AviationSafety WORLD

PRESSING THE APPROACH
A new perspective on pilot error

BREAK, DISTORT OR YIELD
Frangible airport lighting

BLAST-FREE FUEL TANKS
Tank inerting
a decade after TWA 800

LEADERS LOG
Rosenker, Coyne

ANTONOV BLACKLIST
A QUESTION OF CONTINUED AIRWORTHINESS

FSF
THE JOURNAL OF FLIGHT SAFETY FOUNDATION
DECEMBER 2006

ADVERTISEMENT

Cockpit Smoke Solution

According to Air Safety Week, at least once a day somewhere in North America a plane has to make an unscheduled or emergency landing because of a smoke and in-flight fire event.

Statistics from FAA Service Difficulty Reports clearly show that in-flight fires, smoke or fumes are one of the most significant causes of unscheduled or emergency landings and account for 3 precautionary landings per day based on 1,089 events during a 10 month period in 1999.

A pilot encountering smoke in the cockpit so thick that the instruments cannot be seen can utilize a relatively simple device, which provides a clear view.

The Emergency Vision Assurance System (EVAS) provides a clear space of air through which a pilot can see flight instruments and out the front windshield for landing. The pilot still relies on the oxygen mask for breathing, smoke goggles for eye protection and employs approved procedures for clearing smoke from the aircraft. When smoke evacuation procedures are not sufficient, EVAS provides emergency backup allowing the pilot to see and fly the aircraft to a safe landing.

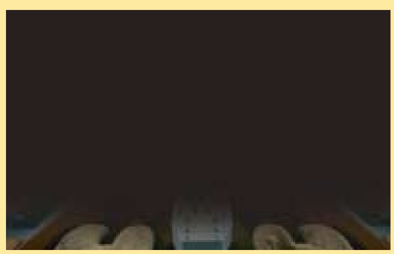
EVAS measures 3 x 8.5 x 10 inches when stowed, the approximate space of a Jeppessen navigation manual. When needed, the pilot removes the IVU (Inflatable Vision Unit) from the EVAS case and pulls a tab to activate the system. The IVU inflates with one lobe above and one below the glareshield. According to EVASWorldwide, the manufacturer, the whole process takes 15-20 seconds. The pilot leans forward, placing his smoke goggles in contact with the EVAS clear window, giving him an unimpaired view of both vital instruments and the outside world.

After it is activated, EVAS is continually pressurized with filtered cockpit air to maintain volume, and preserve a clear view. The device is independent of aircraft power, relying on a self-contained battery-power supply, pump and filters in each storage case. EVAS systems are designed to run for at least two hours, and filter down to .01 microns. The system requires virtually no installation.

While FAA regulations require smoke detectors, fire extinguishers, smoke goggles and oxygen masks, pilots point out that these safeguards and all other systems and equipment for flight safety are useless if the pilots cannot see to control and land the aircraft.

EVASWorldwide uses a fleet of mobile cockpit demonstration units to show potential customers the benefits of the system. EVAS demonstrations use a fog generator to reduce cockpit vision so the pilot cannot see his hand in front of his face. Smoke goggles offer no vision improvement, though they do protect the eyes. After EVAS is deployed, the pilot can clearly see both the vital instruments and out through the windshield. It is truly an amazing experience. Most pilots are sold on the benefits of EVAS on the spot.

Normal cockpit visibility



Uncontrolled smoke in the cockpit –No visibility

Uncontrolled smoke in the cockpit –Visibility with EVAS

EVAS™ Worldwide
Suite 2B
545 Island Road
Ramsey, NJ USA 07446
201.995.9571
Fax: 201.995.9504
E-Mail: Info@EVASWorldwide.com
www.EVASWorldwide.com

CURRENTLY SEEKING LAUNCH AIRLINE CUSTOMER

YOUR Voice

Flight Safety Foundation has a proud history of publicly speaking out to advance aviation safety. The voice of the Foundation ultimately is the voice of its members, and it can be a powerful tool. As president, it falls to me to decide when and how to put that tool to use. In my first few weeks in office I have made that decision several times, so I thought I'd share with you what we have said on your behalf and why.

The first example could be easily overlooked. At the International Air Safety Seminar in Paris, I had a chance to publicly recognize Anatoly Kolisnyk, chairman of the Ukrainian State Aviation Administration, and Dmitry Kiva, general designer of the Antonov Design Bureau. They made public a list of operators who are using Antonov airplanes without approved maintenance or flying them beyond their service life (see story, page 18). Some of these operators are tough characters. Regulators out in the real world who take heroic stands against them often end up in prison, or worse. By making this proprietary Antonov information public, these two gentlemen are standing behind those heroes. So I thanked them, for you, and for those heroic regulators who no longer have to stand alone.

The second example is a big effort that should be hard to miss. The Foundation has joined with the Royal Aeronautical Society, Académie Nationale de l'Air et de l'Espace, and the Civil Air Navigation Services Organisation to make a broad declaration condemning the growing trend to criminalize aircraft accident investigations. If you take a look at this resolution on our Web site, you'll see the trend is pretty frightening. Left unchecked, it could threaten the openness and innovation upon which our industry's safety record is built.

Imagine what our safety culture would look like if everyone knew that if they were involved in an accident they would face charges, and anything they said would be used against them. Imagine how much innovation would exist in our industry if the people who invented technologies capable of saving thousands of lives knew they would go to prison if these technologies didn't save *every* life.

We are all familiar with the graphs that show aviation's declining accident rate with a line slowly descending towards the goal, zero. When we, the safety professionals, look at those charts we tend to focus below the line on those accidents that still occur. Step back for a moment to consider the white space above the line. That space represents the accidents that *did not* occur. That space represents the thousands of lives that have been *saved*. That is what is at risk here.

Prosecutors around the world are pressing criminal charges to obtain justice for those who have been injured or lost their lives. However, justice is a balance. Just as someone has to speak for those who have died, someone also must speak for the thousands of people *who have yet to be saved*. It is up to us and our partners in this effort to make that case now, not to avoid justice, but to restore the balance that lets us do our job and save those lives.

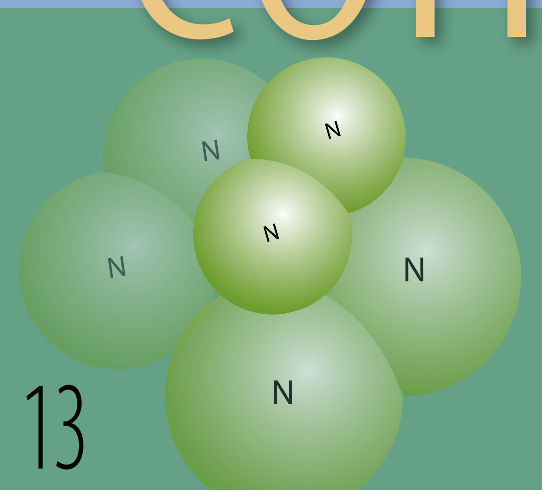
That is how the Foundation has been using your voice lately, and with your support we will continue.

William R. Voss
President and CEO
Flight Safety Foundation

AviationSafetyWORLD

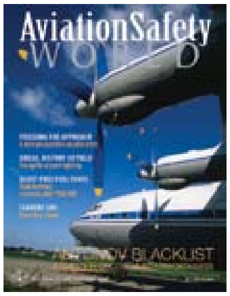
contents

December2006 Vol 1 Issue 6



features

departments



About the Cover
The Antonov list of questionable aircraft includes a number of An-12s.
© Steve Lake

We Encourage Reprints (For permissions, go to <www.flightsafety.org/asw_home.html>)

Share Your Knowledge

If you have an article proposal, manuscript or technical paper that you believe would make a useful contribution to the ongoing dialogue about aviation safety, we will be glad to consider it. Send it to Director of Publications J.A. Donoghue, 601 Madison St., Suite 300, Alexandria, VA 22314-1756 USA or <donoghue@flightsafety.org>.

The publications staff reserves the right to edit all submissions for publication. Copyright must be transferred to the Foundation for a contribution to be published, and payment is made to the author upon publication.

Subscriptions: Subscribe to *Aviation Safety World* and become an individual member of Flight Safety Foundation. One year subscription for 12 issues includes postage and handling — US$350. Special Introductory Rate — $280. Single issues are available for $30 for members, $45 for nonmembers. For more information, please contact the membership department, Flight Safety Foundation, 601 Madison Street, Suite 300, Alexandria, VA 22314-1756 USA, +1 703.739.6700 or <membership@flightsafety.org>.

Aviation Safety World © Copyright 2006 by Flight Safety Foundation Inc. All rights reserved. ISSN 1931-6135
Suggestions and opinions expressed in *Aviation Safety World* are not necessarily endorsed by Flight Safety Foundation.
Nothing in these pages is intended to supersede operators' or manufacturers' policies, practices or requirements, or to supersede government regulations.

AviationSafetyWORLD

William R. Voss, publisher,
FSF president and CEO
voss@flightsafety.org, ext. 108

J.A. Donoghue, editor-in-chief,
FSF director of publications
donoghue@flightsafety.org, ext. 116

Mark Lacagnina, senior editor
lacagnina@flightsafety.org, ext. 114

Wayne Rosenkrans, senior editor
rosenkrans@flightsafety.org, ext. 115

Linda Werfelman, senior editor
werfelman@flightsafety.org, ext. 122

Rick Darby, associate editor
darby@flightsafety.org, ext. 113

Karen K. Ehrlich, web and print production coordinator
ehrlich@flightsafety.org, ext. 117

Ann L. Mullikin, production designer
mullikin@flightsafety.org, ext. 120

Susan D. Reed, production specialist
reed@flightsafety.org, ext. 123

Patricia Setze, librarian
setze@flightsafety.org, ext. 103

Editorial Advisory Board

David North, EAB chairman, consultant

William R. Voss, president and CEO
Flight Safety Foundation

J.A. Donoghue, EAB executive secretary
Flight Safety Foundation

Mike Ambrose, director general
European Regions Airline Association

Steven J. Brown, senior vice president–operations
National Business Aviation Association

Barry Eccleston, president and CEO
Airbus North America

Don Phillips, transportation reporter
International Herald Tribune

Russell B. Rayman, M.D., executive director
Aerospace Medical Association

Serving Aviation Safety Interests for More Than 50 Years

Flight Safety Foundation is an international membership organization dedicated to the continuous improvement of aviation safety. Nonprofit and independent, the Foundation was launched officially in 1947 in response to the aviation industry's need for a neutral clearinghouse to disseminate objective safety information, and for a credible and knowledgeable body that would identify threats to safety, analyze the problems and recommend practical solutions to them. Since its beginning, the Foundation has acted in the public interest to produce positive influence on aviation safety. Today, the Foundation provides leadership to more than 1,000 member organizations in 143 countries.

Member**Guide**

Flight Safety Foundation
601 Madison Street, Suite 300, Alexandria, VA, 22314-1756 USA
tel: +1 703.739.6700   fax: +1 703.739.6708
www.flightsafety.org

Member enrollment — ext. 105
Ann Hill, director, membership and development — hill@flightsafety.org

Seminar registration — ext. 101
Namratha Apparao, membership services coordinator — apparao@flightsafety.org

Seminar/*Aviation Safety World* sponsorships — ext. 105
Ann Hill, director, membership and development — hill@flightsafety.org

Exhibitor opportunities — ext. 105
Ann Hill, director, membership and development — hill@flightsafety.org

***Aviation Safety World* orders** — ext. 102
David Chu, membership manager — chu@flightsafety.org

Technical product orders — ext. 101
Namratha Apparao, membership services coordinator — apparao@flightsafety.org

Library services/seminar proceedings — ext. 103
Patricia Setze, librarian — setze@flightsafety.org

Web Site — ext. 117
Karen Ehrlich, web and print production coordinator — ehrlich@flightsafety.org

Flight Safety Foundation

OFFICERS AND STAFF

Chairman, Board of Governors	Amb. Edward W. Stimpson
President and CEO	William R. Voss
Executive Vice President	Robert H. Vandel
General Counsel and Secretary	Kenneth P. Quinn, Esq.
Treasurer	David J. Barger

ADMINISTRATIVE

Manager, Support Services	Linda Crowley Horger

FINANCIAL

Chief Financial Officer	Penny Young
Staff Accountant	Maya Barbee

MEMBERSHIP

Director, Membership and Development	Ann Hill
Membership Manager	David Chu
Membership Services Coordinator	Namratha Apparao

COMMUNICATIONS

Director of Communications	Emily McGee

TECHNICAL

Director of Technical Programs	James M. Burin
Technical Programs Specialist	Millicent Wheeler
Managing Director of Air Transport Safety Services	Louis A. Sorrentino III
Technical Specialist/ Safety Auditor	Robert Feeler
Manager, Data Systems and Analysis	Robert Dodd, Ph.D.
Manager of Aviation Safety Audits	Darol V. Holsman
Past President	Stuart Matthews
Founder	Jerome Lederer 1902–2004

FLIGHT SAFETY FOUNDATION SINCE 1947

INSTILLING Culture

Care must be taken in viewing safety in the developing world not to assign blame too quickly, nor to assume that the lapses in adherence to proven safety procedures are the result of a pervasive disregard. This is the judgment of Paul-Louis Arslanian, director of France's Bureau d'Enquêtes et d'Analyses (BEA), the nation's accident investigation agency.

"There are two worlds of safety," he says. One world is "the classic Western world, pushing safety toward its present achievement, developing a culture of safety." The other is developing nations, where problems arise mostly when people from outside aviation come into the industry believing it to be just another business.

"In the developing world, you find excellent people with the proper culture, highly competent, some more competent than we have in [developed] countries because they have so many challenges to overcome," Arslanian says. "But these people usually are at the level of action, not at the level of decision."

Those people coming from outside aviation "are mercenaries, coming with just one logic — to make money. This logic is colliding with our safety logic."

Arslanian relates his experience investigating the Dec. 25, 2003, crash of a Boeing 727 attempting to take off from Cotonou, Benin, that killed 141 people. A group based in the United Arab Emirates bought the aircraft out of the U.S. desert that January. It was used by the owner under the guise of three different operators that year, registered successively in Afghanistan, Swaziland and Guinea. The operations manual, approved by Guinean aviation authorities months after operations began, lacked, the BEA accident report says, "a chapter on loading and balancing the aircraft."

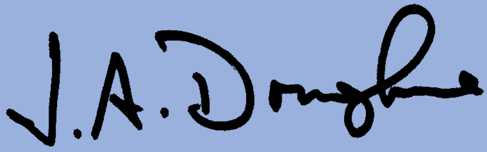
The 727 was heavily loaded with a center of gravity far forward of limits when a takeoff was attempted on a hot day. The airplane had just left the ground at the end of the runway when its landing gear hit a small concrete building that housed navigation aids. The airplane veered left, crashed on a beach and slid into the ocean.

"The whole [Benin] government was totally concerned; none were saying, 'Well, this is just another accident.' They were aware that aviation is a must for their country, not only for the economic stimulation it brings, but also for opening their door to the world," Arslanian says.

When "mercenaries" cut corners, "the cheaters can take business away from others. If we don't protect them from this sort of competition, [cheating] may become contagious, imitated just to gain the same efficiency.

"We must develop the [safety] culture. They have the training, they have money, what they need is culture, developing the team concept at the level of the workers and the level of the rulers. In Benin, we did not meet bandits in positions of authority. They just are isolated from normal world activities and it is not their fault, it is our fault."

There remains, Arslanian says, a need to punish the "bandits, but when we identify a failure we should do it the same way as in our safety culture — no blame, just correct the problem."



The Laura Taber Barbour Award

1956-2006

Sixty-one years ago — April 14, 1945 — a Douglas DC-3 with 17 passengers and three crewmembers was en route from Pittsburgh to Birmingham, Alabama, U.S. The captain of Pennsylvania-Central Airlines Flight 142 had checked several sources to learn the weather at Morgantown, West Virginia, a scheduled stop where minimums were a 1,000-ft ceiling and 1 mi visibility and instrument approaches were not authorized. The captain and first officer discussed the weather. The captain reported that he would "take a look" in the Morgantown vicinity and decide whether to land or proceed to the next scheduled destination.

The pilots encountered a continually lowering ceiling and flew the airplane through the irregular cloud base. At 1658 local time, the airplane crashed near the top of a ridge at about 2,100 ft. It was 7 mi off course. The airplane was destroyed by the impact and a subsequent fire, and all its occupants were killed.

The terrible event probably didn't attract much attention, except among grieving relatives, in a nation that had been fighting a world war for more than three years. But it resulted in the creation of an award, presented by Flight Safety Foundation at its annual International Air Safety Seminar, recognizing individual or group effort that helps avoid aviation tragedies.

The Laura Taber Barbour Award was established in 1956 by Clifford E. Barbour and his son in memory of Laura Taber Barbour, killed in the controlled-flight-into-terrain accident at Morgantown. The recipient is selected by independent aviation professionals on the basis of these criteria:

- A significant individual or group effort contributing to improving aviation safety, with emphasis on original contributions.
- A significant individual or group effort performed above and beyond normal responsibilities.

The award has been presented every year since 1956. The recipients in recent years are Capt. Robert L. Sumwalt (2003), Kay Yong, Ph.D. (2004) and Capt. Ralph S. Johnson (2005). The award for 2006 went to Don Bateman for his many outstanding contributions to aviation safety, particularly his leadership in developing the ground-proximity warning system, which has been instrumental in reducing CFIT accidents such as that which took the life of Mrs. Barbour.

— Rick Darby

FSFSeminars

Exhibit and Sponsorship Opportunities Available

Staying Safe in Times of Change

March 12–14, 2007

Flight Safety Foundation and European Regions Airline Association
19th annual European Aviation Safety Seminar **EASS**

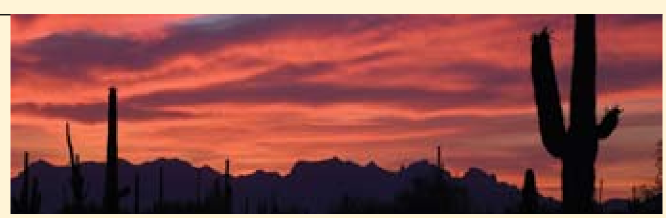
Grand Hotel Krasnapolsky, Amsterdam, Netherlands

Safety — The Foundation for Excellence

May 8–10, 2007

Flight Safety Foundation and National Business Aviation Association
52nd annual Corporate Aviation Safety Seminar **CASS**

Hilton Tucson El Conquistador Golf & Tennis Resort, Tucson, Arizona, USA



© 2006 Getty Images Inc., Dreamstime Inc.

JAN. 21–25 ➤ Transportation Research Board 86th Annual Meeting. Washington. <TRBMeetings@NAS.edu>, <www.trb.org/meeting>, +1 202.334.2934.

FEB. 6–7 (Hong Kong), **FEB. 9** (Nagoya, Japan) **➤ Asian Business Aviation Conference & Exhibition (ABACE)**. National Business Aviation Association. <convention@nbaa.org>, <www.abace.aero>, +1 202.783.9000.

FEB. 6–7 ➤ 2nd Annual Airline Engineering & Maintenance Conference for the Indian Sub-Continent. Aviation Industry Group. Mumbai, India. Daisy Munro, <daisym@aviation-industry.com>, <www.aviationindustrygroup.com>, +44 (0)20 7931 7072.

FEB. 7–11 ➤ Aero India 2007. Ministry of Defence, Government of India; Federation of Indian Chambers of Commerce and Industry; Farnborough International. Bangalore, India. <aeroindia@ficci.com>, <www.aeroindia.in>, +91 11 23357082.

FEB. 12–15 ➤ Annual International Aircraft Cabin Safety Symposium. Southern California Safety Institute. Torrance, California, U.S. Christine Schmitz, <Christine.schmitz@scsi-inc.com>, <www.scsi-inc.com>, +1 310.517.8844, 800.545.3766 (United States and Canada).

FEB. 13–15 ➤ ATC Maastricht 2007. CMP United Business Media. Maastricht, Netherlands. Sam Weller, <sweller@cmpi.biz>, <www.atcmaastricht.com>, +44 (0)20 7921 8544.

FEB. 13–15 ➤ Safety-Critical Systems Symposium 2007. Centre for Software Reliability. Bristol, England. Joan Atkinson, <joan.atkinson@ncl.ac.uk>, +44 (0)1912 227996.

FEB. 15–17 ➤ 18th Annual Women in Aviation Conference. Women in Aviation International. Orlando, Florida, U.S. Connie Lawrence, <www.wai.org>, +1 937.839.4647.

FEB. 21–22 ➤ 3rd Annual European Airline Engineering & Maintenance Conference. Aviation Industry Group. Zurich, Switzerland. Alice Macklin, <alicem@aviation-industry.com>, <www.aviationindustrygroup.com>, +44 (0)20 7931 7072.

FEB. 26–MARCH 1 ➤ CMAC 2007, Civil Military Air Traffic Management Summit. Civil Air Navigation Services Organisation. Bangkok, Thailand. <info@canso.org>, <www.canso.org>, +31 (0)23 568 5380.

MARCH 1–3 ➤ Heli-Expo 2007 Conference & Exhibition. Helicopter Association International. Orlando, Florida, U.S. Marilyn McKinnis, <marilynmckinnis@rotor.com>, <www.heliexpo.com>, +1 703.683.4646.

MARCH 12–14 ➤ 19th annual European Aviation Safety Seminar (EASS): "Staying Safe in Times of Change." Flight Safety Foundation and European Regions Airline Association. Amsterdam. Namratha Apparao, <apparao@flightsafety.org>, <www.flightsafety.org>, +1 703.739.6700, ext. 101.

MARCH 13–14 ➤ 13th Annual Middle East Airline Engineering & Maintenance Conference. Aviation Industry Group. Abu Dhabi, United Arab Emirates. Daisy Munro, <daisym@aviation-industry.com>, <www.aviationindustrygroup.com>, +44 (0)20 7931 7072.

MARCH 20–22 ➤ Aviation Industry Expo. National Air Transportation Association and the Professional Aviation Maintenance Association. Orlando, Florida, U.S. Jill Hilgenberg Ryan, <jill.hilgenberg@cygnusexpos.com>, <www.aviationindustryexpo.com>, +1 952.894.8007, 800.827.8009, ext. 3349 (United States and Canada).

MARCH 20–25 ➤ Australian International Airshow. Aerospace Australia. Victoria, Australia. <expo@airshow.net.au>, + 61 3.5282.0500.

MARCH 26–30 ➤ Worldwide Symposium on Performance of the Air Navigation System. International Civil Aviation Organization Air Navigation Bureau. Montreal. <perf2007@icao.int>, <www.icao.int/icao/en/anb/meetings/perf2007/index.html>, +1 514.954.5831.

MARCH 27–29 ➤ Aerospace Testing Expo 2007. UKIP Media and Events. Munich, Germany. Ben Drew, <bendrew@ukintpress.com>, <www.aerospacetesting-expo.com>, +44 (0)1306 743744.

MARCH 28–31 ➤ Aircraft Electronics Association 50th Annual Convention & Trade Show. Reno, Nevada, U.S. <info@aea.net>, <www.aea.net>, +1 775.789.2000, 800.501.2651 (United States and Canada).

APRIL 2–5 ➤ 58th Annual Avionics Maintenance Conference. ARINC. Phoenix, Arizona, U.S. Roger S. Goldberg, +1 410.266.2915.

APRIL 4–5 ➤ 8th Annual Airline Line Maintenance Conference. Aviation Industry Group. Lisbon, Portugal. <amandap@aviation-industry.com>, <www.aviationindustrygroup.com>, +44 (0)207 931 7072.

APRIL 16–17 ➤ ACI–NA Public Safety & Security Spring Conference. Airports Council International–North America. Spokane, Washington, U.S. Amy Peters, <apeters@aci-na.aero>, <www.aci-na.org>, +1 202.293.8500.

APRIL 24–26 ➤ 9th Annual Canadian Airport Management Conference. Airports Council International–North America and Canadian Airports Council. Ottawa, Canada. <meetings@aci-na.aero>, <www.aci-na.org>, +1 202.293.8500.

MAY 7–9 ➤ 4th International Aircraft Rescue Fire Fighting Conference. *Aviation Fire Journal*. Las Vegas, Nevada, U.S. <www.aviationfirejournal.com/vegas/contact.htm>, +1 914.962.5185.

MAY 8–10 ➤ 52nd annual Corporate Aviation Safety Seminar: "Safety — The Foundation for Excellence." Flight Safety Foundation and National Business Aviation Association. Tucson, Arizona, U.S. Namratha Apparao, <apparao@flightsafety.org>, <www.flightsafety.org>, +1 703.739.6700, ext. 101.

MAY 13–17 ➤ Aerospace Medical Association 78th Annual Scientific Meeting. New Orleans. Pam Day, <pday@asma.org>, <www.asma.org>, +1 703.739.2240, ext. 101.

MAY 22–24 ➤ European Business Aviation Convention & Exhibition (EBACE 2007). National Business Aviation Association and European Business Aviation Association. Geneva. Kathleen Blouin, <kblouin@nbaa.org>, <www.ebace.aero>, +1 202.783.9364.

MAY 28–30 ➤ Airport Show Dubai. Dubai, United Arab Emirates. <mail@theairportshow.com>, <www.theairportshow.com>, +9714 3329029.

JUNE 8–10 ➤ 2007 Regional Air Safety Seminar. Australian and New Zealand Societies of Air Safety Investigators. Wellington, New Zealand. Peter Williams, <p.williams@taic.org.nz>, +64 4 473 3112.

Aviation safety event coming up? Tell industry leaders about it.

If you have a safety-related conference, seminar or meeting, we'll list it. Get the information to us early — we'll keep it on the calendar until the issue dated the month before the event. Send listings to Rick Darby at Flight Safety Foundation, 601 Madison St., Suite 300, Alexandria, VA 22314-1756 USA, or <darby@flightsafety.org>.

Be sure to include a phone number and/or an e-mail address for readers to contact you about the event.

Safety News

Australia Plans Multi-Crew Licensing

© Copyright iStockphoto

A multi-crew pilot license for pilots trained specifically to be first officers in air transport operations is being planned by the Civil Aviation Safety Authority (CASA) of Australia, which is now developing regulations for the new category license.

"People training for the multi-crew license will focus on large-aircraft flying skills, crew resource management, and threat and error management throughout their year-long training," CASA said. They will be required to complete 240 hours of training, including up to 70 flight hours.

The new license is intended to address research findings that failures in teamwork are a primary contributor to aviation accidents, in part because traditional training methods emphasize individual skills and independence, CASA said.

CASA said that the new regulations are intended to "keep Australia at the forefront of international changes in air safety, in line with the latest standards issued by the International Civil Aviation Organization."

