoid the hazard. But the problem with this technique in connection with bird encounters is that it increases the kinetic energy of impact, which equals one-half of the mass times velocity squared. In this case, velocity is determined by engine rotation. By selecting maximum allowed thrust, the crew placed the engine at risk of a high-energy collision, almost guaranteeing damage.

A better technique based on current guidelines for confronting large flocks of birds close to the airport is to fly through the flock at low engine rotation speed, allowing the engine to bypass the bird remains around the engine core without cascading damage to the compressor blades.[6,7]

But the crew had no training on the current technique. Nor is training required by any regulator. Nor is any training available.

In another serious event in 2007 in Rome, a Delta Air Lines 767-400 was taxiing for departure. The crew observed a large number of gulls on the runway and in their departure path. The crew discussed the situation but did not report the gulls, ask for bird dispersal prior to takeoff or delay takeoff waiting for the birds to move. Instead, they took off into the birds and ingested gulls into both engines, the impact causing serious vibrations and significant loss of thrust in both engines. The aircraft was returned safely, but both engines were damaged beyond repair.

Fast forward to February 2010 and another Delta flight conducting a departure from Tampa, Florida, U.S. Warned that large birds were in their departure path by the airport traffic controller and by the crew of the Airbus that preceded them, the Delta crew took off, and bird strikes damaged their aircraft. Delta Air Lines reportedly had no policy for its crews to mitigate this hazard.

Hazard avoidance is superior to application of emergency procedures. Avoidance can take a number of forms, many of them simple and cost-free. If birds are in the takeoff path, the pilot should notify the airport operator and delay departure until the birds move or are scared away. Another alternative is to depart via another runway that is free of hazard.

Likewise, for landing, flight crews should use a different runway if birds are reported on the landing runway. Or go around and wait for the birds to leave.

Another important area where study and action are needed is the lack of adequate aircraft design specifications. This problem is complex, because many interrelated systems are involved: aircraft design and operation, engine design and operation, airport mitigation, bird population control, airport habitat, training, warning systems, policy, etc. It is complicated, because there is no one answer but, as with all aviation hazards, an interdisciplinary approach is required.

The majority of bird strikes occur below 3,000 ft. If departing from an airport in a high-bird-threat environment, jets should use International Civil Aviation Organization Noise Abatement Procedure This rapid climb to above 3,000 ft above ground level would, in all likelihood, have prevented the US Airways accident. General aviation aircraft should depart at best angle-of-climb speed. Those techniques enable the aircraft to clear the hazard zone below 3,000 ft faster and climb at a lower speed, which can lessen the severity of impact. When landing in an area of high bird activity, the aircraft should remain at 3,000 ft or above if possible until necessary to descend for landing.

If birds are encountered en route, on climb or descent, the flight crew should pull up - consistent with good piloting technique - to pass over the birds. If birds see the aircraft, they will treat it as an obstacle, but may misjudge the closing speed because the threat is usually beyond their experience. Birds may turn or dive as avoidance maneuvers, but they rarely climb. So pulling up is the best and fastest avoidance maneuver.

If the aircraft is capable of highspeed flight at low altitude . . . don't do it. The kinetic energy formula applies to airframes and windows. While modern heated windows should resist a gull or duck, larger birds may penetrate them or shower the pilots with glass as the inner pane of the window spalls or shatters. Likewise, the small bird that bounces off like a tennis ball when struck at slower speed suddenly becomes a bowling ball when struck at high speed. Below 10,000 ft, limit aircraft speed to 250 kt indicated airspeed or less.

Aviation operations successfully mitigate a variety of hazards every day. The industry has built strong defenses against them. We can do the same with the birds.

Capt. Paul Eschenfelder is the lead instructor for Embry-Riddle Aeronautical University's Airport Wildlife Training Seminar, the only such course approved by the FAA for full compliance with FAA training guidelines.

Dr. Russ DeFusco is a former associate professor of biology at the U.S. Air Force Academy and formerly chief of the USAF Bird Aircraft Strike Hazard Team.

Notes

1. In October 2007, a Piper Seneca collided with a flock of Canada geese during nighttime operations. The strike significantly damaged the aircraft and was followed by a loss of control and crash that killed both crewmembers.

2. A Cessna Citation was climbing through 3,000 ft after departing from Wiley Post Airport, Oklahoma City, Oklahoma, U.S., in March 2008. It struck a flock of migrating white pelicans, causing right-engine failure and wing damage. Loss of control followed, with the ensuing crash killing all five occupants.

3. A Sikorsky S-76 helicopter, flying at low altitude in January 2009, encountered a large bird that penetrated the front canopy. Either the crew or the controls were disabled by the collision, and the helicopter crashed, killing eight of the nine occupants.

4. In January 2009, a US Airways Airbus A320 ingested Canada geese in both engines, necessitating a ditching on the Hudson River. No occupants were killed, three sustained serious injuries and the aircraft was destroyed.

5. The BAM is an interactive risk calculation tool, accessible on the Internet at <www.usahas.comlbam>.

6. Airbus. Flight Operations Briefing Notes: Operating Environment, Birdstrike Threat Awareness. October 2004.

7. U.K. Civil Aviation Authority. "Operational Considerations in the Event of Multiple Bird Strikes to Multi-Engine Aeroplanes." Aeronautical Information Circular AIC 2812004. April 29,2004.

8. ICAO. Review of Noise Abatement Procedure Research FSR Development and Implementation Results: Discussion of Survey Results. Preliminary edition, 2007, p. 11.

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Aerobatics Versus Upset Prevention and Recovery Training

by Randall Brooks

There are currently no defined standards for the delivery of upset recovery training. Randall Brooks considers some ways to alleviate the problem.

Above: *An integrated UPRT program will most likely include the use of an appropriate surrogate training aircraft.* ***Image credit: Author.***

Every year Boeing releases a statistical summary of worldwide commercial jet accidents covering the preceding ten years.

For several years now, Loss of Control In-flight (LOC-I) has led controlled flight into terrain as the number one cause of both accidents and fatalities. The trend is similar with regard to business aircraft. Clearly, LOC-I is a major flight safety issue. Despite this fact there are currently no defined standards for the delivery of upset recovery training. Now that we understand why this conversation is important, let's consider some ways we can alleviate the problem.

There are two important avenues to reducing this hazard: technology and training. With respect to technology, the most promising area is the envelope protection provided by fly-by-wire (FEW) flight controls. Data shows that there is a significantly lower rate of LOC-I among fleets of FEW aircraft. In non-FEW aircraft, advances in autopilot technology now offer some elements of envelope protection previously seen only in FEW aircraft However, across the design spectrum there are examples of LOC-I accidents and incidents involving failures in flight control system defenses.

