



National Transportation Safety Board

Washington, DC 20594

Safety Recommendation

Date: June 23, 2015

In reply refer to: A-15-11

The Honorable Michael P. Huerta
Administrator
Federal Aviation Administration
Washington, DC 20591

The National Transportation Safety Board (NTSB) urges the Federal Aviation Administration (FAA) to take action on the safety recommendation issued in this letter. This recommendation addresses the safety of the public attending airshows and of pilots with significant medical conditions who perform aerobatic maneuvers for the public that subject the body to *g*-loading. The recommendation is derived from our investigations of a series of fatal airplane accidents involving aerobatic airshow pilots with previously diagnosed medical conditions such as severe coronary artery disease. As a result of these investigations, we have issued one safety recommendation, one of which is addressed to the FAA. Information supporting this recommendation is discussed below.

Previous NTSB Safety Recommendations

On January 14, 1999, we issued Safety Recommendation A-99-1 asking that the FAA “[r]estrict all pilots with special issuance certificates due to cardiac conditions that could affect their *g*-tolerance from engaging in aerobatic flight,” and Safety Recommendation A-99-2 asking that the FAA “[r]estrict all pilots taking medication that reduces *g*-tolerance from engaging in aerobatic flight.” The basis for justification of these recommendations was an accident where a North American T-6-SNJ5 suffered a loss of control in flight while maneuvering near Woodward Field in Camden, South Carolina on September 6, 1997, and several other investigations involving pilot incapacitation, including accidents during airshow performances.

In response to these recommendations, the FAA performed an extensive review of a list of accidents supplied by the NTSB. The FAA developed the following criteria to identify accidents that might have been preventable:

- 1) the accident occurred during aerobatic flight as defined by the FAA,
- 2) the aerobatic maneuver was intentional,
- 3) the aircraft was certified for aerobatic flight,
- 4) the maneuver was authorized under FAA regulations, and

- 5) the airman's cardiac or medication history was documented in his/her FAA medical record at the time of the event.

The FAA evaluated 231 accidents between 1993 and 1999. Of these, 153 met the criteria for aerobatic flight. However, only seven of the cases with aerobatic flight had documented evidence of an aviator's cardiac problem or medication in his/her FAA file and four of those aviators did not have a valid medical certificate. In the remaining three, the flights did not meet the regulatory requirements for authorized aerobatic maneuvers. The FAA responded to the NTSB on November 1, 2001, that the recommendations proposed by the NTSB would "probably not have changed the outcome in any of the accidents." Further, the FAA indicated in its review that had there been a significant number of properly identified pilots experiencing aircraft accidents during authorized aerobatic maneuvers, the adoption of more restrictive practices regarding medical restrictions for pilots performing aerobatic maneuvers may have been justified. We subsequently classified Safety Recommendations A-99-1 and A-99-2 "Closed—Reconsidered."

Since closing Safety Recommendations A-99-1 and -2, we have investigated three additional accidents in which medical factors played a role in airshow pilots' failure to maintain control during low altitude aerobatic maneuvers, including two during airshows attended by large numbers of the public. The first case met all of the FAA's criteria and the accident could clearly have been prevented. In the other two cases, each pilot's FAA certified Aviation Medical Examiner (AME) had reason to know of a disqualifying medical condition the pilot failed to report but had certified the pilot anyway; in the third case the FAA also had the information regarding multiple disqualifying conditions.

Thunder Over the Blue Ridge, Martinsburg, West Virginia; September 17, 2011 (ERA11FA495)

On September 17, 2011, a North American T-28C collided with terrain while performing a low altitude aerobatic maneuver during the Thunder Over the Blue Ridge Open House and Air Show at the Eastern WV Regional Airport/Shepherd Field (MRB), in Martinsburg, West Virginia. The NTSB determined that the probable cause of this accident was "the pilot's impairment or incapacitation that occurred during a low-altitude aerobatic maneuver due to complications from a recent heart attack, resulting in his inability to maintain control of the airplane. Contributing to the accident was the Federal Aviation Administration's willingness to allow an airman with well-documented, severe coronary artery disease to perform high-risk, low-altitude aerobatic maneuvers."

The pilot had suffered his first heart attack in 2003 at age 46. According to his medical records, during that hospital admission, extensive coronary artery atherosclerosis was diagnosed, and the pilot underwent urgent four-vessel coronary artery bypass graft surgery (CABG). In May 2004, testing demonstrated that an area of the heart had reversible ischemia that could not be addressed surgically.¹ By November 2004, repeat nuclear stress testing showed some of the

¹ "Reversible Ischemia" refers to an area of heart muscle that is adequately supplied with blood at rest but becomes ischemic (doesn't have enough blood flow) with the increased demands of exercise. This indicates a significant area of narrowing in one or more of the coronary arteries and predicts an increased risk of a heart attack.

previously “reversible” area was now scarred from a second heart attack and another area remained.