NTSB Cautions Pilots About Severe Weather

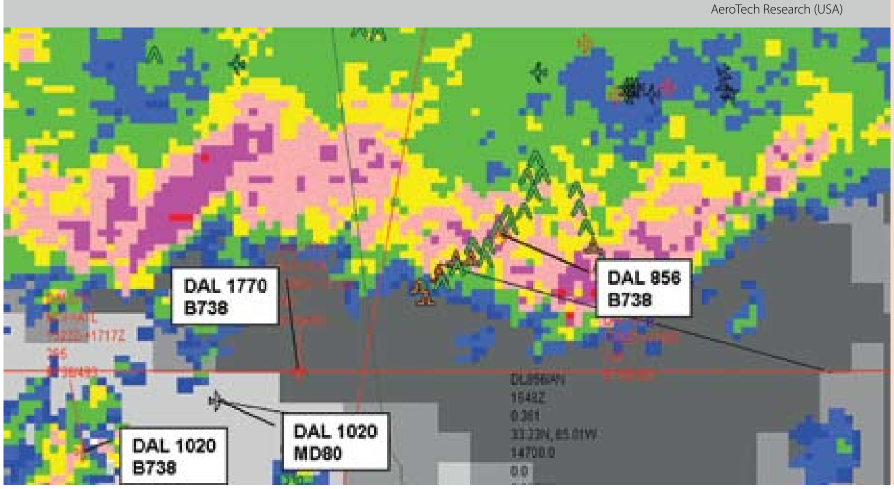
The U.S. National Transportation Safety Board (NTSB), citing several accidents in which severe weather was either a cause or a contributing factor, is urging pilots to "actively maintain awareness of severe weather" during flight.

The accidents cited by NTSB involved aircraft being flown under instrument flight rules (IFR), with pilots in contact with air traffic control (ATC). Although ATC is primarily responsible for keeping IFR aircraft separated, controllers also provide pilots with weather advisories and, at an individual pilot's request, suggested headings to avoid precipitation — but only when a controller's workload permits.

"Severe-weather avoidance is the responsibility of the pilots," NTSB Chairman Mark V. Rosenker said. "We … feel that it is imperative to reiterate the seriousness of this task during flight."

NTSB said that its accident investigations found that pilots of the accident aircraft "were either not advised about areas of severe weather ahead or were given incomplete information." The pilots did not use alternative sources of information — such as weather alerts broadcast by ATC and various on-board weather-avoidance technologies — that probably would have prevented the accidents, NTSB said.

AeroTech Research (USA)



Canada Considers Changes in Emergency Response Plans

Certified Canadian airports would be required to comply with "clear and consistent" criteria in developing and evaluating emergency response plans if regulatory amendments proposed by Transport Canada are adopted.

"Travelers expect to feel safe when they use Canadian airports," said Lawrence Cannon, minister of transport, infrastructure and communities. "These amendments will ensure that our airports have the necessary tools to successfully respond to an emergency situation."

The proposed amendments would require a more structured method of handling emergency planning and evaluation of the emergency plans, Transport Canada said.

Emergency plans would be required for various scenarios. The plans would describe how each type of emergency would be handled and would identify airport and community organizations that could provide assistance during an emergency.

The proposals were published Oct. 7, 2006. After a 30-day response period and subsequent review of the responses by Transport Canada, final regulations will be published.

Better SOPs Sought for EMS Flights

Standard operating procedures and crew coordination should receive greater emphasis in emergency medical services (EMS) helicopter operations, the Swedish Accident Investigation Board says.

The board's recommendation follows its investigation of a Sept. 18, 2004, accident in which a Sikorsky S-76C struck the water during an overwater nighttime visual flight rules (VFR) approach to a landing site on a small, relatively undeveloped island. The final report on the accident said that the pilots "underestimated the difficulty" of the landing and that the accident occurred because of "a lack of adequate routines and procedures for the activity in question, and existing procedures were not followed completely."

The board recommended that the Swedish Civil Aviation Authority "act to ensure that operators who fly to places which are not established takeoff and landing grounds possess, and follow, operational procedures for such flights similar to those used for [instrument flight rules] flights" and that it "act to ensure that operators flying under VFR, with two pilots or with [a medical crewmember] develop and follow some form of crew cooperation for VFR flight corresponding to that in use for IFR flights."

The board also recommended that the authority "seek internationally to ensure that requirements for the use of [flight data recorders] and [cockpit voice recorders] are introduced for this category of helicopter operations."

© Copyright Getty Images

Cold-Weather Reminder

The U.K. Civil Aviation Authority (CAA) has issued a reminder to all operators about two problems accompanying winter flight operations: contaminated runways and airframe icing.

The Flight Operations Division Communication from the Safety Regulation Group says that operators should avoid using snow- and ice-contaminated runways whenever possible and that flight crews should use the most current information in their performance calculations.

In addition, flight crews should be reminded that using electronic flight bag products in performance calculations on a contaminated runway "often produces optimum flap-setting performance where the computer uses the available runway length to accelerate the airplane to a higher speed in order to improve the climb performance. This is unlikely to be appropriate in such conditions where a shorter ground roll would be preferred."

Anxiety Suspected in Pilot Incapacitation

A Boeing 767-300ER pilot who had been taking an antidepressant to treat anxiety and stress may have suffered "an anxiety reaction" during a passenger flight from Auckland, New Zealand, to Melbourne, Australia, the Australian Transport Safety Bureau (ATSB) said in its final report on the incident.

The report said that during cruise, the pilot complained first of increasing fatigue, and later of nausea, headache and neck pain. A cabin crewmember administered oxygen, and the captain was relieved of duty; the first officer flew the airplane to its destination. After landing, the captain was taken to a hospital, where medical tests were inconclusive but ruled out any heart-related problem.

The captain had a "history of stress-related difficulties over several years" and had been treated with stress management and a type of antidepressant medication known as a selective serotonin reuptake inhibitor (SSRI). He also had been treated for high blood pressure, or hypertension.

"It is possible that the incapacitation of the [captain] was related to an anxiety reaction precipitated by a combination of factors, including low blood pressure due to hypertension medication, fatigue and a head cold," the report said.

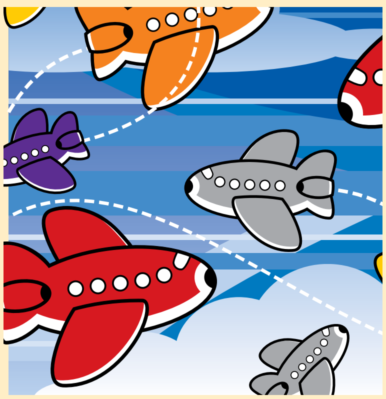
Unlike many other civil aviation authorities, the Civil Aviation Safety Authority (CASA) of Australia issues medical certification to some pilots who take SSRIs.

CASA's policy complies with recommendations of the Aerospace Medical Association. A 2005 review concluded that the policy was "appropriate and that there were no safety concerns relating to the practice," the ATSB report said.

ATSB Urges More Guidance for ATC

The Australian Transport Safety Bureau (ATSB) has recommended that Airservices Australia review guidance material and training for airport air traffic controllers to ensure that they provide pilots with all relevant traffic information.

The recommendation was issued as a result of an ATSB investigation of an April 30, 2005, incident at Hobart Airport in Tasmania in which separation between a converging Cessna 152 and a Boeing 717-200 was as little as 400 m (1,312 ft) horizontally and 300 ft vertically. Pilots of each aircraft took action to avoid the other.



© Copyright iStockphoto

Before the incident, the controller had told the pilot of the Cessna to "make an orbit and then continue downwind" for separation from other aircraft, but the Cessna pilot did not complete a full orbit and then turned onto base while the 717 was on final. The Cessna pilot had not read back his instructions to continue on downwind, and the controller had not requested a readback; published documents did not require a readback, the incident report said.

In addition, the report said, "The controller did not provide the pilot of the C-152 or the B-717 with traffic information or a number in the landing sequence, as required by published documents. This led to a reduction in the situational awareness of the pilots of both aircraft and excluded them from participating effectively in the separation process."

After the incident, Airservices Australia said that it was "addressing the issue of obtaining readbacks" and had begun a standardization program to emphasize use of correct phraseology and readback.

FAA Issues AD on Airbus Crew Seats

One year after the French Direction Générale de l'Aviation Civile issued an airworthiness directive (AD) to require inspections of flight crew seats in some Airbus airplanes, the U.S. Federal Aviation Administration (FAA) has taken similar action.

Both ADs require inspections to determine if a specific actuator is installed at the pilots' seats and performance of applicable corrective actions.

FAA said that the AD was required because of a report of "heavy wear at the driving gear of the rotor-shaft end of the electrical driven motor on certain actuators of the pilot's and copilot's seats." Implementation of the AD is intended to prevent uncommanded movement of the seats during takeoff or landing; this movement could interfere with airplane operations and result in temporary loss of control, FAA said.

The AD applies to some models of the A318, A319, A320, A321, A330 and A340.

In Other News …

The **Italian Air Safety Board** has introduced a voluntary, confidential aviation safety reporting system intended to help prevent accidents. … **Embraer** and **CAE** have agreed to establish a global joint venture to provide pilot and ground crew training for operators of Phenom 100 Very Light Jets and Phenom 300 Light Jets; training programs will begin in 2008 in Dallas and expand to sites in the eastern United States and Western Europe. … **Sherry Carbary** has been named president of Alteon Training; she formerly was vice president of strategic management for Boeing Commercial Airplanes.

© Copyright Embraer

Compiled and edited by Linda Werfelman.

Margins of Safety

BY MARK V. ROSENKER

On the snowy evening of Dec. 8, 2005, Southwest Airlines Flight 1248, a Boeing 737-7H4, ran off the end of Runway 31C upon landing at Chicago's Midway Airport. The airplane struck two cars on a city street, killing a child.

While the flight was en route from Baltimore, the flight crew obtained updated weather information and runway braking action reports from air traffic control. Based on this information, the crew planned for fair braking action on Runway 31C. About 30 minutes before the accident, airport ground personnel had performed a runway friction measurement, which indicated that the runway friction was "good."

The flight crew used an on-board laptop performance computer (OPC) provided in the cockpit of Southwest Airlines' airplanes to calculate expected landing performance. Flight crews enter flight specific data into the OPC, including the expected landing runway, wind speed and direction, airplane gross weight at touchdown and the reported runway braking action. The 737-700 OPC is programmed to assume that the engine thrust reversers will be deployed on touchdown and to calculate the stopping margin (the amount of runway remaining after the airplane comes to a stop).

The flight crew entered weather data into the OPC and input "WET-FAIR" as the runway braking condition. The OPC calculated that the airplane would be able to stop on Runway 31C with about 560 ft (171 m) of runway remaining. When the crew input "WET-POOR," the OPC calculated a 30-ft (9-m) stopping margin.

The assumption that engine thrust reversers would be deployed on touchdown is consistent with Southwest Airlines' *Flight Operations Manual*, which states that, when landing under less than good braking conditions, the thrust reversers are to be used as soon as possible during the landing roll and are to be applied with the brakes. However, the flight data recorder revealed that about 18 seconds passed from the time the airplane touched down to the time the thrust reversers were deployed; at that point, only about 1,000 ft (305 m) of usable runway remained. During post-accident interviews, the captain stated that he attempted to immediately deploy the thrust reversers but was unable to do so. According to the first officer, at some point during the rollout, he noticed that the thrust reversers were

Mark V. Rosenker is chairman of the U.S. National Transportation Safety Board.

not deployed, and he then deployed them. The late deployment of the thrust reversers almost completely negated the stopping-distance benefit that had been expected from their use.

The U.S. Federal Aviation Administration (FAA) does not allow the use of the reverse thrust credit when determining dispatch landing distances. The stopping benefit from thrust reverser use typically has provided a built-in safety margin to offset other variables. However, FAA allows the reverse thrust credit to be used in calculating en route operational landing distances for some transport-category airplanes, such as the accident airplane, a 737-700. Accordingly, when using the reverse thrust credit for contaminated runways, the required runway length for 737-700 model airplanes is about 1,000 ft less than the required runway length without the reverse thrust credit. The OPCs of Southwest Airlines' 737-300 and -500 model airplanes do not use the reverse thrust credit; therefore, these airplanes have a greater landing safety margin. In this accident, when the thrust reversers were not (or could not be) used in a timely manner, the airplane could not be stopped on the runway because of the absence of this extra safety margin.

The late deployment of the thrust reversers almost completely negated the stopping-distance benefit that had been expected from their use.

If the reverse thrust credit had not been factored into the stopping distance calculations made by the OPC, it would have indicated that a safe landing on Runway 31C was not possible under a braking condition of either fair or poor. The U.S. National Transportation Safety Board (NTSB) is concerned that the landing distance safety margin is significantly reduced on a contaminated runway when the reverse thrust credit is allowed in landing stopping distance calculations. As a result, a single event, the delayed deployment of the thrust reversers, can lead to an unsafe condition, as it did in this accident. NTSB believes that the safety margin must be restored to those airplanes for which the reverse thrust credit is currently allowed in landing performance calculations.

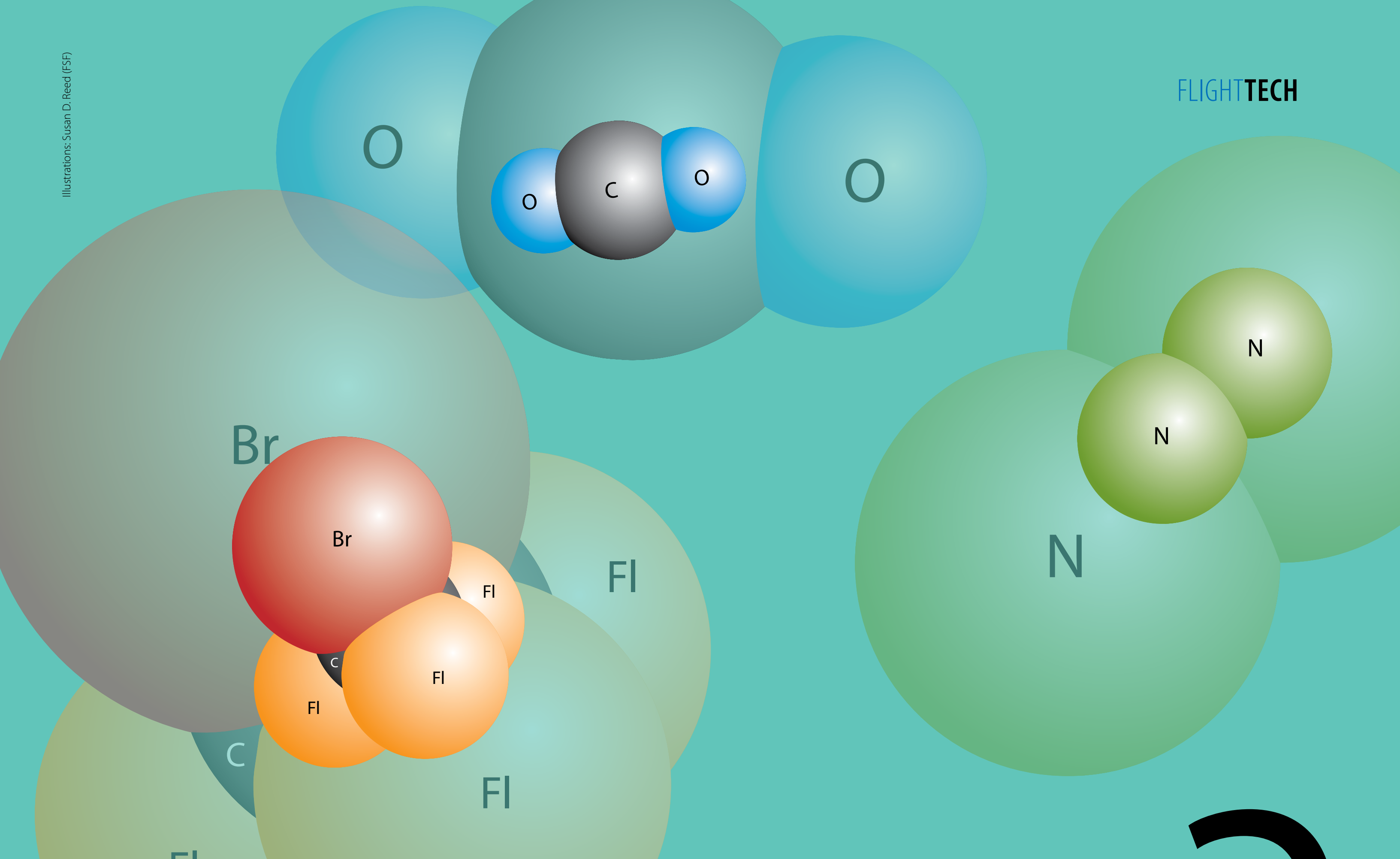
On Jan. 27, 2006, NTSB issued an urgent recommendation, A-06-16, to FAA to immediately prohibit airlines from using the reverse thrust credit in landing performance calculations.

The NTSB staff was informed that FAA agreed with the intent of the recommendation, and intended to develop a new requirement that would yield an even greater safety benefit than a blanket prohibition against taking credit for reverse thrust. Subsequently, on June 7, 2006, FAA published "Announcement of Policy for Landing Performance Assessments After Departure for All Turbojet Operators." This announcement stated that FAA considered a 15 percent margin between the expected actual airplane landing distance and the landing distance available at the time of arrival as the minimum acceptable safety margin for normal operations. As a result, FAA was planning to issue Operations Specification/ Management Specification (OpSpec/MSpec) C082 implementing this requirement by Oct. 1, 2006.

While the proposed FAA action was not precisely what NTSB had recommended, it would have provided the additional safety margin that NTSB was seeking; it went beyond the NTSB recommendation by including all turbojet operators, not just carriers operating under Federal Aviation Regulations Part 121, *Domestic, Flag and Supplemental Operations*. However, on Aug. 31, FAA abandoned this plan and instead published a "Safety Alert for Operators (SAFO)," in which FAA announced that it would begin a rulemaking process to require the practices described in the policy statement. In the meantime, FAA recommended that operators voluntarily comply with the policy statement.

NTSB's concern is that rulemaking can take years and that the next snow and ice season is upon us (in the Northern Hemisphere). Some major airlines have indicated that they will comply with C082, but without a requirement, it could be years before all passengers have the additional safety margin that NTSB believes is required for landing on short, contaminated runways. NTSB urges FAA to follow its first course of action and hopes that, in the interim, all operators will comply with the SAFO. Let's not see a repeat of the Chicago Midway tragedy. ●

Illustrations: Susan D. Reed (FSF)



The FAA has a plan that it says will reduce the risk of aircraft fuel tank explosions. Critics aren't so sure.

BY LINDA WERFELMAN

Blast-Free Fuel Tanks?

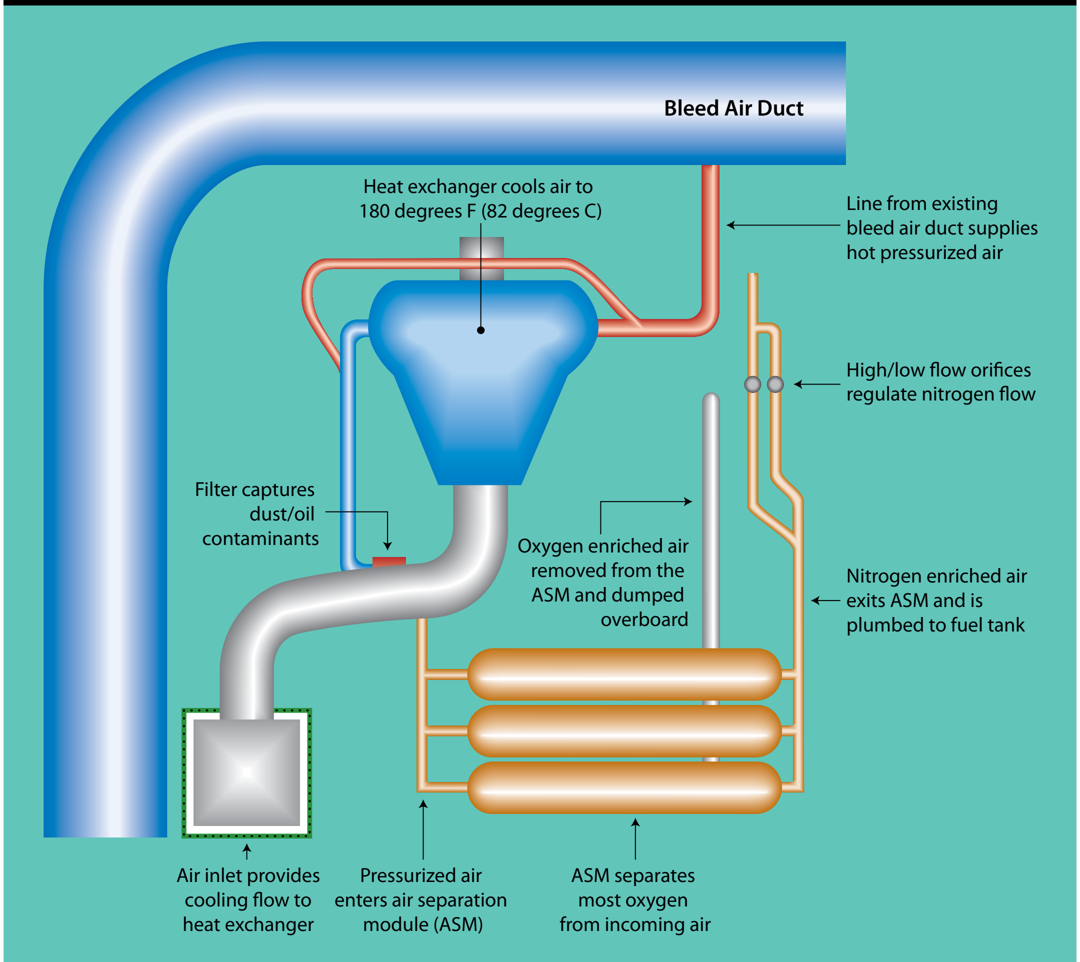
More than 10 years after a Trans World Airlines (TWA) Boeing 747 crashed into the Atlantic Ocean following takeoff from New York's Kennedy International Airport — an accident blamed on an explosion in the center wing fuel tank[1] — the U.S. Federal Aviation Administration (FAA) is reviewing comments on a proposed rule that FAA officials say would substantially reduce the risk of similar accidents.

However, some critics, including major airplane manufacturers and a number of airlines, call the proposed rule unnecessary. Others, including the U.S. National Transportation Safety Board (NTSB), say that the rule — which would apply only to center wing fuel tanks and only to passenger airplanes — would not go far enough.

The proposed rule would require more than 3,200 existing passenger jets, as well as some new jets, to have "acceptable levels of flammability exposure in tanks most prone to explosion or require the installation of an ignition-mitigation means in an affected fuel tank."[2]

FAA says that the best method of meeting the requirement is fuel tank inerting — a

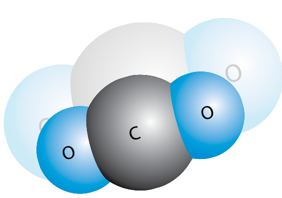
Fuel-Inerting System



Source: U.S. Federal Aviation Administration

Illustration adaptation: Susan D. Reed (FSF)

Figure 1



process in which an inert gas such as nitrogen is introduced into a fuel tank to replace oxygen (Figure 1). The process is effective because, unlike oxygen, which accelerates fire, inert gases are fire suppressants.

"Fuel tank inerting, originally thought to be prohibitively expensive, can now be accomplished in a reasonably cost-effective fashion and protect the public from future calamities, which, we have concluded, are otherwise virtually certain to occur," the proposed rule says. FAA estimates the cost of retrofitting existing airplanes at US$313 million — or about $140,000 to $225,000 per plane. The total cost for the U.S. fleet probably will total $808 million over 49 years, FAA said.

The proposed rule "should greatly reduce the chances of a catastrophic fuel tank explosion," FAA said in its notice of proposed rulemaking. In the past, fuel tank explosions have been a "constant threat," FAA said, citing data that show that, from 1960 through November 2005, there were 17 accidents in which airplanes were destroyed by fuel tank explosions, including the TWA accident that prompted the proposal (see "Related Accidents," page 16). Without remedial measures, nine similar accidents involving transport category airplanes would be likely in the next 50 years, FAA said.

"We believe at least eight of these explosions are preventable if we adopt a comprehensive safety regime to reduce both the incidence of ignition and the likelihood of an explosion following ignition," FAA said. Of the eight, four could be prevented through implementation of the proposed rule, FAA said.

Four others could be prevented through the implementation of Special Federal Aviation Regulation (SFAR) 88, which was adopted in 2001 to minimize ignition sources — an action that resulted in the identification of more than 200 potential sources.

"While the work accomplished by the industry to comply with SFAR 88 has certainly improved safety, the FAA believes that the added safety net of reducing the flammability of the tank is also necessary," FAA said.

NTSB Chairman Mark V. Rosenker agreed but said that progress toward adopting new safeguards is slow and the proposed rule does not do enough to reduce fuel tank flammability risks.

"Ten years after the TWA accident, fuel tank inerting systems are not in place on our airliners, and flammability exposure is largely unchanged," Rosenker said. "And proposed rule changes do not include the majority of fuel tanks, which are in the wings of transport airplanes, nor this country's large fleet of cargo aircraft."

Elimination of flammable fuel/air vapors in all the fuel tanks of transport category aircraft — an item recommended by NTSB in its final report on the TWA accident — has been on the board's list of "most-wanted transportation safety improvements" since 2002.

Military Beginnings

The inerting process has been used for decades in military aircraft. Inerting systems first were used during World War II to reduce the risk of fuel tank explosions during combat. Initially, engine exhaust was used to produce the inert gas; the use of nitrogen is a more recent development.

The inerting systems used by the military have long been considered too heavy, too complex and too expensive to function well in commercial airplanes. In addition, the military systems were designed to be used for relatively short periods — not for the lengthy flying days that are typical for many passenger jets.

FAA researchers — working with their counterparts at Boeing — spent years developing a more practical system for commercial airliners, and in 2002, six years after the TWA accident, they tested a prototype, on-board inerting system that relies on engine bleed air, weighs far less than the systems used by the military and is less complex and less expensive. The researchers determined that, if a properly sized inerting system were operated during flight, the fuel tank would remain inert after landing and there would be no need for ground operation of the inerting system.

In 2005, an inerting system developed by Boeing was certified and is now the subject of an "in-service evaluation" involving two 737s and two 747s. The Boeing system — designed to be installed on new and retrofitted 737s and 747s as early as 2007, and on other Boeing airplanes by 2008 — diverts engine bleed air into an air separation module that separates the nitrogen and pipes the nitrogen into the center wing fuel tanks. The new composite 787 has been designed with inerting systems for all fuel tanks.

