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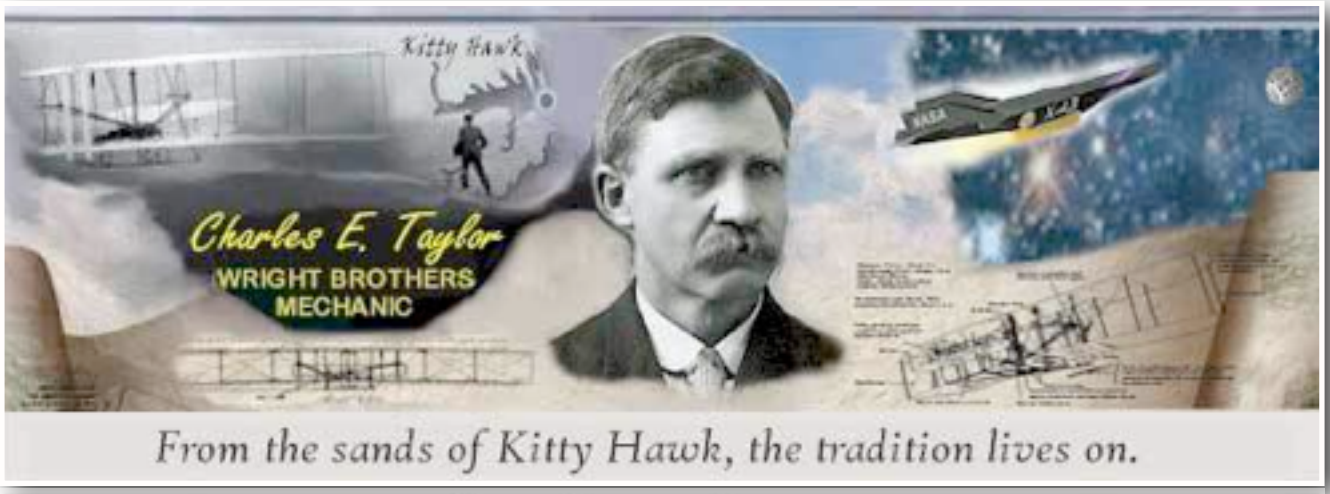
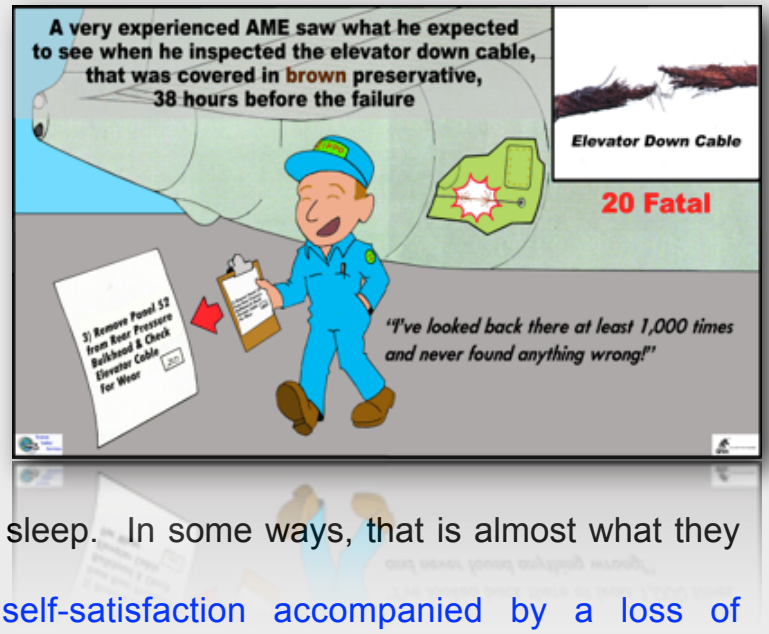


Hello all,
To subscribe send an email to: rhughes@humanfactorsedu.com
In this weeks edition of *Aviation Human Factors Industry News* you will read the following stories:

Complacency

Submitted by Gordon Dupont
With permission from D.O.M. Director of Maintenance magazine