Despite these and future hi-tech advances, thousands of classically controlled aircraft without envelope protection will be carrying the majority of the world's passengers for decades into the future. The last line of defense against upsets will continue to depend, as it does today, on the awareness and capabilities of pilots.

Simulators

As we consider the training side of the equation, we will begin with simulators since that is where the vast majority of pilots receive then operational training.

Flight simulators are unquestionably the greatest tool for aviation safety ever devised. Unfortunately, standard full motion simulators have three limiting areas with regard to providing initial Upset Prevention & Recovery Training (UPRT). First, the prolonged forces associated with the accelerations experienced in flight during dynamic maneuvering cannot be provided.

Secondly, simulators are only as good as the data they are programmed with. Currently, that data ends well before the boundaries of what an aircraft could encounter in a recoverable upset situation. It simply is not safe for a transport category aircraft to mtentionally gather flight test data in the areas of the envelope that might be unintentionally encountered in an upset. Training in simulators past the limits of valid data invites inappropriate pilot response based on unrealistic simulator behavior.

The third area is not a technology related limitation. Even if a simulator could provide accurate cockpit g (some can), and had perfect aerodynamic fidelity, at some level the pilot would still be aware they were in, well... a simulator. It is not unusual to see pilots emerge sweat-soaked from the dark recesses of the simulator after facing the various gremlins and demons that they must be prepared to face in flight. It is not that simulators cannot induce nervousness, surprise, anxiety, and even fear, but only to a degree.

This psychol/physiological dimension is not a trivial aspect of the upset recovery dynamic. A pilot may know with perfect academic clarity the correct response or flight control inputs to make while in the classroom, but unfortunately that knowledge often does not translate into the immediate, proportionate control inputs (often quite different from those used in normal operations) that may be required in an emergency. The practiced ability to suppress the startle response is best achieved through skill development in an environment providing all the inputs encountered in flight, including the perception of risk and the threat of consequences that are present in an actual upset event.

If a pilot encounters an engine failure in flight, or has to deal with a system failure, they have probably seen it and dealt with it in the simulator first. They have familiarity with the situation because they have virtually been there. Not so in the case of an upset event, where a pilot may be experiencing an attitude in an aircraft that they have never seen before, real or simulated.

In a study of several LOC-I accidents, "Defining Commercial Transport Loss-of-Control: A Quantitative Approach", it was shown that it takes on average less than 10 seconds for accident aircraft to progress from an upset condition to loss of control. With less than 10 seconds to fix a time critical problem that could rapidly become life threatening, pilots must respond in a nearly instinctive manner. Expecting pilots to safely accomplish perilous tasks that they have not been trained for, on their first attempt, is not realistic. Viewed in this light, the current LOC-I accident record is not surprising.

Skills

This inability to fully leverage existing flight simulators in the delivery of UPRT is truly unfortunate. With current flight simulation training devices we are unable to provide pilots with training in the domain that accident data shows they need it the most; in the skills required for safe recovery from in-flight upsets. If the simulator cannot provide the environment to practice in, and such maneuvering cannot be accomplished in the transport aircraft in which such a situation could be encountered, an appropriately capable surrogate training aircraft becomes the best option.

Now that we are discussing the use of an aircraft as our training resource, let's get back to the original question: what is the difference between aerobatics and UPRT? Part of the confusion over aerobatics and UPRT comes from the fact that there are elements that they both share. Both types of training encompass operation through the entire range of possible attitudes and cover the entire flight

Above:** The primary focus of a comprehensive UPRT program is the avoidance and safe recovery from upsets.* ***Image credit: Author.

envelope, including those portions never encountered in normal flight operations. This all-attitude all-envelope (A^3E) training is essential to prepare pilots for unexpected upsets, but the application of that training through UPRT can look very different from the familiar maneuvers seen at airshows.

Classic aerobatics can provide pilots with improved capabilities in precision maneuvering and aircraft handling skills. While the enhanced understanding and capabilities that pilots can receive from aerobatic training has been proven to be beneficial in situations that require upset recovery skills, that is not the primary objective of aerobatic training; it is a secondary benefit. Unlike aerobatics, the entire focus of UPRT is the recognition and avoidance of situations that increase the probability of an upset event, and in providing the skills necessary for recovery if it becomes required. This leads to an entirely different approach to training.

Maneuvers

While academics associated with learning aerobatics are generally limited to what is necessary for the completion of a particular maneuver, for UPRT academic fundamentals provide the informed basis for the instinctive understanding required in a time critical upset event. An aerobatic maneuver like an aileron roll might be used in teaching UPRT principles In UPRT, however, the focus is not on the performance of a precise maneuver, as is the case in aerobatics, but instead on the ability to rapidly orient the aircraft's lift vector in order to minimize altitude loss. While a full flight simulator provides little or no help in teaching aerobatics, a comprehensive UPRT program can utilize a simulator, within its valid training envelope, to apply the principles introduced in a surrogate aircraft to the specific aircraft systems and avionics of a transport aircraft A fundamental precept of UPRT is that the most appropriate resources should be used to administer the required elements of training.

A fundamental distinction between aerobatics and UPRT is that while most aerobatic instruction only teaches mastery of the specific aircraft type used in training, in UPRT the airframe used for training is a stand-in or proxy platform for introducing concepts representative of the recovery techniques required for a wide range of aircraft. Much like basic instrument skills, which can be applied to flying a vast array of aircraft, the majority of flight skills and techniques required for upset recovery are not aircraft specific. Such phenomena as lateral control instability at high angles of attack, lift vector orientation, and accelerated stalls apply to all fixed wing aircraft regardless of size or performance.

Just as basic instrument skills learned in lighter and lower performing aircraft are applied to more advanced aircraft, introducing basic upset recovery techniques early in a pilot's

All-Attitude/All-Envelope Flight Training Method Comparison					
	Primary Objective	Secondary Outcome	Applicable Aircraft	Academics	Aerobatic Maneuvers
Aerobatics	Precision maneuvering capability	Improved manual aircraft handling skills	Training platform only	Supporting role, if any	Primary role in training
Upset Prevention & Recovery Training	Aircraft upset avoidance and safe recovery	Improved manual aircraft handling skills	Broad application to many types	Fundamental component	Supporting role in training

The table above helps to differentiate between these two methods of providing A^{3}E flight training.

Fatal Accidents Worldwide Commercial Jet Fleet 2000 Through 2009

Accident Category	Fatalities	Fatal Accident
System/Component Failure or Malfunction (Non-Powerplant)	314	3
Fire/Smoke (Non-impact)	110	2
Fuel Related	23	1
System/Component Failure or Malfunction (Powerplant)	2	3
Combined Total	**449**	**9**
LOC-1	**1759**	**20**

Significant training is provided in these events

No comprehensive training standards or requirements

training provides lessons that will remain with pilots throughout their entire career.