In 2005, the FAA required the pilot to provide the medical records regarding his heart disease as part of the medical certification process. Thereafter, the FAA awarded the pilot a special issuance medical certification in the third class, which was time-limited to one year and required annual stress tests.² As part of the initial special issuance medical certification, the pilot submitted an optional Operational Questionnaire indicating the types of flying he intended to do; at that time, he did not indicate that he intended to fly aerobatics. This questionnaire was not required and was not repeated.

In 2007 and 2008, repeat testing showed the same area of reversible ischemia. All of this information was present in the pilot’s FAA medical certification file. The pilot’s last third class medical certificate was issued on August 30, 2011.

The pilot’s autopsy noted, “White scar tissue consistent with remote myocardial infarctions involves the anterior wall and the lateral wall of the left ventricle. An acute myocardial infarction involves the lateral wall of the left ventricle, embedded in the remote myocardial infarction.” This finding indicates that pilot was actively having a new heart attack at the time of his fatal accident.

It is well known that the risk of death and other major adverse cardiovascular events following CABG surgery is significant and increases over time. This pilot was known to have had significant coronary artery disease, was eight years out from a four-vessel CABG, and one graft was known to have failed. The area of reversible ischemia observed on the nuclear images during his thallium stress test in 2008 indicated the pilot was going to have another heart attack at some point.

The effects of *g*-loading related to aerobatic maneuvering or air racing in this situation are concerning. Because the accident pilot had an area of heart muscle known to be sensitive to oxygen flow (based on reversible ischemia on his nuclear studies), *g*-loading would have significantly increased his risk of developing acutely ischemic heart muscle. Thus, this pilot’s cardiac disease predictably decreased his *g*-tolerance. The acute heart attack that likely began in the hours before the pilot’s performance further decreased his *g*-tolerance and put him at increased risk of acute incapacitation. This accident met all five of the FAA’s criteria in its study discussed in the November 1, 2001, letter about Safety Recommendations A-99-1 and -2 and placed the public at increased risk because the accident occurred at a highly attended airshow.³

² Special Issuance Medical Certificates may be issued to allow pilots with otherwise disqualifying medical conditions to fly. They often involve a shorter certificate duration and the FAA may specify additional testing requirements related to the specific medical condition.

³ In a press release announcing the 2011 Thunder Over the Blue Ridge Open House & Air Show, the show’s organizers indicated that attendance for the 2010 show was over 80,000 people.

Kansas City Aviation Expo, Kansas City, Missouri; August 20, 2011 (CEN11LA582)

On August 20, 2011, at 1341 central daylight time, a Vertical Unlimited LLC model 12 airplane, N2BJ, was substantially damaged and the pilot killed when it impacted terrain at the Charles B. Wheeler Downtown Airport (MKC), Kansas City, Missouri. The pilot was performing an aerobatic routine at the Kansas City Aviation Expo at the time of the accident. The NTSB determined that the probable cause of this accident was “the pilot’s impairment during an aerobatic airshow performance for reasons that could not be determined based on available information, which resulted in an in-flight loss of airplane control.”

In this case, in 2010, this experienced aerobatic pilot had reported having *g*-induced vertigo to his personal physician. The personal physician was also his AME. At the time the pilot experienced the vertigo, it began during *g*-loading and was still so severe when he got out of his plane (after a landing described as less smooth than usual), he was unable to stand up and fell to the ground. At the time, he received a prescription for physical therapy for the condition. However, records indicate that he attended physical therapy only once.

There is no evidence from the medical records that the pilot and his physician ever discussed the condition again. The pilot did not report the condition on his next aviation physical, and the physician, in his capacity as an AME, did not note the omission; instead, the pilot continued to receive first class medical certificates.

During the accident flight, the pilot entered a spin as he exited a Lomcovák maneuver, something he had been observed to do occasionally.⁴ Professional photography at the time of the accident demonstrated that the flight surfaces were in the opposite positions required to exit the spin until the airplane struck the ground.

The pilot’s autopsy identified severe coronary artery disease with greater than 99 percent occlusion of the left anterior descending coronary artery as well as dilation and thickening of both lower chambers of the heart, abnormal mitral and aortic valves, and evidence of inflammation or ischemia of the heart muscle. The exact cause of the pilot’s impairment or incapacitation could not be determined because it was unclear if the source of the problem was *g*-induced vertigo or an acute cardiac event. Although the heart disease appears to have been undiagnosed and the extent of any heart murmur resulting from the valvular abnormalities could not be determined by autopsy, the FAA knew or had the opportunity to know of the severe *g*-induced vertigo because the treating physician was the pilot’s AME, and had previously treated him for it.

⁴ A Lomcovák maneuver is a family of extreme aerobatic maneuvers where the aircraft, with almost no forward speed, rotates on chosen axes due to the gyroscopic precession and torque of the rotating propeller.