Aircraft maintenance calls for a lot of repetitive inspections to be carried out with the hope that nothing wrong is found. This sets one up for the second contributing factor in the Dirty Dozen contributors to human error: **Complacency.**

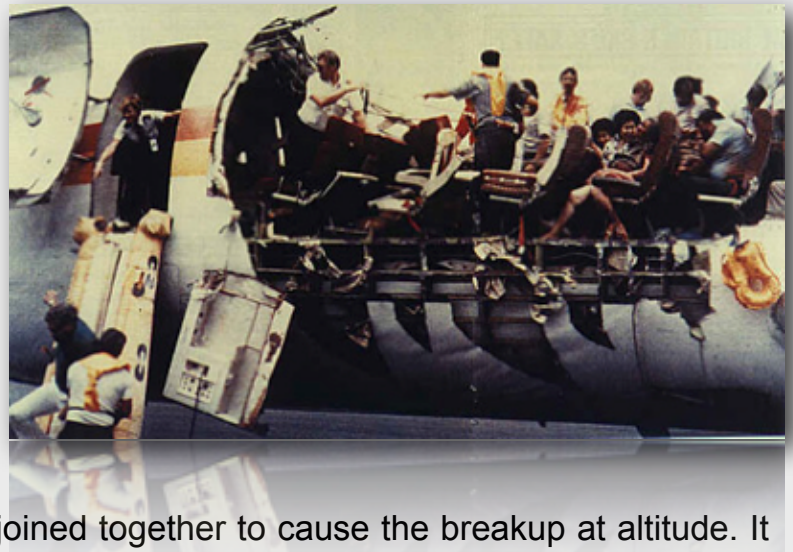
Complacency is most common among the "no hair and grey hair group" who have done the task many times and may even boast that they can do it in their sleep. In some ways, that is almost what they can be doing without realizing it. Complacency is defined as: self-satisfaction accompanied by a loss of awareness of the dangers. Coupled with Complacency is an outcome called Expectancy, where the person will see only what they expect to see. This is done without the realization that it is occurring.

For example, we drive the same route to work every day and in time we become complacent. In fact you may say you could drive it in your sleep. But one night they put temporary 4-way stop signs at one of the intersections you normally drive through. The stop sign is clearly visible but you don't expect it to be there and you drive right through that intersection just like you always do. If there was an accident the first thing you would likely say is *"I didn't see that stop sign"* but it was there and you just drove through it.

Let's look at an actual case study everyone can relate to.

Aloha Airlines, Flight 243, April 28, 1988 became known around the world as "the convertible" when it lost 18 feet of the upper fuselage at 24,000 feet. Only one person out of the 95 on board lost her life but the world demanded to know how this could happen to a modern jet transport.

This was not the first Boeing 737 to have this type of breakup as seven years earlier a Far Eastern Air Transport aircraft broke up over Taiwan and spread wreckage over a four square mile area, 110 lives were lost. The aircraft was experiencing pressurization problems in the days and just before the final flight. Severe corrosion was found at the lap joints.



cracks from the corrosion had joined together to cause the breakup at altitude. It was felt that with proper maintenance and inspections this could never happen again. The cracks would be readily visible long before they joined to cause a decompression. On a previous flight before the accident, a woman walking up the stairs to board noticed a crack estimated to be about six inches long above one of the windows. She said nothing as "they must know about it." They didn't. The pilots, flight attendants and other passengers walked up those same stairs but failed to notice the same crack. But, it was there and so were a lot of other cracks that were evident and about to join on that fateful day.

Five months before the accident the FAA issued a detailed Airworthiness Directive (AD) that called for the careful inspection of 1,300 rivets on the forward upper fuselage. If any crack was found, the entire area was to be eddy current inspected as there would likely be other cracks not visually seen yet. Boeing estimated this inspection would take about eight man-hours, but two very experienced inspectors were able to do it in four. No cracks were detected.