In comments on the proposed rule, Boeing suggested revisions to exempt from the retrofitting requirement older airplanes estimated to be within five years of retirement, questioned FAA's contention that cargo airplanes should not be subject to the rule, and challenged FAA's projection that a fuel tank explosion might occur once in every 60 million flight hours. A more realistic projection would be once every 100 million flight hours, Boeing said.

Workplace Hazards

Airbus also challenged FAA's projection, saying that the proposal was developed using faulty data that overstated not only the risk of a fuel tank explosion but also the benefits of the proposed safety improvements.

"Specifically ... the number of future accidents to passenger airplanes that might be prevented in the next 50 years by enacting this proposal is not four, as the FAA estimates, but 0.67 accidents," Airbus said in comments submitted in response to the proposed rule. "FAA estimates that some 546 statistical fatalities would be avoided by enactment of these proposals. Our comments estimate that 31 statistical fatalities would be avoided in the next 50 years."

Airbus also noted that its aircraft were not involved in the accidents cited by FAA in proposing the rule, and said that because there are "significant differences" between fuel tank designs on its airplanes and those of other manufacturers, "each fuel tank should be assessed on an individual basis." Airbus said that a primary difference between its fuel tank

Inerting systems first were used during World War II to reduce the risk of fuel tank explosions during combat.

design and that of the 747 is that, on the 747, environmental control system packs are located "directly beneath the [center wing tank] without any evident means of limiting heat transfer"; on Airbus aircraft, one of two ventilation devices is used to spread heat over a larger area, thereby causing lower peak temperatures and fewer ignition source scenarios. The proposed rule will not affect the new A380, which was designed without a center wing fuel tank.

In addition, Airbus projected that the proposed changes would create "widespread workplace asphyxiation hazards" that would result in between 1.4 and 4.7 workplace fatalities every year. "Workplace hazards could actually result in statistical fatalities that exceed those that would be avoided by enactment of this proposal," Airbus said.

Airbus said that, in the decade since the TWA crash, the aviation industry had worked with regulatory authorities to adopt other rules changes that "significantly reduced the risk of further heated center wing tank explosions."

Other airplane manufacturers also questioned the FAA's proposal to require action by manufacturers other than Boeing.

"FAA notes that none of the previous tank explosions have occurred on Airbus aircraft but then claims the historical data [imply] that tank explosions on Airbus types should have occurred by now," BAE Systems Regional Aircraft said. "The only possible basis for this claim would be if Airbus fuel tanks, fuel system components and adjacent equipment installations (e.g., air conditioning packs) were very similar to their Boeing counterparts. They are not."

Embraer agreed, saying in its response to the proposed rule, "In general … the flammability concern should be limited to tank designs that have shown an unacceptable service history. The cost associated with applying these standards to conventional wing tanks is not justified by the negligible benefits that will occur."

Several regional airline associations — the Air Transport Association of America (ATA), the Association of European Airlines (AEA) and the Association of Asia Pacific Airlines (AAPA)

Related Accidents

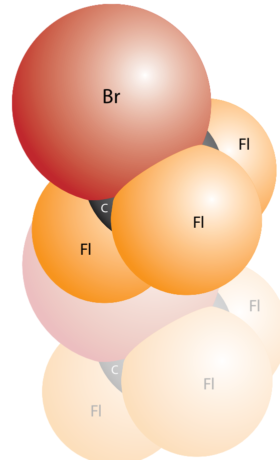
Since the 1996 Trans World Airlines crash, two other accidents involving airplane fuel tank explosions have been reported:

- A Thai Airways Boeing 737-400 was destroyed March 3, 2001, when the center wing fuel tank exploded while the airplane was at the terminal in Bangkok, Thailand, being prepared for a domestic passenger flight. One flight attendant was killed, and six other people received serious injuries. NTSB said that the final report on the accident, issued in April 2005 by the Accident Investigation Committee of Thailand, said that the most likely source of the ignition energy was "an explosion originating at the center wing tank pump as a result of running the pump in the presence of metal shavings and a fuel/air mixture";[1] and,
- Substantial structural damage was reported to the area surrounding the left wing fuel tank of a Transmile Airlines 727-200 on May 4, 2006, when the tank exploded while ground personnel in Bangalore, India, were preparing to tow the airplane after maintenance to repair a fuel leak. No one was injured in the explosion, which remains under investigation. The blast occurred while the airplane's auxiliary power unit was operating; the tow crew felt "a jolt" and observed that a circuit breaker for the left wing fuel-tank boost pump had tripped.[2]

Notes

1. U.S. National Transportation Safety Board (NTSB). Accident report DCA01RA024. March 3, 2001.
2. NTSB. Accident report DCA06RA040. May 4, 2006.

— LW



— said in their responses that the actions described in the proposed rule could not be justified, largely because of steps already taken by the industry to address safety issues.

"Existing and planned ignition-prevention improvements will reduce the risk of a catastrophic fuel tank explosion for airplanes that are affected by the [proposed rule] to less than one occurrence in 1 billion flight-hours, which is the FAA's goal," ATA said. "In other words, [ignition-prevention improvements] alone can reduce the risk of catastrophic fuel tank explosion to the point that it is unlikely one will occur during the operational life of any given airplane type."

AEA, which questioned FAA's data on the costs and benefits that would follow adoption of the rule, added that fuel tank explosions "are not a major cause of aviation accidents (statistically, the percentage of both accidents and fatalities due to fuel tank explosions is approximately 1.2 percent over the last 20 years.)"

AEA said that, in addition, European cost estimates are "significantly higher" than FAA's, with "the investment required to achieve the safety benefit promised by this proposal … 23 times higher than the value of the benefit."

AAPA said that it opposes the mandatory retrofitting of airplanes with inerting systems, but if FAA decides to "unilaterally mandate the retrofit of in-service aircraft, it should consider removing the requirement to complete 50 percent of the fleet within four years, as this will impose a tremendous burden on our members to realign their heavy maintenance schedules to meet the deadline."

AAPA said that FAA also should recognize "the disparity of the efforts undertaken by the respective manufacturers" by allowing them more time to develop flammability-reduction systems that meet the requirements of the proposed rule.

'Waited Too Long'

Support for the proposal has come from groups representing airline passengers and pilots.

The National Air Disaster Alliance/Foundation, which represents survivors of more than 100 aviation accidents worldwide and victims' families, asked FAA to approved the proposed rule as soon as possible.

"The public has waited too long for the safest fuel tanks on aircraft to prevent the possibility of explosions, such as TWA [Flight] 800," the organization said.

The Air Line Pilots Association, International (ALPA) said that it supports the intent of the proposal but takes "strong exception to the exclusion of airplanes used in all-cargo operations." ALPA said that excluding all-cargo operations from the requirement is a "totally unacceptable approach to aviation safety."

Safety Modifications

Despite NTSB's criticism of some aspects of the proposed rule, Rosenker said that other steps taken by FAA as a result of the TWA crash resulted in significant safety improvements.

"Fleet-wide inspections and analytical reviews of fuel tank design have resulted in significant measures that have the potential to reduce the likelihood of an ignition event inside a tank," he said, "and … fuel pumps, fuel-quantity indicating systems, in-tank wiring, co-routed wiring and operational procedures have been modified to make fuel systems safer."

The period for receiving public comments on the proposed rule ended in May 2006; final action from FAA is expected late in 2007. ●

Notes

1. U.S. National Transportation Safety Board (NTSB). *Aircraft Accident Report: In-Flight Breakup Over the Atlantic Ocean, Trans World Airlines Flight 800, Boeing 747-131, N93119, Near East Moriches, New York, July 17, 1996.*

2. U.S. Department of Transportation (DOT), Federal Aviation Administration. "Reduction of Fuel Tank Flammability in Transport Category Airplanes; Proposed Rule." *Federal Register*, Nov. 23, 2005. Comments on the proposed rule from airplane manufacturers, airlines, regulatory and investigative authorities, and others can be viewed at <http://dms.dot.gov> by clicking on "simple search" for docket no. 22997.

Antonov Blacklist

Hundreds of the aircraft have been targeted for grounding until their airworthiness is assured.

BY MARK LACAGNINA


© Steve Lake

In an unprecedented action, a list of Antonov aircraft that apparently are being operated in violation of requirements for continued airworthiness has been published by the International Civil Aviation Organization (ICAO).

"The primary purpose for publishing the list is to share this important safety information," said Paul Lamy, chief of ICAO's Flight Safety Section. "The action is very much in line with the organization's general policy of transparency and sharing of information, which was reinforced by the conference of directors general of civil aviation that was held in March 2006."

The conference, convened in Montreal to forge a "global strategy for aviation safety," included a presentation by Ukraine, home of the Antonov Aviation Scientific/Technical Complex (ASTC), about insufficient communication between countries in which aircraft are registered and countries in which they were designed and/or manufactured.

The presentation provided the following example: In 2004 and 2005, Ukraine's State Aviation Administration (SAA) sent information to several African civil aviation authorities (CAAs), requesting that they take action on aircraft that had been identified as unairworthy. The presentation said that because of an "insufficient level of cooperation" and communication, the SAA does not know if the requested action was taken. Moreover, the presentation said that an analysis of 10 fatal Antonov aircraft accidents in Africa in 2005 indicated that eight of the aircraft were not airworthy.

Among Ukraine's recommendations was that ICAO and its contracting states "take adequate measures to ensure an exchange of mandatory safety-related information … and to improve an effective control on continuing airworthiness."[1]

Biplanes Top List

In August 2006, Antonov gave the SAA a list of 436 aircraft that it does not consider airworthy. The SAA promptly forwarded the list to ICAO and authorized the organization to publish it.[2]

The list includes the names of the 16 countries, all ICAO contracting states, in which the

Eight An-24s are on Antonov's list of aircraft whose airworthiness cannot be confirmed. Introduced in 1959, the twin-turboprop carried more than one-third of the passengers transported in the Soviet Union for several decades. The aircraft reportedly has a design service life of 30,000 hours.

aircraft are registered, the aircraft models, serial numbers, registration numbers, dates of manufacture, airworthiness expiration dates, and operators (see appendix, page 22).

The list includes 362 An-2s operated domestically by 35 airlines in Kazakhstan. The An-2 is a 5,500-kg (12,125-lb) biplane powered by a 746-kW (1,000-hp), nine-cylinder radial engine. Originally designed for aerial application, the aircraft first flew in 1947 and later was modified to carry cargo or as many as 10 passengers. The SAA said that Kazakhstan's Civil Aviation Committee did not comply with ICAO requirements when it established overhaul periods allowing extension of the service lives of the An-2s registered in the country without Antonov's participation.

Also on the list are the following aircraft, which are not considered airworthy because they apparently had not been returned to

© Michael Faby/Jetphotos.net

After overrunning the runway at N'Djamena, Chad, in October 2004, this An-12 reportedly was returned to service following repair of the landing gear.

Kazakhstan's extension of An-2 service life without Antonov's participation landed 362 of the workhorse biplanes on the blacklist.

Antonov for overhauls that were required before they reached established service-life limits:

- Twenty-seven An-12s, a four-engine turboprop freighter with a maximum takeoff weight of 61,000 kg (134,481 lb), which also can carry 14 passengers;
- Twenty-three An-28s, a 5,700-kg (12,500-lb) general-purpose twin-turboprop;
- Ten An-26s, a 24,000-kg (52,910-lb) pressurized short-haul twin-turboprop that can carry freight or as many as 40 passengers;
- Eight An-24s, a 21,000-kg (46,297-lb) predecessor of the An-26;
- Three An-32s, a development of the An-26 for operation at high density altitudes;
- One An-8, a military transport that preceded the An-12;
- One An-72, a 33,000-kg (72,752-kg) twin-turbofan, short-takeoff-and-landing transport that replaced the An-26; and,
- One An-74, a development of the An-72 for operation in arctic regions.

In addition to the 362 An-2s, Kazakhstan's registry includes one of the An-24s on the list. Moldova has the second largest number of aircraft, 18, on its registry, followed by the Democratic Republic of the Congo, with eight; Congo and Sudan, with seven each; Angola, Sierra Leone, Surinam and Togo, with five each; Kenya, with four; Venezuela, with three; Iran, with two; and Cambodia, Nicaragua, South Africa and Uganda, with one each.

The airworthiness-expiration dates range from October 1991, for two An-28s in Sudan, to June 2006, for an An-12 in Congo.

© Steve Lake

Communications Breakdown

ICAO said that there was a breakdown in communications between Antonov and the Ukraine SAA, and the states of registry of the aircraft. "There is an international standard that requires the state of registry and the state of manufacture or design to communicate regularly," Lamy said.

ICAO Annex 8, *Airworthiness of Aircraft*, requires, for example, that states of design notify the states of registry of any information essential to the continuing airworthiness of the aircraft. The states of registry, typically through their CAAs, are responsible for ensuring that every aircraft on their registers is maintained in an airworthy condition. States of registry also are responsible for establishing the channels for communication between their CAAs and the aircraft operators in their countries, and the states of design.

ICAO believes that in some cases, the calls for action on unairworthy aircraft that were issued by the Ukraine SAA in 2004 and 2005 either did not reach the responsible parties or were ignored. Publication of the list was an effort to resolve both problems.

"Making this information public was very important because, of all the people who should have received the information, there were quite a few who did not receive it because of a breakdown in communications," Lamy said. "In a minority of cases — but we still have to take them into account — people may have chosen to look the other way. The ICAO policy on transparency and the sharing information is not to allow this kind of behavior. By making the information

© Steve Lake

public, we want to make sure that there is no possibility of looking the other way."

Annex 8 says, "Any failure to maintain an aircraft in an airworthy condition as defined by the appropriate airworthiness requirements shall render the aircraft ineligible for operation until the aircraft is restored in an airworthy condition." Accordingly, ICAO expects the aircraft on the list to be grounded by their states of registry or by other states in which they are operated until their airworthiness is assured.

Others to Follow?

ICAO anticipates that other states of design will come forward with lists of suspected unairworthy aircraft for publication. "We are hoping that they will," said Lamy. "But you have to be aware that this situation is specific to aircraft built in states that used to be part of the Soviet Union. Service lives have been established for these aircraft; they are time-limited and have to come back to the factory every few years to be overhauled and restored to their original airworthiness conditions."

Service lives typically are not established for Western-built aircraft. Their certificates of airworthiness are maintained, in part, through on-condition maintenance and inspection, and compliance with airworthiness directives and any special conditions established for continuing airworthiness. ●

Antonov built more than 1,000 An-12 freighters for a variety of military and civil applications from 1959 through 1973. The blacklist includes 27 of the aircraft.

Notes

1. Among the actions taken by the International Civil Aviation Organization (ICAO) in response to recommendations made during the conference was the establishment of the Flight Safety Information Exchange (FSIX) Web site, <www.icao.int/fsix>. In addition to the list of apparently unairworthy Antonov aircraft, the site at press time included several ICAO Universal Safety Oversight Audit Program reports voluntarily authorized for public release by states and a July 2006 report by the United Nations Security Council that, ICAO says, contains information on "illegal and unsafe air operations concerning the Democratic Republic of the Congo."

2. William R. Voss, president and CEO of Flight Safety Foundation, presented citations for outstanding service to Anatoly Kolisnyk, first deputy chairman of the Ukraine State Aviation Administration, and to Dmitry Kiva, general designer of the Antonov Aviation Scientific/Technical Complex, during the FSF International Air Safety Seminar in October 2006. Voss cited Kolisnyk and Kiva for "their personal commitments to safety … by making critical airworthiness information available to states, operators and the public."

Appendix

Aircraft Considered Unairworthy by the Antonov Aviation Scientific/Technical Complex

State of Registry	Antonov Aircraft Model	Serial Number	Registration Number	Date of Manufacture	Airworthiness Expiration Date	Operator
Angola	An-12	4342209	D2-MBH	29/07/1964	29/01/1998	unknown
Angola	An-12	3402007	D2-MBE	1964	1999	unknown
Angola	An-12	5343405	D2-MAZ	30/09/1965	20/01/1997	unknown
Angola	An-12	2340608	D2-MBD	1962	1997 Service not extended to civil aviation.	unknown
Angola	An-12	7345210	D2-FRI	1967	1997 Service not extended to civil aviation.	unknown
Cambodia	An-24B	99902009	XU-335	30/06/1969	01/07/2005	Imtrec Aviation Airlines
Democratic Republic of the Congo	An-28	1AI006-03	9XR-KI	17/04/1989	17/04/1993	unknown
Democratic Republic of the Congo	An-28	1AI005-09	9Q-GZN	30/07/1988	30/07/1992	Blue Airlines
Democratic Republic of the Congo	An-28	1AI006-01	9Q-GZL	13/04/1989	13/04/1993	Blue Airlines
Democratic Republic of the Congo	An-28	1AI008-05	9XR-KV	10/07/1990	10/07/1994	Blue Airlines
Democratic Republic of the Congo	An-28	1AI008-09	9Q-CSP	16/08/1990	16/08/1997	Malu Aviation Airlines
Democratic Republic of the Congo	An-28	1AI008-21	EX-018	29/09/1990	29/09/1994	unknown
Democratic Republic of the Congo	An-28	1AI005-10	9Q-GZM	28/07/1988	28/07/1992	Blue Airlines
Democratic Republic of the Congo	An-32	22-10	9Q-CMD	31/01/1990	31/07/2002	unknown
Iran	An-26B	140-01	EP-SAK	04/02/1985	05/12/2006	Saffat Aviation Services Airlines
Iran	An-26B	140-02	EP-SAJ	13/02/1985	23/07/2004	Saffat Aviation Services Airlines
Kenya	An-28	1AI006-11	9XR-IM	12/06/1989	12/06/1993	unknown
Kenya	An-28	1AI007-06	9XR-SR	14/12/1989	14/06/2003	unknown
Kenya	An-28	1AI004-15	9XR-KG	28/02/1988	28/02/2006	SPD Savran P.V.
Kenya	An-28	1AI0010-02	ER-AKA	25/09/1991	25/09/1995	Valan Airlines, Moldova
Nicaragua	An-32	30-07	YN-CGA	31/03/1992	31/12/2003	Aerocharter Airlines
Republic of Kazakhstan*	An-2					
Republic of Kazakhstan	An-24	10-04	UN-47736	23/12/1966	21/11/2005	ACA Airlines
Republic of Moldova	An-12	9346909	ER-AXY	1969	31/05/2001	unknown
Republic of Moldova	An-12	2340605	ER-ADT	1962	01/01/1992	unknown
Republic of Moldova	An-12	9346502	ER-AXD	1969	1999	unknown
Republic of Moldova	An-12	2340403	ER-ADD	1962	29/12/1999	unknown
Republic of Moldova	An-12	00347407	ER-AXG	15/08/1970	2000	Tiramavia S.R.L. Airlines
Republic of Moldova	An-24	27307605	ER-47698	25/02/1972	06/12/2001	Air Moldova Airlines
Republic of Moldova	An-24	108-10B	ER-AFB	23/12/1978	20/04/2004	Aerocom Airlines
Republic of Moldova	An-24	37308801	ER-AZN	24/071973	24/01/2006	Pecotox Airlines
Republic of Moldova	An-24	17306907	ER-AWD	04/1971	01/2003	Aerocom Airlines
Republic of Moldova	An-24	87304102	ER-46417	02/1968	06/2001	Air Moldova Airlines
Republic of Moldova	An-24	97305109	ER-46599	04/1969	02/2001	Air Moldova Airlines
Republic of Moldova	An-26	126-03	ER-AFU	15/01/1983	20/12/2001	Aerocom Airlines
Republic of Moldova	An-26	117-05	ER-AFE	08/12/1981	08/12/2001	Aerocom Airlines
Republic of Moldova	An-26	90-05	ER-AZT	28/12/1979	17/09/2004	Aerocom Airlines
Republic of Moldova	An-26	22-06	ER-AZE	30/05/1974	30/06/1994	Aerocom Airlines

Continued on next page

Appendix

Aircraft Considered Unairworthy by the Antonov Aviation Scientific/Technical Complex

State of Registry	Antonov Aircraft Model	Serial Number	Registration Number	Date of Manufacture	Airworthiness Expiration Date	Operator
Republic of Moldova	An-26	108-07	ER-26046	27/02/1981	27/02/2001	Air Moldova Airlines
Republic of Moldova	An-72	365.720.94889	ER-AEJ	23/01/1992	23/01/2003	unknown
Republic of Moldova	An-74	365.470.95898	ER-AEN	31/03/1992	21/03/2001	Renan, Kishinev
Republic of South Africa	An-26	42-06	9U-BNO	28/07/1976	27/07/2004	Inter Sky Airline, Swaziland
Republic of the Congo	An-12	347003	3C-AAL	25/02/1970	25/05/2005	Trans Air Congo
Republic of the Congo	An-12	4341705	UN-11002	29/12/1963	15/03/2001	Trans Air Congo
Republic of the Congo	An-12	8345504	TN-AHD	31/03/1968	30/06/2004	Natalco Congo
Republic of the Congo	An-12	401912	3X-GDM	14/07/1964	06/07/2005	Aero-Service
Republic of the Congo	An-12	5343108	4L-12008	31/05/1965	18/02/2006	Aero Freight Partner
Republic of the Congo	An-12	402006	TN-AGK	29/11/1963	28/06/2006	Trans Air Congo
Republic of the Congo	An-26	86-02	9Q-CVR	31/08/1979	31/01/2004	Aviatrade Congo
Republic of Togo	An-12	2340606	S9DAF	30/08/1962	06/06/2001	unknown
Republic of Togo	An-12	1340206	TN-AHA	31/12/1961	Service not extended according to civil aviation documentation.	unknown
Republic of Togo	An-12	901306	TN-AGY	05/1960	Service not extended according to civil aviation documentation.	unknown
Republic of Togo	An-12	7345403	TN-AGZ	23/11/1967	09/1995	unknown
Republic of Togo	An-12	8345805	UN-11376	01/07/1968	Service not extended according to civil aviation documentation.	unknown
Sierra Leone	An-8	OG 3410	9L-LEO	23/06/1960	23/06/1995	unknown
Sierra Leone	An-12	5343408	9L-LEA	30/09/1965	22/12/1996	unknown
Sierra Leone	An-12	4341803	9L-LEA	02/1964	02/1999	unknown
Sierra Leone	An-12	2340805	9L-LDW	30/11/1962	29/08/2003	unknown
Sierra Leone	An-32	22-06	9L-LDO	22/12/1989	22/06/2003	unknown
Sudan	An-12	7345310	ST-ARV	25/12/1967	30/03/2006	Azza Transport
Sudan	An-12	9346504	ST-AQQ	30/06/1969	30/12/2003	Sudanese State
Sudan	An-26	102-05	ST-ARO	30/09/1980	30/09/2004	Ababeel
Sudan	An-28	1AJ004-06	ER-AIP	26/07/1988	26/07/1992	AU/AMIS
Sudan	An-28	1AJ004-07	ER-AJH	28/10/1987	28/10/1991	AU/AMIS
Sudan	An-28	1AJ004-08	ST-GWA	27/10/1987	27/10/1991	G. Wings, Poland
Sudan	An-28	1AJ0010-19	EK-28019	25/03/1992	25/03/1996	Badr Airlines
Surinam	An-28	1AI007-21	PZ-TSA	22/11/1990	22/11/1994	Blue Wing Airlines
Surinam	An-28	1AI007-10	PZ-TSV	18/01/1990	18/01/1994	Blue Wing Airlines
Surinam	An-28	1AI007-20	PZ-TSN	22/11/1990	22/11/1994	Blue Wing Airlines
Surinam	An-28	1AI008-04	PZ-TST	10/07/1990	10/07/1994	Blue Wing Airlines
Surinam	An-28	1AI007-17	PZ-TSO	02/04/1990	02/04/1994	Blue Wing Airlines
Uganda	An-12	7344801	3C-AAG	28/02/1967	28/03/2003	unknown
Venezuela	An-28	1AI009-11	28945	02/01/1991	02/01/1995	Angar 74
Venezuela	An-28	1AI007-15	28730	06/02/1990	06/02/1994	Angar 74
Venezuela	An-28	1AI007-12	28727	25/01/1990	25/01/1994	Angar 74

* Antonov said that 362 An-2 aircraft are being operated by 35 airlines in the Republic of Kazakhstan. In accordance with Decree No. 272, dated 30 November 2005, issued by the chairman of the Civil Aviation Committee of the Republic of Kazakhstan, rules for the extension of the service life of An-2 civil aviation aircraft in the Republic of Kazakhstan have been established with respect to overhaul periods. These rules provide for procedures for extension without the participation of the aircraft designer, which runs contrary to ICAO regulatory documents.

Source: International Civil Aviation Organization

Filling the Envelope

HOW RISKY ARE AVERAGE WEIGHTS?