There is some skepticism that a light aerobatic aircraft can teach anyone anything about flying a swept-winged jet transport. The flight training of a true UPRT program strives to remain within the structural envelope of the non-aerobatic subject aircraft. For a transport category aircraft that would be a 2.5g limit load and a 3.75g ultimate load. Likewise, while it is unsafe to flirt with the area at or beyond stall in an aircraft not certified for spins, that threat is not present in an appropriate training aircraft recoverable from autorotation. The excess structural capability and high angle of attack/spin recovery ability of the surrogate training aircraft merely provides a safety margin for the exceedances of the trainee; a safety margin not present in the transport category aircraft in which an upset could be encountered or in a non-aerobatic training aircraft.

It is not the type of training aircraft platform used that matters. What is important are the lessons the aircraft is used to deliver and how they are conveyed. Unfortunately, today too many of these important lessons are not being delivered at all.

While the primary focus of a comprehensive UPRT program is the avoidance and safe recovery from upsets, secondary benefits in the development of manual handling stalls, confidence, and ainnanship are significant.

We would not conceive of putting pilots on the flight deck unprepared to deal with engine failures, or failures of fuel, electrical, hydraulic, or pressurization systems, yet we continue to inadequately prepare pilots to face the real threat of LOC-I. Accident data shows that among commercial jet transports worldwide there are more accidents and fatalities from the category of LOC-I than from all powerplant or other systems related accidents combined. Introduction of pilots to the fundamentals of all-attitude/all-envelope flight through a comprehensive program involving underlying academic principles, practical skill development in appropriate surrogate aircraft, and aircraft specific characteristics in a full flight simulator provides the most thorough approach to the reduction of the LOC-I accident rate.

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About the Author

Randall Brooks is the Senior Director of Flight Training for Opinicus Corporation and serves as the President of the Upset Prevention and Recovery Training Association (UPRTA). Mr. Brooks is the Training Matrix subgroup leader for the International Committee for Aviation Training in Extended Envelopes (ICATEE) and before joining Opinicus, was the Director of Customer Training and Manager of Emergency Situation Training for the Eclipse Aircraft Corporation. Mr. Brooks has provided allattitude/all-envelope flight instruction for over 25 years in more than 15 different jet, piston, and sailplane aircraft types. Mr. Brooks holds a B.S. in Aerospace Engineering from the University of Colorado.

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Preventing Unstable Approach

by Julian Ogilvie, Vice President Policy, Guild of ATCO's and first published in GATCO's Transmit Magazine.

Are we, while striving to be as expeditious as possible in our controlling, inadvertently compromising the stability of an approach?

The Civil Air Navigation Services Organisation (CANSO) has recently published guidelines to controllers highlighting the considerations that air traffic control should take into account to prevent unstable approaches (www.canso.org/safety). In another move a major UK airport's operating company has asked that all go-arounds from unstable approaches are to be reported and investigated to decide if there was any ATC involvement.

Unstable approach incident

One of numerous examples of unstable approaches is from 26 December 2008 when a DH8C in Australia was conducting a regular public transport flight from Moree to Sydney. While on final approach, and after capturing the glideslope for runway 34L ILS, the autopilot commanded the aircraft to descend. The crew were forced to make several quick configuration changes in an effort to continue the approach. Those changes negatively affected the aircraft's performance and activated the stickshaker. Shortly after a missed approach was executed.

Airbus briefing

According to Airbus in its flight operations briefing notes in 75% of off-runway touchdown, tail strike or runway excursion accidents, the major cause was an unstable approach. Continuing an unstabilised approach is a causal factor in 40% of all approach and landing accidents.

Although it is ultimately the flight crew's responsibility to throw away a potentially unstable approach, Airbus lists the following examples of ATC involvement as possible causal factors:

- Any crew-induced or controller-induced circumstances resulting in insufficient time to plan, prepare and execute a safe approach. This includes accepting requests from ATC for flying higher and/or faster than desired or flying shorter routeings than desired

- ATC instructions that result in flying too high and/or too fast during the initial or final approach (for example, request for maintaining high speed down to a set distance from the threshold or for glideslope capture from above)

- Late runway change (for example, lack of ATC awareness of the time required to reconfigure the aircraft for a new approach).

A correct arrival

Arriving correctly at the company SOP derived minimum height for a stabilised approach is a result of energy management throughout the different stages of descent. Aircraft deceleration characteristics largely depend on the aircraft type, however from our own personal experiences also by individual operators! Airbus publishes the following figures as a guideline for a quick assessment;

- Deceleration in level flight with approach flaps extended, 10-15kt per nm

- Deceleration in level flight with full flap and gear extended, 20-30kt per nm

- Deceleration on a 3° glidepath with landing gear and flaps extended 10-20kt per nm.

- Decelerating on a 3° glidepath in clean configuration is usually not possible.

Elsewhere, ICAO requires an aircraft to reduce its airspeed when instructed at the rate of 1kt per second or more.

Understanding the elements

In the Eurocontrol *Hindsight* publication, Captain Rob Van Eekeren, a KLM Airbus A330 pilot and safety expert, has written about the cooperation between aircrew and ATC to minimise the risk regarding unstable approaches. He highlights that all ATCOs should understand precisely all elements of an approach and that the design of good procedures will help pilots perform a stable approach. Good ATC guidance will help in their execution. He states that, secondly, controllers should understand the importance of timely and factual information needed for their performance calculations. These may include distance to run, wind and runway friction characteristics. He believes that runway optimisation while good for occupancy figures may have a direct and adverse effect on flight safety.

This last point is a controversial one as the pressure placed on air navigation service providers and, therefore, controllers to consistently 'pack them in' by the airlines and airports themselves may be contradictory to the overall system safety.

French Invetigation

The French CAA (DGAC) has investigated the use of radar vectoring procedures to directly reduce the number of unstable approaches. At Charles de Gaulle and Orly airports reference markers are displayed on the radar video maps to which controllers aim their inbound aircraft. These markers are placed on the extended centrelines of the runways and guarantee an aircraft a minimum of 30 seconds of level flight before beginning its descent. This has been reported to significantly reduce the number of unstable approaches due to ATC and is to be implemented across France.

This is, of course, in contradiction to the increasingly used continuous descent approach paths favoured to address environmental concerns. At some point the benefits of a reduced environmental impact need to be compared with potential safety benefits of consistent aircraft operation.