An examination of the aircraft after the accident determined that when the aircraft was last inspected for cracks there should have been 140 cracks that should have been detectable to the eye, ranging in length from 0.020" to 0.250." The two very experienced inspectors, who missed those cracks, had been with the company for 22 and 33 years respectively. They had worked on that 737 since it had arrived, new, at Aloha in 1969. Since that time it had flown 35,496 hrs. and had been cycled (Pressurized and depressurized) 89,680 flight cycles. These cycles made it the second highest cycled 737 in the world. One of its sister 737s was the highest and after this accident, new non-complacent inspectors found so many cracks that it was scrapped, as were two others.

As an aside, how did they know the length of the cracks when they were inspected five months earlier? A crack will begin at a stressor. In this case, corrosion, and each time the crack is stressed by pressurization cycle, the crack gets just a little bit longer. These crack expansions leave what are called “beach marks” that can be easily seen under a microscope. By counting back the number of known cycles since the inspection, one can determine the exact length of the crack at the time of the inspection.

So how could they possibly miss 140 cracks? I have no doubt that they didn’t do it on purpose, so WHY? It happened for the same reason that you ran that stop sign: **Complacency**. They had inspected that aircraft and others exactly like it (Aloha only had 737s) hundreds of times. They didn’t expect to find any cracks and thus, they didn’t see any cracks. While there are other human factors involved in this accident which we’ll touch on in later issues, I believe that **Complacency** was the prime factor. The interesting thing is, they likely didn’t know themselves, how they could have missed those cracks, after the fact.

One of the evil side effects of Complacency is your self-satisfaction in knowing the job so well begins to justify, at least in your mind, the taking of the odd short cut. The fact that they were able to do the job in half the time that Boeing felt it should take suggests that they were taking the odd short cut. If you look at the cartoon at the beginning of this article, you see a short cut being taken with no awareness of the danger. He gave it the “boy look” but he did not see anything wrong and 20 people would pay the price for his Complacency.

So what’s a “boy look?” When I am unable to find something that my wife sent me to the pantry for, she gives me that scornful glare and says that I only gave it a “boy look” as she hands me the unfound item that was right under my nose. Perhaps it’s one of our male genes we are born with to give things a “boy look”, much like the communication “tune out” gene. At least that is my excuse until a better one comes along.

So what can we do about this insidious, dangerous human factor?

Awareness is our strongest ally. We have to constantly remind ourselves that Complacency can be doing more of the decision making than we wish. What if prior to going up to look for those cracks, the Aloha inspectors had said to themselves: *“Tonight I’m going to find a crack”?* They could have repeated it a few times while thinking of the task ahead. I think it could have made the difference. So get in the habit of “talking to yourself” before beginning a repetitive task.

Set your mind to avoid the “boy look.” Keep in mind our enemy “Murphy’s law #101”. If you skip giving a good, hard look at a component because you’ve NEVER found anything wrong YET (remember You’re Eligible To), Murphy will guarantee there will be something that could bite you hard today. By training yourself to expect to find a fault every time, you can help eliminate Complacency.

Reading about other people’s mistakes helps reduce Complacency, especially if the error was made on the task that you are about to do. One overhaul company compiled every known error and near error for each of their task cards. It was then mandatory that you read the applicable list before you started the task. This resulted in about a 50% decrease in the repeat of the previous errors.

By always following a detailed check sheet and never ever signing for anything you haven’t done, just because it’s never been a problem before, you can also help ensure that you never become a victim of **Complacency.**

Incident: Aruba A320 near Miami on Sep 19th 2016, dropped engine cowl

An Aruba Airlines Airbus A320-200, registration P4-AAA performing flight AG-820 from Miami,FL (USA) to Aruba (Aruba), departed Miami's runway 08R and was climbing out when the crew stopped the climb at FL220 after the outboard fan cowl had separated from the right hand engine (V2527).

The crew advised ATC it appeared an outboard panel on the right hand engine had blown away, they sure whether it had really detached, it wasn't visible from the inside of the aircraft. Everything was normal for now, as a precaution they decided to return to Miami. The aircraft landed safely on Miami's runway 09 about 40 minutes after departure. There were no injuries, the aircraft sustained damage to the engine, engine pylon, right main landing gear, right main landing gear door and right fuselage.