BY PATRICK CHILES

The inaugural issue of *Aviation Safety World* carried an InSight column titled "One Size Fits All? The Danger of Average Weights" (July 2006, page 55). The author made a good case for requiring actual weights and seating control, but that solution would be impractical for many operators. While average weights may not reflect all passenger types, the risks of deviation were not considered in the proper context. There are methods by which we account for these variables, and they are described in the advisory circular cited by the author.[1]

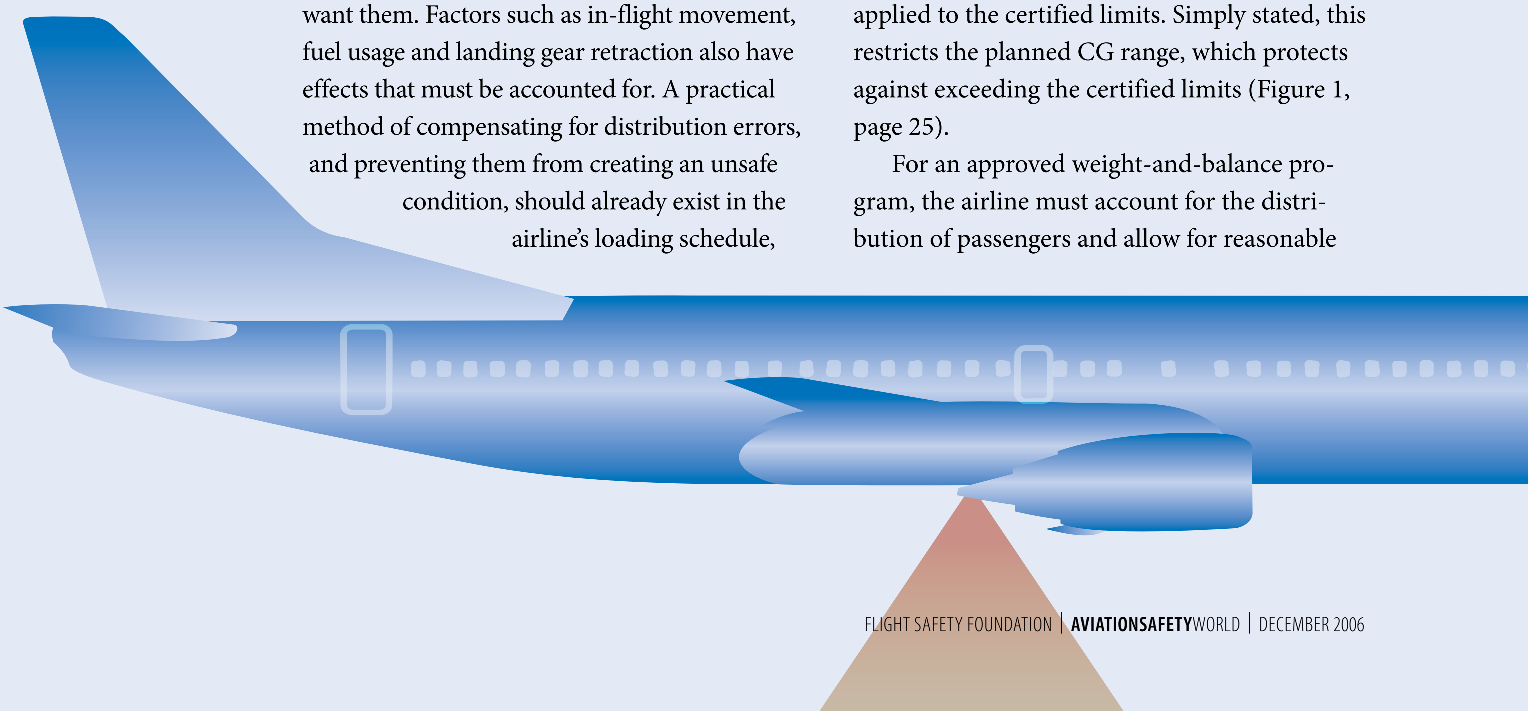
Potential errors in weight distribution are recognized and allowed for in a properly engineered loading envelope. It is not absolutely necessary to determine exact seating locations. Even when that's done, we can never be certain that people or their carry-ons will stay where we want them. Factors such as in-flight movement, fuel usage and landing gear retraction also have effects that must be accounted for. A practical method of compensating for distribution errors, and preventing them from creating an unsafe condition, should already exist in the airline's loading schedule, which typically includes a graphic depiction of the loading envelope and specific loading instructions.

Certified vs. Operational

It is important to recognize the fundamental difference between the manufacturer's certified limits and the airline's operating limits. The certified envelope provided in the aircraft flight manual (AFM) represents the approved safe limits for the airplane. However, it is not intended for use in actual load planning. The manufacturer's certified envelope by itself will not protect against center of gravity (CG) changes from inevitable loading variations. An operating envelope must be developed to account for this.

Probable deviations are accounted for by creating curtailments, or reductions, that are applied to the certified limits. Simply stated, this restricts the planned CG range, which protects against exceeding the certified limits (Figure 1, page 25).

For an approved weight-and-balance program, the airline must account for the distribution of passengers and allow for reasonable



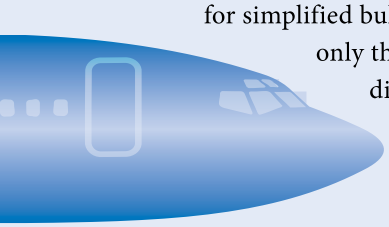
seating assumptions. One way of dealing with this is the "window-aisle-remaining" method. It assumes that window seats will be filled first, followed by aisle seats and middle seats, with worst-case moment changes calculated from the front and back. The potential variation from the cabin's centroid becomes the envelope curtailment and is subtracted from the certified forward and aft limits.[2] This protects against differences between planned and actual cabin centroids. Cabins frequently are subdivided into separate loading zones to further reduce potential error and to minimize reductions of the certified limits.

Curtailment for the in-flight movement of passengers and crewmembers depends on the same seating assumptions. The predicted magnitude of this movement places another limit on the loading envelope.

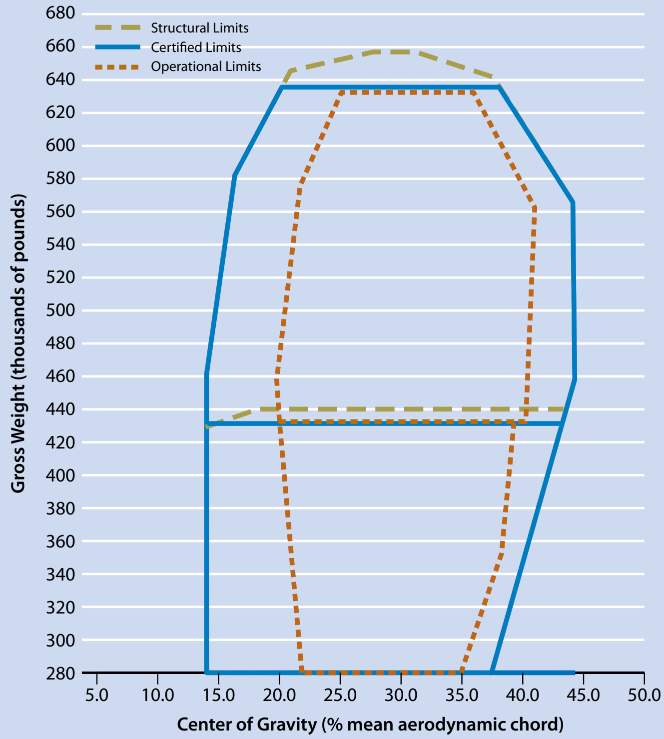
Cargo Loading Variation

The author's statement that "there are too many variables in how the baggage is loaded to allow for any reasonable predictions of probability" is inconsistent with common practice. Loading schedules account for the fact that baggage and cargo may not be distributed evenly. As with the cabin, cargo compartments can be subdivided into multiple zones with probable variations to each zone centroid applied to the new envelope.

Some curtailments are more complicated than others, and it is true that cargo variations are difficult to predict if the individual balance arms of each item are considered. The calculations must consider compartment design and other factors, such as whether the cargo is bulk-loaded or "containerized." For example, Boeing's single-aisle 737 and 757 are designed for simplified bulk-loading, requiring only that the bags are evenly distributed around the compartment centroid. Wide-body aircraft have more complex considerations for containerized loading and lateral imbalance.



Sample Certified vs. Operational Envelope



The horizontal lines at 430,000 to 440,000 lb gross weight are the zero fuel weight limits.

Source: Patrick Chiles

Figure 1

The Envelope, Please

Probable CG variations are determined by the airline's weight engineer and applied to the manufacturer's certified envelope. The resulting operational envelope will appear on the aircraft-specific weight-and-balance form, or loadsheet.

Loading schedules are commonly created by the manufacturers, airline engineering departments, or third-party vendors and completion centers. Pilots, dispatchers and load planners must be diligent to use a properly calculated loading schedule and operating envelope, and not confuse them with the manufacturer's certified envelope.

This does not relieve the operator of the responsibility to use the most realistic average weights available. For instance, while a 30-lb (14-kg) baggage allowance is "legal," an operator can use a higher weight allowance if it is believed to be more realistic. Likewise, the operator may

account for a higher ratio of male to female passengers and use the appropriate higher average weight. Operators should conduct their own passenger and baggage surveys if they believe the standard average weights are not appropriate.

With smaller aircraft, there are more opportunities for adverse effects from nonstandard weights. One solution is to use *segmented weights* as provided for in the advisory circular. This involves adding back part of the standard deviation to the average weight to improve the likelihood that actual weights won't exceed the new average.

Finally, average weights cannot be used when operating sports or military charters. Some type of actual-weight program must be used.

In Practice

The author's hypothetical airplane is similar to a 737-700 — 132 passengers, 200 bags, 118,000 lb (53,525 kg) zero fuel weight. Beginning with a fairly nose-heavy CG of 15 percent mean aerodynamic chord (MAC), the given worst-case forward passenger distribution would move the CG to 9.6 percent MAC. This is still within the airplane's certified limits.

Of greater concern are smaller operators that do not have engineering departments and mistakenly use the manufacturers' certified envelopes for load planning.

Of greater concern are smaller operators that do not have engineering departments and mistakenly use the manufacturers' certified envelopes for load planning. For example, consider a large airplane like a BBJ that has been loaded to within a few percent of the forward limit and has additional water tanks in the aft compartment that have not been filled or have faulty gauges. With 800–900 lb (363–408 kg) "missing" from the back end, the CG creeps forward. The airplane still is able to take off because AFM performance assumes the most forward limit. Soon, however, the CG will be pushed further forward when the landing gear and flaps are retracted. What happens then?

That's precisely why we have curtailments. Use of a good loading schedule helps prevent any of those variables from causing the airplane to exceed its envelope and become uncontrollable.

Magnitude of risk depends on the likelihood of a given event actually occurring. The author's probability model illustrates the intuitive notion that a particular error is less likely to occur as its severity increases. While it is possible that the worst-case distribution could happen, the given probability was 1 in $7.7\text{x}10^{160}$. Those are astronomically high odds, much higher than the recently reported 1 in $5.3\text{x}10^{7}$ probability of being involved in an airline accident.[3]

For passenger carriers, mandating the use of actual weights and distribution probably is not necessary or even practical. It also would reduce the magnitude of the envelope curtailments commonly used as a safety margin. If certified envelopes were used in daily operations, with no accounting for probable errors, weight and distribution errors would be much more dangerous. But in current use, envelope curtailments mitigate the risks well enough to operate safely. If the loading schedule is properly constructed and adhered to, it then becomes a matter of training our personnel and being vigilant for extreme loading conditions. Mandating an actual-weight/distribution program won't change that.●

Patrick Chiles is the technical operations manager for the NetJets Large Aircraft (BBJ) program and has been a member of the Flight Safety Foundation Corporate Advisory Committee since 2000.

Notes

1. U.S. Federal Aviation Administration. Advisory Circular 120-27E, *Aircraft Weight and Balance Control.* June 10, 2005.
2. The centroid is the center of gravity of an aircraft section, such as the cabin, when passengers and/or baggage are distributed evenly in the section.
3. U.S. National Transportation Safety Board. Press release SB-06-14, "NTSB Reports Increase in Aviation Accidents in 2005." March 2006.

InSight is a forum for expressing personal opinions about issues of importance to aviation safety and for stimulating constructive discussion, pro and con, about the expressed opinions. Send your comments about the author's call for computing aircraft CG based on the actual weights and distributions of passengers and baggage to J.A. Donoghue, director of publications, Flight Safety Foundation, 601 Madison St., Suite 300, Alexandria VA 22314-1756 USA.

MembershipUPDATE

Have you ever watched 873 people emerge from an airplane in 78 seconds?

No, we didn't think so … unless you were in Hamburg, Germany, last March or at the 59th annual International Air Safety Seminar in Paris, October 23–26. Attendees saw a video of the Airbus A380 evacuation trial — one of many interesting presentations.

By all accounts, the seminar was a huge success. More than 450 delegates from 53 countries attended. Flight Safety Foundation and its co-presenters, International Federation of Airworthiness and International Air Transport Association, would like to particularly thank this year's host committee for making the seminar possible:

Aer Lingus
Air France
Airbus
ATR
Aviation Safety Alliance
CFM
Dassault Aviation
DGAC
EADS
Eurocontrol
Eurocopter
GIFAS
Hamilton Sundstrand
KLM Royal Dutch Airlines
Rockwell Collins
Safran
Snecma
Swiss International Air Lines
TAP Portugal
TOTAL

During the IASS, Flight Safety Foundation and International Federation of Airworthiness presented awards to outstanding individuals and companies who have made the aviation industry safer. They were:

FSF President's Citation

Hans Almér, Saab Aircraft AB (retired)

Susan Coughlin,
Member, Board of Governors,
Flight Safety Foundation

Capt. Alex de Silva,
Singapore Airlines

Dmitry Kiva, General Designer,
Antonov Design Bureau

Vladimir Kofman, Flight Safety Foundation International

Anatoly Kolisnyk, Chairman,
SAA of Ukraine

Capt. Dan Maurino, International Civil Aviation Organization

Valery Shelkovnikov, Flight Safety Foundation International

James Terpstra,
Jeppesen (retired)

Edward R. Williams,
The Metropolitan Aviation Group

Richard Teller Crane Founder's Award

Embraer

Flight Safety Foundation–Boeing Aviation Safety Lifetime Achievement Award

Minister Yang Yuanyuan,
General Administration of
Civil Aviation of China

FSF Airport Safety Award

Airports Council International

Flight Safety Foundation–Airbus Human Factors in Aviation Safety Award

R. Curtis Graeber, Ph.D.,
Boeing Commercial Airplanes

Admiral Luis de Florez Flight Safety Award

J. Kenneth Higgins,
Boeing Commercial Airplanes

FSF Cecil A. Brownlow Publication Award

Larry Pynn,
Vancouver Sun

The Laura Taber Barbour Air Safety Award

Don Bateman,
Honeywell

IFA Whittle Award

Stuart Matthews,
Flight Safety Foundation

Grande Médaille d'Or de l'Aéro-Club de France

Stuart Matthews,
Flight Safety Foundation

If you would like more information on the Flight Safety Foundation award program, please visit our Internet site: <www.flightsafety.org/awards.html>. ●

— Ann Hill, director,
membership and development,
Flight Safety Foundation

PRESSING THE

BY BENJAMIN A. BERMAN AND R. KEY DISMUKES, PH.D.

June 1, 1999 — American Airlines Flight 1420 was seconds from landing at Little Rock, Arkansas, U.S., when the captain's view of the runway was obscured by heavy rain lashing the windshield. "I can't see it," he said, but the runway quickly reappeared. From 200 ft to the ground, he struggled against the thunderstorm's crosswinds to align the McDonnell Douglas MD-82 with the centerline, and the ground-proximity warning system (GPWS) produced two warnings of excessive sink rate. The first officer thought about telling the captain to go around, but if he spoke, his voice was too soft to be heard. Saturated with high workload during the last stages of the approach, the crew had forgotten to arm the jet's ground spoilers for automatic deployment and had not completed the last steps of the landing checklist, which included verification of the spoilers; consequently, braking performance was greatly degraded. During the landing rollout, the airplane veered left and right by as much as 16 degrees before departing the left side of the runway at high speed. The crash into the approach light stanchions at the far end of Runway 04R destroyed the airplane and killed 11 people, including the captain.[1]

March 5, 2000 — Runway 08 at Burbank, California, U.S., would have appeared very short and very far beneath the airplane as the captain nosed Southwest Airlines Flight 1455 down at a steep angle to try to land near the beginning of the 6,032-ft (1,840-m) strip. Air traffic control (ATC) had brought the Boeing 737-300 in high and fast, and there was a shearing tailwind aloft. As the captain looked at the situation on final approach, he thought he could make it; in quick succession, he called for gear and flaps to try to slow the 737. The first officer could see that the airplane was exceeding the limits for a stabilized approach. However, he said nothing because he could see that the captain was doing all he could to correct it. The jet landed near the normal touchdown point — but at 182 kt, the airspeed was more than 40 kt faster than the computed target speed. The pilots were unable to stop the airplane, and it crashed through a blast fence at the end of the runway, crossed a street and came to a stop near a service station. Two passengers were seriously injured, and the airplane was substantially damaged.[2]

Why did these experienced professional pilots make these errors? The U.S. National Transportation Safety Board (NTSB) concluded that the crews caused both accidents. It's true that the pilots' actions and errors led to the accidents — and that in the final moments they were in a position to prevent the crashes but did not. However, our recently completed U.S. National Aeronautics and Space Administration (NASA) study of these and 17 other recent accidents gives a different perspective on pilot error, and this perspective holds keys to making flights safer in the future.[3]

Our analysis suggests that almost all experienced pilots operating in the same environment in which the accident crews were operating, and knowing only what the accident crews knew at each moment of the flight, would be vulnerable to making similar decisions and errors. Our study draws upon growing scientific understanding of how the skilled performance of experts, such as airline pilots, is driven by the interaction of moment-to-moment task demands, the availability of information and social/organizational factors with the inherent characteristics and limitations of human cognitive processes. Whether a particular crew in a given situation makes errors depends as much, or more, on this somewhat random interaction of factors as it does on the individual characteristics of the pilots.

Flights 1420 and 1455 came to grief, in part, because of two of the most common themes in the 19 accidents studied: plan continuation bias — a deep-rooted tendency of individuals to continue their original plan of action even when changing circumstances require a new plan — and snowballing workload — workload that builds on itself and increases at an accelerating rate. Although other factors not

© Scroggins Aviation/Jetphotos.net

APPROACH

A NASA study of 19 recent accidents yields a new perspective on pilot error.

© Joe Pries–ATR Team/Airliners.net

discussed here played roles in these accidents, the problems encountered by the crews seem to have centered on these two themes.

Plan Continuation Bias

The pilots of Flight 1420 were aware from the outset that thunderstorms could affect their approach to Little Rock. Before beginning the approach, they saw lightning and rain near the airport, and they used on-board weather radar to identify a thunderstorm cell northwest of the field. At that point, the crew had no way of knowing whether they could land before the thunderstorm arrived.

Later, as Flight 1420 continued its approach, the pilots received a series of ATC radio transmissions suggesting that the thunderstorm was beginning to affect the airport: reports of shifting winds, gusts, heavy rain and low visibility. In hindsight, assembling all the cues that were available to the crew, one can readily infer that the thunderstorm had arrived at the airport. Yet the crew of Flight 1420 persevered, accepting a change of runways to better accommodate the winds, attempting a close-in visual approach to expedite their arrival, and then, as conditions continued to deteriorate, changing to an instrument landing system (ILS) approach and

Radar Data and Partial Air Traffic Communication

Southwest Airlines Flight 1455, March 5, 2000, Burbank, California, U.S.

MM = Middle marker OM = Outer marker SOCAL = Southern California Approach Control

Source: U.S. National Transportation Safety Board

Figure 1

pressing that approach to a landing instead of executing a missed approach.

Similarly, the pilots of Flight 1455 tried to cope in a situation in which their airplane was obviously high and fast, and they continued their approach despite numerous cues that landing safely would be challenging (Figure 1). For example, 1,000 ft above touchdown elevation, where company operating procedures specified that flights should be stabilized, this flight was unstabilized, far above the glide path, more than 50 kt too fast and descending at more than three times the desired rate; flaps were at the approach setting because of excessive airspeed, and idle thrust was set. Below 1,000 ft, the GPWS repeatedly annunciated "SINK RATE" and "PULL UP," and the approach remained highly unstabilized through touchdown.

Too often, pressing an approach in these circumstances is attributed to complacency or an intentional deviation from standards, but these terms are labels, not explanations. To understand why experienced pilots sometimes continue ill-advised approaches, we must examine the insidious nature of plan continuation bias.

Plan continuation bias appears to underlie what pilots call "press-on-itis," which a Flight Safety Foundation task force found to be involved in 42 percent of accidents and incidents they reviewed.[4] Similarly, this bias was apparent in at least nine of the 19 accidents in our study. Our analysis suggests that this bias results from the interaction of three major components: social/organizational influences, the inherent characteristics and limitations of human cognition, and incomplete or ambiguous information.

Safety is the highest priority in commercial flight operations, but there is an inevitable trade-off between safety and the competing goals of schedule reliability and cost effectiveness. To ensure conservative margins of safety, airlines establish written guidelines and standard procedures for most aspects of operations, including specifications for minimum clearance from thunderstorms and criteria for stabilized approaches. Yet considerable evidence exists that the norms for actual flight operations often deviate considerably from these ideals, in ways that are strikingly similar to Flights 1420 and 1455.[5,6,7]

Our study suggests that, when standard operating procedures are phrased not as requirements but as strong suggestions that may appear to tacitly approve of bending the rules, pilots may — perhaps without realizing it — place too much importance on schedule and cost when making safety/schedule/cost tradeoffs. Also, pilots may not fully understand why guidance should be conservative; that is, they may not recognize that the cognitive demands of recovering an airplane from an unstabilized approach severely impair their ability to assess whether the approach will work out. For all these reasons, many pilots, not just the few who have accidents, may deviate from procedures that the industry has set up to build extra safety into flight operations. Most of the time, the result of these deviations is a successful landing, which further reinforces deviant norms.

Our study suggests that as pilots amass experience in successfully deviating from procedures, they unconsciously recalibrate their assessment of risk toward taking greater chances. This recalibration is abetted by a general tendency of individuals to risk a severe negative outcome of very low probability — such as the very small risk of an accident — to avoid the certainty of a much less serious negative outcome — such as the inconvenience and the loss of time and expense associated with a go-around.

Another inherent and powerful human cognitive bias in judgment and decision making is expectation bias — when someone expects one situation, he or she is less likely to notice cues indicating that the situation is not quite what it seems. Having developed expectations that the thunderstorm had not yet reached the airport (Flight 1420) and that the descent and approach profile was manageable (Flight 1455), the crews in these accidents may have become less sensitive to cues that reality was deviating from their mental models of the situation.

Expectation bias is worsened when crews are required to integrate new information that arrives piecemeal over time in incomplete, sometimes ambiguous, fragments. Human working

Many pilots, not just the few who have accidents, may deviate from procedures that the industry has set up to build extra safety into flight operations.

memory has extremely limited capacity to hold individual chunks of information, and each piece of information decays rapidly from working memory. Further, the cognitive effort required to interpret and integrate these fragments can reach the limits of human capacity to process information under the competing workload of flying an approach.

The crew of Flight 1420 had to make inferences about the position of the thunderstorm and the threat it presented by using information obtained from their view through the windshield, cockpit radar, automatic terminal information service (ATIS) information and a series of wind reports from ATC spread over time. The information available from these sources was incomplete and ambiguous; for example, the weather radar was pointed away from the thunderstorm for several minutes while the flight was being vectored, and in any case, this radar does not delineate the wind field extending from a thunderstorm.

The situation facing the crew of Flight 1455 may seem to have been obvious from several miles before touchdown, as the 737 joined the final approach course above the glideslope at a very fast airspeed. But although the excess energy — in the form of altitude and speed — was apparent, it was not at all clear that the approach could not be stabilized in time for a safe landing. No display in any airline cockpit directly indicates or projects the energy status of the aircraft all the way to the stopping point on the runway; thus, the pilots had to continuously observe cues about the gradient path to the runway, airspeed, pitch attitude, altitude and thrust, and integrate them with other factors that were not displayed — lift, drag and braking performance — to update their understanding of the situation.

Snowballing Workload

Errors that are inconsequential in themselves have a way of increasing crews' vulnerability to further errors and combining with happenstance events — with fatal results. By continuing the unstabilized approach, the captain of Flight 1455 increased the crew's workload substantially. Getting the aircraft configured and down to the glideslope made strong demands on the pilots' attention — a very limited cognitive resource. The high speed of the aircraft (197 kt), with a 2,624 foot-per-minute descent rate, increased the rate of events and reduced the time available for responding. This situation would produce stress, and acute stress narrows the field of attention ("tunneling") and reduces working memory capacity.

An airplane that landed ahead of Flight 1455 was slow clearing the runway — another development that placed demands on the crew's attention. These factors combined to impair the crew's ability to monitor all relevant flight parameters and to determine whether they could land the airplane safely. In post-accident interviews, the captain said that he had no idea the airspeed was so fast. Also, the snowballing workload made it less likely that the pilots would remember that the assigned runway was considerably shorter than the runways they were accustomed to and recognize the implications.

Similarly, the decision of the crew of Flight 1420 to continue the approach in the face of challenging weather substantially increased their workload. After the accident, the first officer told investigators, "I remember that around the time of making the base-to-final turn, how fast and compressed everything seemed to happen." Undoubtedly, this time compression and the high demands on the crew's attention contributed to their forgetting to arm the spoilers and to complete the landing checklist. Also, the pilots had been awake more than 16 hours at the time of this approach, and they were flying at a time of day when they were accustomed to sleeping. Among the effects of fatigue are slowing of information processing and narrowing of attention. The combination of fatigue, the stress of a challenging approach and heavy workload can severely undermine cognitive performance.

A particularly insidious manifestation of snowballing workload is that it pushes crews into a reactive, rather than proactive, stance. Overloaded crews often abandon efforts to think ahead of the situation strategically, instead simply responding to events as they occur and failing to ask, "Is this going to work out?"

Implications and Countermeasures

Simply labeling crew errors as "failure to follow procedures" misses the essence of the problem. All experts, no matter how conscientious and skilled, are vulnerable to inadvertent errors. To develop measures to reduce this vulnerability, we first must understand its basis in the interaction of task demands, limited availability of information, sometimes conflicting organizational goals and random events with the inherent characteristics and limitations of human cognitive processes. Even actions that are not inadvertent, such as continuing an unstabilized approach, must be understood in this context.

Almost all airline accidents are system accidents. Human reliability in the system can be improved — if pilots, instructors, check pilots, managers and the designers of aircraft equipment and procedures understand the nature of vulnerability to error. For example, monitoring and checklists are essential defenses, but in snowballing-workload situations, when these defenses are most needed, they are most likely to be shed in favor of flying the airplane, managing systems and communicating. Monitoring can be made more reliable, though, by designing procedures that accommodate the workload and by training and checking monitoring as an essential task, rather than as a secondary task.[8] Checklist use can be improved by explaining the cognitive reasons that effectiveness declines with extensive repetition and showing how this can be countered by slowing the pace of execution to be more deliberate, and by pointing to or touching items being checked.

We also must accept that some variability in skilled human performance is inevitable and put aside the myth that because skilled pilots normally perform a task without difficulty, they should be able to perform that task without error 100 percent of the time.

Although plan continuation bias is powerful, it can be countered once acknowledged. One countermeasure is to analyze situations more explicitly than is common among crews. This would include explicitly stating the nature of the threat, the observable indications of the threat and the initial plan for dealing with the threat. Crews then should explicitly ask, "What if our assumptions are wrong? How will we know? Will we know in time?" These questions are the basis for forming realistic backup plans and implementing them in time, but they must be asked before snowballing workload limits the pilots' ability to think ahead.

Airlines should periodically review normal and non-normal procedures and checklists for design features that invite errors. Examples of correctable design flaws are checklists conducted during periods of high interruptions, critical items that are permitted to "float" in time (e.g., setting takeoff flaps at an unspecified time during taxi) and actions that require the monitoring pilot to go "head-down" during critical periods, such as when a taxiing airplane nears a runway intersection.

Operators should carefully examine whether they are unintentionally giving pilots mixed messages about competing goals such as stabilized approaches versus on-time performance and fuel costs. For example, if a company is serious about compliance with stabilized approach criteria, it should publish, train and check those criteria as hard-and-fast rules rather than as guidelines. Further, it is crucial to collect data about deviations from those criteria — using flight operational quality assurance (FOQA) and line operations safety audits (LOSA) — and to look for organizational factors that tolerate or even encourage those deviations.

