PSYCHED OUT
Understanding Human Error

UNPREPARED
HEMS Crew Lacked Training

NEXT ISSUE
All-Digital ASW

ON THE LINE
ADVANCING MRO SAFETY
CRITICAL AVIATION SAFETY INFORMATION AT YOUR FINGERTIPS

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As the only independent, impartial and international source for aviation safety, the Flight Safety Foundation takes keeping our skies safe seriously.

To ensure the aviation industry has the most up-to-date safety information, FSF has launched a new and improved website — your go-to repository of comprehensive, trustworthy aviation safety information.

As safety continues to evolve from reactive to proactive to predictive, FSF members will gain even more insight through expanded online offerings, including curated external content and our own AeroSafety World journal in a new digital-first format for maximum flexibility. Moreover, you’ll be able to interact via an exclusive online community designed to facilitate additional discussion of key safety initiatives.

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www.flightsafety.org
FIGHTING Complacency

We in aviation often point to the sterling safety record in commercial air transport and business aircraft operations with justifiable pride. A lot of work has gone into building a robust safety culture that is held in high esteem by other professions and industries around the world. Yet we also have to recognize that a lot more work is needed and that complacency cannot be allowed to set in.

Complacency, as defined by Merriam-Webster, is “a feeling of being satisfied with how things are and not wanting to try to make them better.” It is also a recipe for disaster in flight operations and in the life of any organization responsible for them.

We cannot feel satisfied, despite the year-to-year statistical evidence, that, as an industry, we are doing a good job. Continued advancements in training, technology, human factors research and in the philosophies that guide the world’s regulatory bodies are essential to improving safety.

We must collect, analyze and share data and other information to identify new risks, and we need to be vigilant against the re-emergence of previously identified and mitigated threats. For example, Flight Safety Foundation’s ongoing Global Safety Information Project (GSIP) seeks to study and facilitate the effective analysis and sharing of aviation safety data in the Pan America and Asia and Pacific regions, but what we already have learned in the past two years — and will share in our GSIP tool kits — will be applicable around the world.

Complacency also is a concern for organizations like the Foundation. We have been in the business of safety improvement for nearly 70 years, but we know past achievements are not a guarantee of future success. Aviation safety is evolving, and so are we. I’m happy to say that the new FSF website I discussed in my message last month is just about ready for deployment, and we’re very excited about the capabilities and flexibility it will give us to deliver important safety news and information in a more timely and compelling fashion.

As a member of the Foundation, you will be notified as soon as the new website is ready. When you receive the announcement, I encourage you to check it out at <flightsafety.org>. Let us know what you think about it and how we can make it even better. Please direct your comments and suggestions to Frank Jackman at <jackman@flightsafety.org>.

Jon L. Beatty
President and CEO
Flight Safety Foundation
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I am excited to announce that AeroSafety World is going all-digital. In order to better serve the Foundation’s members and the aviation safety community globally, we are no longer going to print the magazine. Instead, we will offer important safety news, information and features in a responsive, easy to access and search format on our newly redesigned and relaunched website at <flightsafety.org>. In addition, by early 2017, we plan to roll out an ASW app for mobile devices that will keep our content accessible regardless of whether you are online.

The decision to stop printing ASW with this issue was not an easy one, but I firmly believe it is the right one. I have spent large swaths of my more than 30 years in journalism reporting, writing and editing print publications — newspapers, newsletters, magazines and even a book. My parents met while working at a newspaper. Ink is in my blood. I understand the loyalty to print.

But I also have spent considerable time in various roles in the digital world, and our new website and its dedicated ASW section will allow us to disseminate critical information and interact with our members in ways that simply are not possible with print. For example, the new website features a federated search function that will allow a user to input a topic — for example, “lithium batteries” — and have results returned from not only ASW and the Foundation’s database, but also SKYbrary and the Aviation Safety Network. We also will be able to get the word out more quickly on important safety issues, and then to follow up every month with the in-depth analysis and information that you have come to expect from ASW.

Our commitment to aviation safety and journalistic integrity will not change, but the way we serve our members will, and I think you are going to like what you see.

Frank Jackman
Editor-in-Chief, ASW
Flight Safety Foundation
Serving Aviation Safety Interests for Nearly 70 Years

Since 1947, Flight Safety Foundation has helped save lives around the world. The Foundation is an international nonprofit organization whose sole purpose is to provide impartial, independent, expert safety guidance and resources for the aviation and aerospace industry. The Foundation is in a unique position to identify global safety issues, set priorities and serve as a catalyst to address the issues through data collection and information sharing, education, advocacy and communications. The Foundation’s effectiveness in bridging cultural and political differences in the common cause of safety has earned worldwide respect. Today, membership includes more than 1,000 organizations and individuals in 150 countries.

OCTOBER 5–7 ➤ BowTie Barrier-Based Training. TAG Bologna. Bologna, Italy. <sms@mys.it>, <mycs.it/bologna.htm>.


Small UAS Rules

ew rules for the use of small unmanned aircraft systems (UAS) — with aircraft weighing less than 55 lb (25 kg) — have taken effect in the United States, aimed at establishing a “flexible framework of safety without impeding innovation,” Administrator Michael Huerta of the U.S. Federal Aviation Administration (FAA) says.

The rules, which took effect in late August, call, among other things, for small UAS aircraft to be flown within the visual line of sight of the operator or of a visual observer and to be flown during daylight hours, at a maximum ground speed of 87 kt, and no higher than 400 ft above ground level. Air traffic control permission is required for operations in some airspace.

Huerta said that the rules create “an environment in which emerging technology can be rapidly introduced while protecting the safety of the world’s busiest, most complex airspace.”

Operators of small UAS must hold a remote pilot airman certificate with a small UAS rating or be directly supervised by another individual who has such a certificate.

The rules do not apply to model aircraft, most of which must be registered with the FAA and comply with other rules.

In a related matter, the FAA’s Drone Advisory Committee — made up of UAS manufacturers and operators, traditional manned aviation organizations, airport operators, government officials and others — was to hold its first meeting in mid-September. The panel, which will meet at least three times a year, will discuss challenges associated with integrating UAS into the National Airspace System.

“Safety is a shared responsibility in which each of us plays a vital role,” Huerta said in advance of the meeting. “We know from experience that the FAA’s policies and overall regulation of small unmanned aircraft will be more successful if we involve a strong and diverse coalition.”

Boost for ICAO Mideast Cooperation

iddle Eastern member states of the International Civil Aviation Organization (ICAO) have taken what the organization calls “bold steps” to strengthen their cooperation toward civil aviation safety goals.

During a late August meeting in Riyadh, Saudi Arabia, the Global Aviation Ministerial Summit approved the Riyadh Declaration on Aviation Security and Facilitation in the Arab Civil Aviation Commission and the ICAO Middle East regions.

The declaration reaffirms “member states’ need to enhance regional development and integration initiatives for aviation security while seeking new efficiencies for collaborative information sharing and security and facilitation training,” ICAO said.

ICAO Council President Olumuyiwa Benard Aliu said the need remains for speedy agreement on a new Middle East/North African Regional Safety Oversight Organization.

“The regional safety oversight approach is fundamentally about pooling resources for shared benefit,” Aliu said. “Here, in the Middle East, it would assist many states with meeting the targets established under the ICAO Global Aviation Safety Plan (GASP), as well as associated [Middle East] Regional Aviation Safety Group (RASG) objectives.”

The summit was attended by representatives of 54 countries from the Middle East, Africa and other regions.
**Cell Phone Warning**

Citing reports that a number of Samsung Galaxy Note7 cell phones have overheated and exploded, civil aviation authorities are advising passengers not to turn the phones on or charge them while aboard an aircraft and not to stow them in checked baggage.

The U.S. Federal Aviation Administration said in early September that its warning followed “recent incidents and concerns raised by Samsung,” which has stopped sales of the Galaxy Note7 while it conducts “a thorough inspection with our suppliers to identify possible affected batteries in the market.” The company has told owners of Galaxy Note7s that it would issue new replacement devices.

The European Aviation Safety Agency issued a similar warning, adding, “Passengers are also reminded of the need to inform the cabin crew when a device is damaged, hot, produces smoke, is lost, or falls into the seat structure.”

In a Sept. 10 statement, Samsung said that “a small number of cases” had been reported worldwide and told Galaxy Note7 owners that they should “power down your device and return to using your previous phone.” Company plans called for the Note7s to be replaced with new phones beginning in mid-September.

**Ground Coordination**

The Australian Transport Safety Bureau (ATSB), citing a collision between an Airbus A330 and an airbridge at Melbourne Airport during boarding, has issued a notice urging improved communication and coordination between airport ground workers.

“An aircraft is attended at a terminal bay by people carrying out a wide range of concurrent tasks,” the ATSB said in Safety Advisory Notice AO-2016-028-SAN-001. “Typically, they and their respective organisations work alongside many others, each operating with different processes and to varying contractual agreements. Defining a set of processes that can apply across such varied situations and aligning them well with the other activities can be difficult. … An effective procedure will include steps to ensure that activities are appropriately aligned with other procedures. One way to achieve this is to pause and check if the situation is as it should be, and to inform others of activities that could affect them.”

The ATSB cited the March 31, 2016, collision at Melbourne, which occurred after a maintenance technician, having noticed that the A330’s parking brake was set, removed the main chocks early. Other personnel later removed the nose gear chocks without checking to see whether the main gear chocks were still in place.

“The captain, unaware that no chocks were in place, released the [parking] brake, and the aircraft rolled back, striking the aerobridge,” the ATSB said. No one was injured in the collision, but the A330’s door and the airbridge were damaged.

The ATSB said the collision occurred because “the ground and flight crew procedures were not harmonised,” and “key steps involving the chocks and parking brake were performed out of sequence and without being communicated between tractor, engineering and flight crews.”
Updated Emergency Training Urged

Training requirements should be regularly updated to ensure that pilots and air traffic controllers receive the most “current and relevant” input on how to handle emergency situations, the U.S. National Transportation Safety Board (NTSB) says.

In safety recommendations issued in September to the U.S. Federal Aviation Administration (FAA), the NTSB said that the FAA should annually revise required training to help pilots who experience emergencies, including power losses, fuel emergencies, control difficulties and pilot medical issues.

The recommendations also called on the FAA to develop and require training for air traffic controllers to instruct them on recognizing emergencies, determining what type of assistance is required and taking actions to help pilots resolve the problems.

In making the recommendations, the NTSB cited a Jan. 13, 2015, accident in New Smyrna Beach, Florida, U.S., in which the commercial pilot of a Cessna 152 requested help from air traffic control after inadvertently entering instrument meteorological conditions. The Cessna crashed, and the pilot was killed.

The NTSB said, in its final report on the accident, that controllers "did not act in accordance with … FAA guidance that dictates how to assist pilots experiencing this type of emergency."

Proposed Penalties

The U.S. Federal Aviation Administration (FAA) has proposed nearly $900,000 in civil penalties against Air Methods for its alleged operation of an Airbus EC135 to carry passengers while the helicopter was not airworthy.

According to the FAA, one of its inspectors discovered during a November 2014 inspection in Tampa, Florida, that the helicopter’s pitot tubes were severely corroded. Air Methods was notified immediately but operated the helicopter, without replacing or repairing the pitot tubes, on 51 passenger-carrying revenue flights over the next week.

The FAA said that “because of the corroded pitot tubes, Air Methods operated the helicopter when it was unairworthy, in violation of its operations specifications, after it failed to correct a known defect in the aircraft and in a careless or reckless manner that endangered lives and property.”

Air Methods has 30 days after receiving the FAA’s formal enforcement letter to respond.

NextGen Coordination Questioned

The U.S. Federal Aviation Administration (FAA) is lacking a “clear process for identifying and coordinating” long-term research and development associated with NextGen — the Next Generation Air Transportation System that will transform the nation’s air traffic control system, a government oversight agency says.

The Department of Transportation’s Office of Inspector General (OIG) said, in an audit report released in August, that the audit was designed to determine how the FAA had reallocated the responsibilities of the Joint Planning and Development Office, after funding for the office was eliminated by Congress in 2014. Among other responsibilities, the office identified high-priority research and development (R&D) and determined whether the FAA was maintaining an effective method of coordinating with other federal agencies on R&D.

The audit found the FAA’s Interagency Planning Office, which was established later in 2014 to coordinate NextGen R&D throughout the federal government, had begun identifying long-term projects, but “these efforts have not been synchronized with any long-term vision for NextGen.”
In Other News …

Nearly a dozen industry groups are calling for action to “preserve the high level of safety in European airspace” by ensuring the safe operation of unmanned aircraft systems (UAS). Among their recommendations are an extensive public awareness campaign and the compulsory registration of all UAS. … Mark Skidmore, CEO and director of aviation safety for the Australian Civil Aviation Safety Authority (CASA), plans to leave the agency in October, CASA said. At press time, a successor had not been named.

SESAR Planning

Eurocontrol has pledged €500 million (about US$558 million) to advance the Single European Sky Air Traffic Management (SESAR) Joint Undertaking (JU) and taken on a larger role in the project, which is designed to develop a new-generation air traffic management system throughout Europe.

The financial pledge was part of an agreement signed in Brussels in early September by top officials of Eurocontrol and the SESAR JU (SJU).

The agreement for SJU’s extended mandate, which runs through 2024, “signals Eurocontrol’s continued commitment as co-founder and active member in the SESAR partnership,” said Eurocontrol Director General Frank Brenner, who also is vice chair for the SESAR JU Administrative Board. “I believe that it is only through this type of collaboration that we can improve the overall performance of the European air transport network.”

The SJU is responsible for implementing the European air traffic management (ATM) master plan to upgrade ATM throughout Europe.

Compiled and edited by Linda Werfelman.

Safety is Our Guiding Light

Safety Training with IATA

With safety as our top priority, we are committed to making working environments throughout the industry safer and more productive while enhancing the travel experience of every passenger. IATA’s training portfolio includes safety courses for airlines in addition to diploma programs focused on safety management, workplace safety, operational safety, and industry best practices. Strengthen your skills and stay up to date with regulatory changes and compliance requirements with courses that go above and beyond through a hands-on approach.

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Emirates has become synonymous with comfort and luxury, but its priority has always been safety. Over 50 million passengers travelled on Emirates last year to its global network of over 150 destinations, and as the passenger and destination count continue to grow, managing safety at the airline inevitably becomes even more critical. Capt. Mark Burtonwood, vice president of flight safety at Emirates, shares how he and his team implement and maintain a culture of safety.

**How do you implement a culture of safety at Emirates?**

Safety in aviation is especially crucial when you are responsible for more 61,000 colleagues and over 50 million passengers each year.

We maintain a culture of safety at Emirates by making safety the responsibility of all employees. Safety is one of our corporate values, which is supported by our senior management. As emphasized by His Highness Sheikh Ahmed bin Saeed Al Maktoum, chairman and chief executive, Emirates Airline and Group, our objective is to “protect our customers, staff and assets through a ceaseless commitment to international and all other appropriate safety standards.” This is reinforced by President Sir Tim Clark, who has signed our safety policy and is the accountable manager for Emirates’ Safety Management System (SMS).

Everyone is encouraged to identify hazards, intervene if appropriate and report.