NBAA Report: Flight Crews Skip Checks

A study conducted by NBAA has found that 15 percent of flights in business jets begin without a complete flight-control check, the association reported last week. The NTSB suggested a need for the study after its investigation of a fatal 2014 accident involving a Gulfstream G-IV at Hanscom Field, in Bedford, Mass. The safety board found the crew had not performed a flight-control check before takeoff, and as a result, they had no way of knowing the aircraft's gust lock was engaged. The jet ran off the runway and caught fire, killing all seven on board. The NTSB recommended that NBAA lead an industry-wide, collaborative study to measure the extent of non-compliance with before-takeoff flight checks.The NBAA study analyzes data from 143,756 business aviation flights between Jan. 1, 2013, and Dec. 31, 2015. The analysis found that an average of 15 percent of those flights began with a partial flight control check, and 2 percent began with no check at all. The report defined a valid flight check as the stop-to-stop deflection of all flight controls specified by a manufacturer's aircraft flight manual. "As perplexing as it is that a highly experienced crew could attempt a takeoff with the gust lock engaged, the data also reveals similar challenges across a variety of aircraft and operators," said NBAA President Ed Bolen.

"This report should further raise awareness within the business aviation community that complacency and lack of procedural discipline have no place in our profession."

Among the report's recommendations, NBAA urged operators to establish flight-data monitoring programs (only 1 percent of operators currently have such programs), and to participate in a formal data-sharing program similar to the Aviation Safety Information Analysis and Sharing System, which focuses on the root causes of accidents in an effort to prevent their recurrence. The study also urges manufacturers to provide clearer requirements for pre-departure flight-control checks.

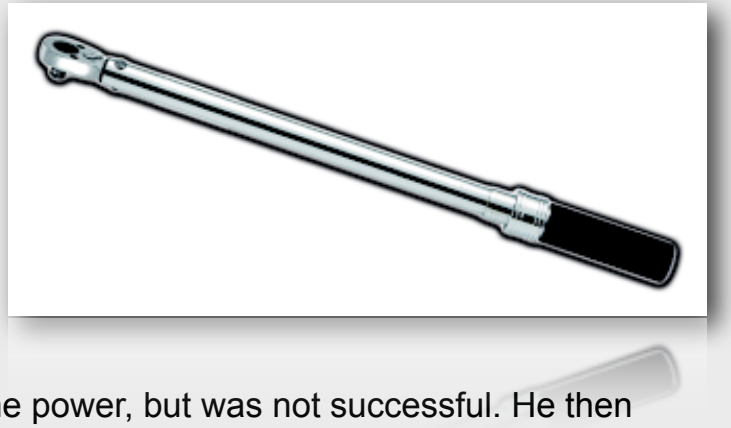
The complete report is posted on the NBAA website.

http://www.avweb.com/avwebflash/news/Lack-of-Control-Checks-Found-In-Gulfstream-Crash-Probe-223818-1.html

http://www.avweb.com/avwebflash/news/Seven-Die-in-Gulfstream-Crash-222097-1.html

Mechanic error leads to forced landing for SR-22

The commercial pilot was conducting a cross-country personal flight in the Cirrus SR-22. He reported that, during cruise flight, the airspeed began to decrease, and the engine began to lose power.



He attempted to restore engine power, but was not successful. He then conducted a forced landing to a road in Langola Township in Minnesota.

During the landing roll, he maneuvered the plane to miss an oncoming car, and the plane subsequently struck a guy wire, which resulted in substantial damage to the left wing.

A post-accident examination of the engine revealed that the throttle control lever nut was not torqued to factory specifications in accordance with an engine manufacturer service bulletin (SB).

The knurl teeth of both the throttle control lever and shaft displayed signatures of machining with adhesive wear scars on the surfaces.

In addition, the surface of the control lever that the nut was normally secured to displayed scoring wear scars. The surface signatures were consistent with the throttle control lever nut not having been properly torqued.