These are some of the ways to increase the reliability of human performance on the flight deck, making errors less likely and helping the system recover from the errors that inevitably occur. This is hard work, but it is the way to prevent accidents. In comparison, blaming flight crews for making errors is easy, but ultimately ineffective. ●

Benjamin A. Berman is a senior research associate at the U.S. National Aeronautics and Space Administration (NASA) Ames Research Center/San Jose State University and a pilot for a major U.S. air carrier. R. Key Dismukes, Ph.D., is chief scientist for aerospace human factors in the Human Factors Research and Technology Division at the NASA Ames Research Center.

Notes

1. U.S. National Transportation Safety Board (NTSB). *Runway Overrun During Landing, American Airlines Flight 1420, McDonnell Douglas MD-82, N214AA, Little Rock, Arkansas, June 1, 1999*. NTSB report no. AAR-01-02.

2. NTSB. *Southwest Airlines Flight 1455, Boeing 737-300, N668SW, Burbank, California, March 5, 2000*. NTSB report no. AAB-02-04.

3. Dismukes, R.K.; Berman, B.A.; Loukopoulos, L.D. (in press). *The Limits of Expertise: Rethinking Pilot Error and the Causes of Airline Accidents*. Aldershot, U.K.: Ashgate.

4. Flight Safety Foundation (FSF). "Killers in Aviation: FSF Task Force Presents Facts About Approach-and-Landing and Controlled-Flight-Into-Terrain Accidents." *Flight Safety Digest* Volume 17 (November–December 1998) and Volume 18 (January–February 1999).

5. Rhoda, D.A.; Pawlak, M.L. *An Assessment of Thunderstorm Penetrations and Deviations by Commercial Aircraft in the Terminal Area*. Massachusetts Institute of Technology, Lincoln Laboratory, Project Report NASA/A-2. (1999).

6. NTSB. *Flight Into Terrain During Missed Approach, USAir Flight 1016, DC-9-31, N954VJ, Charlotte/Douglas International Airport, Charlotte, North Carolina, July 2, 1994*. NTSB report no. AAR-95-03.

7. Chidester, T.R. "Progress on Advanced Tools for Flight Data Analysis: Strategy for National FOQA Data Aggregation." Paper presented at Shared Vision of Flight Safety Conference. San Diego, California, U.S. 2004.

8. Sumwalt, R.L. III; Thomas, R.J.; Dismukes, R.K. "Enhancing Flight-Crew Monitoring Skills Can Increase Flight Safety." In *Keeping Safety a Worldwide Priority: Proceedings of the 55th International Air Safety Seminar*. Alexandria, Virginia, U.S.: Flight Safety Foundation, 2002.

Auditing Human

BY DAROL HOLSMAN

Looking at how aviation departments managed their operational personnel, the Flight Safety Foundation (FSF) Audit team found that 14 of the 20 departments audited — 70 percent — had no administrative tracking of crew duty or rest deviations from flight operations manual (FOM) standards.

The team recommended that the departments develop a deviation tracking form to record all FOM exceptions and require its use by all staff and line personnel. The forms should be available and compiled at one designated location such as the scheduling office. Staff at that location would track all crew duty or rest deviations caused by corporate requirements.

The department should review deviation reports quarterly to verify that nonstandard operations are not becoming the norm in operations planning, and, if the deviations become excessive, evaluate the FOM standards for possible revision.

© Chris Sorensen Photography

Management

Operators in seven of the audits — 35 percent — did not have any days off or vacations scheduled in advance, a situation that adversely affects the staff's quality of life.

The FSF Audit Team recommended that the departments analyze their pilot requirements for the flight operation and determine if existing manpower meets the scheduling requirements. If not, sufficient pilots should be hired to meet those requirements.

In conducting this analysis, consideration should be given to training, vacation, days off and illness for all personnel. Vacation plans should be submitted six to 12 months in advance. On the other hand, the department should provide advance notice of scheduled days off to enhance the quality of life for crewmembers. Finally, at the end of the year, management should assess the staff's opinion of the effectiveness of the scheduling process.

Operators did not make full use of the capability of their computer-based scheduling program in seven of the 20 audits.

Departments should evaluate the full capability of the computer-based scheduling program, the team recommended, and analyze the specific needs of the flight operations to determine if the existing scheduling program can be used to meet requirements.

Once a good program is found in place or is obtained, the department should use the scheduling program to develop management reports and to alert the scheduling office when pilots do not meet recent flight experience requirements, are due for a check ride and when scheduling conflicts exist. Training programs for department personnel should be coordinated by the scheduling office to maximize the use of the computer-based scheduling program.

In 40 percent of the audits — eight departments — the team found that the operator had not developed a consistent pattern of pilot line checks or standardization checks.

The only effective means for an operator to verify the implementation of standard operating procedures (SOPs) is through the use of a third pilot observing the cockpit activities. The industry best practice is to conduct annual pilot line or standardization checks.

Line or standardization checks should be recorded on an appropriate form, with both the examiner and the evaluated pilot signing the form. The form should be filed in the pilot's training record. The FSF Audit Team also suggested that departments consider conducting line or standardization checks while observing pilots in a simulator.

In seven departments — 35 percent of the total — the team found either a lack of aircraft type-specific SOPs or SOPs that were not fully developed.

The development and implementation of SOPs is a proven safety enhancement program that all operators should adopt. The SOPs should define each critical step and pilot action during the operation of an aircraft, from preflight to postflight.

The Audit Team recommended that departments contact other operators of the type of aircraft in their company's fleet to determine if they have developed SOPs that can be used to guide the development of in-house SOPs. Some OEM pilot handbooks can serve as valuable resources for SOPs, the audit team believes.

Specific aircraft-type SOPs should be published as a separate appendix in the FOM.

Pilots should be trained on SOPs during their initial training in an aircraft and closely monitored for their adherence to the standards during pilot check rides. ●

This article extends the discussion of the aviation department problems most frequently found by the FSF Audit Team, based on the final reports submitted to clients that contracted for operational safety audits during 2004, detailing the observations, findings and recommendations identified during the review (Aviation Safety World, Sept. 2006, page 46). Observations are documented policies, procedures and practices that exceed the industry best practices; findings identify areas in which the team advises the client to adopt better policies, procedures or practices to parallel industry best practices; and recommendations describe actions that could be taken by the client to meet industry best practices. The recommendations cited in this story are the opinions of the FSF Audit Team.

Thorn Airfield Lighting

BREAK, DISTORT or YIELD

Updated approach lighting system standards address risks during the 100-millisecond impact of an airplane.

BY WAYNE ROSENKRANS

© Antti Salo/Airliners.net

If an airplane strikes an approach lighting system (ALS), the severity of aircraft damage and likelihood of occupant injuries primarily depend on the ALS design. With this in mind, a 25-year-old ALS safety initiative this year produced its final product: *Frangibility,* Part 6 of the International Civil Aviation Organization (ICAO) *Aerodrome Design Manual.* The new part covers not only ALS but many other visual and nonvisual navigation aids installed by necessity within airport operational areas.

ICAO defines a frangible object as having "low mass designed to break, distort or yield so as to present the minimum hazard to aircraft." A frangible ALS design can involve lightweight materials, intentionally brittle or weak structural members and/or connections, and proven break-away or failure mechanisms such as disintegration during impact.

Design engineers in several countries began cooperating in the 1970s on reducing the hazards of aircraft–ALS collisions. Part 6 of the ICAO manual reflects their extensive full-scale dynamic testing of ALS designs in the early 1990s and a series of dynamic tests and computer simulations from 1998 through 2004.

A frangible ALS can reduce outcome severity in scenarios such as the December 2000 incident in which a Delta Air Lines McDonnell Douglas–Boeing MD-90 landed short of the threshold of Runway 34R during an instrument landing system (ILS) approach in poor weather at Salt Lake City International Airport. No injuries occurred; the left main wheel splash guard was damaged, the no. 2 tire was cut, a 1-inch square (6.5 sq cm) piece of metal was lodged in the left engine noise-suppression material, and the left engine fan section was damaged. FAA's incident report said, "Upon reaching the gate, the captain notified the control tower that he had 'possibly touched down short of the runway.' … Subsequent inspection revealed debris on Runway 34R. The airplane [had] struck the approach lights 400 ft [122 m] short of the runway. Two threshold lights and one light each from the 100-ft [30-m]

Exel Oyj

and 200-ft [61-m] approach light bars were found knocked off.”

Global accident and incident records show that aircraft–ALS collisions have directly and indirectly caused fatalities. For example, after the June 1999 American Airlines Flight 1420 overrun accident involving an MD-82, the U.S. National Transportation Safety Board (NTSB) said, “The FAA determined that the Runway 22L [ALS] at Little Rock [Arkansas], which is located in a flood plain area of the Arkansas River, could not be retrofitted to a frangible design because of the possibility that moving water, ice and floating debris would affect the structural integrity of the system. … The airplane’s collision with the nonfrangible lighting system was the direct cause of the fatal blunt-force-trauma injuries sustained by the captain and the passengers in seats 3 and 8A and [damage; see related article on page 28] on the left side of the fuselage.”

One example of loss of control following an aircraft–ALS collision occurred in May 2002, when six crewmembers, 67 passengers and 30 people on the ground were killed; one passenger, one crewmember and 24 people on the ground were seriously injured; and the aircraft and more than 25 buildings were destroyed by impact and post-impact fire after a British Aerospace BAC One-Eleven Series 500 operated by EAS Airlines struck approach lights during takeoff from Kano Airport, Nigeria, according to Ascend. The following occurrences, which involved no injuries to aircraft occupants, also were reported by Ascend:

- In April 2004, the flight crew of an Airbus A340-310 operated by Emirates overran Runway 21R on takeoff at Jan Smuts International Airport, Johannesburg, South Africa, continued through the approach lights for about 150 m (492 ft) — during which three tires burst and the flaps were jammed in the takeoff position — and completed the takeoff; they jettisoned fuel, and four more tires failed during landing at the departure airport.
- In June 2004, the aircraft received minor damage when an A300 B4-200 operated by EgyptAir overran Runway 18 at Khartoum (Sudan) Airport and traveled through the ALS onto rough ground.
- In January 2005, a Boeing 747-200F operated by Atlas Air overran Runway 23L at Düsseldorf (Germany) International Airport and struck the ALS and the instrument landing system (ILS) before coming to a stop.

ALS Installations Vary

Dr. Ir. Jaap Wiggenraad, a research engineer who has specialized in ALS frangibility research and business manager of the Aerospace Vehicles Division of National Aerospace Laboratory (NLR)–Netherlands, considers the most relevant advance of 2006 to be increased awareness of the need for frangible ALS installations. “Awareness also applies to other structures at airports such as ILS towers — the key is lightweight design, whereas the tendency was to build robust structures to withstand weather, vandalism, abuse, etc.,” Wiggenraad said.

NLR has observed significant variation among frangible ALS designs that comply with current standards and among those that do not. “I think a few providers exist in Canada, Finland, the United States, Germany and Norway, each with a different concept,” Wiggenraad said. “In many Western countries, frangible systems have already been placed. Elsewhere, you may find improvised, locally constructed systems.”

A European company that tracks airport compliance with frangible ALS standards also sees room for improvement in some regions. “Part 6 requirements differ quite a lot from the [ICAO] 1991 Interim Guidance on Frangibility, [and] some installations which conformed to interim guidance may not comply with Part 6 [— such as in] new limitations [on] frangible behavior of a mast,” said Jaakko Martikainen, sales manager, airport products, for Exel Oyj, a manufacturer of ALS poles and lattice-type masts based in Finland. Specifically, earlier designs with relatively long distances between frangible points in their break-away or failure mechanisms may not comply, he said. “We have estimated that some 85 to 90 percent of European and North American airports have been upgraded,” Martikainen said. “Outside of these [regions], the overall percentage is far below 50 percent, with some positive exceptions. We are talking about quite large numbers that require replacement.”

Early frangible ALS designs can be traced to FAA research during the 1970s. “These structures consisted of hollow poles made of aluminum or glass/epoxy, aluminum truss structures and an aluminum tripod structure of an originally Swedish design,” one report said. “Initial engineering analysis suggested that the important parameters required to define frangibility were the peak force occurring during the impact, the energy absorbed during the contact period and the duration of the impact.”[1]

ICAO’s Frangible Aids Study Group — formed in 1981 with members from Airports Council International, Canada, The Netherlands, the United Kingdom and the United States who last met in 1998 and 2003 — was

Exel Oyj

disbanded upon completion of Part 6, according to Sue-Ann Rapattoni, an ICAO spokeswoman, although related standards were implemented on earlier dates as specified in Annex 14, Volume 1, *Aerodromes.* States were expected to comply with a protection date of Jan. 1, 2005, for their existing elevated approach lights. "The new [design] guidance took effect in June 2006," she said.

Closely associated with several ICAO annexes, Part 6 has been written to reduce the risk of an accident primarily by making the ALS "frangible and mounted as low as possible to assure that impact will not result in loss of control of the aircraft." ICAO's goal is to help states implement Part 6 specifications so that guidance on design is applied uniformly, Rapattoni said. The following excerpts summarize the key concepts of a frangible ALS:

- "A frangible structure should … break, distort or yield readily when subjected to the sudden collision forces of a 3,000-kg [6,614-lb] aircraft airborne and traveling at 140 km/h (75 kt) or moving on the ground at 50 km/h (27 kt). … To allow the aircraft to pass, the failure mode of the structure should be one of the following: fracture; windowing [opening a space]; or bending."

- "Elevated approach lights and their supporting structures should be frangible except that, in that portion of the approach lighting system beyond 300 m [984 ft] from the threshold, where the height of a supporting structure exceeds 12 m [39 ft], the frangibility requirement should apply to the top 12 m only; and where a supporting structure is surrounded by nonfrangible objects, only that part of the structure that extends above the surrounding objects should be frangible."

- "The location of break-away or failure mechanisms should be such that disintegration results in components of predictable mass and size, which, in case of secondary impact, do not present a greater hazard [to the aircraft] than they present as part of the undamaged structure."

- "The design materials selected should preclude any tendency for the components, including the electrical conductors, etc., to 'wrap around' the colliding aircraft or any part of it. … After a collision, the structure should not become entangled with the aircraft in a manner that will prevent the aircraft from maneuvering safely either in flight or on the ground. … In the case of towers that may be impacted by airborne aircraft, it is desirable to not only minimize the amount of damage to the aircraft but also to not significantly impede the flight trajectory."

- "It is recommended that [electrical] conductors be designed such that they do not rupture but break at predetermined points within the limits for frangibility of the structure. … In addition, the connectors should be protected by a break-away boot … to contain any possible arcing at disconnection."

Among influences on Part 6 was a study published in 2004 by National Research Council Canada (NRCC), comparing full-scale dynamic impact testing of airport approach lighting towers using truck-mounted impactors with computer simulation. "The objective … was to simulate the transient dynamic impact," said the report. "There was good correlation between deformation mode, location and timing of failure, impact force and energy absorption curves obtained from full-scale test results and simulation. Evaluation of the model showed that it was computationally stable, reliable and repeatable."[2]

David Zimcik, Ph.D., one of the NRCC researchers, in April 2006 noted that computer simulation reduces costs. "Dynamic testing is expensive and dangerous; it's also difficult because there are so many parameters to investigate," Zimcik said. "The analytic tools we're developing allow us to become proactive — to design in [frangibility] as opposed to [designing] after-the-fact, so that fewer tests are required. Airplanes do hit towers. We wanted to understand the phenomena so we could design a safer tower. That was the driver." As a result of such studies, Part 6 allows validated computer simulation of aircraft–ALS collisions to prove frangibility.

Advisory Circular Update

A few months after Part 6 was published, FAA issued an advisory circular (AC) embodying the current state of U.S. and ICAO research and experience in the agency's ALS Improvement Program (ALSIP), which began in 1978. The Airport Engineering Division issued AC 150/5345-45B, *Low-Impact Resistant (LIR) Structures,* on Sept. 5, 2006. "The most significant advance is the work being done toward the approval of the use of frangible bolts for anchoring devices," said Paul Takemoto, an FAA spokesman. "FAA intends to use the force and energy standards in Part 6 in establishing performance standards for the approval of frangible bolts, called 'fuse bolts' in Part 6."

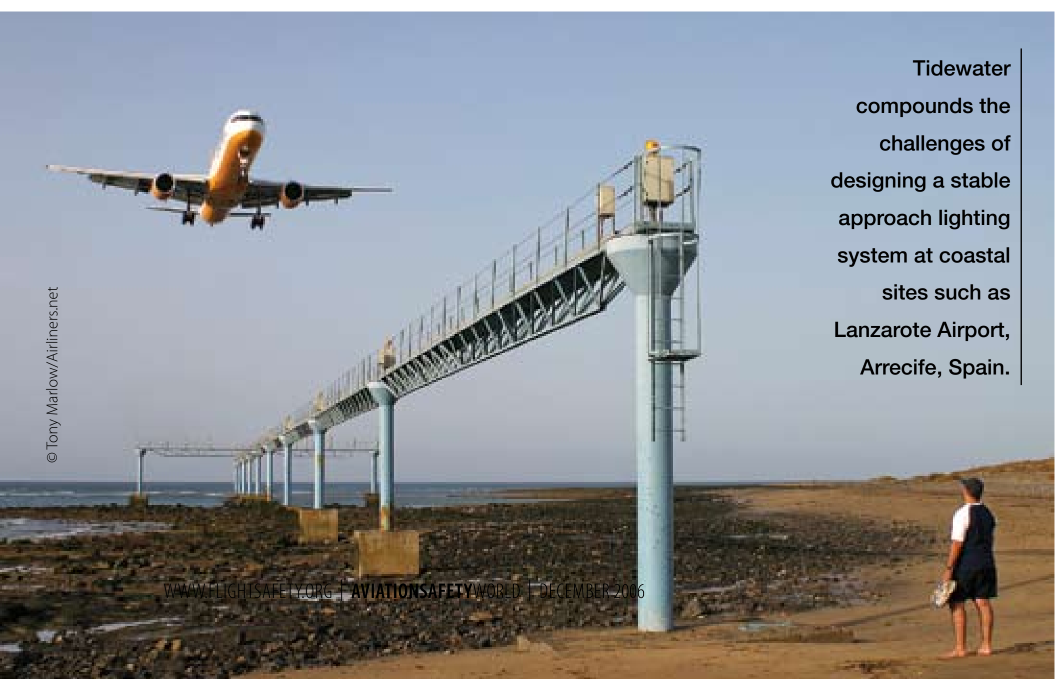
FAA's current standard equipment for Category III approaches is a dual-mode high-intensity approach lighting system with sequenced flashing lights model 2 (ALSF-2)/simplified short approach lighting system with runway-alignment indicator lights (SSALR), which enables air traffic controllers to operate the system in the energy-saving SSALR mode during Category I or II conditions. Today's ALSIP projects involve either total ALS replacement or a new installation, although a few salvaged components may be refurbished as spare parts for older ALS equipment still in service. "The cost for the complete replacement of a 2,400-ft long [732-m] medium-intensity approach lighting system with runway-alignment indicator lights (MALSR) starts at US$750,000 with the more complicated ALSF-2 starting at $1.5 million," Takemoto said.

FAA sometimes has attributed variation in ALSIP project completion to funding limitations and the nature of expenditures in the field. "The bulk of the costs involves construction to replace unreliable underground power cables and control lines, new foundations, [engine-powered] back-up generators and other infrastructure requirements based on local site conditions," Takemoto said. "A typical low-impact-resistant structure fiberglass pole with base plate mounting on break-away anchor bolts and light crossbar costs approximately $2,000 for the hardware. That would [total] $22,000 if all the MALSR support structures beyond 600 ft [183 m] from threshold were a nominal 20 ft [6 m] tall. If the terrain drops off, the hardware for [each of] the 40-ft [12 m] fiberglass poles can cost $4,500."

Ongoing research also addresses what NTSB has classified as FAA's "open acceptable response" to a safety recommendation left from the Little Rock investigation: that frangible ALS designs be developed as soon as technology allows for sites with exceptionally difficult design challenges, such as flood plains. "FAA design engineers consider the installation of fiberglass pole LIR structures in flood plains wherever practical," Takemoto said. "Several years ago, the ALSF-2 in Chattanooga, Tennessee, survived [except for some ground-level electronic equipment] when many of the fiberglass pole approach light supports were subjected to significant flooding. In the last two years, the FAA completed … 24 MALSR and eight ALSF-2 improvement projects [under ALSIP]. An additional nine MALSR and 11 ALSF-2 projects were completed [to establish new service]."

One clue to other near-term U.S. research is a $300,000 grant by the Airport Cooperative Research Program of the Transportation Research Board of the National Academies. The announcement said, "The [fiscal year 2007 ALS] research will explore and identify nonmetallic, all-composite construction with sufficient durability [for] sustainability, yet optimize frangibility through engineered fragmentation to specific energy forces; identify design options and possible solutions of an in-pavement automated de-energizing sensor/trigger to immediately cut all electrical power downstream when traversed by aircraft within the runway safety area; and equip [ALS] with [an] indicator pilot light for emergency responders to rapidly assess the power status of the system."

Also on the horizon are concepts for installing next-generation ALS flush with the ground. "The implementation of in-pavement ALS has great potential to improve runway safety," Takemoto said. "Future studies include the technical evaluation of light-emitting diodes for use on above-ground and inside-semi-flush approach lighting fixtures. Semi-flush approach lighting fixtures are very useful as airports extend their runways and move thresholds/runway ends closer to the perimeter of their property." ●



© Tony Marlow/Airliners.net

Tidewater compounds the challenges of designing a stable approach lighting system at coastal sites such as Lanzarote Airport, Arrecife, Spain.

Notes

1. Wiggenraad, Jaap F.M.; Zimcik, David G. "Frangibility of Approach Lighting Structures at Airports." National Aerospace Laboratory (NLR)–Netherlands. NLR-TP-2001-064, Feb. 13, 2001.
2. Zimcik, D.G.; Ensan, M. Nejad; Jenq, S.T.; Chao, M.C. "Finite Element Analysis Simulation of Airport Approach Lighting Towers." *Journal of Structural Engineering*, May 2004.

Saving an Airport With Safety

BY JAMES K. COYNE

© Copyright Nick Onkow

Teterboro Airport (TEB), the primary New Jersey-based general aviation airport serving the New York metropolitan area, has long been a case study in confrontational aviation dynamics. Local politicians, media and citizens groups watch every new development at the airport like a hawk, and when something goes wrong, they're ready to attack.

From day to day, the issue might be aircraft noise, nighttime operations, pollution, traffic congestion, terrorism risks, the threat of unwanted commercial service or just the general not-in-my-backyard opposition that so many urban airports face. Last year, the *casus belli* — the issue at the heart of the conflict — was aviation safety.

© Copyright David Almy

James K. Coyne, president of the National Air Transportation Association, presented the safety program to the press and community representatives.

A heavily loaded Bombardier Challenger failed to climb after takeoff from Runway 06, crossed a busy highway, struck several cars and careened into a nearby warehouse. Network television cameras were there in minutes; within hours, local politicians were demanding that the airport be closed or, at a minimum, that the number of flights and operations be limited. Their message was simple: If there are fewer flights at Teterboro, there will be fewer accidents — and no flights would be even better!

The airport's safety record over the past decade or so is, in fact, quite good. The Port Authority of New York and New Jersey, the airport operator, spares no expense in keeping facilities up to date, and since most users of Teterboro are corporate and commercial operators whose aircraft are professionally flown, the equipment and crews are typically first-rate. Still, the airport's opponents had a point: The status quo wasn't good enough.

By late 2005, the Teterboro Airport Industry Working Group was formed with the help of the Port Authority and several national aviation associations to seek a community-wide solution to the challenges the airport faced. The goal, simply put, was that Teterboro should be the safest general aviation airport in the nation — a tough goal for any airport, let alone one as complex as Teterboro.

In October 2006, airport and Port Authority officials, local politicians and representatives of the four major general aviation associations joined aircraft operators to present formal pledges to improve operations and enhance safety. No general aviation airport in the United States has ever taken such a step; time will tell if such a collaborative safety program is a model for other airports. There's no doubt, however, that a successful airport-based safety program is an essential part of Teterboro's future.

From this point on, it was declared, managing safety shall be a fundamental business goal for every business operator at Teterboro. Like any management goal, success will only come if there is commitment. Thus, the new Teterboro Safety Initiative began with the most basic demonstration of commitment that the participants can make: A promise.

Having said that, the content of the promise needed to be settled.

The participants concluded that the essential element required to improve safety was the creation of safety management systems (SMS) that all operators, including the airport itself, would implement. The airline community has long relied on such systems, and today, virtually all airlines consider them essential. But the question remained whether the hundreds of aviation businesses that want access to Teterboro could make the same kind of commitment. For big operators, like NetJets, this might not be difficult; but would smaller operators have the resources to support such a change? Anything less, it was decided, would have little effect. The group decided that a Teterboro-wide SMS was the solution.

"Raising the bar on safety" is not simple, nor is it easy. Convincing the Teterboro-based operators and other major users to "make the

A successful airport-based safety program is an essential part of Teterboro's future.

© Copyright David Almy

pledge" was pretty straightforward: They're easy to contact, understand the importance of the mission, and generally have both the resources to support the program and an incentive to do so. But if improvements in safety truly are to be achieved, then hundreds of other transient and occasional users of the airport will have to make the same kind of commitment. To reach them, a broader strategy was needed.

The solution was to get the working group's major members to contact more than 95 percent of Teterboro operators and persuade them to voluntarily implement an SMS that would reduce the risk of operational errors on flights to or from Teterboro. Operators who are unwilling to make this kind of commitment will be most helpful if they just stay away.

But steps such as these inevitably raise new questions: Can such a transformation in the way numerous private and commercial operators manage safety be achieved without federal regulations forcing their hand? Would independent aviation businesses voluntarily make costly investments in safety in a real-world marketplace where competitors are less willing to meet higher standards? Can a public airport insist on superior safety procedures and still meet the "equal access" provisions of federal grant assurances? Most fundamentally, can one airport, with its unique political and operational issues, craft its own program within its community of users to improve safety and ensure its survival?

The Teterboro Safety Initiative assumed that the answer to these questions is "yes" and developed a very different framework for aviation safety advancement at a public airport, an airport that faces organized opposition to its very existence. Now, the challenge is to produce specific safety recommendations that significantly reduce the risk of operational errors and provide meaningful mitigation of traditional airport hazards.