All our colleagues have access to the company online safety reporting system called SiD and are actively encouraged to use it. We’ve had great success with above-industry-average reporting levels.

**Tell us more about safety management at Emirates.**

The regulatory requirements came into place in 2012 to enhance safety best practice and compliance within the company. However, Emirates already had an SMS in place long before it was required.

The Emirates SMS is designed to align with International Civil Aviation Organization recommendations and meet the regulatory requirements of the United Arab Emirates General Civil Aviation Authority. The Emirates SMS has four components and 12 elements that cover safety policy and objectives, safety risk management, safety assurance and safety promotion.

The formal structure of Emirates’ SMS is vital to effective and safe operation across our diverse and expansive organisation. Our safety communication and training ensure that all employees understand their responsibilities and the roles they play in the overall safety of the airline.

The company SMS manual is available on the company intranet, where all employees can access it, both in the office and remotely.

**How does Emirates’ SMS work?**

The success of SMS lies in the hands of every Emirates employee, and we provide regular training and communication to encourage employee participation. Group Safety provides
support and guidance to the various departments for the implementation of the company SMS.

This includes assistance in understanding hazard identification, classification and risk management; advice on risk assessments; and maintenance of the departmental risk registers. Group Safety also ensures regulatory compliance both locally and internationally, constantly striving to go beyond compliance standards in all areas of safety management.

What hazard identification strategies do you have in place?

We have three strategies — reactive, proactive and predictive. The reactive involves the analysis of past events. Hazards are identified through investigation of safety occurrences, incidents and accidents. These can provide information to identify systematic and human factor issues to assist in the recommendations of mitigations.

Our proactive strategy involves the analysis of existing or real-time situations, and this is the primary job of the safety assurance function of our SMS with its audits, evaluations, employee reporting and associated analysis and assessment processes. This involves actively seeking hazards in the existing processes.

Lastly, our predictive strategy involves gathering high quality data to analyze and identify possible future outcomes or events, analyzing system processes and the environment to identify potential future hazards, and initiating mitigating actions.

Together, the different methodologies help us to learn from past events, assess the current situation and pre-empt future risks.

How do you think the role of flight safety will evolve in the coming years?

Risk management, safety investigations, debriefs, safety assurance, and safety promotion activities will always be part of what we do.

In the future, there will be an increasing focus on the use of big data for predictive safety management. Data received from safety reports already goes through detailed analysis, enabling us to present useful and relevant safety information — we are committed to further improve this process.

We will continue to be leaders in SMS, sharing safety knowledge both internally and externally.

Safety is everyone’s business.
Preliminary Agenda
(as of September 9, 2016)

Sunday, November 13, 2016

0900–1200  FSF International Advisory Committee Meeting
0900–1200  SKYbrary Supervisory Board Meeting
            (closed meeting)
1200–1700  FSF Board of Governors Meeting (closed meeting)
            Board of Governors Lunch Sponsored by Embraer
1400–1800  Registration/Exhibitor Move-in
            Conference Totes Sponsored by The Boeing Company
            Hotel Keycards Sponsored by Safran
1700–1730  Day One Speakers Meeting

Monday, November 14, 2016

0730–1500  Registration/Exhibit Marketplace Open
            Conference Totes Sponsored by The Boeing Company
            Hotel Keycards Sponsored by Safran
0730–0830  Morning Coffee and Tea in the Exhibit Marketplace

0830–1000  Welcome and Keynote Address
            General Session Sponsored by The Boeing Company
0830–0850  Welcome
            Greg Marshall, vice president, global programs, Flight
            Safety Foundation (FSF)
            Jon Beatty, president and CEO, FSF
            Capt. Bill Curtis, chairman, FSF International Advisory
            Committee
0850–0925  Keynote Address
            Capt. Henry Donohoe, divisional senior vice president–flight
            operations, Emirates; member, FSF Board of Governors
0925–1000  Global Collaboration: Frontline Results
            Gretchen Haskins, CEO, HeliOffshore; member, FSF
            Board of Governors

1030–1200  SESSION I: Updates
            General Session Sponsored by The Boeing Company
1035–1100  Standardization Through Cooperation
            Capt. Craig Hildebrandt, director, safety and flight
            operations technical affairs, Airbus
1100–1125  An Update to Lithium Battery Transport by Air
            Capt. Scott Schwartz, Ph.D., director, Dangerous Goods
            Program, Air Line Pilots Association, International (ALPA)
1125–1150  Justice in a Just Culture
            Capt. Peter Stein, director of flight operations, Johnson
            Controls; member, FSF Board of Governors
1150–1200  Questions and Wrap-up
1200–1330  Lunch in the Exhibit Marketplace
1330–1500  SESSION II: Safety Information Protection
            General Session Sponsored by The Boeing Company
            Moderator: Kenneth Quinn, partner, Pillsbury Winthrop
            Shaw Pittman; general counsel and secretary, FSF Board of
            Governors
1340–1450  Panel: Protecting Accident/Incident Data and
            Evaluating Pilot Mental Health: Safety and the Law
            Allison Kendrick, principal senior counsel, The Boeing
            Company; chair, FSF Legal Advisory Committee
            Dr. Jonathan Aleck, head of Legal Service Group, Australian
            Civil Aviation Safety Authority
            Aurelia Grignon, avocat, Soulez Larivière and
            Associates
1450–1500  Questions and Wrap-up
1500–1530  Day Two Speakers Meeting
1600–2100  Host Sponsor Event
            Sponsored by Emirates.
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<td>Safety UAS integration challenges: Views and Concerns From the Airline Cockpit</td>
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<td>How Much Safety Do Small Drones Embed?</td>
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**CONCURRENT TRACK SESSION: Maintenance and Engineering**

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<td>Maintenance LOSA: A Tool for Diagnosis and Safety Promotion</td>
<td>Christine Zylawski, MLOSA project manager/deputy flight safety manager, Air France</td>
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<td><strong>Moderator:</strong> Capt. Linda Orlandy, president, Orlady Associates; member, FSF Board of Governors</td>
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<tr>
<td>0840–0905</td>
<td>Presentation to be announced</td>
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<td>Capt. Harry Nelson, executive operational advisor to product safety, Airbus; vice chair, FSF International Advisory Committee</td>
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<tr>
<td>0905–0930</td>
<td>Cognitive Biases and Other Challenges in Going Beyond Human Error in Safety Investigations</td>
<td>Dr. Kathy Abbott, chief scientific and technical advisor for flight deck human factors, U.S. Federal Aviation Administration (FAA); Dr. William Bramble, senior human performance investigator, U.S. National Transportation Safety Board</td>
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<tr>
<td>0930–0955</td>
<td>One-Team Cockpit</td>
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<td>Capt. Christian Popp and Capt. Christof Kemény</td>
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<td>0955–1000</td>
<td>Questions and Wrap-up</td>
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<td>1000–1030</td>
<td>Morning Break in the Exhibit Marketplace</td>
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<td>1030–1200</td>
<td><strong>SESSION VIII: Managing Risk</strong></td>
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<td>General Session Sponsored by Embraer</td>
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<td><strong>Moderator:</strong> Tzvetomir Blajev, coordinator, safety improvement Initiatives, Eurocontrol; chair, FSF European Advisory Committee</td>
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<tr>
<td>1040–1105</td>
<td>Next Generation Flight Safety Systems: A Business and Corporate Aviation Perspective</td>
<td>Dr. Ratan Khatwa, senior chief engineer, human factors, Honeywell Aerospace; member, FSF International Advisory Committee</td>
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<td>1130–1155</td>
<td>Higher Risk Operations and Dynamic Risk Management Dashboards</td>
<td>Ilias Panagopoulos, safety manager, NATO Airlift Management Program</td>
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<td>1330–1500</td>
<td><strong>SESSION IX: Go-Around Compliance</strong></td>
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<td><strong>Moderator:</strong> Capt. Bill Curtis, Air Canada; chair, FSF International Advisory Committee</td>
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<td>1340–1405</td>
<td>Pilot Decision Making and Go-Arounds</td>
<td>Capt. Michael Gillen, ASAP event review representative, United Airlines</td>
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<td>1405–1430</td>
<td>Improving Go-Around Compliance at Porter Airlines</td>
<td>Capt. John Gronlund, manager pilot training, Porter Airlines</td>
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<tr>
<td>1430–1455</td>
<td>Operational Considerations for Safety Go-Around Procedures</td>
<td>Capt. Bryan Burks, ALPA</td>
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<td>1500–1530</td>
<td>Afternoon Break in the Exhibit Marketplace</td>
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<td>1530–1610</td>
<td><strong>SESSION X: Somatogravic Illusion</strong></td>
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<td>General Session Sponsored by Embraer</td>
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<td></td>
<td><strong>Moderator:</strong> Dr. Ratan Khatwa, senior chief engineer – human factors, Honeywell Aerospace; member, FSF International Advisory Committee</td>
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<tr>
<td>1535–1600</td>
<td>Creating the Somatogravic Illusion in Your Simulator — Early Research Results</td>
<td>Dr. Jeffrey Schroeder, chief scientific and technical advisor, Flight Simulator Systems, FAA</td>
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<td>1600–1625</td>
<td>Reducing the Threat of Somatogravic Illusion</td>
<td>Capt. Simon Ludlow, Dragon Airlines</td>
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<tr>
<td>1625–1650</td>
<td>How Flight Crew Can Be Trained on Strategies to Counteract Illusions in a Traditional Simulator</td>
<td>Capt. Endre Berntzen, director, crew training, Widerøes Flyveselskap AS</td>
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<td>1650–1700</td>
<td>Questions and Wrap-up</td>
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<td>1700–1730</td>
<td>Closing Remarks</td>
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<td>1730</td>
<td>IASS 2016 Concludes</td>
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THE WORLD
in Dubai

DON'T JUST VISIT, LIVE IT.

From some of the world's largest malls to the tallest buildings, a world of grandeur awaits you in Dubai. Book your flight today at emirates.com/us

Hello Tomorrow
Safety management systems (SMSs) within airlines and maintenance and repair organizations (MROs) have advanced rapidly in the past decade. Conceived by the International Civil Aviation Organization and gradually being put into practice through regulation by national aviation authorities, SMSs soon will be required for airlines around the world. For example, the U.S. Federal Aviation Administration (FAA) mandates that all U.S. commercial airlines (Part 121) implement an SMS by Jan. 8, 2018. One major component of an SMS is risk management, which requires that hazards to safety of flight be identified and assessed for risk, and that unacceptable risk be mitigated to acceptable levels.

International guidance for SMS design recommends three approaches in identifying safety hazards: a reactive approach (the investigation of accidents, incidents and events); a proactive approach (the active identification of safety hazards through the analysis of the organization’s activities, using tools such as mandatory and voluntary reporting systems, safety audits and safety surveys); and a predictive approach (capturing system performance as it happens in real time during normal operations, such as observations of the performance of the aircraft maintenance technicians (AMTs) during a heavy check of a large commercial jet.

As part of its predictive approach, the Airlines for America (A4A) Maintenance and Ramp Human Factors Task Force has extended the line operations safety audit/assessment (LOSA) concept to assess maintenance and ramp (M/R)
AFI Three-Phased MLOSA Campaign

<table>
<thead>
<tr>
<th>Completed</th>
<th>In Progress</th>
<th>Scheduled</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st quarter 2015</td>
<td>2nd quarter 2016</td>
<td>3rd quarter 2016</td>
</tr>
<tr>
<td>Line and Base Maintenance</td>
<td>Component Shops</td>
<td>Engine Shops</td>
</tr>
<tr>
<td>1,500 AMTs</td>
<td>700 AMTs</td>
<td>600 AMTs</td>
</tr>
<tr>
<td>~300 observations</td>
<td>~250 observations</td>
<td>~250 observations</td>
</tr>
</tbody>
</table>

AMTs = aircraft maintenance technicians

Source: Air France Industries (AFI)

Table 1

operations.1 The FAA and A4A also have published separate versions of M/R LOSA implementation guidelines.

Through strictly non-punitive, peer-to-peer observations, maintenance LOSA (MLOSA) takes “snapshots” of normal aircraft maintenance operations and helps the MRO to understand safety-related decisions of ordinary people who are under the influence of normal, everyday pressures. MLOSA incorporates the threat and error management (TEM) conceptual framework, which recognizes that safety threats and errors are likely to occur in all normal operations. Compared with traditional audits conducted by external agencies or by internal safety and quality assurance staff, MLOSA “paints” for the organization a much more realistic picture of what is going on.

In addition to identifying safety threats and errors, MLOSA data can help an organization to estimate — by a sampling process — the occurrence probability; this capability exceeds that of most mandatory and voluntary reporting systems. The predictive capability of MLOSA also can help analysts to discover emerging risks from future operational changes expected inside or outside the organization and its operational environment. Mitigating action therefore can be initiated before the risk actually appears. MLOSA also identifies exemplary AMT behaviors that can be reinforced in training.

Boeing Commercial Aviation Services offers MLOSA support and training to the international airline industry. For example, Boeing supported Air France Industries (AFI) to launch an MLOSA program in November 2014.

Case Study Background

Within AFI, the Flight Operations business unit carried out a LOSA in 2011, and this assessment was considered very successful. AFI subsequently made a commitment to a campaign of recurrent LOSAs for pilots.

In maintenance operations, by mid-2013, AFI recognized the need to complement its existing reactive and proactive safety programs by capturing snapshots of day-to-day performance — i.e., operational difficulties or safety threats in unscheduled or scheduled maintenance — and by developing strategies for dealing with those difficulties or threats. AFI also renewed its commitment to increase the involvement of frontline employees and to further enhance its safety culture.

One expected outcome was to measurably put into practice the slogan “safety is not just for safety professionals within the organization, it’s a responsibility of everyone in the organization.”

AFI leaders presumed that frontline employees are the true experts, and have the best vantage point to observe maintenance operations as they occur and, consequently, to identify the problems and fixes. Maintenance failures are not random. There is a clear need to understand how the safety threats, the latent conditions and the errors committed eventually come together and lead to a reduced safety margin.

Implementation Begins

Assisted by Boeing, AFI launched the MLOSA program after a six-month preparation period and educational campaign by a new project team. Since 2014, work toward full implementation has progressed through three phases for each of the following three AFI business units (Table 1): Line and Base Maintenance (in which base maintenance personnel perform, on average, 275 C-check or D-check inspections for narrow- and wide-body aircraft each year); Component Shops (which support more than 1,300 aircraft worldwide); and Engine Shops (which handle 500 visits and 280 thrust reverser overhauls each year).

Line and Base Maintenance was the focus of Phase 1, completed in the first quarter of 2015. To promote the entire program and generate buy-in, the MLOSA project team attended or conducted more than 90 face-to-face meetings with the frontline employees and union groups. Twenty-six AMTs soon volunteered to become MLOSA observers. They were trained by Boeing during a one-day MLOSA observer training course. The course covered theoretical background, classroom practice and practice observations in hangars.

Based on safety information from event investigations and voluntary reporting by AMTs, the project team
selected a number of maintenance tasks as their primary focus within Phase 1, such as wheel/brake change, engine change, landing gear servicing, landing gear removal/installation, flight controls components removal/installation, cabin systems repair, avionics/mechanical systems troubleshooting, and tooling management.