A review of the engine logbook entries revealed that a rebuilt engine was installed on the airplane about 73.1 flight hours before the accident. The mechanics at the repair station who installed the engine, which would have included installing the throttle body and torqueing the throttle control lever nut, reported that they were knowledgeable of the manufacturer SB, and no discrepancies in their procedures were found.

Even though the mechanics reported that they were familiar with the SB, it is likely that they did not apply sufficient torque on the throttle control lever nut during the installation of the engine.

The NTSB determined the probable cause as maintenance personnel's failure to apply sufficient torque on the throttle control lever nut, which resulted in a loss of throttle control and subsequent loss of engine power.

NTSB Identification: CEN14LA486

This September 2014 accident report is provided by the National Transportation Safety Board. Published as an educational tool, it is intended to help pilots learn from the misfortunes of others.

How the deadly 1986 Cerritos midair collision ultimately made air travel safer for all

Gary Schank was piloting an airliner from San Francisco to Memphis when he received an urgent warning over the cockpit alert system that his plane was climbing dangerously close to a twin-engine airplane's altitude.

After the system commanded Schank to descend, he guided the plane downward by 500 feet – and a potential midair collision was averted.

"It was resolved quickly," said Schank, an airline captain and practicing attorney who lives in Coto de Caza. That life-saving technology, known as a traffic collision avoidance system, was introduced in the U.S. in the late 1980s after an Aeroméxico airliner and a small plane collided over Cerritos.

The crash – which 30 years ago killed 82 people in the air and in the neighborhood where both planes went into the ground – would become a pivotal moment in aviation safety history.

AVOIDANCE SYSTEMS

Blame for the crash was shared equally by the pilot of the smaller plane and the Federal Aviation Administration, a jury found.

Later, the FAA would implement a series of major changes, requiring jetliners to install automatic crash-avoidance systems; mandating the use of transponders operating within certain areas; and consolidating approach spaces for more organized airspace management.

“It highlighted some of the deficiencies that have been corrected ... in areas that technology could help,” said George Perry, senior vice president of the Air Safety Institute, part of the Aircraft Owners and Pilots Association.

Prior to those changes, federal investigators concluded that a few minutes before noon on Aug. 31, 1986, the small plane, a single-engine Piper Archer, entered unauthorized airspace and went undetected.

Ultimately, the Piper collided with Aeroméxico Flight 498, which was starting its descent to Los Angeles International Airport after originating in Mexico City. The Piper then crashed into an empty elementary school playground, but the airliner, a DC-9, crashed into a residential neighborhood in Cerritos. Homes were destroyed or damaged, a fire was started, and 15 people on the ground were killed.

“The sights, sounds, smells, the burning material – the destruction made an impression on me,” recalled John Lauber, who surveyed the wreckage as a National Transportation Safety Board member.

Lauber, who is now retired in Seattle, says aviation safety standards and protocols have since “come a long way.”

The biggest lesson aviation officials drew from the Cerritos crash, he said, was that traffic in high-density airspace in major metro areas had to be more “actively managed.”

“I am ... and was a pilot,” Lauber said. “So I understand how air traffic control worked and their shortcomings and limits” at the time.

Perhaps the most significant change prompted by the tragedy was the implementation of traffic collision avoidance systems, which were mandated for all jetliners in a 1989 FAA rule.

The system identifies potential midair crashes based on readings of aircraft transponders and instructs pilots to either climb or descend to avert a collision, said FAA spokesman Ian Gregor in an email to the Register.

"It is not an exaggeration to say this has been one of the most important aviation safety improvements in commercial aviation in recent decades," Gregor added.

What's more, following the Cerritos incident, the FAA required all aircraft flying within 30 miles of major airports to have transponders, which wasn't mandated in 1986. The Piper aircraft was not equipped with a transponder that reports altitude and "was not in radio contact with any air traffic control facility when the accident occurred," the federal investigation concluded.

According to Gregor, other major changes included:

• Implementing systems that alert air traffic controllers about potential aircraft conflicts.

• Establishing dedicated routes for small-plane pilots who want to fly through the busy airspace around major airports.