Performance based navigation

The introduction of performance based navigation (PBN) approach procedures in the future may address the predictability of flying stable approaches. These are likely to reduce direct controller intervention significantly, leaving the final approach management entirely up to the aircraft and its crew. However, these procedures may not be suitable for all airports and traffic and where these are not in place air traffic control will still be involved as a part of the aircraft energy management process.

In the DH8C incident mentioned at the beginning of the article air traffic control was not a factor. During the analysis by the Australian investigation team it was stated that: 'Opportunities existed prior to the final approach fix for the crew to voice any concerns about deviations from the planned approach profile, and to take appropriate action to ensure that the aircraft was correctly configured.'

Pilot-controller communication

Flight crew and controllers through direct communication on the R/T or in discussion forums, are in the best place to 'voice any concerns' about which factors need to be addressed to work together to produce a stable approach; whether it is by requesting more track miles, a slower approach speed or the introduction of clear procedures to benefit the overall safety of the system.

AFRASCO
AFRICA AVIATION SAFETY COUNCIL

The Africa Aviation Safety Council (AFRASCO) will host its 20th annual general meeting in Gaborone Botswana. The dates for the AGM are November 8 to 9, 2011.

The theme for this year's AGM is: **ADVANCING AVIATION SAFETY IN THE AFRICAN AND INDIAN OCEAN REGION.**

AFRASCO represents aviation organisations operating in the African and Indian Ocean region.

The AFI's safety record remains a major concern to all stakeholders in the world of aviation primarily due to a few pockets in North Africa, West Africa and the Great Lakes region (primarily the Congo) where representation is minimal or does not exist at all. AFRASCO is forging a partnership with the African Airlines Association (AFRAA) and other progressive organisations in the battle to enhance the safety of aviation in Africa.

Thus the 20th AGM will seek to address this major concern. Topics to be discussed include:

- Implementing a safety management system
- SMS tools
- Criminalisation of air accidents
- Emergency response planning and management
- The aftermath of aviation disasters
- Flight data analysis
- Risk management
- Aviation and the environment
- Flight, cabin and ground safety

Speakers will be drawn from Industry Associations, Airlines, Aviation Training Organisations, Manufacturers, Disaster Managers, Solicitors and Insurers.

The Cargo From Hell

In the beginning, the flight was about as routine and humdrum as commercial aviation can be. The two pilots were the only occupants of a Boeing 747-400F freighter on a six-hour and 20-minute night flight from Dubai to Cologne/Bonn in Germany. There were no goodbyes at the boarding gate, no entranced passengers gazing out of their windows, just two professionals on the last leg of a regular run that had begun in Hong Kong. Unheralded, they had departed in darkness into the 35-degree heat of the desert night.

But when UPS Airlines flight 006 was about 28 minutes into its journey the fire alarm sounded: smoke on the main cargo deck. It was the first of three warnings of a cargo fire on the doomed flight, investigators from the United Arab Emirates say.

At the time of writing, the multinational investigation team (from the US and the UAE) has not officially determined the cause of the crash on 3 September last year, but has issued details of what confronted the American pilots as they tried to return to Dubai.

The smoke was so dense, investigators said, that the pilots had difficulty in seeing the primary flight instruments, and even in communicating with each other.

They also could not change radio frequencies; so nearby aircraft passed on messages from Dubai controllers.

The crews of these aircraft heard the tragedy unfolding. 'To hear the initial panic and plain fear during their transmissions (in real time as opposed to a DVR playback on a documentary) has been the most chilling event in my 25 years of flying,' a British airline pilot who heard the transmissions wrote in an online forum.

At some point during the emergency, one of the pilots apparently left the flight deck to try to fight the flames but never returned, sources close to the investigation told Andy Pasztor of *The Wall Street Journal*.

Dubai Airport gave the freighter clearance to land on any runway. The aircraft did not descend enough to land, but flew over the airport at 4,000ft, turned right and crashed. Its captain, Doug Lampe, 48, and first officer Matthew Bell, 38, were killed, or were perhaps already dead as a result of the smoke and heat. By sheer luck the plane came down in an unpopulated area and no-one on the ground was hurt.

Just over a month after the crash, and long before the official report had been written, the US Federal Aviation Administration (FAA) issued an unusual and disturbing communiqué. Safety Alert for Operators 10017 concerned the risks of transporting lithium batteries as aircraft cargo, and specifically mentioned UPS 006.

'Investigation of the crash is still underway, and the cause of the crash has not been determined. We are aware, however, that the plane's cargo did include large quantities of lithium batteries and believe it prudent to advise operators of that fact,' the FAA said.

The inference was clear: lithium batteries were implicated in the destruction of UPS 006.

The implications for international commerce are immense because these batteries make up a large and rapidly growing proportion of international air freight.

Civil Aviation Safety Authority crashworthiness specialist Mark Bathie says tens of millions of lithium batteries are flown every year as luggage or freight.

'One figure I saw, was that in 2009, just one carrier shipped 49 million lithium batteries from seven suppliers.'

US Census Bureau figures show that 66 per cent of mobile phones, 70 per cent of video equipment and 86 per cent of laptops sold in the US were shipped by air in 2009.

The chemistry of lithium batteries makes them both the ideal candidate and a significant risk for air shipment. They are small, valuable and, with a limited shelf life, fit the classic profile of an airfreight item.

'Because they must be shipped in a partially charged state and slowly lose charge over time, manufacturers do not want to waste months putting lithium batteries into warehouses or ships' holds,' Bathie says.

In the absence of an official report there are unanswered questions about whether the lithium batteries carried on UPS 006 were real or counterfeit; had been properly packed; or had been declared, labelled, consigned, accepted and stowed as dangerous goods.

Dangerous goods experts agree that the accident reinforces the need for correct packaging and handling of the newgeneration batteries.

While rare in comparison with the number and frequency of flights worldwide, battery-related safety incidents are by no means uncommon on commercial aircraft.

There is some evidence that the problem is growing in step with the increasing popularity of electronic goods. The 6th Triennial International Aircraft Fire and Cabin Safety Research Conference held in New Jersey last October heard that 34 battery-related incidents have been reported to the FAA since February 2007.

An FAA report found that from 1991 to 2010 there were 113 incidents of 'smoke, fire, extreme heat or explosion' involving batteries and battery-powered devices on passenger and cargo planes. This covered many types of batteries, including leadacid batteries which, as any mechanic knows, can give off hydrogen and oxygen if overcharged.

In one incident in 2006, flight attendants saw smoke coming from a bag in an overhead locker and had to use fire extinguishers on it, NTSB investigator Frank Hilldrup told a public hearing. 'The bag was removed from the plane and placed on the ramp, where it burst into flames. The fire seemed to have started from a spare laptop battery being carried in the bag.'