During the following two and a half months, the 26 observers completed 186 observations and compiled 406 observation reports. A total of 1,500 AMTs at Paris Charles de Gaulle Airport (CDG) and Paris Orly Airport (ORY) were involved in this phase. Table 2 summarizes the distribution of the types of observations.

Each MLOSA observer took this task very seriously. The TEM conceptual framework was new to the observers and to those who were observed. The observers soon found that a significant amount of analysis and paperwork were required while they conducted and documented each observation. Once the technicians overcame this step in the learning curve, their work took off and produced highly valuable MLOSA observation reports.

Phase 2 of MLOSA focused on the Component Shops. After four months of preparation, this business unit completed its launch of Phase 2 in the second quarter of 2016. The preparation comprised getting top management and unions involved; selecting and training observers; customizing observation forms; and creating a Microsoft Excel data-entry form suitable for analysis. The resulting Component Shops form includes three new sections titled “Incoming Inspection Check,” “Disassembly” and “Assembly.” Similarly, a corresponding Engine Shops observation form includes three new sections titled “Incoming Check,” “Cleaning and Nondestructive Testing (NDT) Inspection” (Table 3).

Twenty-three observers from CDG and ORY were trained in-house in French, a decision based on prevailing proficiency in this language. The observer training was expanded to one-and-a-half days; theoretical content, classroom practice and field practice each took half a day. The AFI MLOSA project team created and integrated new examples applicable to the Component Shops environment.

The Phase 2 target population comprised 700 AMTs at CDG and ORY. For the two airports, 300 observations were scheduled on
tasks such as avionics components overhaul, mechanical/pneumatic/air conditioning/flight controls components repair/overhaul, parts machining, NDT inspections, wheel/tire repair or overhaul, escape slide overhaul, and oxygen system components overhaul.

As of this September, 301 observations had been completed in the Component Shops. AFI has received positive feedback from the AMTs involved in the program, and the data produced by LOSA observers were considered detailed and of high quality. The next step in Phase 2 will be data analysis for the Component Shops.

The MLOSA project team has scheduled Engine Shops — a business unit with 600 AMTs — to be the focus of Phase 3 during the third quarter of 2016. The schedule calls for 40 observers from CDG and ORY to be trained and then to conduct more than 300 observations of specified tasks such as CF6/CFM56/GE90/GP7200 engine overhaul, engine line replaceable units repair/overhaul, engine component NDT inspections, and engine test cell inspections.

Data Analysis So Far

AFI working groups dedicated to MLOSA have performed five major steps of safety-diagnostic analysis — combining manual calculations and Minitab statistical analysis software — for the observation data collected with the Excel data-entry forms. These steps were factors analysis to determine TEM profiles; detailed prevalence (frequency) analysis; statistical testing performed to validate correlations and calculate probability of threats and errors using multinomial logistic regressions; statistical interaction analysis and transposition to the AFI risk model (bow-tie model) to build safety key performance indicators (KPIs) and determine barriers; and setting targets for improvement (recommendations to AFI).

Deployed as subject matter experts, the AMT observers later described themselves as “empowered” by their new MLOSA duties. The observers helped the MLOSA project team come up with both accurate diagnoses of issues and successful solutions to them. They also provided recommendations to improve AFI safety management overall.

Through MLOSA, AFI identified some systemic issues across the board — independent of aircraft type or maintenance task — and corresponding precursor latent conditions. The MLOSA observations from Phases 1 and 2 revealed four predominant types of threats, categorized as individual factors, organizational factors, information/technical documentation and tools/supplies. The MLOSA project team’s diagnosis resulted in a plan of corrective actions, which was tracked by AFI safety assessment groups chaired by executive management to assess effectiveness and outcomes.

AFI specifically was able to capture best practices such as cohesive teamwork, compliance with the anti–foreign object debris/damage (FOD) plan and self-initiated promotion of safety culture by many of the observers or by the other AMTs.

Success Stories

The MLOSA program helped AFI identify several systemic issues and, consequently, systemic solutions that can be applied across the fleet. For example, based on Phase 1 findings, AFI improved its “Change of Oxygen Bottle/Cylinder” task procedures for multiple aircraft types (e.g., Airbus 320/330/340 and Boeing 777/747). This solution used an integrated approach by introducing a new communication procedure and tool (Figure 1) to facilitate coordination and reduce errors due to routine interactions between maintenance personnel and flight crews.

The revised elements of this task introduced anti-FOD toolboxes dedicated to oxygen bottle/cylinder replacement. The toolboxes have specific fitted spaces to help AMTs ensure replacement of each tool used, and they contain materials required for leak tests. Other improved elements are simplified provisioning processes for oxygen cylinders and consumables (e.g., the O-ring for the flared tube), and a working group dedicated to modernize maintenance human factors training. The new training promotes the desired safety culture and emphasizes safety strategies to prepare AMTs for challenging situations in the field. Upon completion of this new recurrent training, AMTs sign a pledge (see “Aircraft Maintenance Technician Safety Pledge,” p. 22) that complements the existing corporate-level safety pledge.

Lessons Learned

AFI attributes the MLOSA program’s positive outcomes to careful preparation through cohesive teamwork; the

![New Communication Procedure and Tool for AMTs](source: Air France Industries)
high level of commitment by executive management; the enthusiasm shown by the observers; and the training and support received from Boeing. Executive management credits program-level leadership and its self-assessment of implementation-launch readiness, especially the preparations for the marketing campaign, the customized posters and the special tool kits for recruiting the observers.

Part of this preparation for MLOSA launch was a discussion of “what if” scenarios in case the implementation did not go as planned. For example, the project team members asked themselves, “If AMTs do not accept MLOSA, what should we do?” This risk assessment in turn led to pre-planned mitigation solutions.

The MLOSA project team used AFI Flight Safety Forums as a key venue to promote LOSA and customized its communication media and messages to audiences from different business units. They also had to ensure they were ready to respond to many questions — such as, “How is MLOSA related to other safety programs?” In the communication campaign rollout, they emphasized a motivational message: “Talent wins games, but teamwork and intelligence win championships.”

Executive management showed strong commitment to the program and the required changes in several ways. One example was the co-signing of a memorandum of understanding with AMT labor groups — clearly specifying how MLOSA data and results would be used — by leaders of AFI Engineering and Maintenance Management and the AFI Quality Assurance Directorate. MLOSA also was incorporated into AFI’s SMS annual action plan. Hervé Page, senior vice president of maintenance and engineering, AFI, visited each session of MLOSA observer training to thank the AMTs for their contribution.

Anne Brachet, executive vice president, AFI, told employees at the end of Phase 1, “Involvement of aircraft maintenance technicians in maintenance safety initiatives is a key factor for removing the barriers to flight safety. Our first MLOSA campaign has been a tremendous opportunity to collect safety-minded data to appraise our performance and continue safety promotion within our organization. Commitment deployed by all AFI subject matter experts to develop this innovative initiative supports our common goal to expand our safety culture and, therefore, demonstrate AFI KLM Engineering and Maintenance involvement in industry safety standards.”

Executive management also cited frontline managers as crucial in ensuring that procedures are actually followed, and for bringing about true cultural changes in which production leaders govern and improve safety performance while managing operations. Through the MLOSA campaign, people in all relevant AFI business units came to realize, and uniformly agreed, that flight safety depends on collective safety intelligence derived from multiple sources of data, and that each professional has an important role to play in ensuring flight safety.

Currently, the MLOSA manager is supported by one project coordinator and two data analysts. The project team comprised a human resources–labor union specialist (called a social affairs manager), a human factors–regulatory compliance specialist, a worker–production specialist, a communication specialist, a LEAN transformation/efficiency expert, and a corporate change–management specialist.

Finally, AMT observers and safety coordinators from CDG and ORY asked many insightful questions during observer training. Their practice observations in the Boeing 777 hangars were productive for everyone. During actual observations, the MLOSA project team and safety coordinators kept in close contact with the observers on a weekly basis.

AMTs came to understand the underlying safety theory and processes much better over time through their personal participation directly or indirectly. As a result, their perceptions of, and attitudes toward, the MLOSA program became more positive. As trust in

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**Air France Industries**

**Aircraft Maintenance Technician Safety Pledge**

- I incorporate safety as a daily essential in each of my activities.
- I have a professional attitude for the benefit of safety and regulatory compliance.
- I ensure continued awareness and I act accordingly.
- I respect the maintenance standards in the work I carry out.
- If in doubt, I choose safety, and I alert my management.
- I am aware of my limitations and I question myself.
- I adopt a transparent attitude; I report my difficulties/malfunctions.

— MM and CZ
MLOSA grew, the AMTs became more interested in program details and in taking part.

Because its working groups included flight safety coordinators and safety experts conducting data verification and analysis, the MLOSA project team was able to summarize results quickly and to disseminate best practices and tips to the observers. For example, 80 percent of an observer’s time/description tasks, they said, should be spent on recording-describing threats, errors and consequences; 20 percent of time/description tasks should be spent on recording-describing contextual information. Moreover, their Phase 1 observations led to creating a new task-flow logic (Figure 2) taught during Phase 2 observer training, which improves how observers focus their attention and capture the most useful data.

Concluding Insights
In summary, AFI’s MLOSA program introduced a “bottom-up” process for collecting maintenance safety data — a process made possible by the frontline AMT volunteers, who were selected because of each individual’s desire to promote and constantly improve safety culture. This process carried forward from the Flight Safety business unit’s need to obtain an accurate understanding of day-to-day operations, and from their mantra: “Without data, you are just another person with an opinion.” The MLOSA program similarly transformed a basic concept into a new capability — conducting organizational self-assessment diagnoses of systemic safety issues. AFI essentially recognized through MLOSA that such field data are critical for supporting and improving the entire SMS.

On average, an MLOSA program requires an investment of 125 man-hours per AMT observer. The MLOSA project team — citing team members’ experience calculating return-on-investment in other domains — reported a quantifiably positive impact on safety culture and safety climate change. The project team’s drive to further refine the AFI program includes recommending enhancements to the FAA’s model database for M/R LOSA programs. The team believes that FAA guideline revisions should include information on how to set up reporting, and should explain how to use the FAA database in its appendix.

Independent recognition of this program’s value — especially as a case study for others — has encouraged the leaders of AFI KLM Engineering and Maintenance to pursue collaboration with other airlines and MROs, to share and compare de-identified MLOSA data, and to globally maximize the lessons learned from all MLOSA programs.

Maggie Ma, Ph.D., is a systems engineering engineer at Boeing Commercial Aviation Services. She supports Boeing customers and other maintenance organizations on a wide array of maintenance human factors safety programs. Christine Zylawski is the deputy flight safety manager who leads the MLOSA program for Air France Industries.

The authors will be presenting on MLOSA at the Foundation’s IASS 2016 in Dubai in November. For more information and to register, go to <flightsafety.org/meeting/iass-2016>.

Notes
When smoke fills your cockpit...
Will you be protected?

The only FAA tested and certified smoke displacement system that provides pilots with a clear path of vision through continuous dense smoke in the cockpit.
Although the actions of pilots historically have been responsible for the majority of aircraft accidents,\(^1\) most do not arise from any mental disorder. In fact, less than 0.3 percent of 2,758 fatal civil aircraft accidents in the United States during a recent 10-year period were caused by suicide, and all involved general aviation (GA) flights, not commercial airline operations.\(^2\) Instead, most accidents are caused by inadvertent errors made by flight crewmembers — errors that arise from normal physiological and psychological limitations inherent in the human condition. This article examines the role these limitations play in piloting performance and suggests strategies to help pilots minimize their influence on the flight deck.

Understanding human error follows from understanding human thinking, which is primarily the domain of cognitive psychology. Using the computer as a metaphor, this approach to the study of human thought and behavior postulates that inputs (stimuli, or other information) from the environment are received by the senses and are processed before a response (output) is made. The model assumes that information processing takes time as inputs travel from left to right, but also rejects the purely behaviorist notion that humans are merely passive responders to external stimuli; rather, people actively search for information, often processing from right to left.

A more elaborate model, developed by one of the world’s foremost researchers in the field of aviation human factors, Christopher Wickens, is found in Figure 1 (p. 26). Information processing begins with stimulation of sensory receptors in the eyes, ears, skin, vestibular
It is generally agreed that some sort of attentional mechanism filters these sensations (inputs), often limiting the type and amount of information that is perceived, or interpreted, by the brain. These perceptions are influenced by previous experience (long-term memory) and current inputs (short-term memory, or working memory). Higher level cognitive functioning, such as decision making and problem solving, is also memory-dependent and influenced by the accuracy of one’s perception of the situation, or “situation awareness.” Finally, the model recognizes that the human brain, like a computer, has limited processing capacity, and if overloaded with inputs (task saturation), the attentional resources allocated to the various mental operations needed to effectively perform a task will significantly diminish.

Through experiments, cognitive psychologists often study these processes in isolation but recognize that they are interdependent. For example, a distraction (e.g., a wing flap anomaly) may lead to a breakdown in voluntary attention, causing a pilot to focus too much on the flap indication, which, in turn, could lead to forgetting to accomplish a checklist item such as extending the landing gear before landing. Also, research shows that any distortions upstream in the model (e.g., sensory processing and/or perception) will adversely affect downstream cognitive functions such as decision making and response selection and execution (Table 2, p. 28).

Lessons learned from aircraft accident investigations reveal how otherwise normal everyday human cognitive limitations in perception, attention, memory and decision making play a causal role. The following examples highlight some of these limitations.

**Perceptual Errors**

In clear flying weather, flight crews have missed or misperceived visual cues necessary to avoid a midair collision (MAC) in the day and controlled flight into terrain (CFIT) at night. They also have failed to detect or correctly perceive vital auditory cues in air traffic control communications. For example, numerous incidents (and some accidents) have resulted from call sign confusion, which occurs when controllers issue, and/or pilots respond to, a clearance intended for another aircraft with a similar call sign.

**Attention Failures**

Misperceptions are often the result of breakdowns in selective attention. Pilots attend to the wrong stimulus while failing to pay attention to the correct one. CFIT, loss of control and other fatal accidents have occurred because pilots were preoccupied with nonessential tasks, or were saturated with tasks and their diminished attentional resources were unable to cope with all of them.

**Forgetting**

Successful flight performance is memory-dependent, but pilots sometimes forget past information that they have learned (retrospective memory failure) or forget to execute an important task in the future (prospective memory failure). Examples of the latter include forgetting to extend the landing gear before landing, an
event so common that a cynical adage has developed among aviators that says, “There are only two kinds of pilots — those who have landed with the gear up and those who will.” In addition, fatal commercial airline accidents have occurred because flight crews have forgotten — whether due to distraction, task overload or both — to properly configure the aircraft for takeoff.

### Decision Making

One of the most complex of mental operations is decision making. Any deficiencies in sensory processing, perception, attention or memory can lead to poor decisions, but decision making comes with its own limitations. For example, biases are often evident in the decision making of GA pilots, and some commercial pilots, who attempt visual flight rules (VFR) flight into instrument meteorological conditions (IMC). Compared with a fatal U.S. GA accident rate of less than 18 percent, some 95 percent of U.S. GA VFR-into-IMC accidents in 2012 resulted in fatalities. Empirical studies and accident investigations indicate that decision biases — such as invulnerability, optimism bias (the tendency to be overly optimistic in envisioning the likely outcome of a decision), and ability bias (a bias that favors the able-bodied and highly skilled), overconfidence and escalation bias (leading to entrapment by acceptance of increasing risks) — have had a part in pilots’ decisions to continue VFR flight into IMC.