- The consolidation of several approach operations into one facility in San Diego, which makes it easier for air traffic controllers to track all aircraft.

SAFER FLYING

Since the Cerritos tragedy, there has not been another midair crash between a major commercial air carrier and a general-aviation aircraft – thanks to these aviation reforms, some experts say.

The number of all types of midair crashes in U.S. airspace has fallen from 29 to the single digits over the past three decades, according to data from the Aircraft Owners and Pilots Association.

Potential midair collisions – where an incident likely would have occurred had neither pilot taken action – have also dramatically decreased. In 2014, there were a little more than 80 such near-misses reported by pilots – down from 420 the year before the Cerritos crash,according to the U.S. Department of Transportation.

Air safety standards have continued to change over the years with better technology, said Schank, the Orange County pilot.

He recently purchased a device that contains a relatively new technology that allows general-aviation pilots to see other aircraft in the sky, up-to-the-minute weather reports and other important flight information.

The satellite-based technology – called automatic dependent surveillance-broadcast – is similar to the crash avoidance technology available to jetliners but is far more affordable. The key difference is that the satellite-based devices do not provide pilots automated resolution advisories.

The average cost of such a system is $2,000, according to Perry, the Air Safety Institute executive.

The new system wasn't developed specifically to address midair collisions, but it certainly has the "capability to mitigate those" types of situations, Perry added.

By 2020, all aircraft, including airliners and general aircraft, that plan to fly in high-density airspace are supposed to be equipped with this technology, according to an FAA rule.

With the technology, "I can see every airplane in the area," Schank said.

http://www.ntsb.gov/investigations/AccidentReports/Pages/AAR8707.aspx

http://www.ocregister.com/articles/cerritos-314711-plane-people.html#fancy-1

Bizjet Ground-handling Mishaps Overshadow Accidents

For aircraft insurers, ground events account for the largest single source of customer claims payments, according to a recent study from industry consultancy VanAllen Group. Based on historical industry data, Peter Agur, the study's author and company chairman, determined that business aircraft operators are 800 times more likely to incur damage to their aircraft during ground handling than in an accident.Since neither the FAA nor the NTSB tracks damage caused by ground incidents, the overall incident rates are hard to calculate. But a confidential, two-year survey of flight departments conducted by the Georgia-based company, found respondents suffered on average, one ground event per 4,000 flight hours. Of those incidents, half were cases of "hangar rash," while a third of the damage was attributed to towing accidents. The remainder consisted of ground vehicle collisions and taxiing incidents.

Agur did note the rate of such incidents seems to be declining, perhaps a result of recent increased industry awareness and training programs from organizations such as the National Air Transportation Association (NATA), the International Business Aviation Council (IBAC), NBAA, the Flight Safety Foundation and major FBO chains. But he added they remain a concern due to a variety of potential factors. They include: financial pressure to pack aircraft into hangars; FBO staff turnover; lack of management supervision; improper towing equipment due to lack of capital resources; poor facility lighting; a lackadaisical attitude regarding insurance coverage; and the fact that towing multimillion-dollar aircraft is generally not a high-paying job.

Agur told **AIN** that he believes smart, largely autonomous, robotic tow tugs will be the eventual answer to the problem. Envisioned models would have a variety of sensors and the ability to recognize the specifications of whatever aircraft they are towing. But as he pointed out, no such product currently exists on the market.

In the meantime, he recommends that flight crewmembers take personal responsibility for the aircraft under their care, as if they owned it. He believes it is imperative that the crew observe line service operations, rather than simply park the aircraft and walk away. And if they see issues that raise concerns, they should speak directly to a supervisor. If they cannot witness such activity in person due to duty rest requirements, Agur advises crewmembers to introduce themselves to a location's line service manager and consider tipping them for extra care of the aircraft. Flight departments should also make sure the FBOs they frequent carry appropriate insurance coverage.