Flammability concerns regarding laptop lithium-ion batteries increased between 2006 and 2009 as Dell, Sony, Toshiba and Hewlett Packard were forced to issue recalls for laptop computers that could overheat or burst into flames.

CASA dangerous goods inspector, Ben Firkins, says: 'Lithium batteries can be found either in cargo or being carried on by passengers. Whilst the international aviation DG community has been working on the risks presented in carrying batteries, the last few years can be viewed as resulting in some significant progress in cabin safety.'

The FAA's Technical Centre in Atlantic City, New Jersey, is undertaking tests on thermal runaway, auto-ignition and sympathetic initiation of lithium batteries, as well as fire containment and suppression.

It has produced videos which show how cabin crews should approach and treat laptop and lithium battery fires. These have been widely circulated via CASA's cabin safety inspectors and the Australian Dangerous Goods Air Transport Council to Australian operators for use in cabin crew training materials.

Firkins says:

'The preference is for passengers' lithium battery-powered equipment to be carried in the cabin, although provision is still made for it to be carried as checked-in baggage.

Any spare batteries, however, must have the terminals protected from short circuit and be carried in the cabin. Fires are likely to be small, and confined to one battery, and most will be easily extinguishable by cabin crew. The rationale is similar to allowing cigarette lighters to be carried by passengers (but not in their carry-on baggage). If there is a fire, the passenger will soon know about it and trained cabin crew can deal with it quickly and effectively.'

Dangerous goods experts agree that lithium batteries carried in cargo are the continuing field of focus for compliance.

The FAA's Safety Alert for Operators 10017 reports that lithium batteries can enter a condition called thermal runaway and reach temperatures of nearly 600 degrees Celsius.

Lithium metal batteries produce more severe thermal runaway than rechargeable lithium-ion cells, the FAA trials found 'The lithium metal cell releases a flammable electrolyte mixed with molten lithium metal, accompanied by a large pressure pulse. The combination of flammable electrolyte and the molten lithium metal can result in an explosive mixture.

The study found that lithium-ion and lithium-ion polymer batteries, while not quite as dangerous as lithium metal batteries, were more hazardous than previously thought. 'The results of the tests showed that the lithium-ion and lithium-ion polymer battery cells can react violently when exposed to an external fire, Safety Alert 10017 said. 'Under test conditions, when the battery cells failed, flammable electrolyte was released and ignited, which further fuelled the existing fire. This release and ignition of the electrolyte resulted in significant temperature and pressure increases within the test fixtures.'

The FAA made four recommendations in its alert. Airlines should:

1) Request customers to identify bulk shipments of currently excepted lithium batteries by information on airway bills and other documents provided by shippers offering shipment of lithium batteries.

2) Where feasible and appropriate, stow bulk shipments of lithium batteries in Class C cargo compartments, or in other locations where fire suppression is available.

3) Evaluate training, stowage and communication protocols with respect to the transportation of lithium batteries in the event of an unrelated fire.

4) Pay special attention to ensuring careful handling and compliance with existing regulations covering the air transportation of Class 9 hazardous materials, including lithium batteries.

The FAA Technical Centre is continuing its research into lithium battery fires, with projects including an investigation of how well water mist systems work in battery fires; an evaluation of how well shipping containers withstand a lithium battery fire; and development of a standard for lithium battery shipping containers.

Firkins says lithium batteries will, in time, be superseded by other technologies, each with its own risks and benefits: 'New technologies emerge, and in the case of batteries, the newest developing technology is in 'fuel cells'. The International DG community has been active in working with fuel cell manufacturers and the Fuel Cell Council to ensure that these can be transported safely. It is likely that in the future this will have a great impact on the number of lithium batteries being transported. Until then, we have to manage the current risks presented by lithium batteries.

CASA's Melbourne-based dangerous goods inspector and representative on the ICAO Dangerous Goods Panel, Adrian Tusek, says lithium batteries are a global issue and there is an identified need for increased education and compliance.

'In 2009, the rules regarding packing, marking, labelling and declaring lithium batteries, either in equipment or purely as batteries, were significantly strengthened.

There was an impost upon consignors and freight forwarders, especially as the new classification and packing criteria meant that these items could no longer travel as air mail.

'We worked with the aviation industry and IATA (International Air Transport Association) to provide some guidance around the new packing instructions for lithium batteries.

'We are yet to see a DG incident or accident involving properly packed and labelled lithium batteries, so our focus will be on educating and encouraging compliance with international standards, with an outreach program in 2011.'

Further Reading

Two sites about the classification and packing of lithium batteries: www.iata.org/whatwedo/cargo/dangerous_goods/Pages/lithium_batteries.aspx

http://www.icao.int/anb/fls/dangerousgoods/icaolithiumbatteryguidance/icaolithiumbatteryguidance.pdf

The FAA Technical Centre website: www.fire.tc.faa.gov

The General Civil Aviation Authority of the United Arab Emirates: www.gcaa.ae/en

Several less-than-scientific but dramatic versions of how lithium batteries burn and explode when overheated, overcharged or damaged by impact: www.youtube.com 'Lithium battery explosion'

Reprinted with kind acknowledgement to Safety FOCUS Magazine.

The Ten Commandments of Aviation Safety

by Captain Russ Williams FRAeS, Chairman, Air Safety Group

The Ten Commandments of Aviation Safety Are:

1. Thou Shalt Fly The Aircraft

The number one priority throughout the flight, and particularly in any emergency situation, is to ensure that one pilot has the responsibility to control and fly or monitor the aircraft. History shows numerous occasions where flight crews have been distracted, sometimes by quite insignificant events or warnings in the cockpit, and have allowed the aircraft to depart the normal flight regime and crash. This certainly appears to have been the case with the Tristar that flew into the Everglades in Florida whilst both pilots were attempting to resolve an undercarriage problem, unaware the autopilot had disconnected. Changing control from one pilot to the other must be consistently covered by the statements "You have control" and "I have control" so that there can be no doubt whatsoever as to whose responsibility it is for flying that aircraft. Whilst perhaps too early to quote as an example, the Air France with apparently iced up Pitot tubes and unreliable airspeed indications would appear to have demanded one pilot to set an attitude and power settings for normal cruise flight and to maintain those settings regardless of all the warnings generated. Training is of course one of the key factors in 'flying the aircraft' and knowledge of the systems, particularly where so much automation is now prevalent in operating modern aircraft, is a vital key. If you ever find yourself asking that oft quoted phrase "Why is the aircraft doing that?" the answer, obviously, is that you should already know and if you do not, then find out!