### TABLE 1

**Major Human Senses Involved in Piloting an Aircraft**

<table>
<thead>
<tr>
<th>Human Sensation</th>
<th>Description</th>
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<tbody>
<tr>
<td>Vision</td>
<td>Sense of sight. Photoreceptors (rods and cones) in the retina of each eye are stimulated by light, causing a chemical reaction that converts light energy into neural signals that are sent to the visual cortex via the optic nerve.</td>
</tr>
<tr>
<td>Audition</td>
<td>Sense of hearing. Hair-like receptors in the organ of Corti, located in the cochlea of the inner ear, are stimulated by sound waves and create neural impulses that are sent to the auditory cortex via the auditory nerve.</td>
</tr>
<tr>
<td>Cutaneous</td>
<td>Sense of touch. Different types of receptors in the skin specifically sense pressure, temperature or pain.</td>
</tr>
<tr>
<td>Olfaction</td>
<td>Sense of smell. Olfactory receptors located in the nasal cavity chemically react to a variety of odors. Specific receptors detect specific smells.</td>
</tr>
<tr>
<td>Vestibular</td>
<td>Sense of balance. Receptors in the cupula, located in the semicircular canals in the inner ear, move in response to angular acceleration while the membrane located in the adjacent otolith bodies moves in response to linear acceleration.</td>
</tr>
<tr>
<td>Somatosensory</td>
<td>Sense of overall position and movement of body parts in relation to each other. Receptors in the body’s skin, muscles and joints respond to gravitational acceleration, providing sense of body position and movement. Sometimes called the kinesthetic or postural sensation, it is more commonly referred to as the “seat-of-the-pants” sensation because accelerations experienced in flight can be confused with gravity.</td>
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</table>

Several conclusions and recommendations can be made from an understanding of human cognitive performance and its role in aircraft accidents.

First, there are specific flight situations in which particular limitations pose a greater risk. For example, conducting a visual landing approach in dark-night conditions in clear weather increases the likelihood of a pilot experiencing a perceptual illusion (e.g., black-hole effect, a threat present on dark nights when there are no ground lights between an aircraft and the runway threshold) with its risk of a CFIT accident short of the runway. Distraction-induced attention and memory failures are also more likely, and more consequential, during certain phases of flight. Flight crews should, therefore, seek to fully understand the exact nature of these limitations and the context in which they are likely to manifest themselves on the flight deck.

In addition, there are effective strategies that pilots can use to overcome these cognitive limitations. For example, despite the inherent limitations of the “see-and-avoid” method in detecting traffic in flight, best practice strategies exist to overcome them: Pilots can utilize an effective scanning technique; increase aircraft conspicuity (e.g., turn on landing lights); ensure the transponder is correctly set; use party-line radio information to increase situational awareness; and comply with a variety of rules designed to reduce the chance of an MAC (such as maintaining a sterile flight deck). Similarly, there are practices and procedures designed to help improve attention and memory while carrying out the tasks involved in piloting an aircraft: Pilots can use effective monitoring strategies, comply
Accidents/Incidents Related to Cognitive Limitations

**Perception Errors**

**Visual Perception**

In November 2013, a Boeing 747 Dreamlifter, destined for McConnell Air Force Base in Wichita, Kansas, U.S., unintentionally landed on a 6,100-ft (1,859-m) runway at Col. James Jabara Airport about 8 nm (15 km) north of McConnell. Less than two months later, a Southwest Airlines Boeing 737, on approach to Branson Airport in Missouri, mistakenly landed on a 3,738-ft (1,139-m) runway at M. Graham Clark Downtown Airport, about 5 nm (9 km) north of Branson. The crews of both aircraft were conducting visual approaches at night in visual meteorological conditions (VMC) and thought they saw the correct airport and runway.1

**Auditory Perception**

In February 1989, a FedEx Boeing 747 crashed into a hillside short of Runway 33 at Kuala Lumpur, Malaysia, killing all four occupants. While the 747 was on a nondirectional beacon (NDB) approach, air traffic control provided the following clearance ‘descend four zero zero’ (2,400 ft), which the crew misinterpreted as ‘descend to four zero zero’ (400 ft).2

**Attention Errors**

All four occupants were killed after a Eurocopter AS350 helicopter crashed in August 2011, following an engine failure due to fuel exhaustion near the Midwest National Air Center, in Mosby, Missouri, U.S. The investigation determined that the pilot missed three opportunities to detect the low fuel status, in part because he was frequently texting on his cell phone, a “self-induced distraction,” according to the U.S. National Transportation Safety Board (NTSB) report, “that took his attention away from his primary responsibility to ensure safe flight operations.”3

A Eurocopter AS350 helicopter, operated by the Alaska Department of Public Safety under visual flight rules at night, struck terrain while maneuvering after attempting to lift off from a fishing vessel. The helicopter mechanic, who witnessed the event, saw the pilot trying to remove the tail rotor pedal lock in flight (unsuccessfully). He had forgotten to lock the lock before takeoff.4

All three passengers were killed in September 2003 when a Cessna 206 struck terrain in Greenville, Maine, U.S., and came to rest inverted after the pilot failed to select the fuel selector in the proper position, resulting in fuel starvation during the initial climb.5

**Memory Failures**

A pilot of a Hughes 369 was killed after loss of control of the helicopter, which struck the water west of the Solomon Islands in December 2008 while attempting to lift off from a fishing vessel. The helicopter mechanic, who witnessed the event, said the pilot was trying to remove the tail rotor lock in flight (unsuccessfully). He had forgotten to lock the lock before takeoff.4

A pilot of a Hughes 369 was killed after loss of control of the helicopter, which struck the water west of the Solomon Islands in December 2008 while attempting to lift off from a fishing vessel. The pilot, who was not current for instrument flying, became disoriented after flying into instrument meteorological conditions. The NTSB said the probable cause of this accident was “the pilot’s decision to continue under visual flight rules into deteriorating weather conditions.”7

**Decision Errors**

 Shortly after takeoff from Springfield, Illinois, U.S., in October 1983, Air Illinois Flight 701 lost electrical power from the left generator. The first officer erroneously shut down the right generator and was unable to get it back on line. All 10 occupants were killed after the crew lost control of the Hawker Siddley 748 while approaching their destination of Southern Illinois Airport in night instrument meteorological conditions. The probable cause of the accident was the captain’s decision to continue the flight toward the more distant destination airport after the loss of DC (direct current) electrical power from both airplane generators instead of returning to the nearby departure airport, the NTSB said.6

A Eurocopter AS350 helicopter, operated by the Alaska Department of Public Safety under visual flight rules at night, struck terrain while maneuvering during a search and rescue flight near Talkeetna, Alaska, U.S., in March 2013, killing all three occupants. The pilot, who was not current for instrument flying, became disoriented after flying into instrument meteorological conditions. The NTSB said the probable cause of this accident was “the pilot’s decision to continue under visual flight rules into deteriorating weather conditions.”7

Notes:


Source: Dale Wilson

Table 2

| Table 2 |

with standard operating procedures (SOPs) and employ strategies to effectively manage mental workload and distractions.

Also, airlines can assist pilots by providing training in formal risk- and error-management behaviors. While flight crews undergo extensive training to avoid committing errors on the flight deck, most airlines acknowledge that pilots are subject to the cognitive limitations that all
humans share, and that despite their best efforts to avoid them, errors made by pilots are inevitable. Rather than pretend these errors don’t exist, or punish pilots when the errors occur, flight departments can arm pilots with tools they need to effectively manage error on the flight deck.

**Threat and Error Management**

One such approach to reducing risk in aviation operations is threat and error management (TEM). Used primarily by trained observers as an observation tool during line operations safety audits (LOSA), flight departments can leverage this framework as a training tool to assist crews in effectively managing risks on the flight deck— including those arising from limitations in human performance. As its name implies, TEM is based on the assumption that threats to safe flight are always present and errors made by pilots are unavoidable.

TEM involves using countermeasures to anticipate, detect, avoid and/or mitigate the threats pilots may face, and to detect, capture and correct the errors they do make. An error is an improper action (or lack of action) committed by the flight crew (e.g., manual flying errors, monitoring errors and improper use of checklists), while a threat is generally a condition or event outside their influence (e.g., systems malfunction, adverse weather, distractions from others). Either can lead to an undesired aircraft state — such as an improperly configured aircraft, an unstabilized approach or an undesired trajectory toward higher terrain — which, if not properly managed, could lead to an accident.

Countermeasures are behaviors, procedures or devices designed to avoid or mitigate threats and errors. Whether formally identified as TEM countermeasures or not, airline safety systems have evolved to include best practice countermeasures designed to effectively manage risk on the flight deck. These behaviors are designed to overcome the inherent limitations, as noted, in perception, attention, memory and other cognitive processes, and include:

- Adhering to SOPs;
- Complying with sterile flight deck rules;
- Managing workload and distraction;
- Monitoring/cross-checking;
- Habitually using checklists;
- Using verbal callouts;
- Conducting stabilized approaches; and,
- Managing automation.

These are generic one-size-fits-all strategies designed to counter a variety of unforeseen threats and errors. However, flight crews must also use targeted countermeasures to guard against specific threats and/or errors. For example, domain-specific knowledge and behaviors are vital when attempting to manage the risks associated with flying near thunderstorms, at high altitudes or at night. Similarly, threat-specific countermeasures are needed to avoid an MAC, a runway incursion or encounters with airframe icing.

Ancient Roman philosopher Seneca the Younger observed that “to err is human.” But he also noted that “to persist [with the error] is of the devil.” A successful approach to managing risk on the flight deck acknowledges the former but uses effective best practice strategies to avoid the latter.

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**Notes**


3. Experts believe that humans possess more than the five basic senses. For example, within the broad category of touch, there are separate types of sensory receptors for pressure, temperature and pain.


Pilots who fly long-haul flights and those in short- and medium-haul operations face different challenges in obtaining sufficient sleep and experience different sets of sleep-related problems, according to results of a study published in Aerospace Medicine and Human Performance, the journal of the Aerospace Medical Association.

Therefore, aviation authorities should consider adopting different regulatory flight and duty time limits for the two groups, said the report on the study, published in the September issue.

The report noted that previous research has found that pilots in both groups associate their fatigue with a number of factors, including overnight flights, jet lag, early-morning wakeups, crossing multiple time zones, multiple flight sectors and “consecutive duty periods without adequate recovery breaks.”

The report said that the higher incidence of sleep disturbances in long-haul pilots may be a result of more nighttime flying across more time zones, while the increased daytime sleepiness among short- and medium-haul pilots may stem from a combination of frequent early-morning starting times and long duty periods.

The researchers based their conclusions on a review of responses by 435 Portuguese airline pilots to questionnaires that asked about their duty hours over the course of a 28-day period, along with the number of sectors and hours flown, their start times and what night hours they worked. The questionnaire also gathered sociodemographic data such as the pilot’s age, gender and professional category; and included self-rating scales of sleep complaints, daytime sleepiness and fatigue.

The mean age for study participants was 39.05 years, plus or minus 8.14 years; male pilots made up 97.2 percent of respondents; and 71.95 percent were short- and medium-haul pilots while 28.05 percent were long-haul pilots — a division that “corresponds approximately to the female/male and [small- and medium-haul/ long-haul] ratios of the Portuguese airline pilots’ population,” the report said. Fifty-three percent of short- and medium-haul respondents and 48.4 percent of long-haul respondents were captains; the others were first officers (Table 1, p. 32).

Researchers found that the subjective (self-reported) prevalence of sleep complaints was 34.2 percent among short- and medium-haul pilots and 36.9 percent among long-haul pilots. In addition, 61.66 percent of short- and medium-haul pilots and 53.3 percent of long-haul pilots self-reported daytime sleepiness, while 93.3 percent of short- and medium-haul pilots and 84.4 percent of long-haul pilots self-reported fatigue.

“The prevalence values for reported fatigue were high, especially in pilots who flew [short- and medium-haul flights],” the report said, adding that the study reinforced the findings
Researchers say long-haul pilots face a different set of sleep-related problems than their short- and medium-haul colleagues.

of previous studies, with the highest values of self-reported fatigue and daytime sleepiness reported by short- and medium-haul pilots.

These sleep problems are “commonly attributed to diminished sleep caused by the combination of frequent early starts and long duty periods,” the report said. “The prevalence of sleep complaints was higher in [long-haul] pilots, probably due to the very nature of these flights, often characterized by night flights with multiple time-zone crossings.”

The study found significant differences between the two pilot categories in a number of areas.

Short- and medium-haul pilots “were the ones with a higher mean value of duty hours, sectors, flight hours and early mornings,” the report said. “Only night flights were higher in the [long-haul] pilots’ group.”

The authors conceded that, because of the self-reporting nature of the questionnaire, some bias was likely, “since it is understandable that the individuals who answered it are the most affected, potentially resulting in some overemphasis within the results obtained.” Nevertheless, they added, “Although these values were self-reported subjective values of sleep, they are important tools to quantify and understand fatigue in airline pilots.”

The report said that the findings should be considered in discussions of regulatory limits “because flight hours and duty hours have an approximate value for [long-haul] pilots. The equivalence between flight hours and workload may be related to the closer association between flying a single sector per duty period. When looking at [short- and medium-haul] pilots, their duty hours do not reflect their effective workload, given that they require more duty time for the same amount of flight time.”

The report noted that European laws limit duty time for both groups of pilots to no more than 100 hours in 28 consecutive days. “With the mean values for duty time achieved in this study, we have already observed high levels of reported fatigue and sleep complaints, and the maximum limits established by law were not even reached,” the report said. “As such, in our opinion, these results should be taken into account if the regulatory limits will for any reason be revised.”

The report suggested that pilots on short- and medium-haul flights would benefit if they were subject to different regulatory limits than pilots on long-haul flights. “Alternatively, the European aviation authorities [the European Aviation Safety Agency] could follow the example of the American aviation authorities … who opted for establishing maximum values for duty time and … flight time,” the report said, noting that U.S. Federal Aviation Regulations limit flight time to eight or nine hours, depending on specific sets of circumstances.
The researchers said that their study could be an important tool in the implementation of fatigue risk management systems (FRMS) — data-supported systems intended to develop schedules that balance crew rest needs against a company’s operational requirements, as well as the use of various strategies to manage fatigue.

The study “enhances the importance of crew reporting and monitoring, allowing a greater control in the observed variables, especially for [short- and medium-haul] pilots,” the report said. “This study heightens the importance of defining different strategies to mitigate fatigue, taking into account all the differences between flights. Sleep hygiene techniques — such as avoiding caffeine consumption near bedtime and establishing a relaxing pre-bedtime routine — and other fatigue countermeasures are currently contemplated in FRMS. However, these are not yet mandatory policies, resulting in insufficient, or simply a lack of, implementation in many companies. The study demonstrates the importance of these educational plans in the managing of sleep and fatigue, considering the high prevalence values obtained for sleep and fatigue, for both types of flights.”

Other efforts to reduce pilot fatigue may come from improvements in the designs of the flight deck and of in-flight rest facilities, the report said. For example, the report cited modifications of flight deck seat design, efforts to allow pilots to exercise while seated and the development of “intelligent” lighting to “smooth the day/night light transition between departure and destination airports.”