Adverse operational outcomes can occur in any area of activity subject to human error, on the ground or in the air. Reducing the risk of human error primarily depends on training, technological support, oversight, programmed redundancies and systemic management of human factors. The Teterboro Safety Initiative seeks to promote procedures, within company-based SMSs, that address each of these areas. Fixed base operators, charter operators and flight departments based at Teterboro have enrolled in SMS programs developed by the National Air Transportation Association (NATA) and others that recommend specific operational improvements in each of these areas. Airport officials are committed to similar reforms of their own safety management programs.

© Copyright David Almy

Employee training is perhaps the cornerstone of effective SMS implementation, with one significant difference from more typical training regimes: everyone gets trained — from veteran CEO to the entry-level apprentice — and the training never stops. Training at the airport itself is one thing, but training thousands of pilots at companies around the country who might fly to Teterboro only occasionally is a much tougher challenge. With the support and guidance of the U.S. Federal Aviation Administration (FAA), NATA is developing an online training program to bring Teterboro-specific operational issues to the attention of pilots thousands of miles away. Many charter and fractional jet operators already consider such repetitive training programs the best way to address a fundamental human factors challenge: complacency.

Physical improvements in the airport environment are another element of the Teterboro Safety Initiative. The Working Group has identified more than a dozen important safety projects for the Port Authority and FAA to consider, ranging from better ramp lighting to an engineered material arresting system (EMAS) that soon will be installed at the end of Runway 06.

Finally, the Working Group emphasized that improved navigational and surveillance technologies, along with advanced flight management systems, can enhance safety at Teterboro by enabling more-stabilized approaches and eliminating circle-to-land procedures necessitated by long-standing air traffic management practice in the New York region. Many Teterboro users already have the onboard equipment necessary to support advanced required navigation performance (RNP) approaches, and the Port Authority and others have pledged to promote timely implementation of the new procedures.

The group's broadest priority, however, is to accept responsibility for a progressive safety agenda and not wait for regulators or others to direct how or when the users can do better. That means establishing a permanent safety improvement program at Teterboro that brings the most experienced users of the airport together on a regular basis to plan and promote new solutions to age-old problems of aviation safety. Today it may be EMAS or online training programs, tomorrow it could be human-computer cross-challenging interactive checklists or refuse-to-crash navigational systems, but only with a consistently managed and dynamic airport-based SMS can ambitious safety goals like those at Teterboro become a reality.

In the final analysis, safety is as important to airports as it is to pilots and passengers. Only by constantly improving safety can an airport like Teterboro, where good enough is never good enough, fulfill the expectations of political leaders and promise the public that it will be there when it's needed, today and for years to come. ●

The Challenger's failed takeoff last year was caused by a center of gravity far forward of limits, the National Transportation Safety Board said.

U.S. National Transporation Safety Board

U.S.Air Force photo by Staff Sgt. Jason Serrit

Flying

When an aircraft is engulfed in blowing dirt or snow, the onset of IMC usually is instantaneous.

BY CLARENCE E. RASH

The sudden loss of visual cues during periods of blowing dust and dirt, or blowing snow, typically results in an instantaneous and complete onset of instrument meteorological conditions (IMC), which can result in pilot disorientation and loss of control.[1] Coming at the end of an approach in otherwise unthreatening conditions, the startling onset of total IMC can exacerbate pilot disorientation.

Pilots who understand the phenomena of brownout and whiteout and know how to operate their aircraft to avoid — or, if that fails, to fly their aircraft out of — such adverse conditions are best equipped to avoid the severe consequences.

Brownout occurs in the presence of dust, fine dirt or sand. The smaller the particulate matter, the denser the cloud that develops when these particles are agitated by an aircraft's spinning propeller or rotor blades. IMC typically develops 10 to 20 ft (3 to 6 m) above ground level (AGL), and visual references to the ground are instantly obscured. In the best circumstances, pilots shift immediately to instrument flight and fly the aircraft out of the cloud; in the worst, loss of control leads to a crash.[2] Often, the result is a hard landing.

For example, in June 2004, a Eurocopter AS 350B3 on an emergency medical services (EMS) flight landed hard in Cibecue, Arizona, U.S., where a patient was to be picked up for transport to a hospital in Scottsdale.[3] The pilot was familiar with the landing zone, a baseball field, and in a previous landing and takeoff at this same location, he had encountered blowing dirt. On this approach, the pilot briefed the medical aircrew about the possibility of a dust cloud and selected a nearby grassy area for touchdown. About 3 ft (1 m) AGL and at a speed of 10 kt, a dust cloud developed, causing the pilot to lose all visual cues. The helicopter touched down hard, first on the right skid and then on the left. No one was injured, but the helicopter was substantially damaged. The U.S. National Transportation Safety Board (NTSB) cited as a probable cause the pilot's "failure to maintain a proper descent rate during the landing approach and misjudged landing flare, which resulted in a hard landing"; a contributing factor was "brownout conditions created by the dust cloud that interfered with the pilot's perception of proximity to the ground."

The sudden loss of external visual references also occurs during whiteout. There are two uses of the term whiteout: atmospheric whiteout — also referred to as flat-light conditions — and the more common blowing-snow whiteout. Atmospheric whiteout is encountered during flight and occurs when snow-covered ground cannot be distinguished from a white, overcast sky. As a result, the horizon is virtually indistinguishable. In blowing-snow whiteout, visibility is restricted drastically by ground snow that has been driven into the air by propeller or rotor wash. Approaches and landings on snow-covered ground are particularly likely to create blowing-snow whiteouts. Whiteout also may be encountered some distance from shore during flight over large frozen bodies of water.

For example, in February 1995, a Beechcraft A100 King Air was nearing the end of a regularly scheduled flight from Sioux Lookout, Ontario, Canada, to Big Trout Lake, with nine passengers and a crew of two. The captain briefed an instrument approach with a circling procedure to the landing runway. During the approach, the crew could see the ground; visibility was estimated at 1.0 mi (1.6 km). To ensure safe separation from another aircraft, the crew flew the airplane away from the airport under visual flight rules; during this maneuver, as they flew the airplane over the frozen surface of a lake, they encountered whiteout conditions. The airplane struck the ice. Both pilots and seven passengers received serious injuries, and the airplane was destroyed. The Transportation Safety Board of Canada (TSB) said that the cause of the accident was that "while

© Oliver Baumberger/Jetphotos.net

the crew were maneuvering the aircraft to land and attempting to maintain visual flying conditions in reduced visibility, their workload was such that they missed, or unknowingly discounted, critical information provided by the altimeters and vertical speed indicators." Contributing factors were "the whiteout conditions and the crew's decision to fly a visual approach at low altitude over an area where visual cues were minimal and visibility was reduced."[4]

Civil vs. Military

In civil aviation, brownout occurs infrequently. As in the EMS accident scenario, it is most likely in rural regions or where undeveloped landing zones are encountered. Helicopters are more likely than fixed-wing aircraft to encounter brownout.

Whiteout is much more frequent in civil aviation because snow is common in many locales and can be prevalent even in the most built-up environments. While helicopters — because of their many operations in remote, unconventional locales — are susceptible to whiteout caused by rotor wash, the propellers of fixed-wing aircraft also can induce whiteout.

In military operations, because of frequent operations in hostile environments, brownout and whiteout are more frequent than in civil aviation. Two 1998 U.S. Army studies of spatial disorientation in helicopter operations found that the sudden loss of visual cues, as associated with brownout and whiteout, accounted for 25 percent and 13 percent, respectively, of all spatial disorientation accidents.[5] A 2004 report said that brownout has been the most frequent cause of aviation accidents during the war in Iraq,[6] and the U.S. military has identified brownout and whiteout as critical flight safety issues.

A review of the aviation accident database maintained by TSB for the period 1990–2005 found 22 accidents in which whiteout was cited as a major or contributing factor. These were evenly divided between atmospheric and blowing-snow whiteout scenarios, and evenly divided between helicopters and airplanes.[7]

A similar review of the Aviation Accident and Incident Data System maintained by NTSB for the period 1978 through Oct. 20, 2006, found one accident/incident report involving brownout — the 2004 Eurocopter accident in Arizona — and 79 reports involving whiteout (Figure 1, page 46).[8] Of the 79 whiteout accidents/incidents, 57 (72 percent) involved airplanes, and 22 (28 percent) involved helicopters. Atmospheric whiteout was cited as a causal factor in 52 accidents/incidents (66 percent); of these, 43 involved airplanes and nine involved helicopters. The remaining 27 accidents/incidents (34 percent) involved blowing-snow whiteout; of these, 14 involved airplanes, and 13 involved helicopters.

Prevention Is the Best Solution

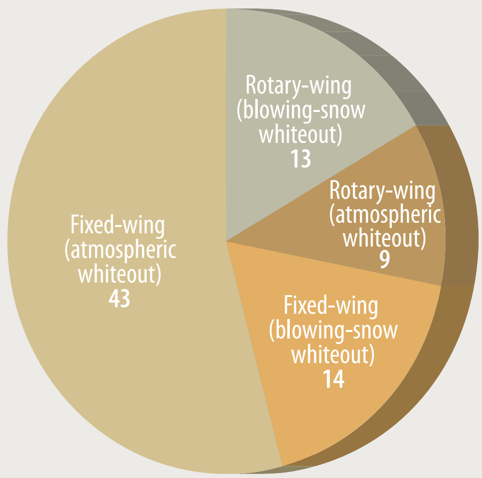
Pilot awareness of the potential for brownout and whiteout is the first step in preventing these accidents. Experience and confidence in handling these phenomena can be achieved through training, which should teach pilots to conduct a risk assessment before all landings. The pilot should determine the potential for brownout or whiteout, be aware of nearby obstacles in case visual cues are lost and have a go-around plan before committing to the approach.

When anticipating the occurrence of brownout or whiteout, available crewmembers should inform the pilot of any developing clouds of dirt or snow. Landing speed should be just fast enough to minimize the cloud's effects and the terminating hover should be eliminated or minimized. The pilot should be ready for an immediate transition to instrument flight.

Technological Remedies

Military services have been pursuing an aggressive program of prevention and mitigation of whiteout and brownout accidents and incidents. They have increased training, using enhanced

Whiteout-Related U.S. Civil Aircraft Events*



*Accidents and incidents from 1978–Oct. 20, 2006

Source: U.S. National Transportation Safety Board

Figure 1

simulations of degraded visual environments in which these events occur. They also have investigated the use of advanced technologies, both as immediate and long-term solutions.

For example, the U.S. Navy is evaluating a device called the tactile situation awareness system (TSAS), which consists of a vest with small, pneumatically or electromagnetically driven stimulators called tactors. The tactors provide a touch input to the pilot's body or legs to signal that the aircraft is drifting or requires a correction. The use of TSAS is intended to reduce the pilot's overall workload, allowing other tasks that demand visual attention to be performed more effectively.[9]

Advanced sensing technologies — such as ultra-wideband radar and thermal and laser sensors — also have been studied to evaluate their ability to allow pilots to "see through" obscuring clouds.

Another technique being studied for combating brownout involves the use of chemical ground treatments to reduce the propensity of sand, dust and fine dirt to form obscuring clouds. For these treatments to be successful, they must be durable and resistant to weather exposure.

The most ambitious approach to preventing brownout and whiteout is a change in rotor blade/propeller design. This has been proposed for the US101, a U.S. variant of the Agusta Westland's EH-101 helicopter.[10] In contrast to standard designs, which push dust toward the fuselage and create brownout, the US101's blades push dust away from the fuselage.

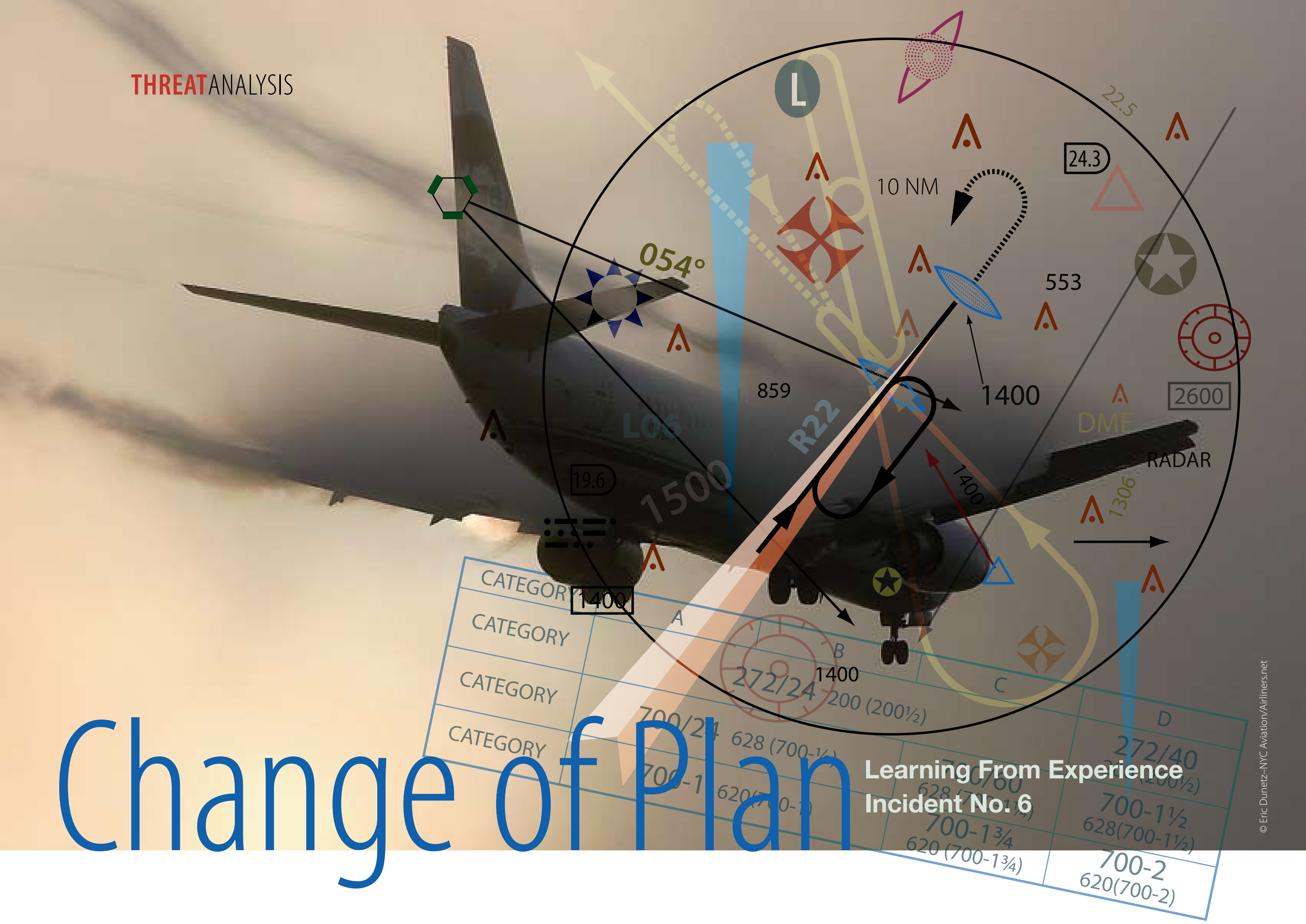
Eventually, after testing by the military, some of these techniques are likely to find their way into civil aviation. In the immediate future, however, pilots in civil aviation will have to rely on their knowledge, training and experience. They must understand the causes and effects of brownout and whiteout, and maintain sufficient instrument skills to avoid disorientation when the resulting inadvertent IMC occurs.●

Clarence E. Rash is a research physicist at the U.S. Army Aeromedical Research Laboratory in Fort Rucker, Alabama, U.S. He has more than 25 years of experience in Army aviation research and development and is the editor of "Helmet-Mounted Display: Design Issues for Rotary Wing Aircraft," SPIE Press, 2000.

Notes

1. A similar phenomenon sometimes affects helicopters hovering over water. This occurs when water droplets that have been blown upward then move downward and are seen in sunlight or moonlight; when this occurs, ground references are obscured. In reacting to this illusion, the pilot may initiate a descent that could result in unexpected ground contact at rates sufficient to damage the aircraft and produce injuries.

2. Brock, J. *Fatal Illusions*. Aviation Medical Society of Australia and New Zealand. 1998.
3. U.S. National Transportation Safety Board (NTSB). Aviation Accident and Incident Data System (AIDS). Accident report no. LAX04LA285. June 26, 2004.
4. Transportation Safety Board of Canada (TSB). Accident investigation report no. A95C0026. 1995.
5. Braithwaite, M.G.; Durnford, S.J.; Crowley J.S.; Rosado, N.R.; Albano, J.P. "Spatial Disorientation in U.S. Army Rotary-Wing Operations." *Aviation Space and Environmental Medicine* Volume 69 (1998): 1031–1037.
6. Hasenauer, H. "Cutting Down Casualties." *Soldier's Magazine* Volume 29 (2004) No. 4, 8–15.
7. TSB. Query of accident investigation reports. October 2006.
8. NTSB. Query of AIDS. September 2006.
9. McGrath, B.; Gierber, G.; Rupert, A. "Can We Prevent SD? The Tactile-Situation-Awareness System." *Approach* May–June 2004.
10. Kennedy, H. "Whose Chopper Has the Right Stuff for the Air Force?" *National Defense News* August 2006.



© Eric Dunetz–NYC Aviation/Airliners.net

Change of Plan

Learning From Experience Incident No. 6

Sixth in a series focusing on approach and landing incidents that might have resulted in controlled flight into terrain but for timely warnings by TAWS.

BY DAN GURNEY

A late change to a different instrument approach procedure, a hurried approach briefing and difficulty in deciphering a cluttered chart might have been involved in a premature descent that took a commercial aircraft about 1,500 ft below the proper altitude in instrument meteorological conditions.

The flight crew had been cleared for — and likely planned and briefed for — the ILS/DME (instrument landing system/distance measuring equipment) approach to the airport. However, just before the aircraft reached the initial approach fix, the tower controller told the crew that the ILS ground equipment had failed and re-cleared the crew to conduct the VOR (VHF omnidirectional radio)/DME approach, a "straight-in" nonprecision approach procedure to the same runway.

The aircraft was 6 nm (11 km) from the runway threshold and descending through 500 ft above ground level (AGL) when the terrain awareness and warning system (TAWS) generated a "TERRAIN, PULL UP" warning. The crew responded immediately and initiated a climb to a safe altitude.

The aircraft's flight path before the TAWS warning was equivalent to a final descent begun about 4 nm (7 km) before reaching the appropriate descent point, an error that might have resulted from mental workload imposed by the complex approach chart that the crew is believed to have used.

Mixed Procedures

Civil aviation authorities (CAAs) are responsible for designing and approving instrument approach procedures for airports in their countries. They publish master copies that all chart providers must follow, but not necessarily using the same formatting and symbology. In this incident, the CAA had published separate master copies of the ILS/DME approach and the VOR/DME approach. Each chart clearly identifies the associated descent point and provides an altitude/range table specific to the approach. The altitude/range table on the CAA's VOR/DME approach chart has ranges from the DME ground station and also from the runway threshold to enable flight management system vertical navigation monitoring.

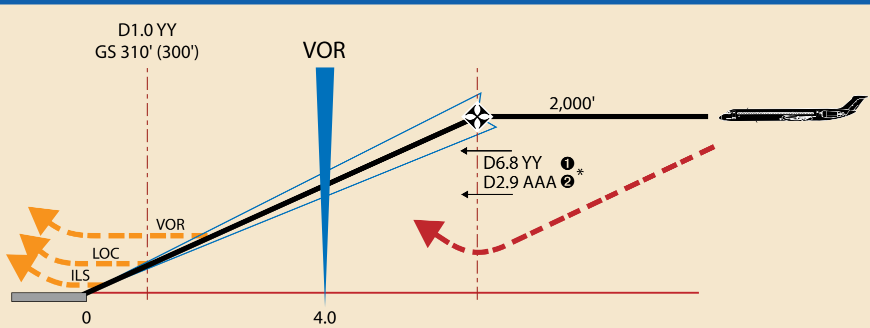
The chart that the incident flight crew is believed to have used, however, depicts an amalgamation of the ILS/DME and VOR/DME procedures, and includes details for a localizer procedure. The chart contains extensive supporting information for the three procedures. Although this decreases clarity, the chart content is typical of many charts that depict amalgamated procedures.

The chart identifies a common descent point at the final approach fix (FAF) for all three approach procedures by its distances from two DME ground stations: "D6.8 YY," or 6.8 nm from the DME ground station for the ILS/DME approach, and "D2.9 AAA," or 2.9 nm from the DME ground station for the VOR/DME approach (Figure 1). Next to each distance figure is a callout to a note identifying its respective approach procedure. The notes indicate that "D6.8 YY" should be used to identify the descent point while conducting the ILS/DME approach and that "D2.9 AAA" should be used to identify the FAF during the VOR/DME approach. The callouts are included in the chart's plan view and profile view; the notes, however, are included only in the plan view.

The plan view depicts the approximate locations of the DME ground stations. YY, which is colocated with the glideslope transmitter, is 0.1 nm beyond the runway threshold. AAA is about 0.2 nm beyond the VOR, which is 4 nm from the runway threshold. However, the positions of the ground stations are not depicted on the profile view.

The altitude/range table also is an amalgamation of data from the CAA's master copies. Its format provides the opportunity for misreading the data and is a potential threat to safety. The table is divided horizontally into "LOC," or localizer, and "VOR/DME" sections, and the altitude and range data are shown together — in much smaller type

Approach Profile View and Aircraft Flight Path



LOC (GS out)	YY DME	2.0	3.0	4.0	5.0	6.0
	ALTITUDE (*HAT*)	600' (*590'*)	890' (*880'*)	1,180 (*1,170'*)	1,470' (*1,460'*)	1,760' (*1,750'*)

VOR DME	AAA DME	2.0 After AAA	1.0 After AAA	0.0	1.0 Before AAA	2.0 Before AAA	2.9 Before AAA
	ALTITUDE (*HAT*)	560' (*550'*)	850' (*840'*)	1,140' (*1,130'*)	1,430 (*1,420'*)	1,720' (*1,710'*)	2,000' (*1,900'*)

*Callouts ❶ and ❷ refer to notes on approach plan view indicating that D6.8YY is used for the ILS/DME approach and D29.AAA is used for the VOR/DME approach.

Source: Dan Gurney

Figure 1

© Chris Sorensen Photography

than appears in Figure 1. For each range figure, an altitude and a height above touchdown (HAT) are provided. This adds visual clutter that could slow data acquisition and increase mental workload. Similarly, the "After AAA" and "Before AAA" notations for the VOR/DME ranges also add complexity.

Moreover, the table shows the range values above the altitudes. As noted in the discussion of incident no. 2 in the August 2006 *Aviation Safety World*, it is essential to check altitude before range when monitoring the flight path. Thus, the table format, which is commonly used by chart providers, could bias the crew to check range before altitude, a procedure that could result in being at a dangerously low altitude at longer ranges.

Lessons to Be Learned

Based on the author's analysis, which was reviewed by a select group of aviation safety professionals, the most likely scenario for this incident is that the flight crew retuned their navigation receivers to the radio frequency for the VOR/DME approach but began the descent when the aircraft was 6.8 nm from the DME ground station for the VOR/DME approach; as previously discussed, the descent should have been initiated 2.9 nm from the station. This could have resulted from the crew following information reviewed during their first briefing, for the ILS approach, in which descent is begun 6.8 nm from the DME associated with that approach.

This lapse might have been compounded by the use of the LOC altitude/range data, rather than the VOR/DME altitude/range data, to monitor the flight path. The approach likely appeared safe and correct to the crew — until TAWS sounded the alarm.

The approach likely appeared safe and correct to the crew — until TAWS sounded the alarm.

Among lessons to be learned from this incident are the following:

- Late changes of plan and hurried briefings expose flight crews to seemingly innocuous threats and opportunities for errors. A rule of thumb to remember is: "Retuning frequencies always requires retuning the mental map."

- Latent threats can originate from well-intentioned alterations of the chart format to simplify procedures or improve efficiency.

- Monitoring is only effective if the correct data are being used. Crews should take extra precautions when using amalgamated charts. ●

[This series, which began in the July issue of *Aviation Safety World*, is adapted from the author's presentation, "Celebrating TAWS Saves, But Lessons Still to Be Learned," at the 2006 European Aviation Safety Seminar, the 2006 Corporate Aviation Safety Seminar and the 2006 International Air Safety Seminar.]

Dan Gurney served in the British Royal Air Force as a fighter pilot, instructor and experimental test pilot. He is a co-author of several research papers on all-weather landings. Gurney joined BAE Systems in 1980 and was involved in the development and production of the HS125 and BAe 146, and was the project test pilot for the Avro RJ. In 1998, he was appointed head of flight safety for BAE Systems. Gurney is a member of the FSF CFIT/ALAR Action Group, the FSF European Advisory Committee and the FSF steering team developing the "Operators Guide to Human Factors in Aviation."

Close Calls

Similar call signs were the most frequent contributing factor in reported air-ground communication incidents in European airspace.

BY RICK DARBY

Confusion caused by similar call signs was the most frequently reported contributing factor in air-ground voice communication incidents in European airspace, according to a study of data from a survey of airlines and air navigation service providers.[1] In 535 reported incidents during communication between pilots and air traffic controllers from Oct. 25, 2004, to March 31, 2005, "similar call sign" was a contributing factor in 33 percent. The next most frequent contributing factor, "frequency change," was found in 12 percent.[2]

The study, undertaken by National Aerospace Laboratory (NLR)–Netherlands for Eurocontrol, analyzed incidents classified as loss of communication; readback/hearback error; communication equipment problem; no pilot readback; or hearback error. Another category — the largest — included incidents that did not fit into any of those and were classified as "other communication problem." In some incidents, the type of problem was not reported. The number of incidents and percentages by category are shown in Table 1. In every category, "similar call sign" was at the top of the list of contributing factors.

Numerous other factors contributed to the 535 incidents, but most played a role in less than 5 percent of incidents (Figure 1).

The study found that 36 percent of all incidents had no safety consequence (Figure 2, page 52). About one-fourth involved a "prolonged loss of communication." Other

European Air-Ground Voice Communication Incidents

Oct. 25, 2004, through March 31, 2005

Category	No. of Incidents	Percentage
Loss of communication	137	26
Readback/hearback error	52	10
Communication equipment problem	44	8
Hearback error	6	1
No pilot readback	5	1
Other communication problem	194	36
Type of communication problem not reported	97	18
Total	**535**	**100**

Incidents were reported by 12 airlines and 10 air navigation service providers in European countries.

Source: Eurocontrol

Table 1

consequences included "altitude deviation," "loss of separation" and "wrong aircraft accepted clearance."

The term "loss of communication" refers to situations in which the flight crew has no radio contact with air traffic control (ATC) for "some time for some reason," the report says. Most of these incidents (73 percent) occurred in the cruise phase of flight; 9 percent and 4 percent occurred during the approach phase and landing phase, respectively.