To combat hangar rash, Agur suggests service locations use a minimum of three wing walkers equipped with whistles or horns for all hangar movements, brightly colored cones at all four corners of the aircraft while in the hangar and a policy of having no part of the aircraft within five feet of any other aircraft or obstruction, effectively eliminating wing overlap. Crews should make sure all towing is performed with a certified tug and tow bar, and monitored by at least two wing walkers. The tow bar should be removed promptly to avoid possible damage to the nose gear.

Other recommended safety practices include maintaining a 25-foot taxi buffer for the aircraft, and not permitting any ground service vehicles to come within 15 feet of any part of it, even in the hangar.

NTSB 2015 Aviation Statistics Show GA Accidents Continue To Decline

But 376 People Were Fatally Injured During The Year

According to the latest aviation accident statistics released by the NTSB, Part 91 general-aviation accidents and fatalities continued their downward trend in 2015.

And, just as in 2014, there were no fatalities for U.S. airlines.

General aviation comprises mostly smaller, private-use aircraft. While general aviation flight hours were up in 2015, the total number of accidents were down, from 1,223 in 2014 to 1,209, as was the rate of accidents per 100,000 flight.

"Even though the fatality rate in 2015 was the lowest it has been in many years, 376 people still lost their lives," said NTSB Chairman Christopher A. Hart *(pictured)*, "which is why improving general aviation safety is on the NTSB's Most Wanted List of transportation safety improvements. While lower, these numbers are still too high."

The accident rate for non-scheduled air carrier flights, or on-demand Part 135 operations (charter, air taxi, air tour, and air medical operations), was up, but only slightly.

(Source: NTSB news release)

FMI: **www.ntsb.gov/investigations/data/Documents/2015_preliminary_aviation_statistics.xls**

Groups Urge NTSB To Set Record Straight on GA Safety

Twenty-one aviation organizations are urging U.S. NTSB chairman Christopher Hart to convey that general aviation is one of the safest modes of transportation. Last week, the organizations wrote to the chairman expressing concerns about a recent NBC news segment that highlighted NTSB data to question general aviation safety, the groups said.The organizations noted that from 2008 to 2014, general aviation aircraft accidents resulted in 3,628 fatalities. This compares with 277,310 automobile accident fatalities; 38,343 fatalities on motorcycles; 5,561 on bicycles; and 5,831 fatalities in recreational boating accidents.

“As you know, just two years ago, the general aviation accident rate dropped to nearly one fatal accident for every 100,000 flight hours,” the organizations added. “Given the hundreds of thousands of flight hours each year it is understandable that aviation accidents receive significant media attention because they are so infrequent given the enormous amount of private and business flying in the U.S.”

The associations stressed that the NTSB has an “inherent responsibility” to provide a comprehensive view of safety trends and outline the improvements in general aviation safety over the years.

Probe confirms actuator jam in Alitalia gear-up landing

Italian investigators have concluded that an Alitalia Airbus A320's right-hand main landing-gear failed to extend after suffering a jammed actuator.

The aircraft carried out a landing at Rome Fiumicino on 29 September 2013 using nose-gear and left-hand main gear.

Italian investigation authority ANSV has detailed the circumstances of the accident, concluding that debris in the gear-door actuator caused the jam.

Analysis identified two components within the actuator as sources of the debris: the spirolox ring and damping ring.

It says the failure appears to have been the result of a design flaw in the spirolox ring, which suffered premature deterioration, leading to metal contamination.

Actuator failure had been linked to a Wizz Air A320 landing accident at Fiumicino, in similar circumstances, less than four months earlier.

Airbus introduced a new actuator design in response while Europe's safety regulator ordered checks on the component in other A320s

40 years of safer aviation through reporting

The U.S. has an incredibly safe aviation system – it's unparalleled when compared to other modes of transportation. The basis for this historic safety record is that we identify and correct safety concerns before they become real problems. NASA's Aviation Safety Reporting System (ASRS) is one of the tools used to make the system as safe as it is.

Celebrating its 40th anniversary this year, NASA's confidential ASRS is widely used by pilots and other airline employees to identify potential hazards. This information is one of 185 data and information sources across government and industry used by the FAA and the aviation community to detect, mitigate and monitor risk.