Notes

1. Short- and medium-haul flights were characterized as those lasting less than six hours with multiple sectors during a single duty period; long-haul flights were described as those lasting at least six hours and typically made up of one or two sectors. Additional differences involved the size of flight crews (with two pilots in short- and medium-haul crews and additional crewmembers in long-haul crews), and the possibility of resting stations outside the flight deck for members of long-haul crews.

2. Reis, Cátia; Mestre, Catarina; Canhão, Helena; Gadwell, David; Paiva, Teresa. “Sleep and Fatigue Differences in the Two Most Common Types of Commercial Flight Operations.” *Aerospace Medicine and Human Performance* Volume 87 (September 2016): 811–815.


4. Researchers began by distributing 1,498 questionnaires, but 1,019 were not returned and 44 were considered invalid.

### Table 1: Flight Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Short/Medium Haul</th>
<th>Long Haul</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>37.63 ± 7.62</td>
<td>42.70 ± 8.31</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>305 (97.4%)</td>
<td>118 (96.7%)</td>
</tr>
<tr>
<td>Female</td>
<td>8 (2.6%)</td>
<td>4 (3.3%)</td>
</tr>
<tr>
<td>Fatigue Severity Scale (FSS)¹</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSS ≥ 4</td>
<td>291 (93%)</td>
<td>103 (84.4%)</td>
</tr>
<tr>
<td>FSS ≤ 3</td>
<td>22 (7%)</td>
<td>19 (15.6%)</td>
</tr>
<tr>
<td>Jenkins Sleep Scale (JSS)²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JSS ≥ 4</td>
<td>107 (34.2%)</td>
<td>45 (36.9%)</td>
</tr>
<tr>
<td>JSS ≤ 3</td>
<td>206 (65.8%)</td>
<td>77 (63.1%)</td>
</tr>
<tr>
<td>Epworth Sleepiness Scale (ESS)³</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESS ≥ 10</td>
<td>193 (61.7%)</td>
<td>65 (53.3%)</td>
</tr>
<tr>
<td>ESS ≤ 9</td>
<td>120 (38.3%)</td>
<td>57 (46.7%)</td>
</tr>
<tr>
<td>Professional category</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commanders</td>
<td>166 (53%)</td>
<td>59 (48.4%)</td>
</tr>
<tr>
<td>First officers</td>
<td>147 (47%)</td>
<td>63 (51.6%)</td>
</tr>
<tr>
<td>Labor variables/28 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duty hours</td>
<td>112.11 ± 25.03</td>
<td>73.38 ± 22.29</td>
</tr>
<tr>
<td>Flown hours</td>
<td>63.03 ± 14.89</td>
<td>55.67 ± 19.70</td>
</tr>
<tr>
<td>Flown sectors</td>
<td>28.89 ± 9.33</td>
<td>7.15 ± 2.70</td>
</tr>
<tr>
<td>Early starts</td>
<td>5.33 ± 3.12</td>
<td>0.72 ± 1.34</td>
</tr>
<tr>
<td>Night periods</td>
<td>0.91 ± 1.10</td>
<td>3.45 ± 1.88</td>
</tr>
</tbody>
</table>

**Notes:**

1. The Fatigue Severity Scale is designed to evaluate the effects of fatigue on a person’s life.
2. The Jenkins Sleep Scale is designed to measure a person’s difficulties in falling asleep and staying asleep.
3. The Epworth Sleepiness Scale is designed to measure a person’s level of daytime sleepiness.

*Source: Reis, Cátia; Mestre, Catarina; Canhão, Helena; Gadwell, David; Paiva, Teresa. “Sleep and Fatigue Differences in the Two Most Common Types of Commercial Flight Operations.” *Aerospace Medicine and Human Performance* Volume 87 (September 2016): 811–815.*
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Unlimited Visibility.
The crew of the Sikorsky S-76A — dispatched to pick up a seriously ill child from a remote town in Northern Ontario, Canada — was “not operationally ready” for a visual flight rules (VFR) departure from Moosonee, Ontario, Canada, into total darkness, the Transportation Safety Board of Canada (TSB) says. The emergency medical services (EMS) helicopter crashed after takeoff, killing its two pilots and two paramedics and destroying the helicopter.

Neither pilot possessed “the necessary night-and instrument-flying proficiency to safely complete this flight,” although both were qualified according to regulations, the TSB said.

Nevertheless, the causes of the May 31, 2013, accident “went well beyond the actions of this flight crew,” the TSB added, pointing to actions by the regulator, Transport Canada (TC), and the operator, Ornge Rotor-Wing (RW), which provides air medical transportation from seven rotor-wing and three fixed-wing bases throughout Ontario.

The TSB said the pilots “had not received sufficient and adequate training to prepare them for the challenges they faced that night,” and the operator’s standard operating procedures did not specifically discuss the hazards of night operations. In addition, “insufficient resources and inexperienced personnel in key positions … led to some company policies being bypassed and, ultimately, a suboptimal crew pairing that night.”

The TSB’s final report faulted TC for “inconsistent and ineffective surveillance” of the operator.

TC knew that Ornge RW “was struggling to comply with regulations and company requirements,” the TSB said. However, “despite clear indications that Ornge RW lacked the necessary resources and experience to address issues that had been identified months before the accident, TC’s approach to dealing with a willing operator allowed non-conformances and unsafe practices to persist.”
Emergency Evacuation

The departure at 0011 local time came about five hours after Ornge RW first received a request for the emergency evacuation of a young patient from Attawapiskat, Ontario; the helicopter would have been flown from Moosonee to Attawapiskat to pick up the patient, and then from Attawapiskat to Moose Factory. The first request — at 1900 local time May 30 — was turned down because of poor weather in Moosonee, as was a second request at 2009.

At 2319, however, the captain told the Ornge Operations Control Centre that weather conditions had improved, and he accepted the trip. The helicopter was fueled for the 108-minute VFR flight, and the pilots began the pre-start checklist at 0000. After takeoff, as the helicopter climbed through 300 ft above ground level (AGL), the first officer, who was the pilot flying, began a left turn, and the crew began post-takeoff checks.

The captain called “30 degrees of bank,” and the first officer’s response “indicated that it was too much bank, and [he] apologized,” the report said. “One second later, the landing-gear warning horn sounded; the captain advised that they were descending and said, ‘Let’s climb.’ The aircraft struck terrain less than one second later.”

The crash came 23 seconds after the first officer had said he was beginning the left turn.

The burned wreckage was found several hours later in a thickly wooded, swampy area about 1 mi (2 km) from the runway.

Working While Vacationing

The captain held an airline transport pilot license—helicopter, with nine type ratings, including one on the S-76; he also was a licensed maintenance engineer. He had 11,500 flight hours, including 10,800 hours in helicopters, 150 hours as pilot-in-command in the S-76A, 650 hours at night and 244 total instrument flight hours.

He was working as a part-time pilot for Ornge RW while on vacation from his full-time job as chief pilot of the Ontario Ministry of Natural Resources (MNR) Rotor-Wing division — and periodically had done similar part-time work since 2001, when he completed his S-76A initial aircraft type course.

MNR helicopter flights were conducted predominantly as day VFR flights, although night VFR flights also were offered. In 2005, the MNR began using night vision goggles (NVGs) on all planned night VFR flights and on some other night flights, provided the NVGs were available and the pilots were trained and current in NVG use. The accident captain was described as instrumental in implementing NVG use at the MNR. Ornge RW had considered introducing NVGs but, largely because of cost, had decided against such a move, the report said.

Although the captain had flown to or from Moosonee on “a few” flights while at MNR and in his previous EMS work, there was no record that he had flown out of Moosonee as pilot-in-command on a night VFR flight “since at least 2001, when he first began flying as an EMS pilot,” the report said.

In 2008, he completed a pilot proficiency check (PPC) in an S-76A and received a score of 2 on a four-point scale for pilot not flying duties, the report said; citing TC’s Pilot Proficiency Check and Aircraft Type Rating Flight Test Guide
The guide said the score signified compliance with the "basic standard" but that "major deviations from the qualification standards occur, which may include momentary excursions beyond prescribed limits but these are recognized and corrected in a timely manner."

The pilot joined Ornge RW in March 2013, briefly as a first officer because of his limited recent experience in night and instrument flight rules operations but ultimately as a captain. His training record included an entry by an S-76 line captain indicating that he had undergone "no training to date" in black hole operations. However, the chief pilot told accident investigators that he "believed that the training had been completed in the simulator," the report said.

His first shifts with Ornge RW were all-day shifts (0700 to 1900) on a rotation from April 25 to May 4, 2013. The accident flight occurred during the second rotation, which began May 23. He worked days for the first week of that rotation, and his first night shift was from 1900 May 30 to 0700 May 31, working with the first officer involved in the accident.

"This was their first night shift together, and aside from the five night takeoffs and landings completed during simulator training at the end of March 2013, it was the captain's first night flight at Ornge RW," the report said. "At the time of the occurrence, the captain had flown approximately 28 hours on the S-76A since joining Ornge RW in March 2013."

During most of his second rotation at Ornge RW, the captain had been "heavily involved with MNR business," the report said, noting, for example, that on one day, he participated by telephone in a 45-minute MNR managers' meeting and sent more than 50 emails — many of them related to MNR — between his four Ornge RW flights.

In the hours before the accident night shift began at 1900 May 30, the captain again filed a number of MNR-related emails and participated in another MNR telephone conference, from 0900 until 1215. The report noted that, although MNR had consistently approved the captain's requests to conduct EMS flights during his vacation time, MNR employees were not aware that he was at Moosonee Airport during the teleconference.

The captain typically napped before night shifts, and investigators said it was "highly likely" that he had done so during the afternoon before the accident flight. There was no indication that fatigue played a part in the accident, the report said.

The captain's logbook showed that, other than the instrument flight rules (IFR) portion of his recurrent S-76 training in March, he had conducted no IFR flights and undergone no IFR training at Ornge RW. Three flights earlier in 2013 were identified as IFR training. The logbook also showed no record of actual or simulated IFR flight between 2011 and 2013, the report said, adding, however, that "there were PPC/IFR entries in December 2012 and April 2013."

The first officer held a commercial helicopter pilot license with endorsements for the S-76 and four other helicopter types. He had 3,700 flight hours, all in helicopters, including 158 hours in S-76s, 140 hours at night and 33 hours in actual or simulated instrument meteorological conditions. He completed his training with Ornge RW in September 2012.

A post-accident review of his records showed that he had conducted two night takeoffs and landings in the 90 days before the accident, and a total of 10 night takeoffs and 11 night landings during his time at the company. Because of his limited night flying experience, he typically performed pilot monitoring duties while the captains flew the helicopter, the report said.

"Company employees considered the first officer to be highly proficient in daytime VFR operations," the report said. "However, he had previously encountered some difficulties at night."

The report cited "a night departure into a black hole in early March 2013, [during which] the first officer began turning at 300 feet AGL. The captain intervened, applied collective thrust and directed the first officer to continue climbing straight ahead up to at least 500 feet AGL. … The captain of the flight had anticipated that the first officer would have difficulties because of his inexperience in night black-hole operations, and therefore did not consider it necessary to report this."
The accident helicopter was manufactured in 1980 and registered as a commercial helicopter at Ornge RW in 2012. It had accumulated 15,600 flight hours at the time of the accident, and 48,400 landings. It was certified, equipped and maintained in accordance with regulations and there was no indication of any malfunction during the accident flight.

Limited Ambient Lighting
At the time of the accident, weather conditions at Moosonee Airport included winds from 40 degrees at 5 kt, visibility of more than 9 mi (14 km), scattered clouds at 4,600 ft above mean sea level and an overcast ceiling at 9,000 ft. About 50 percent of the moon was illuminated, but, the report noted, ambient lighting would have been reduced because of the overcast.

Few visual cues are present off the departure end of Moosonee’s Runway 6, the report said. “Exacerbating this situation on the night of the occurrence was an overcast ceiling, which would have limited the ambient lighting available to provide a visible horizon or other visual cues necessary to maintain orientation” the report said. “Hence, the crew conducted a flight under night VFR regulations without sufficient ambient or cultural lighting to maintain visual reference to the surface. As a result, the occurrence pilots would have required complete reference to flight instruments to maintain control after passing the end of the lit departure runway.”

The investigation concluded that Ornge RW lacked standard operating procedures (SOPs) that would have addressed hazards associated with night flight operations. (Other SOPs applied to designated black-hole locations, but Moosonee was not among those airports.)

The lack of appropriate SOPs contributed to the accident, the report said.

The report also cited other problems in the company’s operations, including that it:

- Was not using a currency-tracking program designed to ensure that pilots were qualified “in accordance with both company and regulatory night flight currency requirements.” As a result, company schedulers “did not identify that … the first officer was not qualified for the flight.”
- “Bypassed and eroded” its own policies and procedures that defined a pilot’s operational readiness. This “resulted in the crew not being operationally prepared for the conditions encountered on the night of the occurrence.”
• Operated “with insufficient and inexperienced personnel in key positions, which allowed unsafe conditions to persist.”

The TSB noted that Ornge RW had eliminated pilot manager positions at each base in 2012, when it began using a centralized scheduling system. The change meant that “knowledge of local operating areas and crews thus was no longer considered when scheduling crews,” the TSB said, adding that because little consideration was given to pilot experience or proficiency, “the company did not recognize the risks associated with pairing the occurrence pilots together on a mission that they were not operationally ready to conduct.”

The report also criticized TC’s handling of oversight activities, which “did not lead to the timely rectification of non-conformances that were identified, allowing unsafe practices to persist.” The report added that the training provided to TC inspectors “resulted in uncertainty, which led to inconsistent and ineffective surveillance of Ornge Rotor-Wing.”

In the year before the accident, TC had repeatedly identified non-conformances involving the company’s pilot training program and did not modify its oversight methods when the problems persisted, the report said.

In a January 2013 inspection, TC identified the heavy workload for the Ornge RW operations manager and chief pilot, noting that several key positions were vacant when the accident occurred and that other manager posts had been eliminated.

“As a result, many safety-related tasks went either incomplete or were not started, including the rectification of training-related problems; support for pilot trainees; tracking/verification of training records, pilot qualifications and pilot currencies; updating and approving company SOPs and company publications; and hiring more staff,” the report said. “As a result of these staffing challenges, unsafe conditions persisted, with the ultimate result that the company was not ensuring that its pilots were qualified and adequately prepared for operational duty.”

The report also cited TC’s delay in mandating implementation of safety management systems (SMS) by smaller aircraft operators while maintaining an oversight philosophy that presumes all operators can identify safety deficiencies and rectify them.

**Aftermath**

In the aftermath of the accident, Ornge RW implemented dozens of related safety actions, including the adoption of new restrictions for all night takeoffs and departures, and new procedures for flight in black-hole conditions; prohibitions of turns that exceed standard-rate turns in night and IFR operations; creation of a program to monitor and document “all necessary steps in a first officer’s progression; and the study and subsequent adoption of plans calling for the use of night vision goggles in night VFR operations.