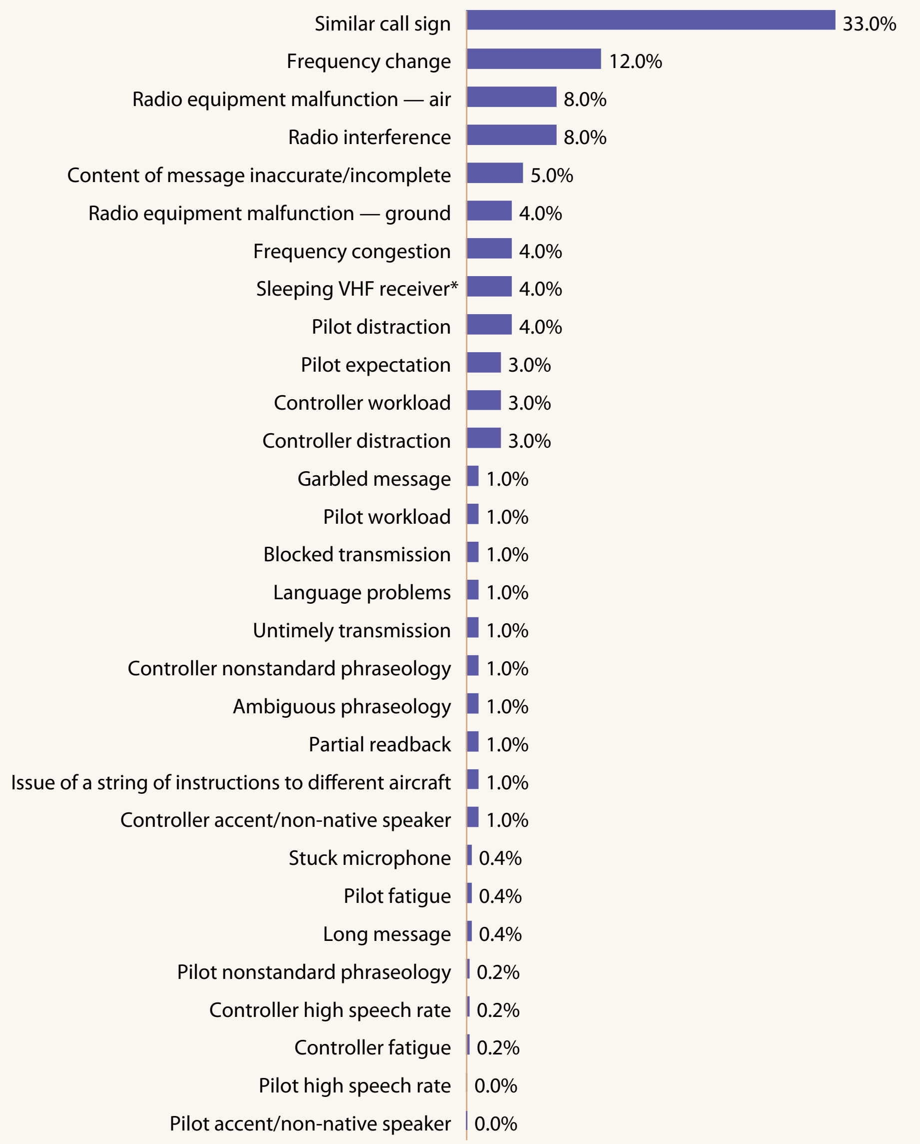
In "loss of communication" incidents, the three most common contributing factors were "frequency change" (35 percent), "sleeping VHF receivers"[3] (15 percent) and "radio equipment malfunction — air" (12 percent).

The most frequent consequence, found in 81 percent of the "loss of communication" incidents, was "prolonged loss of communication."

The report says, "An incorrect readback was reported in 15 of the 52 'readback/hearback error' occurrences, while in 11 of those 15 cases, the incorrect readback was not detected by the controller."[4] Contributing factors in the category included "similar call sign" (37 percent), "pilot expectation" (17 percent) and "frequency change" (15 percent). Consequences of a readback/hearback error included "altitude deviation" (in 37 percent), "wrong aircraft accepted clearance" (31 percent) and "heading/track deviation" (8 percent). There were no safety consequences in 13 percent.

Communication equipment problems were involved in 44 of the 535 incidents. The most frequent problems in this category were "radio equipment malfunction — air" (52 percent), "radio equipment malfunction — ground" (36 percent) and "radio interference" (11 percent). In 34 percent of the incidents there were no

Contributing Factors



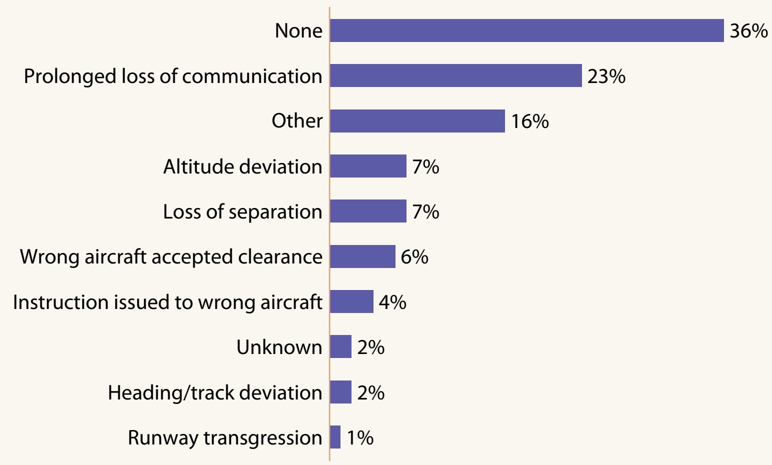
Contributing factors are based on analysis of 535 air-ground voice communication incidents in a study of European airspace, Oct. 25, 2004, through March 31, 2005. More than one contributing factor could be assigned to a single incident.

* *Sleeping VHF receiver* is defined as a loss of communication type in which the VHF frequency becomes silent for a time.

Source: Eurocontrol

Figure 1

Consequences



Consequences are based on analysis of 535 air-ground voice communication incidents in a study of European airspace, Oct. 25, 2004, through March 31, 2005. More than one consequence could be assigned to a single incident.

Source: Eurocontrol

Figure 2

safety consequences; "prolonged loss of communication" occurred in 27 percent; "other" in 23 percent; "altitude deviation" in 7 percent; and "loss of communication" and "wrong aircraft accepted clearance," each in 2 percent.

The study found "no pilot readback" and "hearback error" in five and six incidents, respectively, and researchers considered the samples too small for meaningful findings.

"Other communication problem" represented the largest single category, with 194 incidents representing 36 percent of the total.[5] The most frequent contributing factors were "similar call sign" (46 percent), "radio interference" (13 percent) and "content of message inaccurate/incomplete" (9 percent).

There were no safety consequences in 49 percent of the incidents in this category and "other" consequences in 29 percent. The most frequently identified safety consequences included "loss of separation" (8 percent), "altitude deviation" (4 percent) and "instruction issued to wrong aircraft" (4 percent).

Among incidents categorized as "type of communication problem not reported," the contributing factor most often identified was "similar call sign" (64 percent). Of the consequences with safety implications, most frequent were "loss of separation," found in 12 percent, "instruction issued to wrong aircraft" in 10 percent and "wrong aircraft accepted clearance" in 8 percent.

The report also includes results of a survey of pilots and controllers about the findings, discussion of causal factors and safety recommendations.●

Notes

1. The study, *Air-Ground Communication Safety Study: Causes and Recommendations*, by Rombout Wever, Gerard van Es and Marcel Verbeek, is available via the Internet at <www.eurocontrol.int/safety/gallery/content/public/library/AGC%20safety%20study%20causes_recommendations.pdf>. It was released in January 2006.

   Twelve airlines and 10 air navigation service providers participated in a confidential reporting project in which incident data were de-identified.

2. "Frequency change" included such events as the receiver tuned incorrectly, air traffic control (ATC) neglecting to hand off the flight to the next controller, the flight crew missing a call from ATC and radio equipment malfunction.

3. A "sleeping VHF receiver" problem was defined as a "loss of communication type in which the VHF frequency becomes silent for a period of time." It was a problem with the VHF receivers on the aircraft, not always recognized as such by the pilots and controllers.

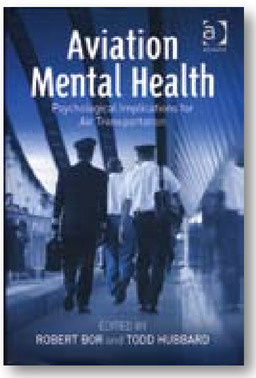
4. In a "readback/hearback error," a pilot reads back the clearance *incorrectly*, and the controller fails to correct the error, or a pilot of the wrong aircraft reads back the instruction. Four of the 15 "incorrect readbacks" were reported as "readback/hearback errors" and therefore classified as such, although it was not specifically stated that the controller did not detect the incorrect readback.

   In a "hearback error," a pilot reads back the clearance *correctly*, and the controller fails to notice his or her own error or fails to correct critical erroneous information in a pilot's statement of intent.

5. "Other communication problem" was a miscellaneous category for reported incidents that fit no other. Reported examples included, "Three aircraft with similar call signs are confusing ATC" and "there was some noise on frequency."

Mind in Flight

The nature of aviation creates its own psychological challenges that call for specialized monitoring and help.



BOOKS

Aviation Mental Health: Psychological Implications for Air Transportation

Bor, Robert; Hubbard, Todd (editors). Aldershot, England, and Burlington, Vermont, U.S.: Ashgate, 2006. 375 pp. Figures, tables, references, index.

Aviation professionals tend to distrust psychological evaluation and mental health therapy. Those processes involve subjectivity and ambiguity, which are not valued in the realm of aviation, where clarity and precision are standard procedure. It also appears to many who work in aviation that mental health issues arise only as a sign of something wrong, which can endanger a career.

Nevertheless, the human organism was not designed by evolution to fly — to be in a totally artificial environment disconnected from the earth for hours, sometimes in abnormal spatial attitudes, experiencing daytime and a demand for alertness when body and mind insist it's night and time to sleep — and some psychological difficulties are to be expected as a result.

No matter how well trained and experienced crewmembers are, they cannot be completely immune to stressors that aviation presents. Some, like jet lag, are mainly physiological. Others are psychological or emotional: the need to make decisions with potentially catastrophic consequences if they are wrong, the requirement for concentration and perception, and having to depend on and trust other professionals who may not be personally known to the individual. When operating as part of a crew, a pilot's actions are constantly monitored by other crewmembers, a situation that the editors describe as feeling like an endless driving test. Being repeatedly away from home for days at a time, possibly in a foreign environment, creates further pressures.

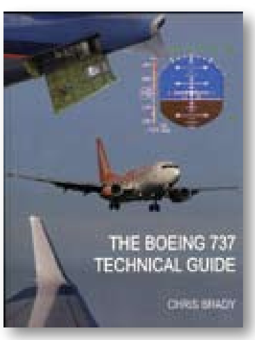
The editors hope their book will make the case that aviation mental health practitioners are there to help with the issues that flight introduces, not to find fault.

"This book seeks to present a modern, informed, balanced and useful application of mental health issues in aviation and to challenge outdated and negative impressions held by some about what mental health insights can offer to aviation," the editors say. "It is about the mental health of the millions of professionals worldwide responsible for flight. It is not, however, a book about aviation human factors."

Aviation mental health is concerned with six main tasks, the editors say: identifying those who are psychologically unfit for the work; monitoring the psychological health of those in training and employment in the aviation industry; assessing and treating those who develop psychological problems at work; determining whether and for how long an individual is unfit for aviation duty; emotionally supporting those considered unfit for duty, whether temporarily or long term; and preventing mental health problems through intervention, health promotion and research.

The papers comprising the book are organized under three headings: "Psychological Issues of Flight and Cabin Crew"; "Psychological Processes Among Passengers and Crew"; and "Related Themes in Aviation." Among the topics of papers are psychiatric disorders and syndromes among pilots; psychiatric evaluation of crewmembers; psychological factors in flight crew selection; and psychological problems among cabin crew. The several chapters about psychological problems of passengers in connection with flight might at first seem off-topic, but fear of flying and on-board psychiatric emergencies affect cabin crewmembers.

"The field of aviation mental health should not be seen to be limited to the diagnosis and treatment of psychopathology and psychiatric problems," the editors say. "A book of this scope is also concerned with the prevention of psychological problems, especially among crew." They acknowledge that some important groups are left out of the discussion, particularly air traffic controllers and maintenance technicians. The reason, they say, is a lack of scientifically sound published literature on those populations.



The Boeing 737 Technical Guide

Brady, Chris. United Kingdom: Tech Pilot Services, 2006. Version 15. 366 pp. Figures, diagrams, photographs, index.

An old engineering joke says, "When all else fails, read the manual." This guide is designed for Boeing 737 pilots who have read the flight operations manual and want to know more. The author, easyJet's maintenance test pilot, started and maintains The Boeing 737 Technical Website at <www.b737.org.uk>.

Brady says that the book is "intended to fill in the gaps left by existing publications. It contains facts, tips, photographs and points of interest, rather than simply being a reproduction of the manuals. Its broad scope will hopefully make it as interesting to students doing their type rating as it will be to training captains fielding unusual and searching questions from colleagues."

The book opens with a look at the history and development of the 737, from the 737-100 to the latest "next generation" and specialized models. Following a section about production, including materials, the book examines the systems that enable the airplane to do its job. Variations in systems among versions of the airplane and upgrades to systems are discussed.

Numerous photographs, all black-and-white except the front and back covers, illustrate the points covered by the text. Descriptions, while technical, sometimes have a personal touch: "On a couple of occasions, I have seen three reds and three greens [gear position indicator lights] after the gear has been selected 'DOWN.' This was because the telescopic gear handle had not fully compressed back toward the panel. If this happens to you, give it a tap back in and the red lights should extinguish."

A section titled "Pilots' Notes" gives background information on topics such as Boeing's new "Normal" checklists, crosswind takeoff and landing guidelines, landing techniques, procedures for loss of thrust from both engines, and sample type rating examination questions. The notes are to aid understanding and do not supersede company operational policies.

Every 737 hull-loss accident is described, and many descriptions include the investigative authority's determination of causal factors.

REPORTS

Assessing Institutional Resilience: A Useful Guide for Airline Safety Managers?

Wood, Margot; Dannatt, Robert; Marshall, Verena. Australian Transport Safety Bureau (ATSB). B2004/0240. Final report. June 2006. 63 pp. References, appendix. Available via the Internet at <www.atsb.gov.au/publications/2006/AVISE_20040240.aspx> or from ATSB.*

"History shows that some organizations operating in hazardous environments or using hazardous processes appear to 'forget' to be afraid of the hazards they face," the report says.

The term "institutional resilience" often is used to describe an organization's ability to "bounce back" from unexpected problems or to resist hazards. James Reason, a professor of psychology at Manchester (England) University who specializes in the organizational dimension of human error, has developed a checklist for assessing institutional resilience, including a version for the airline industry. This report presents the findings of a qualitative study investigating factors perceived to facilitate institutional resilience in airlines, obtained through interview questions adapted from Reason's checklist. Senior managers at 12 airlines operating in the Asian and Pacific regions were interviewed.

"If management is committed to facilitating institutional resilience, what does this *look like*?" the report asks. "The term 'committed' is included in Reason's checklist, and while overlapping with some terms, appears to be the 'driving force' behind others [identified in the study]."

The study found that strategies prevailing at resilient airlines included these:

- The chief executive and senior managers attend safety meetings and crew resource management seminars, and make themselves available for discussions with crewmembers.
- A safety department is backed by adequate resources, independent of flight operations and accountable to senior management.
- Recommendations for safety initiatives are endorsed and financially supported by top management and the governing board.
- Safety-related data are discussed openly and acted on without negative reference to individuals or groups.
- The safety department manager and personnel interact regularly and directly with crewmembers.

Reason's checklist for assessing institutional resilience in an aviation environment is included in an appendix. It includes 20 company characteristics that can be scored as "yes," "unsure" or "no," with numerical equivalents of 1, 0.5 and 0, respectively.

Total scores are interpreted as follows: "16–20 — So healthy as to be barely credible. 11–15 — You're in good shape, but don't forget to be uneasy. 6–10 — Not at all bad, but there is still a long way to go. 1–5 — The organization is very vulnerable. 0 — Jurassic Park."

New Refractive Surgery Procedures and Their Implications for Aviation Safety

Nakagawara, Van B.; Wood, Kathryn J.; Montgomery, Ron W. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine. DOT/FAA/AM-06/9. Final report. April 2006. 45 pp. Figures, tables, references, appendixes. Available via the Internet at <www.faa.gov/library/reports> or through the National Technical Information Service.**


New Refractive Surgery Procedures and Their Implications for Aviation Safety

Since the 1980s, U.S. pilots have been allowed to correct refractive error — an eye defect that prevents light rays from focusing on the retina — by undergoing surgery. The types of refractive surgery, which formerly consisted mainly of photorefractive keratectomy (PRK) and laser in situ keratomileusis (LASIK), have recently been augmented by new surgical techniques such as laser epithelial keratomileusis (LASEK), laser thermal keratoplasty (LTK), conductive keratoplasty (CK) and others.

The report describes the techniques of the recently developed procedures and their applications, advantages and risks. The text includes summaries of experimental results, which are enhanced by extensive references to the clinical literature.

"It is unknown at this time how the long-term effects of refractive surgery may affect the performance of civil airmen and if the known refractive surgery complications summarized in this paper may be exacerbated by age," the report says. "It is important that pilots be aware of possible problems that may result from having refractive surgery that may affect their ability to safely perform aviation tasks."

WEB SITE

ASRS Database Online, <http://asrs.arc.nasa.gov/main.htm>

The aviation safety reporting system (ASRS), administered by the U.S. National Aeronautics and Space Administration, now allows everyone access to its large incident database of unsafe occurrences and hazardous situations.

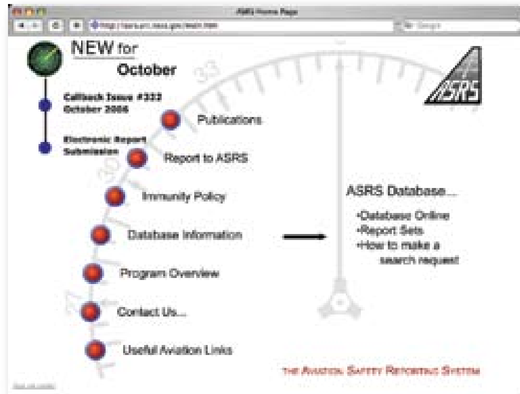
ASRS describes itself as "the world's largest repository of voluntary information provided by aviation's frontline personnel, including pilots, controllers, mechanics, flight attendants and dispatchers." Currently, more than 130,000 incident records compiled from more than 700,000 submitted reports are in the database. The online database contains incident records from 1988 to the present and is updated monthly.

The purpose of the program is "to lessen the likelihood of aviation accidents." Data are used by government, industry and academia to identify and remedy deficiencies and discrepancies in the aviation system; formulate policy and planning; and support human factors safety research. Depending on an individual researcher's needs and creativity, any number of uses are possible — education and training aids, examples of specific event types, identification of risks associated with certain actions, and information to support a personal opinion or observation, to name a few.

Confidential incident reports of occurrences in the most recent month are submitted to ASRS, where they are analyzed by a professional staff of former air traffic controllers and pilots. Identifying information is removed to protect confidentiality, and safety hazards are identified and flagged. The U.S. Federal Aviation Administration (FAA) or the U.S. National Transportation Safety Board (NTSB) determines whether to corroborate reported events and address remedies. The reporting system is non-punitive, and the FAA cannot use these reports for enforcement action. There are two exceptions – accident reports are forwarded to NTSB and reports involving criminal offenses are forwarded to the U.S. Department of Justice.

Reports of events appearing in the database are "soft" data, meaning that the data should be reviewed with care. Submissions are selectively corroborated, reporter biases and perceptions may exist, and multiple reports of the same incident may be combined into a single record. Individual database records can contain more than 40 categories of information, plus the reporter's narrative and a brief synopsis.

With so much information, getting the information that is wanted could be challenging. However, the database employs sophisticated search features and precise criteria selection. Researchers are given drop-down selection lists with recognized aviation terms. Narratives of individual records usually contain FAA terms and abbreviations and ASRS codes unique to this database, so ASRS provides encoding and decoding lists on line. Researchers can print all information as it appears on the viewing screen or reformat search results for customized reports.



This database is complex. Users will benefit from reviewing background and supporting information in advance of searching. For optimum results, they should read descriptions of database content and structure and ASRS's recommendations for creating queries, formulating search strategies, manipulating data and displaying reports.

Until now, access to this type of information has been limited. Researchers had to contact ASRS directly, or access brief reports of similar data at the FAA's National Aviation Safety Data Analysis Center (NASDAC) web site, using a search form with limited options and a search engine with limited capability. (NASDAC was recently renamed Aviation Safety Information Analysis and Sharing [ASIAS].) ●

Sources

* Australian Transport Safety Bureau
P.O. Box 967, Civic Square
ACT 2608 Australia
Internet: <www.atsb.gov.au>

** National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161 U.S.A.
Internet: <www.ntis.gov>

— *Rick Darby and Patricia Setze*

Wake Turbulence Triggers Control Loss

Challenger pilot could not correct an uncommanded roll during landing.

BY MARK LACAGNINA

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

JETS

Another Jet Departed in Opposite Direction

Canadair CL-600. Substantial damage. No injuries.

The airplane was inbound to land on Runway 15 at Aspen–Pitkin (Colorado, U.S.) County Airport in daytime visual meteorological conditions (VMC) on Feb. 9, 2006. While clearing the flight crew to land, the tower controller said that the winds were calm.

The pilot told investigators that the airplane was 50 ft above ground level (AGL) when it encountered wake vortices from a British Aerospace BAe 146 that had departed from Runway 33. The Challenger rolled into a steep left bank, and the stall-warning horn sounded. The pilot increased power. The airplane then rolled steeply right and pitched nose-down. The pilot said that he was unable to stop the roll, and the right main landing gear struck the runway.

"The right main landing gear strut penetrated the right wing, the leading edge of the right wing was crushed aft, and the right aft wing spar was bent and buckled," said the report by the U.S. National Transportation Safety Board (NTSB). The pilot, copilot and passenger were not injured.

NTSB said that the probable cause of the accident was "the flight's encounter with wake turbulence from the departing airplane, resulting in the pilot's inability to control the airplane."

Brake Failure Leads to Ground Accident

Boeing 737-8AS. Minor damage. No injuries.

The aircraft was landed and taxied to a stand at Glasgow–Prestwick (Scotland) Airport on Nov. 26, 2005. Approaching the parked aircraft, the driver of a baggage belt-loading vehicle applied the wheel brakes, but the brake pedal went to the floor without slowing the vehicle. The driver tried unsuccessfully to engage the parking brake. The vehicle struck the aircraft, denting the lower fuselage aft of the front cargo hold and breaking a radar antenna.

The U.K. Air Accidents Investigation Branch (AAIB) report said that the hydraulic brake pipe had fractured, causing a loss of fluid and pressure for the brake cylinder, and a hand-brake cable had seized, rendering the hand brake inoperative. "The impending brake pipe failure and the defective parking brake might have been detected had a daily check, or quarterly service, together with an effective defect-reporting system been used," the report said.

AAIB recommended that the U.K. Civil Aviation Authority "remind airport operators that their safety management systems should ensure that safe standards of maintenance and use are applied to all vehicles and mobile ground equipment used in the proximity of aircraft."

Wet-Runway Overrun

Cessna 525 CJ1. Substantial damage.
One minor injury, two uninjured.

The pilot conducted a go-around after losing sight of the runway during a visual approach to Old Bridge (New Jersey, U.S.) Airport on July 17, 2005. Clouds associated with a nearby thunderstorm had moved into the area, said the NTSB report. The pilot requested and received clearance to conduct a global positioning system (GPS) approach to Runway 24.

An airport 14 nm (26 km) from Old Bridge was reporting surface winds from 160 degrees at 11 kt, gusting to 14 kt, 10 mi (16 km) visibility and a broken ceiling at 1,500 ft.

Performance data in the aircraft flight manual (AFM) indicated that at the airplane's landing weight of 9,500 lb (4,309 kg), landing distance on a dry runway, with no wind, was 2,770 ft (845 m). However, the report said that the runway was wet, increasing the no-wind landing distance to 3,550 ft (1,083 m). Runway 24, the only runway at the airport, has a 400-ft (122-m) displaced threshold and an available landing length of 3,194 ft (974 m).

Landing reference speed, V_{REF}, was calculated as 107 kt. The airplane was about 0.1 nm (0.2 km) from the runway threshold when its terrain awareness and warning system (TAWS) generated a "SINK RATE" warning. Data obtained from the TAWS indicated that the airplane's groundspeed was 133 kt and its descent rate was 1,522 fpm.

Clouds associated with a nearby thunderstorm had moved into the area.

TAWS data also indicated that the airplane touched down about 815 ft (249 m) beyond the displaced threshold. The pilot attempted to reject the landing when he realized that the airplane could not be stopped on the runway. He applied full power and retracted the flaps to the takeoff position, but the airplane did not accelerate to flying speed. It overran the runway and struck several objects before coming to a stop 400 ft (122 m) beyond the departure end.

NTSB said that the probable causes of the accident were "the pilot's improper preflight planning, his failure to consult performance data and his failure to obtain the proper touchdown point."

Blocked Grease Fitting Causes Nosewheel Jam

BAE Systems Avro RJ85. Substantial damage. No injuries.

Soon after takeoff from the Gothenborg/Landvetter (Sweden) airport in nighttime VMC on March 10, 2006, the flight crew observed an indication that the nose landing gear had not retracted. The crew made several unsuccessful attempts to resolve the problem and then requested and received clearance to return to the departure airport, said the report by the Swedish Accident Investigation Board (SHK).

Air traffic control (ATC) approved the crew's request to conduct the instrument landing system (ILS) approach to Runway 03 and conduct a low pass near the control tower. After being told that ground personnel believed that the landing gear was extended, the crew landed the aircraft on Runway 03. The report said that the aircraft touched down smoothly on the main landing gear at about 100 kt; however, the nose landing gear collapsed soon after it was lowered onto the runway. "The nose of the aircraft hit the runway and the aircraft slid further, supported by its nose and the main landing gear for about 300 m [984 ft] before it stopped," the report said. There was no fire. The four crewmembers and 28 passengers were not injured.

The report said that the technical investigation showed that the accident was caused by "seizure of the nosewheel-locking mechanism as a result of a blocked grease nipple, which prevented correct lubrication."