2. Thou Shalt Check Thy Fuel Uplift And Contents Religiously

How many aircraft over the years have run out of fuel? Ensuring the correct amount of fuel is onboard for the planned flight can prove difficult when the uplift may be measured in Imperial gallons, US gallons or Litres and registered on the cockpit fuel gauges in Pounds weight all with different conversion factors. Ultimately there must be recognition that the only thing a fuel gauge in a cockpit can tell you for sure is that there either is, or is not, one fitted! Very careful thought and control of the fuel uplift prior to flight is, therefore, essential.

3. Thou Shalt Do Thy Pre-Flight Preparation, Checks And Drills Slowly And Methodically And Every Time

Resist that feeling of complacency (one key word that has no place at all in the aviation safety dictionary!), that rush to get off on time (start earlier), that hurried whip around the cockpit switching it all on, the assumption the brakes will work, that the altimeters are on the correct settings (it can't have changed already!), and so on. So many accidents and incidents have occurred, and will continue to occur, because the pre-flight planning was rushed and the checks and drills were not correctly completed in the haste to meet that slot time, occasionally from the wrong runway! One classic example I witnessed many years ago was a pilot walking out to the ramp where two aircraft were parked. He quickly walked around one of the aircraft, climbed onboard, started both engines, called for taxi and reached the runway before requesting a return to the stand. ATC queried whether he had a problem to be told by a somewhat embarrassed pilot that he was in the wrong aircraft!

4. Thou Shalt Think About And Follow Thy Clearance

There have been a number of cases where pilots have correctly repeated their clearance and then inexplicably turned the wrong way after take-off and flown into a mountain. Could the reason be that the clearance given during the taxi to the runway phase and repeated correctly at that time, was not actually thought about mentally until after take-off, when the decision had to be made? As humans we are all prone to mis-interpretation and can think 'right' yet turn 'left'.

5. Thou Shalt Always Ensure Both Pilots Are On The Same Wavelength And Happy

By this I mean that both pilots should be fully aware of what is intended at every stage of flight. Only in this way can one query a situation they might be unhappy about. If, for example, a go-around occurs, the handling pilot is usually aware of the total picture throughout the procedure, whereas the non-handling pilot is busy getting clearance from ATC for a further approach, doing the go-around drills, telling the passengers and so on. After completing the drills, the non-handling pilot comes back into the cockpit, mentally, and may not be fully aware of precisely where in space they are. Meanwhile, if the handling pilot for whatever reason has decided to modify the go-around or is intent on cutting a corner to speed up the next approach, it is essential that both pilots get back quickly onto the 'same wavelength' and both are aware and happy with the overall progress and the total picture. Only then can the non-handling pilot fulfil the monitoring duty and, if unhappy at any stage, make it known.

6. Thou Shalt Never Try Or Say Anything Unusual In The Cockpit

If you intend to do or say anything out of the ordinary, fully brief your crew about it first. All communication must be kept to essentials and related to the task in hand. For any communication to have effect, there are five stages to go through – 1. Think about what you are going to say. 2. Say it clearly. 3. The person receiving the communication must hear it. 4. They must understand it and perhaps above all 5. They must accept it!

Unless all five phases are achieved, there is no communication. There have been a number of classic communication disasters. There was the case of the Captain telling his unhappy and disgruntled pilot during the take-off run to "Cheer up". The co-pilot, with his hand on the undercarriage lever and expecting the next command to be "Gear Up" did just that, accompanied by grauching sounds. On another occasion my co-pilot for some unknown reason suddenly uttered a loud "Oh Christ!" The adrenaline was pumping as he then enlarged by saying "I've locked my keys in my car". He couldn't understand why I then thumped him.

7. If Questioned About Anything, Thou Shalt Assume The Worst And Check Again

It would seem that one of the world's biggest aviation accidents, the KLM B747 in Tenerife, could have been avoided by a simple radio call before the take-off run was commenced, simply to ensure the other aircraft was clear of the runway. One crew member in the cockpit actually queried this to be told by the Captain that yes the runway was clear. The take-off commenced and the crash occurred. A simple radio call would have established the fact the runway was not clear.

8. Thou Shalt Admit A Human Failing

If you made a human error and managed to get away with it, report it and let people know because the next one to make that same mistake may not get away with it. Besides it helps build up the statistics, which in turn highlights those areas that may need attention and improvements, be it in procedures, design or human factors. It is well known that human errors become more prevalent the more tired one becomes and it pays to be aware of your own deterioration in performance as the long duty day progresses. Tempting as it may be, do not let the possible monetary reward for that extra flight persuade you to do it when you know you are too tired to do so. Watch a fresh crew during their first start of the day – everything crisp, clear and precise with no mistakes. See that same crew 10 hours or more later and inevitably the small errors will have started to become evident. It was brought home to me when, as a co-pilot at the end of a long day, I was actioning the various items in the pre-landing check list. I had read out loud the check list saying "undercarriage down, three greens". As I closed the check list, the Captain said, quite politely I thought at the time, "Right, we'll have the gear down now shall we?" All I had done is read the check list but failed to actually lower the gear!

9. Thou Shalt Always Keep A Good Look-Out

Air misses, however infrequent, do still occur and, taking the closure rate of jet aircraft and the somewhat limited field of view from some modern cockpits means that especial efforts are required to scan the outside world as often as possible. One must also aim to achieve eye focus at a distance, which can prove difficult when there is nothing to look at of course, other than blue sky. Bear in mind that the eye will naturally focus just beyond the windscreen.

10. Thou Shalt Concentrate Throughout The Flight

The human pilot must admit they are fallible and very likely to make two or three minor mistakes during each flight. Each minor error may be insignificant individually but, the snowball syndrome being what it is, concentration is required to forestall it. If not then those minor errors tend to combine and very quickly escalate to become a major issue. Whilst 'Complacency' in aviation safety is a word to be banned, 'Concentration' is the key to a successful and safe flight. I think, however, it is fair to say we shall never achieve a 100% safety record, simply because human beings are always in the loop. Human beings design, manufacture, maintain, operate and eventually sift through the wreckage. They are all liable to err. With the experience levels in aviation safety of today, let us ensure we all err on the side of safety.

Captain Russ Williams FRAeS,
Chairman, Air Safety Group, June 2011
Chairman@airsafetygroup.org

Know Your Limits - Airborne Holding

By Simon Grace, Thomas Cook Airlines and Graham Hill, flybe

This article is written under the banner of the Safety Partnership Agreement (SPA). The SPA is a working group comprising of NATS and associated stakeholders, including airline operators. The remit of this group is to consider and raise awareness of safety issues to all interested parties. One of the work streams has been tasked to look at Controller/Pilot interface. Simply put, to help controllers and pilots have a better understanding of each others roles and expectations.