The TSB issued 14 safety recommendations, including one that calls on TC to “clearly define the visual references” required to reduce the risks associated with night VFR flight and another that calls for instrument currency requirements “that ensure instrument flying proficiency is maintained by instrument-rated pilots who may operate in conditions requiring instrument proficiency.”

In addition, TC should establish PPC standards that “distinguish between, and assess the competencies required to perform, the differing operational duties and responsibilities of pilot-in-command versus second-in-command”; require all commercial operators to implement a formal SMS, assess those SMSs regularly and enhance its oversight policies to “ensure the frequency and focus of surveillance, as well as post-surveillance oversight activities, including enforcement, are commensurate with the capability of the operator to effectively manage risk,” the report said.

*This article is based on TSB Aviation Accident Investigation Report A13H0001, “Controlled Flight Into Terrain; 7506406 Canada Inc.; Sikorsky S-76A (Helicopter), C-GIMY; Moosonee, Ontario; 31 May 2013.” 2016. Available at <www.tsb.gc.ca>.*

**Note**

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All aircraft classifications have operating limitations subject to the complex effects of weather phenomena, but helicopters are particularly susceptible to certain operating risks that arise from aerodynamic characteristics, flight environments, mission profiles and other factors different from those in the fixed-wing community.

Air movement (wind and turbulence), air density and degraded visibility are of critical concern for helicopter pilots. Even the airflow generated by the helicopters themselves can be problematic. In addition, many helicopter missions require flying at low levels, which increases the risk of collision with objects or the ground.

According to the U.S. Federal Aviation Administration’s (FAA’s) Helicopter Flying Handbook,1 “Wind direction and velocity affect hovering, takeoff and climb performance.” FAA characterizes wind in this handbook as one of “the three major factors that affect performance.” The other factors are air density and weight of the aircraft.

Translational lift, for example, occurs when there is a secondary relative airflow over the rotor disk. In addition to the forward motion of a helicopter in flight, translational lift can be produced by a surface head wind, and the efficiency of a hovering rotor system increases with the speed of the incoming wind. Crosswinds and tail winds, however, can decrease lift, meaning that more power is needed for takeoff or hovering. In these situations, takeoffs involving horizontal flight occur at a shallower angle than when the wind conditions are absent, which could be dangerous if obstacles are in the flight path. This means that, in some situations, wind direction can be a critical safety factor.

Another problem — one unique to flying helicopters — is loss of tail rotor effectiveness (LTE). The purpose of a tail rotor in a helicopter with one main rotor is to neutralize the torque created by the main rotor. If the tail rotor’s performance is impeded, it can lead to an uncontrollable spin (rotation of the fuselage). The magnitude of the LTE and difficulty of landing can be significantly affected by the speed and direction of the wind.

FAA notes in the handbook, “An effective tail rotor relies on a stable and relatively undisturbed airflow.” Anything that can disrupt airflow into the tail rotor can cause problems. This would include variable, gusty winds and turbulence.

Wind direction also is important. For example, winds from approximately 60 degrees left of the nose (10 o’clock) can blow the main rotor vortex (swirling air generated by the helicopter downwash) into the tail rotor, greatly increasing the turbulence of the airflow. Any significant tail wind can decrease tail rotor effectiveness. This decrease may be due to a loss of translational lift, requiring more main rotor thrust and generating more torque than the tail rotor can counteract. The aircraft may also begin to weathervane with its nose into the relative wind. This can also cause an accelerating spin.

A typical LTE accident occurred on May 29, 2013, north of Fort McMurray, Alberta, Canada. The pilot of a Bell
206B was conducting wildlife survey work with two biologists aboard the helicopter. While slowing for an attempted landing, the helicopter began to spin to the right. The pilot lost control of the aircraft, and it crashed into the woods, killing the pilot and one passenger and seriously injuring the other passenger. The Transportation Safety Board of Canada concluded, “The helicopter was operating in a flight regime where it was exposed to the left crosswind and tail wind, which would have placed the relative wind into the critical azimuth zone. The helicopter experienced LTE, causing a loss of directional control at a height above the trees that precluded an effective recovery.”

Another high-risk, potentially weather-related situation for a helicopter in flight is mast bumping (i.e., contact between the inboard end of a main rotor blade or the rotor hub and the main rotor drive shaft), which is caused by excessive flapping of the rotor blades. Mast bumping can cause significant damage to the main rotor assembly and may cause it to detach from the aircraft. The rotor may strike the fuselage. A number of fatal accidents have been attributed to mast bumping — which some data indicate may be more likely in some two-bladed–rotor designs. This occurs under “low-g” flight conditions (relative to 1 g standard gravitational acceleration), such as in a weightless state. Besides mechanically or pilot-induced situations, low g also occurs with vertical turbulence.

For example, on March 9, 2013, a Robinson R66 crashed in the Kaweka Range on New Zealand’s North Island. The New Zealand Transport Accident Investigation Commission (TAIC) determined that the main rotor blade struck the fuselage, causing a midair breakup. The pilot was killed in the crash. According to the TAIC’s final accident report, “The mast bump very likely occurred when the helicopter encountered moderate or greater turbulence, which likely resulted in a condition of low g. The effect of any turbulence would have been exacerbated by the helicopter’s light weight and estimated airspeed of 115 kt.”

Low-level flying means that helicopters are likely to encounter what meteorologists call mechanical turbulence, which is generated when the prevailing wind encounters obstacles. An urban area with tall buildings is such a place. Turbulence also is common in mountainous regions, and helicopters being flown in firefighting, search and rescue, and sightseeing are especially at risk.

For example, the pilot of a Robinson R44 II was flying close to a ridge line near Carcross, Yukon, Canada, on July 10, 2012. A strong wind gust pushed the helicopter into a leeside mountain wave. A rapid, uncontrollable descent resulted in a crash that killed the pilot and injured the two passengers.

When a helicopter is in contact with the surface during takeoff or landing, it is susceptible to dynamic rollover, a lateral roll of the aircraft. An initial tilt angle of five to eight degrees can be enough to initiate the sequence of events that will lead to the rollover. At this range of tilt angle or greater, the main rotor thrust produces a strong moment rolling the aircraft, and the
pilot often cannot overcome that force with the flight controls. One cause of dynamic rollover is a strong crosswind, which can give the initial sideways push. Takeoffs and landings on sloping terrain are even more problematic — with upslope winds and tail winds increasing the risk of rollover.

Adequate visibility is essential to unaided visual helicopter operations. A degraded visual environment increases the risk of collisions with buildings, towers, power lines and the terrain itself, especially in mountainous regions. Instrument meteorological conditions (IMC) due to fog or clouds are a major cause of a degraded visual environment. For example, an Agusta Westland AW109 struck a construction crane in dense fog on Jan. 16, 2013, in Vauxhall, London, England. The aircraft crashed into a building below, killing the pilot and one person on the ground (ASW, 11/14, p. 32).

It is difficult sometimes to avoid, in a discussion of weather-related rotorcraft flying risks, issues that also occur in airplane flight operations. Spatial disorientation, as one case, counts as a very real possibility for helicopter pilots and is often followed by loss of control — in flight (LOC-I). The crash of a Louisiana Army National Guard Sikorsky UH-60 Black Hawk helicopter, which killed 11 people on March 10, 2015, in Santa Rosa Sound, Florida, U.S., was attributed to spatial disorientation of the pilots due to thick fog.\(^5\)

So was the crash of an Agusta Westland AW139 on March 13, 2014, in Norfolk, England, which killed four occupants.\(^6\) Five occupants were killed when a Robinson R66 crashed in Noxen, Pennsylvania, U.S., on July 27, 2013. The pilot of the visual flight rules (VFR) flight inadvertently entered IMC. Spatial disorientation was reported as the probable cause of the LOC-I accident.\(^7\)

According to a report published in June 2015 and prepared through cooperation of the Helicopter Association International, American Helicopter Society International, the General Aviation Manufacturers Association and the Aircraft Electronics Association, “Over the period of 2001 to 2013, for single-engine helicopters worldwide, there were 194 accidents related to IMC or CFIT [controlled flight into terrain] due to low-level flight to avoid weather, with 133 of these accidents involving fatalities and 326 people [who] lost their lives. None of these rotorcraft were equipped with instruments required for instrument flight rules (IFR) flight. In fact, IFR-certified single-engine rotorcraft are virtually nonexistent in the current fielded fleet. For multi-engine [rotorcraft] (over the same period), 54 accidents were related to IFR [operation], IMC or CFIT due to low-level flight to avoid weather, with 46 of these accidents involving fatalities.”\(^8\)

Besides operation in clouds and fog during landing or other maneuvers close to the ground, the helicopter accident record shows that heavy rainfall can significantly reduce visibility. Even worse is the risk during heavy snowfall, which can produce whiteout conditions with visibility near zero. In drier climates, dust or sand storms also can reduce visibility, producing so-called brownout conditions.

As noted, FAA calls air density a “major factor” in determining safety margins in helicopter performance. High density altitude (HDA) — unusually “thin” (low-density) air due to the combination of hot temperatures and/or high altitude — can affect all aircraft, but once again, helicopters are even more susceptible than airplanes to severe problems.

The lift generated by the main rotor and the torque generated by the tail rotor (in single-rotor helicopters) are decreased. Takeoffs can be difficult. Risk of LOC-I is a strong possibility. Checking the actual HDA values in advance is critical for pilots in these situations. Loads must be carefully monitored and managed.

The normal ability to autorotate and to land safely in emergency situations also is compromised. Depending on the gross weight of the aircraft, the vertical descent rate reduction of an autorotation may not be enough to safely land. Another problem with HDA can be low rotor rpm that leads to main rotor blade stall. With HDA, the power output of the engine can be significantly reduced. This can lead to low rotor rpm even with maximum throttle being applied by the pilot.

Lift generation can be greatly reduced, and the risk of rotor blade stall may increase greatly. HDA can also affect tail rotor aerodynamic performance. Thrust and efficiency are reduced by the thin air. LTE can occur especially with heavy loads. For example, a Bell 407 entered an uncontrollable spin and crashed on Feb. 15, 2012, in Moran Junction, Wyoming, U.S., while on a search and rescue mission. The crash resulted in one fatality and two serious injuries. The U.S. National Transportation Safety Board’s (NTSB’s) final accident report cited as the probable cause “the pilot’s failure to maintain yaw control while hovering at high density altitude, which resulted in a loss of tail rotor effectiveness.”\(^9\)

With the main rotor of a helicopter displacing so much air, this factor alone can produce safety problems with weather-like characteristics. Since helicopters often land vertically, they
can be exposed to risks from their own downwash. Descending to a surface area composed of fine dirt or sand can produce a cloud of dust that in seconds can reduce visibility to near zero. A similar situation can occur if the landing area has a loose snow cover.

Another problem discussed in AeroSafety World articles through the years has been helicopter self-generated airflow that can produce vortex ring state, sometimes called settling with power. When a helicopter descends into its own downwash, unusually large vortices can develop around the main rotor blades. These vortices dissipate the lifting capacity of the main rotor. The aircraft will continue to descend regardless of power applied, often to a rate that can approach 6,000 fpm/1,829 mpm. The low airspeed called translational velocity often initiates the cycle. Vortex ring state was cited as a probable cause in the crash into the North Sea of an Airbus Helicopters AS332 L2 Super Puma, which resulted in four fatalities on Aug. 23, 2013 (ASW, 7/16, p. 24).

One sector of the aviation industry that has responded to accident rates with many new risk mitigations in recent years, as reported in ASW, is helicopter emergency medical services (HEMS). In terms of weather-related HEMS accidents, the FAA and the University Corporation for Atmospheric Research (UCAR) held a weather summit in Boulder, Colorado, U.S., in March 2006. Two major results of this initiative were analysis of the related weather concerns and new mitigations specifically dealing with HEMS operations (most recently addressed in FAA Advisory Circular (AC) 135-14B, “Helicopter Air Ambulance Operations”)\(^8\) and the Helicopter Emergency Medical Services Tool (www.aviationweather.gov/hemst).

The AC highlights the threats of IMC — especially inadvertent VFR flight into IMC and other degraded-visibility issues, including whiteouts and brownouts. It also emphasizes the benefits of a preflight risk analysis, which specifically includes all relevant factors from appropriate sources of current and forecast weather.

Critical elements in the AC include awareness of “ceiling, visibility, precipitation, surface winds, winds aloft, potential for ground fog (especially for off-airport operations), and severe weather such as thunderstorms and icing. These factors should be considered for the departure point, en route, and primary destination and contingency routes/diversion landing facilities.” The HEMS Tool, as described by the U.S. National Weather Service is “a graphical flight planning tool for ceiling and visibility assessment along direct flights in areas with limited available surface observations capability. It improves the quality of go/no-go decisions for air ambulance operators.”

Edward Brotak, Ph.D., retired in May 2007 after 25 years as a professor and program director in the Department of Atmospheric Sciences at the University of North Carolina Asheville.

Notes


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On-Board Fatalities Plummet

Boeing data show 16 fatalities — all involving people on the ground — stemming from Western-built commercial jet crashes in 2015.

BY LINDA WERFELMAN

On-board fatalities in crashes involving Western-built commercial jets declined to zero in 2015, down from 278 fatalities in 2014, according to data from Boeing Commercial Airplanes. The death toll for people on the ground — killed in three separate accidents — totaled 16; the comparable 2014 figure was one.

Boeing’s annual Statistical Summary of Commercial Jet Airplane Accidents, published in July, reported 28 accidents involving Western-built commercial jets in 2015; six of the accident airplanes were destroyed. By comparison, in 2014, airplanes were destroyed in three of 29 accidents involving Western-built commercial jets.

Seven of the 28 accidents in 2015 were considered major accidents — a term defined by Boeing to describe an accident in which any of these three conditions is met: The airplane

<table>
<thead>
<tr>
<th>Type of operation</th>
<th>All Accidents</th>
<th>Fatal Accidents</th>
<th>On-board Fatalities (External Fatalities)*</th>
<th>Hull Loss Accidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger</td>
<td>1,525</td>
<td>312</td>
<td>29,165 (800)</td>
<td>717</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3,133 (82)</td>
<td>115</td>
</tr>
<tr>
<td>Scheduled</td>
<td>1,404</td>
<td>288</td>
<td>25,039</td>
<td>647</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3,117</td>
<td>118</td>
</tr>
<tr>
<td>Charter</td>
<td>121</td>
<td>24</td>
<td>4,126</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>7</td>
</tr>
<tr>
<td>Cargo</td>
<td>269</td>
<td>63</td>
<td>273 (350)</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>41 (23)</td>
<td>37</td>
</tr>
<tr>
<td>Maintenance test, ferry, positioning, training and demonstration</td>
<td>124</td>
<td>11</td>
<td>208 (66)</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>17 (0)</td>
<td>7</td>
</tr>
<tr>
<td>Totals</td>
<td>1,918</td>
<td>386</td>
<td>29,646 (1,216)</td>
<td>973</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3,191 (105)</td>
<td>159</td>
</tr>
<tr>
<td>U.S. and Canadian operators</td>
<td>571</td>
<td>69</td>
<td>6,202 (381)</td>
<td>230</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>26 (6)</td>
<td>25</td>
</tr>
<tr>
<td>Rest of the world</td>
<td>1,347</td>
<td>317</td>
<td>23,444 (835)</td>
<td>743</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3,165 (99)</td>
<td>134</td>
</tr>
<tr>
<td>Totals</td>
<td>1,918</td>
<td>386</td>
<td>29,646 (1,216)</td>
<td>973</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3,191 (105)</td>
<td>159</td>
</tr>
</tbody>
</table>

*External fatalities include ground fatalities and fatalities on other aircraft involved, such as helicopters or small general aviation airplanes, that are excluded.