The report noted that the evacuation of passengers through the left rear door had been difficult because a cabin crewmember had been unable to lock the door in its full-open position. "Certification requirements for emergency evacuation from an inclined aircraft do not contain a requirement for the door to be capable of being secured in the open position," the report said. As a result of this finding, SHK recommended that the European Aviation Safety Agency (EASA) "ensure that physical strength is not a decisive factor for opening and locking emergency exits on aircraft … even in the case of abnormal tilting angles."

Learjet Hits Van After Engine Start

Learjet 45. Substantial damage. One serious injury.

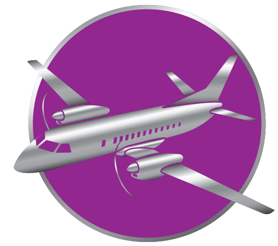
The aircraft was at a stand at London Gatwick Airport and was being prepared for a flight to Paris the evening of March 17, 2006. The copilot set the parking brake and started the right engine to provide electrical power and air-conditioning for the cabin. The aircraft was not equipped with an auxiliary power unit. While moving out of his seat, the copilot inadvertently moved the right thrust lever nearly to the detent for maximum cruise power, said the AAIB report.

The report said that the copilot had not activated the auxiliary hydraulic pump before setting the parking brake, and there might not have been sufficient pressure in the accumulator to apply the wheel brakes. If there was sufficient pressure, the wheel brakes likely were overcome by the thrust being produced by the engine. The nosewheel had been chocked with relatively lightweight chocks carried aboard the aircraft, but the chocks were pushed aside when the aircraft began to move forward while accelerating rapidly.

The captain, who was stowing his baggage in the rear of the cabin, observed that the aircraft was moving and called to the copilot, who did not hear him. While moving forward through the cabin, the captain fell out of the aircraft through the open door and was seriously injured. A ramp-handling agent was knocked to the ground by the aircraft.

The left wing struck a parked service van. The aircraft pivoted almost 180 degrees around the van and came to a stop against it. By then, the copilot had moved back into his seat; he closed the right thrust lever and shut down the engine.

TURBOPROPS



Crew Had 'No Viable Landing Option'

Beech King Air A100. Substantial damage. No injuries.

The aircraft was on a scheduled flight from Purvirnituq, Quebec, Canada, to Kuujjuaq, in northern Quebec, the evening of Dec. 24, 2004. The report by the Transportation Safety Board of Canada (TSB) said that weather conditions at the destination were worse than had been forecast.

The King Air was 97 nm (180 km) from the airport when a Kuujjuaq Flight Service Station (FSS) specialist told the flight crew that the winds were from 310 degrees at 28 kt, gusting to 38 kt; visibility was 1/8 mi (200 m); vertical visibility was 200 ft; and Runway 07 RVR (runway visual range) was 2,600 ft (800 m) with moderate snow, heavy blowing snow and drifting snow. The specialist also said that Runway 07 was covered with frost and compacted snow, and that there were 6-in (15-cm) snowdrifts covering almost half of Runway 31.

The crew requested and received information from the FSS specialist on weather conditions at three alternate airports. The crew then advised the company's dispatch office that they would attempt one approach at Kuujjuaq and, if unable to land, proceed to an alternate airport.

The captain, who had 5,500 flight hours, including 1,500 flight hours in type, was the pilot flying. He told the first officer that they would conduct the ILS approach to Runway 07 and land on that runway or on Runway 31 if the winds were still strong.

However, the report said that the crew had no viable landing option at Kuujjuaq. During the approach, the pilots were told three times that the winds were from 320 degrees at 30 kt, gusting to 45 kt. The reported ceiling was below the minimum descent altitude for a circling approach to Runway 31. "Regardless, the surface of Runway 31 was 40 percent covered with

The aircraft had a crosswind component of 28 kt to 44 kt and a tailwind component between 10 kt and 15 kt.

six-inch snow drifts," the report said. Landing on Runway 07, the aircraft had a crosswind component of 28 kt to 44 kt and a tailwind component between 10 kt and 15 kt.

A crosswind and runway-friction-index reference chart in the Canadian *Aeronautical Information Publication* indicates that, with the wind conditions that existed at Kuujjuaq, a landing should be attempted only on a dry runway. "Use of the crosswind chart in preparation for landing on Runway 07 at Kuujjuaq would have clearly shown that a landing [on the contaminated runway] would have little chance of success," the report said.

The crew said that the drift angle required to maintain the localizer was not excessive, and they obtained visual contact with the runway environment after crossing the final approach fix. The captain decided to land on Runway 07. "Immediately after landing, the aircraft started skidding to the right and departed the landing surface, coming to rest 1,600 ft [488 m] from the threshold and 40 ft [12 m] to the right of the runway," the report said. "The captain advised the FSS of the runway excursion, and help was sent to assist the four passengers and crew."

Engine Loses Power During Steep Takeoff

Mitsubishi MU-2B-25. Destroyed. Four fatalities.

Pilots who witnessed the accident said that after the aircraft lifted off the runway at Portland–Hillsboro (Oregon, U.S.) Airport on May 24, 2005, it entered a nose-high pitch attitude of about 40 degrees, climbed to about 1,000 ft AGL, rolled into a steep left bank, pitched nose-down and spun to the ground. The pilot and three passengers were killed.

The NTSB report said that the AFM indicated that the takeoff climb performance described by the witnesses could have been achieved only by maintaining airspeed below 100 kt — the minimum control speed with the critical engine inoperative, V_{MC} — and near 86 kt, the power-off stall speed with flaps extended 5 degrees. Normal climb speed under the existing conditions was 125 kt.

Investigators determined that a partial loss of power from the left engine had occurred. A teardown examination of the engine indicated that the high-speed pinion bearings in the gearbox had failed after a fatigue-induced failure of an oil-supply tube.

The pilot had purchased the aircraft about a month before the accident occurred. "The pilot had stated to personnel at the place where he purchased the aircraft that he had not received, nor did he need, recurrent training in this aircraft as he had several thousand hours in the aircraft," the report said. "Flight logs … indicated that the pilot had accumulated about [2,170 flight hours, including] 551 hours in a Mitsubishi; however, the last time that the pilot had flown this make and model was 14 years prior to the [purchase of the aircraft]. Logbook entries indicated that only a few hours of flight time had been accumulated in all aircraft during the approximately two years prior to the accident." The pilot had flown the MU-2 about 11 hours after purchasing it.

NTSB said that the probable cause of the accident was "the pilot's failure to obtain minimum controllable airspeed during the takeoff climb, which resulted in a loss of aircraft control when the left engine lost partial power." The board said that the pilot's failure to follow procedures, his lack of recent experience and recurrent training, and the oil-tube failure were contributing factors.

No Explanation for Control Loss

Reims Cessna F406 Caravan II. Destroyed. One fatality.

The AAIB said that because of extreme fragmentation of the wreckage and the absence of recorded flight and voice data, no conclusions could be made on what might have caused the twin-turboprop aircraft to depart from controlled flight soon after the pilot began a descent in instrument meteorological conditions (IMC) to land at Inverness, Scotland, the morning of Oct. 22, 2004. The aircraft was in a steep spiral dive when it struck the ground at about 350 kt.

The trip had begun at Inverness about five hours earlier, and the pilot, who had 2,735 flight hours, including 510 flight hours in type, had completed four flight segments transporting newspapers and magazines to Scotland's northern and western islands. There was no cargo aboard the aircraft for the fifth segment, a positioning flight to Inverness from Stornoway. The last radio transmission received from the pilot was his acknowledgement of clearance to descend from cruise altitude, Flight Level 95 (about 9,500 ft), to FL 75. He did not respond to subsequent calls from ATC.

A mountain rescue team found the wreckage the next day on a 2,500-ft ridge 30 nm (56 km) northwest of Inverness. "The severity of the impact had scattered the aircraft over a wide area and into many pieces," the report said.

The elevator trim actuators were found to be near their full nose-down positions, which might have been caused by a fault in the electric trim system or in the autopilot, the report said. The trim position also might have been set involuntarily by the pilot, who was 6 ft 4 in tall, if he had become incapacitated after striking his head on the ceiling of the cockpit during an encounter with a vertical gust. "A severe encounter could have rendered him unconscious, and if he started to regain consciousness, any involuntary arm and leg movements might have been sufficient to 'upset' the aircraft," the report said.

However, there was "insufficient evidence from which to draw a firm conclusion [about] the cause or causal factors for [the] rapid deviation from controlled flight," the report said. Noting that the installation of flight data recorders in aircraft like the F406 is "impractical and economically unacceptable," AAIB recommended that EASA "develop standards for appropriate recording equipment that can be practically implemented on small aircraft."

PISTON AIRPLANES

Aztec Crippled by Ice

Piper PA-23-250. Substantial damage. One serious injury.

Dark nighttime IMC prevailed for the unscheduled cargo flight from Kansas City, Missouri, U.S., to Wichita, Kansas, on March 20, 2006. During his preflight weather briefing, the pilot was told that he could expect icing conditions and that the freezing level was at 1,500 ft AGL.

Soon after takeoff, the aircraft encountered icing conditions at 4,000 ft. The pilot observed that the wing deice boots were shedding the ice, and he requested and received clearance to climb to 6,000 ft. The pilot later told investigators, "After attempting to climb several times, I realized the aircraft could not climb and [had] started to buffet, and the speed was beginning to decrease." He requested a descent to 3,000 ft and was cleared to descend to 3,200 ft, the minimum en route altitude. The pilot said that while descending, "I realized that I could not hold altitude. I was unable to level; the airplane continued to descend and buffet."

The air traffic controller, who had lost radar contact with the airplane, asked the pilot if he could conduct a landing at Emporia (Kansas) Airport, which was nearby. The pilot replied, "No, sir. I'm going down." The airplane struck a tree and came to rest, upright, in a field 4 nm (7 km) from the airport. NTSB said that the probable causes of the accident were "the pilot's attempted flight into adverse weather conditions and improper in-flight planning, which resulted in loss of control."

Neither Pilot Looked for 'Three Green'

Piper PA-31 Navajo. Substantial damage. No injuries.

The pilot, who was receiving instruction for a class endorsement in the aircraft, said that he moved the landing gear selector to the "DOWN" position late on the downwind leg to land at Birdsville (Queensland, Australia) Airport on Nov. 12, 2005. "Both pilots reported that they usually checked for landing-gear-down indications but could not recall whether the three green 'Down-Locked' lights or the red 'Not-Locked' light were illuminated," said the report by the Australian Transport Safety Bureau (ATSB).

The instructor said that the approach and landing were normal until the propellers struck the runway. Neither pilot recalled hearing the gear-unsafe warning horn, which sounds when a throttle is reduced below 12 in manifold pressure with the landing gear retracted.

The landing gear selector was found in the "DOWN" position after the aircraft landed gear-up on the runway. "The pilot's operating handbook explained that the gear selector moved from the 'DOWN' to a neutral position when the landing gear extension cycle was complete," the report said. "It stated that the gear lights were the primary means of confirming the landing gear status." The report noted that in most aircraft with retractable landing gear, the selector remains in the "DOWN" position after the gear are extended.

Post-accident tests conducted by a maintenance engineer indicated that the landing gear system operated normally. ATSB said that the investigation did not determine why the landing gear did not extend during the landing at Birdsville. "It was possible that the pilot flying did not fully engage the landing gear selector and used the position of the gear selector as an indication of landing gear extension," the report said. "More importantly, it appeared that neither pilot confirmed that the landing gear was down and locked by checking that the three green 'Down-Locked' lights were illuminated."

Descent Below Minimums

Piper PA-34-200T Seneca. Destroyed. One fatality.

The automated weather observation at Skagit Regional Airport in Burlington, Washington, U.S., the evening of Jan. 6, 2006, included 5 mi (8 km) visibility, a broken ceiling at 100 ft AGL and an overcast at 800 ft AGL. The pilot, who was inbound on an unscheduled cargo flight from Seattle, requested and was cleared to conduct the NDB (nondirectional beacon) approach. The published minimum descent altitude is 1,240 ft, or 1,096 ft above the runway touchdown zone elevation.

The airport also had two GPS approaches, but the airplane's GPS receiver was certified only for visual flight rules navigation.

Radio and radar contact were lost soon after the pilot, who had 4,685 flight hours, including 220 flight hours in type, reported that the airplane was inbound on the procedure turn. The wreckage was found the next morning in a heavily wooded area 2,090 ft (637 m) from the runway threshold. The report said that there was no sign of a preimpact mechanical malfunction or failure.

NTSB said that the probable causes of the accident were "the pilot's failure to maintain the published minimum descent altitude and not adhering to the published missed approach procedures."

HELICOPTERS

Engines Fail to Respond on Approach to Glacier

Bell 212HP. Substantial damage. No injuries.

The pilot was conducting heli-skiing operations in the Blue River area of British Columbia, Canada, on Feb. 24, 2005. He departed, alone, from the top of a glacier at 8,000 ft and conducted a downwind approach to a pick-up area at the bottom of another glacier at about 6,100 ft. The helicopter was 150 ft above the ground, and airspeed was about 30 kt, when the pilot increased collective pitch to slow the rate of descent. The engines did not respond, however, and rotor speed decreased.

"The pilot flew the helicopter toward a snow-covered, frozen lake," said the TSB report. "The sink rate could not be arrested as the rotor rpm [revolutions per minute] had not recovered, and the helicopter landed hard, yawed right about 90 degrees and remained upright. … After the landing, the rotor rpm appeared to start accelerating, and the pilot shut the engines down immediately."

Investigators found that the power-turbine governors were not rigged correctly; their control arms were statically positioned at about 74 degrees, rather than the standard 85 degrees or 90 degrees. When the control arms were positioned to 90 degrees, the engines operated normally.

Pilot Loses Control in Low Visibility

Robinson R44 Raven. Destroyed. Two fatalities, one serious injury.

On the morning of July 9, 2005, the pilot telephoned the Waterford (Ireland) Airport control tower to request permission to fly from New Ross to an area over the ocean south of Waterford, so that he and his passengers could view the beginning of a yacht race. The controller rejected the request because of low visibility and clouds in the Waterford ATC zone, said the report by the Irish Air Accident Investigation Unit (AAIU). The pilot told the controller that he would fly west and would not enter the ATC zone.

The pilot, who had 123 flight hours, including 58 flight hours in type, then filed a visual flight rules flight plan to the helicopter's home base, a heliport near Galway Airport, which is on the west coast of Ireland, about 170 km (92 nm) northwest of New Ross. The pilot estimated 50 minutes en route at 2,000 ft.

About 40 minutes after takeoff, the pilot attempted to establish radio contact with the Galway Airport control tower but received no response. "The duty controller had left the tower for a brief break," the report said. Another helicopter pilot heard the accident pilot's radio transmissions, told him that the tower was "off-air at the moment" and relayed the local altimeter setting.

"Radar tracking indicates that the helicopter slowed down and then made a sharp turn before disappearing off the screen," the report said. The wreckage was found in dense forest on a mountain slope near Derrybrien. One passenger had been killed, and the pilot died that evening in a hospital. The surviving passenger told investigators that the flight had been uneventful before the helicopter suddenly entered cloud. "We seemed to hit something, and I saw [the pilot] struggling with the controls," he said. "I remember that we went chopping through trees before coming to an abrupt halt."

Investigators determined that the pilot likely lost control of the helicopter, which was in a steep descent with a high nose-down pitch attitude when it struck the trees. The engine was producing power and the rotor blades were turning on impact. "The reports of various witnesses indicated that the cloud was sitting on the high ground in the Derrybrien area at the time of the accident and that visibility was poor," the report said.

AAIU said that the probable cause of the accident was "the pilot's loss of spatial orientation resulting from inadequate visual reference with the ground due to limited visibility."

Crosswind Thwarts Vertical Takeoff

Bell 206-L1. Substantial damage. One fatality, three serious injuries.

The pilot landed the emergency medical services helicopter on the front lawn of a residence in Gentry, Arkansas, U.S., on Feb. 21, 2005, to pick up a patient who had been severely injured in a motor vehicle accident.

"The 3,438-hour commercial pilot was unable to determine wind direction; however, he knew the wind was forecast to be out of the north between 330 and 030 degrees between 10–15 knots," the NTSB report said. Another pilot said that winds at the accident site were from 030 to 050 degrees at 10 kt or less.

The helicopter was on a 360-degree heading when the pilot conducted a vertical ascent to avoid striking the residence and 60-ft powerlines that crossed over the property. The report noted that when a helicopter is maneuvered in a high-power, low-airspeed environment, a crosswind or tailwind can cause a loss of tail rotor effectiveness and an uninitiated turn.

The helicopter was just below the level of the powerlines when it began an uncommanded right turn. "The pilot had full left torque pedal applied at the time, and he attempted to gain forward airspeed; [he] also used the cyclic to follow the nose of the aircraft in an attempt to fly out of the turn," the report said "The pilot was unable to gain airspeed, and the helicopter began to spin to the right and descend. The pilot initiated an autorotation by lowering the collective and placing the throttle in the idle position."

The helicopter was just below the level of the powerlines when it began an uncommanded right turn.

The helicopter landed hard in an adjacent field. The patient was killed; the pilot, flight nurse and paramedic were seriously injured. NTSB said that the probable causes of the accident were "the pilot's improper decision to maneuver in an environment conducive to a loss of tail rotor effectiveness and his failure to properly execute an autorotation." ●

Preliminary Reports

Date	Location	Aircraft Type	Aircraft Damage	Injuries
Oct. 2, 2006	Decatur, Illinois, U.S.	Learjet C-21	destroyed	2 none
Winds were from 220 degrees at 17 kt, gusting to 20 kt, when the flight crew was cleared to conduct an "option approach" to Runway 24 during a U.S. Air Force training flight. The airplane, a military version of the Learjet 35, crashed on a taxiway and burned.				
Oct. 3, 2006	Tirana, Albania	Boeing 737-400	none	113 none
Soon after takeoff from Tirana for a scheduled flight to Istanbul, Turkey, the airplane was hijacked by an unarmed man who threatened to blow himself up if the flight was not diverted to Italy. The airplane was landed in Brindisi.				
Oct. 3, 2006	Tarakan, Indonesia	Boeing 737-200	substantial	110 NA
Visibility at the Tarakan–Juwata Airport was about 400 m (1/4 mi) in smoke from nearby forest fires when the airplane overran the 1,845-m (6,053-ft) runway on landing and came to a stop in a swamp. There were no fatalities.				
Oct. 5, 2006	Colville Lake, Northwest Territories, Canada	Bell 206L	substantial	1 minor, 3 none
The pilot conducted an autorotative landing after a loss of engine power occurred during an approach to a remote landing site. One passenger received minor injuries.				
Oct. 5, 2006	Villamblard, France	Agusta-Bell AB206A	destroyed	3 serious
The helicopter was in cruise flight in visual meteorological conditions (VMC) when it struck powerlines and terrain.				
Oct. 10, 2006	Stord, Norway	British Aerospace BAe 146	destroyed	4 fatal, 9 minor, 3 none
The airplane caught fire after running off the end of the 1,200-m (3,937-ft) runway while landing in VMC at the Stord–Sorstokken Airport.				
Oct. 11, 2006	Sosua, Dominican Republic	Robinson R44	destroyed	4 fatal
The helicopter was en route from the Playa Grande golf resort to Puerto Plata International Airport when a loss of control occurred while it was being maneuvered in unknown weather conditions. The two pilots and two passengers were killed.				
Oct. 11, 2006	Denver, Colorado, U.S.	McDonnell Douglas MD-90	substantial	145 none
The flight crew heard an unusual noise and observed a nose landing gear "UNSAFE" indication when they extended the landing gear on approach. After attempting unsuccessfully to resolve the problem, the crew landed the airplane on Runway 16R with the nose gear retracted.				
Oct. 15, 2006	Antlers, Oklahoma, U.S.	Aero Commander 690A	destroyed	4 fatal
The airplane broke up in instrument meteorological conditions during a flight from Oklahoma City to Orlando, Florida. Recorded air traffic control radar data indicate that the airplane was cruising at 23,000 ft when it began a 180-degree left turn and a 13,500-fpm descent. Radar contact was lost at 15,100 ft.				
Oct. 18, 2006	Besancon, France	Beech King Air 90	destroyed	4 fatal
The airplane crashed during takeoff in nighttime VMC from La Veze Airport.				
Oct. 18, 2006	Perkinsville, Arizona, U.S.	Piper Cheyenne III	destroyed	5 fatal
The tail section separated from the Cheyenne while it was being maneuvered below a MiG 21. Both airplanes had departed from Prescott for an aerial photography flight. The MiG pilot had a problem retracting the landing gear, and the Cheyenne pilot was visually checking the jet's gear when radio contact between the pilots was lost. The Cheyenne crashed in desert terrain. The MiG was landed uneventfully, and no sign of contact with the Cheyenne was found.				
Oct. 25, 2006	Tulear, Madagascar	Cessna 425 Conquest	destroyed	6 fatal
The airplane struck terrain and burned soon after takeoff in nighttime VMC.				
Oct. 26, 2006	Falsterbokanalen, Sweden	CASA 212-200	destroyed	4 fatal
All four crewmembers were killed when the airplane crashed in a canal and sank in 6 m (20 ft) of water during a research flight conducted by the Swedish Coast Guard.				
Oct. 29, 2006	Abuja, Nigeria	Boeing 737-200	destroyed	104 fatal
The airplane crashed and burned in a corn field soon after takeoff from Abuja International Airport.				

NA = not available

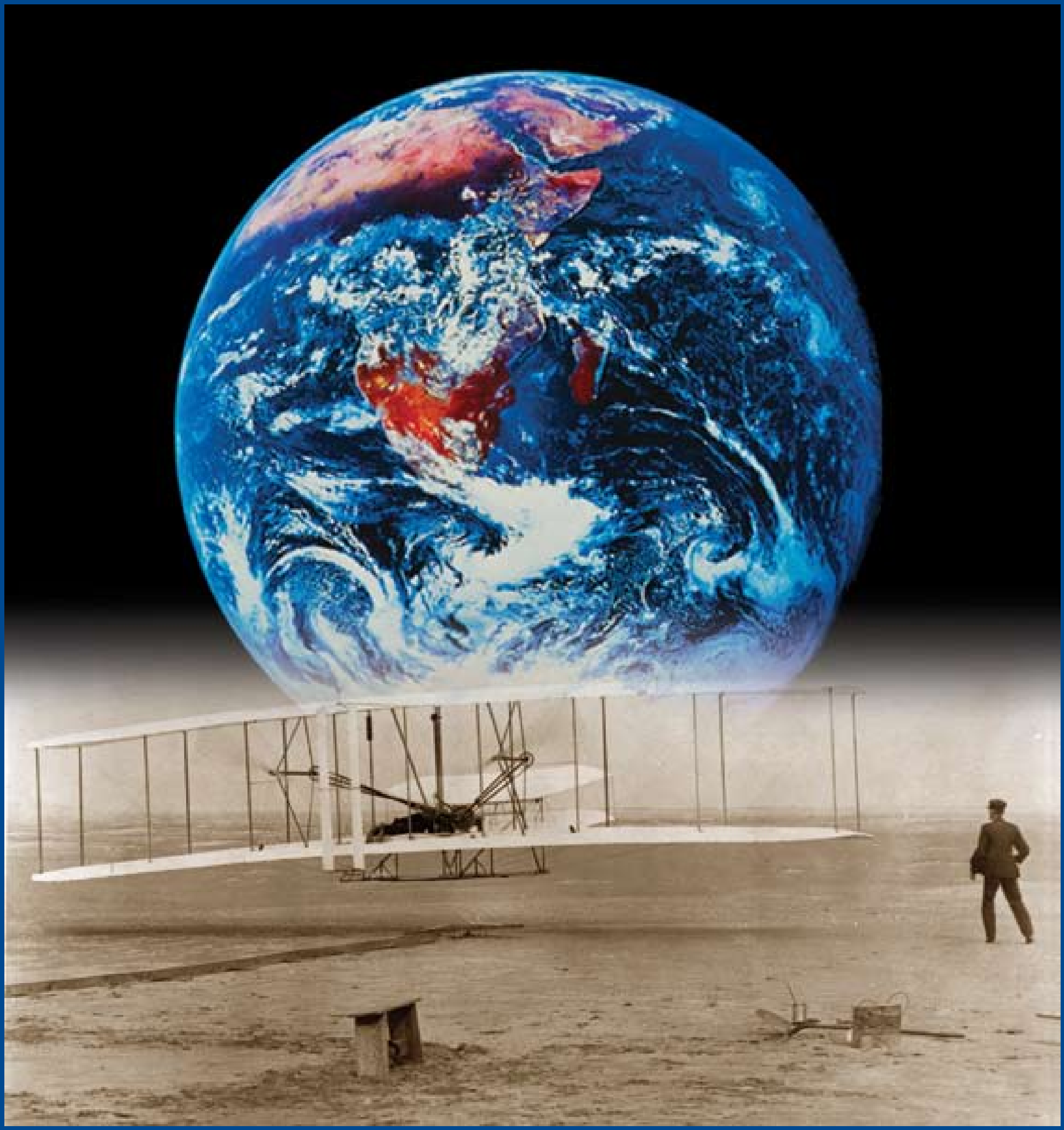
This information, gathered from various government and media sources, is subject to change as the investigations of the accidents and incidents are completed.

What can you do to improve aviation safety?

Join Flight Safety Foundation.

Your organization on the FSF membership list and Internet site presents your commitment to safety to the world.

- Receive *Aviation Safety World*, a new magazine developed from decades of award-winning publications.
- Receive discounts to attend well-established safety seminars for airline and corporate aviation managers.
- Receive member-only mailings of special reports on important safety issues such as controlled flight into terrain (CFIT), approach-and-landing accidents, human factors, and fatigue countermeasures.
- Receive discounts on Safety Services including operational safety audits.



Wright Flyer photo/source: U.S. National Aeronautics and Space Administration

Flight Safety Foundation

An independent, industry-supported, nonprofit organization for the exchange of safety information for more than 50 years

If your organization is interested in joining Flight Safety Foundation, we will be pleased to send you a free membership kit.

Send your request to: Flight Safety Foundation
601 Madison Street, Suite 300, Alexandria, VA 22314 USA
Telephone: +1 703.739.6700; Fax: +1 703.739.6708
E-mail: membership@flightsafety.org

Visit our Internet site at www.flightsafety.org

Flight Safety Foundation

era
european regions airline association

19th annual European Aviation Safety Seminar EASS

Staying Safe in Times of Change

March 12–14, 2007

Amsterdam, Netherlands

To receive agenda and registration information, contact Namratha Apparao,
tel: +1 703.739.6700, ext. 101; e-mail: apparao@flightsafety.org.
To sponsor an event, or to exhibit at the seminar, contact Ann Hill, ext. 105; e-mail: hill@flightsafety.org.

© Copyright 2006 Getty Images Inc.