People working on the front lines of aviation submit their safety concerns to ASRS in the form of incident reports. The system analyzes these cases and responds by distributing vital information from its conclusions to the aviation community. The reports, always handled confidentially, are also used to identify deficiencies and discrepancies in the National Airspace System that need to be remedied.

"Voluntary reporting programs have significantly contributed to the nation's impressive commercial aviation safety record," said FAA Associate Administrator for Aviation Safety Peggy Gilligan. "In addition to reporting programs that are investigated and verified, ASRS gives aviation workers another way to report potential safety issues."

Making the nation's airways safer

"Since the implementation of the Aviation Safety Reporting System, approximately 1.4 million reports have been submitted by pilots, dispatchers, mechanics, air traffic controllers, flight attendants, ground personnel, and others," said Linda Connell, director of the NASA ASRS, which is located at NASA's Ames Research Center, Moffett Field, Calif. "Many of those reports have had a direct influence on making the nation's airways safer, and we are extremely proud of these contributions to safety."

Over the past 40 years, the ASRS has issued more than 6,200 safety alerts to the FAA and other decision makers in the aviation community who are in a position to correct unsafe conditions. Recent alerts have addressed a wide range of safety issues, including air traffic departure procedures, aircraft equipment problems, airport signage and marking issues, confusion among similar-sounding navigation fixes, or positions, and aeronautical chart deficiencies. Many of these issues involve significant human factors and performance contributions.
One example of a safety alert issued by ASRS emerged from reports of intense sunlight reflecting off a large concentrated solar power plant in the southwestern United States, temporarily blinding pilots in the cockpit. The pilots reported the safety hazard to ASRS, which then issued an ASRS Alert Message. Ultimately, this process led to the formal marking of the solar plant obstruction on charts, so that pilots could avoid flying over the area. ASRS information was also instrumental in the revision of solar plant operations to help reduce the adverse effects of certain mirror array configurations.

Other significant ASRS accomplishments include identification of fire hazards associated with the packaging of lithium ion batteries for shipment in aircraft, health hazards associated with the use of certain de-icing fluids, and the susceptibility of certain pressure-sensitive aircraft systems to icing from super-cooled water droplets.

A research repository for aviation safety

"The ASRS is the largest repository of aviation human factors incidents in the world," Connell noted, "and it has conducted more than 7,200 database searches for government agencies, industry groups, research organizations, aircraft manufacturers, aviation students, and a wide variety of other organizations." Since 2006, all reports are logged and processed with full anonymity and that de-identified data has been accessible to the public. In the last 10 years, the ASRS Database has had more than 189,000 queries.

Like safety alerts and database searches, ASRS research findings have also been influential. ASRS data findings on the content and formatting of aviation checklists and manuals for flight crews were incorporated in a FAA Advisory Circular. An ASRS Alert concerning an aircraft wing oscillation issue contributed to the FAA Aircraft Certification Service taking action to mitigate the problem. Through its website, the ASRS provides access to a range of safety products, including publications, database reports, program overview materials, and ASRS reporting forms for four categories within the aviation community, divided up broadly as pilots and dispatchers; air traffic controllers; maintenance technicians and ground crew; and cabin crew.

A model for safety reporting systems everywhere

ASRS has become a model for safety reporting systems worldwide. It has become a charter member of the International Confidential Aviation Safety Systems, a group of 13 nations that operate ASRS-like voluntary, confidential, non-punitive aviation safety reporting systems. The ASRS has also been recognized for its safety contributions by other industries, including rail operations in which NASA ASRS collaborated with the Federal Railroad Administration to create and operate the Confidential Close Call Reporting System.

TED Talks : Ideas Worth Spreading

Designer Bastian Schaefer shows off a speculative design for the future of jet planes, with a skeleton inspired by strong, flexible, natural forms and by the needs of the world's, ahem, growing population. Imagine an airplane that's full of light and space — and built up from generative parts in a 3D printer.

https://www.ted.com/talks/bastian_schaefer_a_3d_printed_jumbo_jet