Source: Boeing Commercial Airplanes

Table 1
was destroyed, the accident resulted in multiple fatalities, or the accident involved one fatality and substantial damage to the airplane.

Boeing’s data show a total of 386 crashes, including 65 fatal crashes for the 10-year period from 2006–2015, down from 404 crashes and 72 fatal crashes for the previous comparable period of 2005–2014 (Table 1, p. 45). On-board fatalities in 2006–2015 totaled 3,191, compared with 3,946 for the previous period.

From 1959, when Boeing’s record-keeping began, through 2015, data show a total of 1,918 accidents, including 619 fatal accidents with 29,646 on-board fatalities and 1,216 “external” fatalities involving people outside the airplane.

The fatal accident rate for the 2006–2015 period was 0.29 per million departures, the report said. That figure represents a decline from 0.32 per million departures for the previous 10-year period (Figure 1). The data also show a hull loss accident rate of 0.70 per million departures. Boeing uses the term hull loss to characterize an airplane that is “totally destroyed or damaged and not repaired.” The category also includes airplanes that are missing or inaccessible.

Data show a total of 159 hull loss accidents from 2006–2015, including 55 fatal accidents and 104 without fatalities (Figure 2). From 1959 through 2015, data show a total of 973 hull loss accidents, including 502 that were fatal.

More than half of all on-board fatalities recorded from 2006 through 2015 involved loss of control—in-flight accidents — 1,396 (Figure 3). The second-largest number of onboard fatalities — 658 — resulted from controlled
flight into terrain accidents, followed closely by 632 onboard fatalities in runway excursion accidents. Fatalities in these three categories far exceeded all others.

Nearly half of all fatal accidents from 2006 through 2015 occurred during final approach (26 percent of all fatal accidents and 27 percent of fatalities) and landing (23 percent of fatal accidents and 20 percent of fatalities), the report said.

An additional 12 percent of fatal accidents and 24 percent of fatalities occurred during cruise flight, the report said, adding that another 12 percent of accidents occurred during takeoff and initial climb. In addition, 11 percent of fatal accidents occurred during taxiing and other ground activities, 6 percent during climb, 2 percent during descent and 8 percent during initial approach.

Notes

1. The data include worldwide commercial jet airplanes with maximum gross weight of more than 60,000 lb (27,217 kg), with two exceptions: airplanes manufactured in the Commonwealth of Independent States or the former Soviet Union, because of insufficient operational data, and commercial airplanes operated in military service. Airplanes destroyed by sabotage or terrorism also are excluded.


3. Boeing considers an aircraft to have been destroyed if “the estimated or likely cost of repairs would have exceeded 50 percent of the new value of the airplane had it still been in production at the time of the accident.”
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false cues prompt ‘stall recoveries’

Abrupt pitch changes injured several passengers and flight attendants.

By Mark Lacagnina

The following information provides an awareness of problems that might be avoided in the future. The information is based on final reports by official investigative authorities on aircraft accidents and incidents.

JETS

Pitot Blocked by Ice


Inbound from Newark, New Jersey, U.S., with 131 passengers and eight crewmembers the morning of Oct. 20, 2013, the flight crew saw only light precipitation on their weather radar as they neared their destination in Dublin, Ireland.

Investigators later determined, however, that the on-board weather radar likely was not adjusted correctly and did not display an area of heavy precipitation that the 757 would encounter during the descent to Dublin.

The aircraft was about 80 nm (148 km) from Dublin, descending through 25,000 ft in instrument meteorological conditions, when it encountered turbulence that the copilot, the pilot flying, described as severe, said the report by the Air Accident Investigation Unit of Ireland.

The pilots also saw St. Elmo’s fire form on the aircraft. This phenomenon was described by the report as “a visible electrical discharge when an aircraft is flown through a heavily electrostatically charged atmosphere. It is often associated with nearby cumulonimbus or thunderstorm activity and/or flight through ice crystal.”

As the turbulence subsided, the copilot saw that the airspeed shown on his primary flight display (PFD) had dropped to about 90 kt. The report said that he likely was startled by this indication.

“The copilot, believing that the aircraft was about to stall, immediately pushed the control column forward and applied full power without disengaging the autopilot or autothrottle” in accordance with prescribed procedure, the report said.

“If the copilot had carried out the first actions of the aircraft manufacturer’s stall recovery checklist, which are to hold the control column firmly and disconnect the autopilot and autothrottle, it is likely he would have sensed the control loads on the control column, especially as he applied forward pressure. The control loads and pitch rate become more pronounced as the [airspeed] of the aircraft increases.”

Because he did not follow the procedure, the copilot did not sense the normal control loads. However, seeing the indicated airspeed increase in the dive, he began to raise the nose and reduce power. The indicated airspeed again began to decrease to a low value. Reacting to this indication and to the sound of the overspeed warning, which he misinterpreted as a stall warning, the copilot pushed the control column forward a second time.

The 757’s actual airspeed reached 380 kt — about 30 kt higher than the maximum operating speed. The report said that neither pilot noticed a
After a takeoff roll of 2,410 m (7,907 ft), the nose landing gear collapsed, and the aircraft came to a stop on the wet, grass runway end safety area. Neither pilot was hurt.

Investigators determined that the Citation’s parking brake had not been released before takeoff. The resulting friction slowed acceleration during the takeoff roll but was not sufficient to prevent the aircraft from reaching rotation speed.

Furthermore, the nose-down moment generated by the partial brake pressure probably prevented the aircraft [from] rotating sufficiently to become airborne, despite normal nose-up elevator deflection,” the report said. “Heat in the brakes due to partial pressure during the takeoff run may have reduced their effectiveness when the captain rejected the takeoff, contributing to the runway overrun.”

The ATSB recommended that the manufacturer take action to address the absence of an annunciator showing that the parking brake is engaged and the absence of a parking brake check on the Citation 550’s “Before Takeoff” checklist.

**Limited Runway Remaining**

Airbus A319. No damage. No injuries.

Before boarding the A319 for a flight from Lisbon, Portugal, to Basel, Switzerland, the afternoon of Oct. 16, 2015, the flight crew discussed the weather conditions, which included light and variable surface winds, and the possibility that they would depart from Runway 03.

Although the automatic terminal information service indicated that Runway 21 was in use, the crew subsequently used their electronic flight bag to derive performance data for a departure from an intersection of Runway 03, which would provide a takeoff distance of 3,530 m (11,582 ft). The data then was entered into the aircraft’s flight management guidance computer.

“During this time, the commander’s attention was distracted by people entering the cockpit,” said the report by the U.K. Air Accidents Investigation Branch.

Neither pilot later noticed the data discrepancy when they were cleared for takeoff from an intersection of Runway 21, which provided a takeoff distance of 2,410 m (7,907 ft).

“The crew considered the takeoff normal until the aircraft approached $V_1$, when they noticed there was limited runway remaining, but the remainder of the flight was uneventful,” the report said. ($V_1$ is defined as the maximum speed during takeoff at which the pilots must take the first action to stop the airplane within the accelerate-stop distance.)

The aircraft, with 147 passengers and six crewmembers aboard, had lifted off with 213 m (699 ft) of runway remaining. “The commander later commented that this occurrence was a result
of multiple distractions during pre-flight preparation and some complacency as a result of operating from his home base,” the report said.

“The commander added that in the future, if he is interrupted during a brief or crosscheck of data, he will start the process again to ensure that it is completed fully.”

**TURBOPROPS**

**Control Lost at Night**


Night visual meteorological conditions (VMC) prevailed for the cargo flight from the Dominican Republic to San Juan, Puerto Rico, on Dec. 2, 2013. Nearing the destination, the flight crew was cleared by air traffic control (ATC) to descend from 11,000 ft to 3,000 ft.

“During the descent, at about 7,300 ft and 290 kt, the airplane entered a shallow left turn, followed by a 45-degree right turn and a rapid, uncontrolled descent, during which the airplane broke up about 1,500 ft over uneven terrain,” said the report by the U.S. National Transportation Safety Board (NTSB).

Investigators concluded that the flight crew had lost control of the Metro, but they were unable to determine why. The airplane, which had no data recorders or downloadable avionics memory, had been loaded properly, and there was no sign of an initiating mechanical failure or abnormality.

“Other similarly documented accidents and incidents generally involved unequal fuel burns, which resulted in wing drops or airplane rolls,” the report said. “However, [the Metro’s] fuel crossfeed valve was found in the closed position, indicating that a fuel imbalance was likely not a concern of the flight crew.”

The report said it was likely that the breakup was precipitated by overstress during attempted recovery from the control loss.

“With darkness and the rapid descent at a relatively low altitude, one or both crewmembers likely pulled hard on the yoke to arrest the downward trajectory and, in doing so, placed the wings broadside against the force of the relative wind, which resulted in both wings failing upward,” the report said.

“As the wings failed, the propellers simultaneously chopped through the fuselage behind the cockpit. At the same time, the horizontal stabilizers were also positioned broadside against the relative wind, and they also failed upward.”

**Glass Beads Cause Engine Failure**

Cessna 208. Substantial damage. No injuries.

The Caravan was climbing through 8,000 ft after departing from Kahului, Hawaii, U.S., for a charter flight the evening of Oct. 21, 2013, when the flight crew heard a loud bang and a grinding sound, and saw sparks emerge from the engine’s right exhaust pipe.

The engine lost power, and the crew turned back toward Kahului Airport, 13 nm (24 km) north. “The crew accomplished the emergency checklists and elected to perform an emergency landing on a highway,” the NTSB report said.

“During the landing roll, the airplane struck two highway traffic signs, which resulted in substantial damage to the right wing.” The pilots and their eight passengers were not injured.

Examination of the engine revealed that all of the blades on the compressor disc had separated, and glass beads and bead fragments were found embedded in the blade “fir-tree” attachment joints.

This indicated that the compressor disc, fully assembled, had been cleaned by aggressive bead-blasting, likely when the engine was removed for repair about two months before the accident, the report said.

“The engine manufacturer specifies that all media-blast cleaning be performed with the [compressor] disc and blades disassembled,” the report said. “The glass bead contamination of the fir-tree joints caused the [compressor] blades to be unevenly restrained, and it altered the blades’ designed vibration frequency,
making them susceptible to the aerodynamic vibrations from the combustor gas flow. 

“Therefore, the fatigue fracture of the blades was most likely due to the glass bead contamination.”

**Tire Bursts on Takeoff**
Bombardier Q400. Substantial damage. Three minor injuries.

The inboard tire on the right main landing gear ruptured as the aircraft reached rotation speed on takeoff from Calgary, Alberta, Canada, the night of Nov. 6, 2014. The flight was scheduled to land at Grand Prairie, but the flight crew decided to divert to Edmonton.

During the approach to Edmonton, the pilots received indications that the landing gear was down and locked. However, the right main landing gear collapsed shortly after touchdown.

“Upon contact with the ground, all of the right-side propeller blades were sheared, and one blade penetrated the cabin wall,” said the report by the Transportation Safety Board of Canada (TSB). Three passengers were injured by debris from the propeller impact.

The Q400 came to a stop off the right edge of the runway, and the passengers and crew evacuated using all four exits. There were no injuries during the evacuation.

The TSB concluded that the tire rupture on takeoff from Calgary “most likely [was the] result of impact with a hard object.”

**PISTON AIRPLANES**

**Water in Fuel System**
Britten-Norman Islander. Destroyed. Three fatalities, one serious injury.

The airport at St. John’s, Antigua, had been closed due to thunderstorms and heavy rain, and was reopened shortly before the Islander was cleared to depart on a visual flight rules (VFR) scheduled flight to Montserrat the morning of Oct. 7, 2012.

The pilot did not drain the fuel system sumps during preflight preparations or conduct power checks before initiating a takeoff to the northeast, toward the sea, from a runway intersection, said the report by the Eastern Caribbean Civil Aviation Authority.

Witnesses saw the Islander climb about 200 to 300 ft, roll right and descend to the ground near the runway departure threshold. Two passengers and the pilot were killed, and another passenger was seriously injured.

Investigators determined that the right engine had lost power due to contamination of the fuel supply by water. The fuel filler caps on the airplane were of a type included in an equipment modification designed to prevent water from entering the fuel system. However, the adapter plates were original equipment and had not been replaced in conformance with the modification.

“Although the caps appeared to fit satisfactorily, it was found that the right tank cap did not always seal properly, with corrosion on the adapter plate possibly contributing to this condition,” the report said. “A simple experiment indicated that water could leak past the cap seal and into the tank.”

The report said that the right fuel tank contained a significant amount of water that could have been detected if the pilot had checked the sumps before takeoff.

**Spatial Disorientation**
Beech 58 Baron. Destroyed. Three fatalities.

Marginal VMC, including 6 mi (10 km) visibility, a broken ceiling at 1,000 ft and an overcast at 1,700 ft, prevailed when the Baron departed from Midway Airport in Chicago for a VFR flight to Kansas the night of Oct. 12, 2014.

Recorded ATC radar data indicated that the Baron entered the clouds shortly after takeoff. Track and altitude then varied substantially before the airplane entered a descent exceeding 5,000 fpm and struck the ground. The pilot and his two passengers were killed.

The pilot was certified for instrument flight in multiengine airplanes but had not filed a flight
plan. “The airplane’s avionics and instruments could not be functionally tested due to the extent of the impact damage,” the NTSB report said.

The NTSB concluded that the probable cause of the accident was “the pilot’s loss of airplane control due to spatial disorientation while operating in night instrument meteorological conditions.”

**Too Late to Go Around**

Piper Twin Comanche. Substantial damage. No injuries.

A 15-kt crosswind existed at the airstrip in Innamincka Township, South Australia, where a fly-in was being held on Oct. 26, 2012. “As a precaution, the pilot elected to increase the aircraft’s airspeed for the approach by about 5 kts and selected 1/2 flaps,” the ATSB report said.

The Twin Comanche was high on the approach and was flared for landing about 100 ft above the 980-m (3,215-ft) gravel runway. “The aircraft floated and touched down about a quarter [of] the way along the runway,” the report said. The pilot reduced power to idle and applied light wheel braking.

The aircraft was about halfway down the runway when the pilot realized that ground-speed was excessive. “The pilot determined that it was too late to commence a go-around” and applied full braking, the report said. “He reported that the braking appeared to be ineffective due to the surface of the runway, and the aircraft continued beyond the runway end.”

Damage was substantial, but the pilot and his passenger were not hurt.

**HELICOPTERS**

**Dynamic Rollover**


The pilot made several practice approaches and landings before beginning flights to transport passengers to a rock ledge on Mount Cook in Queensland, Australia, on the morning of Oct. 7, 2014.

During the practice landings, he decided that resting the right skid on the edge of the ledge was preferable to touching down on the uneven surface with both skids.

After transporting five passengers to the ledge, the pilot returned to pick up some of the passengers. The JetRanger was lifted by a gust of wind on touchdown, and the right skid began to scrape along the surface of the ledge. The helicopter then rolled onto its right side, slid and struck two waiting passengers.