In our working environment we all like actions to be predictable. One area where this concept is tested is the airborne clearance limit. The data that has been reviewed shows that a controller's expectation does not always match a pilot's. Let's look at an example:

"MidJet12AB London Control. Maintain FL110, OCK1G arrival, no delay" "Maintain FL110, OCK1G arrival MidJet12AB"...and a little later... "MidJet12AB descend FL70, level by OCK" "Descend FL70, level by OCK, MidJet12AB"

As the aeroplane approaches the OCK VOR, what is the mind set of the controller/pilot? Will the aeroplane continue with the STAR as published on the plate, i.e. run through OCK on the 290 Radial, or will the aeroplane hold at OCK as published?

This is just one example of many situations experienced crews face. The latest statistics from NATS reveal that many crews have plumped for option 1. Are they correct?

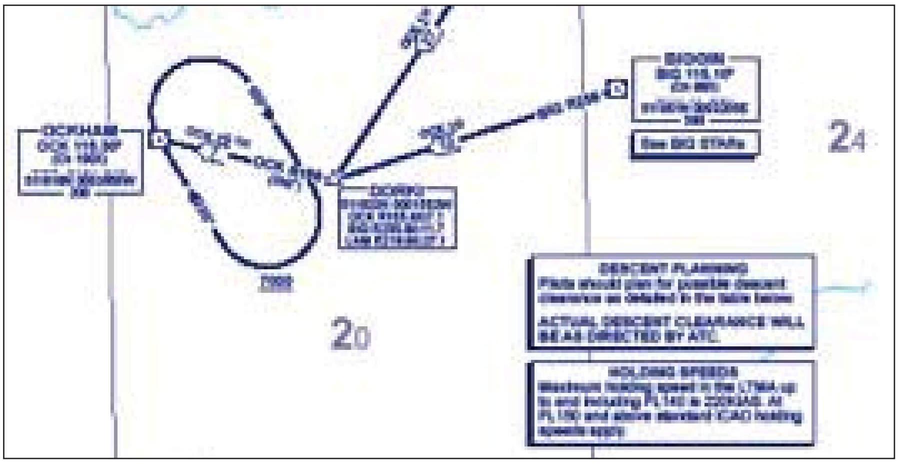
So why is there confusion and why is behaviour not always predictable?

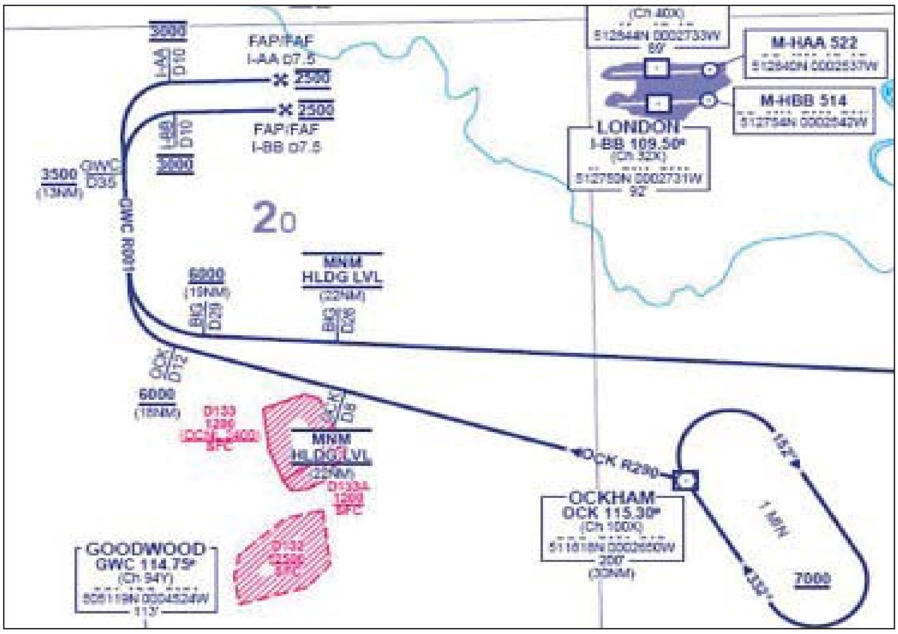
Initially understanding the meaning of the clearance is vital.

On the ground we are given a 'clearance' which relates to our filed flight plan to our destination, but following this flight plan clearance limit, this initial clearance will often be superseded by a new clearance limit specified by the controller. This may be a reporting point, a holding fix, or the edge of controlled or advisory airspace. In the example above the revised clearance limit issued on first contact with London Control was to the OCK VOR. That is as far as the aeroplane is authorised to proceed.

Next we need to understand the term 'No Delay'.

"No delay expected", often shortened to 'no delay', means, as many of you are aware "...delays are expected to be *less than 20 minutes* and should only be used to genuinely reflect the situation". This phrase is found within the definition of EAT (ICAO PANS-ATM and in the UK MATS Pt1). This phrase remains an important tool within the controllers' day to day workplace, but despite a solid understanding of this definition, the term 'no delay' still seems to be interpreted by crews that holding will not be required. This has been reflected in many reports and investigations reviewed. It is a phrase which is designed to assist crews in understanding the maximum length of time you can expect to hold - nothing else.





So hopefully we can see that the correct answer above is option 2.

Is that the end of the holding issues?
Not quite.

Incident records are littered with such examples as the de-identified report below:

Example

A loss of separation occurred at the LAM VOR between AAA123 inbound to EGLL and ZZZ987 outbound from EGLL.

ZZZ987 was passing north abeam the LAM hold climbing FL170.

AAA123 had been instructed to enter the hold at LAM (left turns are published).

The controller had instructed AAA123 to descend FL150. AAA123 passed the entry fix for the LAM hold and incorrectly commenced a right hand turn.

The controller issued avoiding action to AAA123, instructing the aircraft to turn left heading 220 degrees. Simultaneously, and as result of AAA123's actions, on a second ATC frequency a second controller was issuing avoiding action to ZZZ987.

The following conversation took place:

Controller: "It should have been a left hand hold at LAM please, that was a left hand hold at LAM"

AAA Pilot: "Yes, but the entry is to the right"

Controller: "Negative, it's a left hand hold. You should enter the hold heading 266 degrees and then left hand from there"

AAA Pilot: "Roger AAA123"

A snapshot of the Radar picture below has LAM VOR sitting just off the bottom right hand corner of the picture. Minimum separation was 2.8nm laterally and 500 feet vertically.

The Error

The loss of separation was caused when AAA123 flew an incorrect entry into the LAM hold. The right turn taken by the aircraft positioned it into confliction with ZZZ987 passing north, abeam the holding pattern.

The controller expected the AIP published hold to be flown.