One passenger was seriously injured; the other passenger and the pilot sustained minor injuries.

“The roll onto the right side by the helicopter is consistent with the phenomenon known as dynamic rollover,” the ATSB report said. “When a helicopter rests on one skid, the aircraft may begin rolling, and under certain circumstances it cannot be controlled.”

**’Low Risk, Go Flying’**

Airbus AS350. Substantial damage. No injuries.

Before departing to pick up four seismic workers near Deadhorse, Alaska, U.S., the afternoon of Oct. 26, 2015, the pilot conducted a risk assessment of the landing site, where visibility was between 1 and 3 mi (1,610 m and 4,831 m).

“The assessment fell within the ‘low risk, go flying’ category, and a VFR company flight plan was filed,” the NTSB report said.

The pilot, who was not certified for instrument flight, encountered deteriorating weather en route and flat-light conditions at the landing site. “While slowing down to land, blowing snow from the main rotor downwash subsequently reduced the visibility to whiteout conditions with no ground reference, which likely led the pilot to experience spatial disorientation,” the report said.

The right skid snagged the ground on touchdown, and the helicopter rolled onto its side. Damage was substantial, but the pilot was not hurt.
### Preliminary Reports, July 2016

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Aircraft Type</th>
<th>Aircraft Damage</th>
<th>Injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 1</td>
<td>Rybnyi Uyan, Russia</td>
<td>Ilyushin 76TD</td>
<td>destroyed</td>
<td>10 fatal</td>
</tr>
<tr>
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</tr>
<tr>
<td>July 6</td>
<td>Italy, Texas, U.S.</td>
<td>Bell 525</td>
<td>destroyed</td>
<td>2 fatal</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>July 11</td>
<td>Montijo Air Base, Portugal</td>
<td>Lockheed C-130H</td>
<td>destroyed</td>
<td>3 fatal, 4 serious</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>July 11</td>
<td>Georgetown, Delaware, U.S.</td>
<td>Bell 429</td>
<td>none</td>
<td>1 fatal, 3 none</td>
</tr>
<tr>
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<tr>
<td>July 11</td>
<td>Bartow, Florida, U.S.</td>
<td>Cessna 310Q</td>
<td>substantial</td>
<td>1 minor</td>
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<tr>
<td>July 11</td>
<td>Montijo Air Base, Portugal</td>
<td>Cessna 310Q</td>
<td>substantial</td>
<td>1 fatal</td>
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<tr>
<td>July 14</td>
<td>Kona, Hawaii</td>
<td>Piper Apache</td>
<td>destroyed</td>
<td>2 minor</td>
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<tr>
<td>July 15</td>
<td>Elwyn Creek, British Columbia, Canada</td>
<td>de Havilland Beaver</td>
<td>destroyed</td>
<td>1 fatal</td>
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<tr>
<td>July 20</td>
<td>Jinsan City, China</td>
<td>Cessna 208B</td>
<td>destroyed</td>
<td>5 fatal, 5 serious</td>
</tr>
<tr>
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<tr>
<td>July 21</td>
<td>Plainfield, Illinois, U.S.</td>
<td>Piper Twin Comanche</td>
<td>destroyed</td>
<td>1 fatal</td>
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<tr>
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<tr>
<td>July 21</td>
<td>Baldwin, Wisconsin, U.S.</td>
<td>Cessna 208B</td>
<td>substantial</td>
<td>15 none</td>
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<tr>
<td>July 22</td>
<td>Bay of Bengal</td>
<td>Antonov 32</td>
<td>NA</td>
<td>29 NA</td>
</tr>
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<tr>
<td>July 23</td>
<td>Byron, California, U.S.</td>
<td>Beech King Air A90</td>
<td>substantial</td>
<td>15 none</td>
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<tr>
<td>July 24</td>
<td>Leshara, Nebraska, U.S.</td>
<td>Beech BSS Baron</td>
<td>destroyed</td>
<td>2 fatal</td>
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<tr>
<td>July 26</td>
<td>Houston, Texas, U.S.</td>
<td>Embraer Phenom 300</td>
<td>substantial</td>
<td>2 minor, 1 none</td>
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<tr>
<td>July 27</td>
<td>Columbia, California, U.S.</td>
<td>Cessna 310B</td>
<td>substantial</td>
<td>4 fatal</td>
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<tr>
<td>July 29</td>
<td>McKinleyville, California, U.S.</td>
<td>Piper Cheyenne</td>
<td>destroyed</td>
<td>4 fatal</td>
</tr>
<tr>
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<tr>
<td>July 31</td>
<td>Kemerovo, Russia</td>
<td>Antonov 2R</td>
<td>destroyed</td>
<td>3 fatal</td>
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<tr>
<td>July 31</td>
<td>Londrina, Brazil</td>
<td>Embraer EMB-820</td>
<td>destroyed</td>
<td>8 fatal</td>
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</tbody>
</table>
| NA = not available
|            |                     |                |                 |                     |

This information, gathered from various government and media sources, is subject to change as the investigations of the accidents and incidents are completed.
## Selected Smoke, Fire and Fumes Events, May–August 2015

<table>
<thead>
<tr>
<th>Event Date</th>
<th>Flight Phase</th>
<th>Classification</th>
<th>Subclassification</th>
<th>Aircraft</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 1</td>
<td>Cruise</td>
<td>Air distribution system</td>
<td>Smoke</td>
<td>767</td>
<td>Hawaiian Airlines</td>
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<tr>
<td>May 5</td>
<td>Descent</td>
<td>Air distribution system</td>
<td>Smoke</td>
<td>DHC8</td>
<td>Horizon Air</td>
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<tr>
<td>May 6</td>
<td>Cruise</td>
<td>Air distribution system</td>
<td>Smoke</td>
<td>737</td>
<td>United Airlines</td>
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<tr>
<td>May 7</td>
<td>Climb</td>
<td>Cabin cooling system</td>
<td>Smoke</td>
<td>EMB-145LR</td>
<td>Atlantic Southeast Airlines</td>
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<tr>
<td>May 14</td>
<td>Climb</td>
<td>Air distribution system</td>
<td>Smoke</td>
<td>EMB-145XR</td>
<td>Atlantic Southeast Airlines</td>
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<tr>
<td>May 15</td>
<td>Climb</td>
<td>Air distribution system</td>
<td>Smoke</td>
<td>MD-88</td>
<td>Delta Air Lines</td>
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<tr>
<td>June 5</td>
<td>Descent</td>
<td>Autopilot computer</td>
<td>Smoke</td>
<td>767</td>
<td>ABX Air Inc</td>
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<tr>
<td>June 6</td>
<td>Cruise</td>
<td>Air distribution system</td>
<td>Smoke</td>
<td>EMB-145LR</td>
<td>Atlantic Southeast Airlines</td>
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<tr>
<td>June 7</td>
<td>Cruise</td>
<td>Air distribution system</td>
<td>Smoke</td>
<td>CL600</td>
<td>Express Airlines</td>
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<tr>
<td>June 7</td>
<td>Cruise</td>
<td>Air distribution system</td>
<td>Smoke</td>
<td>EMB-145LR</td>
<td>American Eagle Airlines</td>
</tr>
</tbody>
</table>

**May 1**: A 767 aircraft experienced smoke in the cabin while cruising. The flight crew initiated an air turn back and performed a visual inspection of the cockpit, cabin, and electronic equipment compartments, finding no defects. The aircraft was approved for return to service.

**May 5**: A DHC8 aircraft experienced smoke during descent. The crew declared an emergency, and the aircraft landed without incident. Maintenance found no defects and the aircraft was approved for continued service.

**May 6**: A United Airlines aircraft experienced smoke during cruise. Maintenance replaced both air cycle machines and found no defects.

**May 7**: An Atlantic Southeast Airlines aircraft experienced smoke on a climb. Maintenance found no defects and the aircraft was approved for continued service.

**May 14**: A Delta Air Lines aircraft experienced smoke during a climb. Maintenance found no defects and the aircraft was approved for continued service.

**June 5**: An ABX Air Inc aircraft experienced smoke in the descent phase. Maintenance found no defects and the aircraft was approved for return to service.

**June 6**: An American Eagle Airlines aircraft experienced smoke in cruise. Maintenance found no defects and the aircraft was approved for return to service.

**June 7**: An American Eagle Airlines aircraft experienced smoke during cruise. Maintenance found no defects and the aircraft was approved for return to service.
### Selected Smoke, Fire and Fumes Events, May–August 2015

<table>
<thead>
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<th>Event Date</th>
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<th>Aircraft</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 8</td>
<td>Descent</td>
<td>Air distribution system</td>
<td>Smoke</td>
<td>MD-88</td>
<td>Delta Air Lines</td>
</tr>
<tr>
<td>June 12</td>
<td>Cruise</td>
<td>Cabin cooling system</td>
<td>Smoke</td>
<td>EMB-145LR</td>
<td>American Eagle Airlines</td>
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<td>June 17</td>
<td>Cruise</td>
<td>Cabin cooling system</td>
<td>Smoke</td>
<td>EMB-145XR</td>
<td>Atlantic Southeast Airlines</td>
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<tr>
<td>June 29</td>
<td>Unknown</td>
<td>Cabin cooling system</td>
<td>Smoke</td>
<td>EMB-145LR</td>
<td>American Eagle Airlines</td>
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<td>July 10</td>
<td>Cruise</td>
<td>Cabin cooling system</td>
<td>Smoke</td>
<td>EMB-145LR</td>
<td>American Eagle Airlines</td>
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<td>July 18</td>
<td>Cruise</td>
<td>Air distribution system</td>
<td>Smoke</td>
<td>MD-10</td>
<td>Federal Express</td>
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<tr>
<td>August 2</td>
<td>Climb</td>
<td>Cabin cooling system</td>
<td>Smoke</td>
<td>EMB-145LR</td>
<td>Atlantic Southeast Airlines</td>
</tr>
<tr>
<td>August 2</td>
<td>Climb</td>
<td>Engine reverse thruster</td>
<td>Smoke</td>
<td>757</td>
<td>Delta Air Lines</td>
</tr>
<tr>
<td>August 13</td>
<td>Climb</td>
<td>Engine (turbine/turboprop)</td>
<td>Smoke</td>
<td>777</td>
<td>Omni Air Express</td>
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<tr>
<td>August 14</td>
<td>Climb</td>
<td>Emergency equipment</td>
<td>Smoke</td>
<td>Falcon 50</td>
<td>Executive Jet Aviation</td>
</tr>
<tr>
<td>August 16</td>
<td>Cruise</td>
<td>Air distribution system</td>
<td>Smoke</td>
<td>757</td>
<td>American Airlines</td>
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<tr>
<td>August 30</td>
<td>Descent</td>
<td>Electrical power system</td>
<td>Smoke</td>
<td>A320</td>
<td>JetBlue Airways</td>
</tr>
</tbody>
</table>

Flight attendant reported smoke building in the aft cabin on final approach, accompanied by the aft right lavatory smoke detector in alarm. Visible smoke was observed inside lavatory, so the flight attendant discharged the portable fire extinguisher into the aft lavatory and secured the door. Maintenance found a gasper duct behind the aft lavatory mirror disconnected and emitting mist. The duct was secured and a pneumatic system burn-out was performed. No further visible smoke and no odors noted, so the aircraft was returned to service.

At cruise at Flight Level 250, with power in climb thrust, smoke detected in cockpit and cabin. Smoke dissipated after two minutes. After landing, maintenance removed and replaced the number 2 air cycle machine in accordance with the aircraft maintenance manual. Operations checked good.

At cruise, crew noticed smoke in cockpit and cabin. Aircraft diverted and an emergency was declared. Maintenance found right air cycle machine (ACM) making loud squealing noise and smoking. Maintenance removed and replaced the ACM in accordance with the maintenance manual. The unit ops checked good. The aircraft was approved for return to service.

The crew reported vapor/smoke in the cabin and cockpit when switched to engine bleeds after takeoff. The aircraft returned to departure airport, where it landed without incident. Maintenance removed and replaced the number 1 engine, operationally tested with no defects noted, and the aircraft was approved for return to service.


At cruise, excessive smoke filled the cockpit. Appeared to come through the ventilation system. Cockpit temperature setting had recently been adjusted to a warmer setting. Temperature control returned to coldest setting. Smoke dissipated during emergency descent. Ran engines individually while operating packs individually and together. Ran engines together with packs operating. All packs operated with no evidence of smoke or odor. Inspected all three packs and pack bays. No defects noted. Replaced both avionics fan filters and accessory bay fan filters. All packs operated with no evidence of smoke or odor. Replacement avionics fan filters and accessory bay fan filters. All packs operated with no evidence of smoke or odor.

After takeoff, at 4,000 ft, flight attendant called and said there was smoke in the cabin. Pilot and first officer could see smoke, declared an emergency, and returned to the airport. Maintenance inspection found number 2 ACM seized. Determined odor to be from number 1 engine. Found left ACM nearly seized, causing smoke in cockpit. Deferred left pack inoperative. Operations checked good. Minimum equipment list restored.

After takeoff, at 4,000 ft, flight attendant called and said there was smoke in the cabin. Pilot and first officer could see smoke, declared an emergency, and returned to the airport. Maintenance inspection found number 2 ACM seized. Determined odor to be from number 1 engine. Found left ACM nearly seized, causing smoke in cockpit. Deferred left pack inoperative. Operations checked good. Minimum equipment list restored.

At cruise through 22,000 ft, first officer smelled something burning. Donned the oxygen masks, declared an emergency and landed immediately, performing as much of the appropriate emergency checklist as possible. Checked copilot's rechargeable flashlight and found it was hot and had an electrical odor. Verified odor with line personnel. Removed and replaced pilot and copilot flashlight assemblies. Operations check normal. Number 1 engine change accomplished.

Climbing through Flight Level 230, left engine compressor stalled twice, then exhaust gas temperature (EGT) gauge turned yellow, cockpit filled with smoke. Oxygen masks donned. Oil quantity showed zero. Engine was shut down in accordance with severe damage checklist due to accompanying vibration.

Climbing through 22,000 ft, first officer smelled something burning. Donned the oxygen masks, declared an emergency and landed immediately, performing as much of the appropriate emergency checklist as possible. Checked copilot's rechargeable flashlight and found it was hot and had an electrical odor. Verified odor with line personnel. Removed and replaced pilot and copilot flashlight assemblies. Operational check good.

Just after level off, fumes reported in cockpit and cabin suggestive of an electrical fire. Emergency declared, landing uneventful and aircraft not overweight. Found displaced insulation contacted hot duct, secured insulation, Event repeated on next flight with an air interrupt return. Removed and replaced left and right high-efficiency particulate air (HEPA) filters in accordance with aircraft maintenance manual. No findings noted on engine run-up. System checked normal.

Smoke detected on the flight deck during descent through 11,000 ft. Odor of hot plastic, and smoke dissipated briefly and returned at approximately 6,000 ft. Visible light smoke seen beneath captain's map light. Odor dissipated by landing. Inspected all avionics bay for evidence or wiring damage or defective equipment. No defects noted. Found captain’s electrical outlet in cockpit damaged. Removed and replaced electrical outlet in accordance with aircraft maintenance manual. Operational check OK.
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