Other summaries of holding incidents include:

- Aircraft turned left on track, approx 3nm before the OCK VOR holding facility without onwards clearance,
- Aircraft failed to hold at Dayne,
- Following a late transfer of communications to the next controller, the aircraft flew past the clearance limit holding (BIG VOR) before 'checking in',
- Aircraft failed to enter the Rosun hold following weather avoidance,
- Aircraft took up the Lanak hold 12nm north of Lanak.

So those are the examples. Now we need to understand why they continue to catch crews and controllers out.

Like many other areas in aviation and life, it's down to Human Factors.

The incidents don't include any technical aeroplane issues, but reveal a range of Human Factors issues.

These include flight crew failing to recognise and/or execute what was expected of them for one, or more, of the following reasons:

- Inadequate briefing –
  expectation or complacency with procedure or destination airfield, especially at a home base or familiar airfield. An example of a crew conversation might be, "We never usually hold here",

- Human error – correct briefing followed by incorrect action,
- Difficult to interpret/poorly designed Approach charts – many charts now contain the phrase 'Do not proceed beyond xxx without ATC clearance'.
- FMS operation and data input error – direction of turn, hold distance or timing, execution of FMS procedures, is the hold procedure in the FMS data base correct...has it been executed? An example of crew conversation might be, "What's it doing now?"
- An unfamiliar environment
- High workload/distraction – can result in a lack of review, crosschecking, monitoring or lack of SOP compliance.

So how can we improve predictable behaviour in respect of Airborne Holding?

As Pilots

In these days of fuel and time saving, we often want the FMS to reflect what we expect/want to happen. This can mean that certain procedures or holds aren't input, especially if they appear on an approach chart but are not a default in the FMS database. If the requirement to hold suddenly changes due to unforeseen circumstances or if the anticipated radar vector just before the holding fix doesn't materialise then the workload within the flight deck will increase dramatically. As ever it's a balance, but hopefully we have seen in this article what can happen when we get it wrong.

Crews may not input a hold if there is a belief that their aeroplane's FMS will give a computed time or fuel penalty if a hold is input prior to entering the hold. In many types this is not the case and may be a throw back to older types. Checking and understanding how your aeroplane operates will help.

Understanding ATC procedures, what ATC are trying to achieve and, as mentioned above, the meaning of the ATC clearance is vital. They are on our side and are thinking of our safety first and foremost, whilst balancing their objective of moving traffic efficiently and with minimum delay.

As one controller put it perfectly "If you are not on a radar heading or told to leave the holding fix on a heading – HOLD."

If there is any doubt what is expected, ask your colleague outside the aeroplane (the controller) and not your colleague sitting beside you.

As Controllers

Use standard phraseology and give as much notice as possible to help pilots plan and brief the expected procedures you want them to follow.

Summary

In summary, take up the hold as the default action – this should be the expectation of both the controller and the crew.

This article has dealt with lateral holding issues, but clearance to a vertical limit (altitude/flight level) also constitutes a clearance limit and features heavily in holding errors...but that's for another day.

For further information on the SPA (Safety Partnership Agreement) please visit www.customer.nats.co.uk

A Summary of UK Air Traffic Services Outside Controlled Airspace (ATSOCAS)

RESPONSIBILITY FOR COLLISION AVOIDANCE

MATS Part 1; Section 1 Chapter 11 states:

> *"Within Class F and G airspace, regardless of the service being provided, pilots are ultimately responsible for collision avoidance and terrain clearance, and they should consider service provision to be constrained by the unpredictable nature of this environment."*

RESPONSIBILITIES OF THE PILOT

Pilots are reminded to maintain a good lookout at all times, regardless of services being provided.

Understand the level of service you are receiving and the limitation of that service (e.g. Basic Service has no specific requirements for specific traffic information to be passed)

RESPONSIBILITIES OF THE CONTROLLER

MATS Part 1; Section 1 Chapter 5 states:

> *Pilots must be advised if a service commences, terminates or changes when:*
> *a) They are operating outside controlled airspace; or*
> *b) They cross the boundary of controlled airspace.*

LEAVING CONTROLLED AIRSPACE

The change in service and the responsibilities of pilots and controllers when leaving controlled airspace are a key point of risk. Pilots are to ensure that are aware of the class of airspace they are operating in and the collision avoidance requirements. Controllers are to ensure that they have complied with MATS Part 1; Section 1 Chapter 5.

CAP 774 UK FLIGHT INFORMATION SERVICES AND DUTY OF CARE

Further details on ATSOCAS can be found in UK Civil Aviation Authority publication CAP774.
Appendix A of CAP774 provides specific information on obligations under Duty of Care.

	BASIC	TRAFFIC	DECONFLICTION	PROCEDURAL
IDENT. (SQUAWK)	Not Mandatory, but may be useful	Pilots shall be informed and maintain ident	Pilots shall be informed and maintain ident	Not needed but may be done for conspicuity purposes
NOTIFICATION OF SERVICE	**Pilots must be advised which service they are receiving** (this maybe offered or requested, but must be agreed) (Pilots should request the service they require)			
CHANGE OF SERVICE	**Pilots must be informed of any change or termination of service** (e.g. if an aircraft is leaving controlled airspace)			
TRAFFIC INFORMATION	May give generic traffic information on first contact for situational awareness Not updated unless significant change or pilot request Warning maybe issued if a definite risk of collision	Pass Traffic Information on relevant traffic (passing within 3nm or 3A). Aim to pass before traffic is within 5 miles Update if requested or still a hazard Can be reduced (e.g. due workload or radar cover)	May pass Traffic Information on de-conflicted traffic to improve situational awareness Can be reduced (e.g. due workload or radar cover)	Pass Traffic Information to Basic if confliction considered to exist + where Traffic Information passed by another unit
COLLISION AVOIDANCE	Pilot's responsibility at all times	Pilot's responsibility even if Traffic Information is passed.	ATCO gives advice to try and achieve de-confliction minima	Procedural restrictions used to try and achieve minima
DE-CONFLICTION ADVICE	If de-confliction is requested or required consider providing a De-confliction Service	If de-confliction is requested or required consider providing a De-confliction Service	Must pass Traffic information plus headings and/or level to try and get 5nm or 3A; if co-ordinated 3nm/1A	As collision avoidance but no advice can be given against unknown traffic
HEADINGS/ LEVELS	Hdgs for Identification only. Generic Navigation assistance may be provided on request	When providing hdgs/levels controllers should take account of other traffic. Only given above terrain safety level	Headings/levels can be given (see De-confliction advice) Only given above terrain safety level	N/a- Distance and time restrictions used

For further information on the SPA (Safety Partnership Agreement) please visit www.customer.nats.co.uk