Breckenridge, Texas; April 4, 2012 (CEN12LA227)

On April 4, 2012, in Breckenridge, Texas, an experienced aerobatic pilot, who had routinely performed at airshows throughout his flying career, was killed when he crashed while attempting a half Cuban eight maneuver in a Grumman F8F airplane.⁵ The NTSB determined that the probable cause of the accident was “[t]he pilot's loss of airplane control during a low-altitude aerobatic maneuver.”

The pilot had previously reported to the FAA that he had cataracts requiring surgery, hypothyroidism, hyperlipidemia, and a cardiac catheterization. The AMEs involved had issued routine second class medical certificates to the pilot despite two documented disqualifying conditions (cataracts and hypothyroidism) that should have resulted in a deferral of the pilot's medical certificate pending further information. The pilot's official FAA medical certification file included 2010 documentation from the pilot's private cardiologist that noted additional diagnoses of hypertension, coronary atherosclerosis severe enough to have required a stent, and peripheral vascular disease severe enough to have required angioplasty and stent. One of the AMEs had annotated some test results from those records and included them in the FAA medical certification file but did not comment on the additional diagnoses of severe coronary artery disease, severe peripheral vascular disease, and hypertension. Personal medical records requested from outside providers are routinely reviewed by the FAA but the extent of that review in this case is unclear. In addition, it is unclear from the FAA medical certification file exactly when these documents arrived at the Civil Aerospace Medical Institute, but it was before the accident.

Although the records annotated by the AME in 2010 documented two additional disqualifying conditions the pilot had failed to report (coronary artery disease and peripheral vascular disease), the pilot again received a second class medical certificate directly from the AME. Because of the extent of damage to the pilot's body as a result of the crash, only a small portion of the heart, including the stent, was available at autopsy. This experienced aerobatic pilot lost control of his airplane while doing a low altitude, aerobatic, *g*-loading maneuver, which suggests impairment or incapacitation from his medical conditions. However, the limitations of the autopsy precluded the NTSB from including impairment in the probable cause in this case. Nonetheless, the pilot regularly performed aerobatic maneuvers for the public and had known medical conditions which likely reduced his *g*-tolerance, placing him at increased risk of impairment/incapacitation from *g*-loading. The FAA had the opportunity to know of those conditions because the information was contained in his FAA medical certification file.

Summary

Pilots are generally restricted from performing aerobatic maneuvers over populated areas or at low altitudes which mitigates risk to persons on the ground.⁶ However, these restrictions are

⁵ A half Cuban eight maneuver is an aerobatic maneuver that combines a partial loop, inversion, and roll, before returning to level flight.

⁶ Title 14 CFR §91.303 requires that aerobatic flight may not occur “(a) Over any congested area of a city, town, or settlement, (b) Over an open air assembly of persons; (c) Within the lateral boundaries of the surface areas of Class B, Class C, Class D, or Class E airspace designated for an airport; (d) Within 4 nautical miles of the center line of any Federal airway; (e) Below an altitude of 1,500 feet above the surface; or (f) When flight visibility is less than 3 statute miles.” In this part, aerobatic flight is defined as an intentional maneuver involving an abrupt change in an aircraft's attitude, an abnormal attitude, or abnormal acceleration, not necessary for normal flight.

lifted for public performances such as airshows and air races, each of which require a “certificate of waiver or authorization for an aviation event” from the FAA. A waiver or authorization guidance includes requirements that are unique to these events; including a specific definition of aerobatic flight.⁷ In the United States, there are typically about 300 public airshows each year that are attended by 10 to 12 million spectators. Individual airshows may range in size from 3,000 to 350,000 spectators.⁸ Although a number of protections are in place to protect the public from being injured during these events, pilot impairment or incapacitation means an aircraft is no longer being safely operated and may stray toward spectators.

Each of the aerobatic airshow pilots in these fatal accidents had serious medical conditions that were either known to their AME or well-documented in their official FAA medical certification file. In aviation, significant, intentional *g*-loading predictably occurs when performing certain aerobatic maneuvers and air racing. In each case, the decreased *g*-tolerance and increased risk of impairment/incapacitation due to *g*-loading associated with the identified medical conditions was predictable. The NTSB concludes that allowing pilots with medical conditions that could decrease their *g*-tolerance to perform aerobatic maneuvers at airshows or air races creates an undesirable risk to the public. As a result, the National Transportation Safety Board makes the following recommendation to the Federal Aviation Administration:

Restrict all pilots with medical conditions that could affect their *g*-tolerance from performing aerobatic maneuvers or air racing at events requiring a certificate of waiver or authorization for an aviation event. (A-15-11)

Chairman HART, Vice Chairman DINH-ZARR, and Members SUMWALT and WEENER concurred in this recommendation.

The NTSB is vitally interested in this recommendation because it is designed to prevent accidents and save lives. We would appreciate receiving a response from you within 90 days, as required by 49 *United States Code* section 1135, detailing the actions you have taken or intend to take to implement it. When replying, please refer to the safety recommendation by number and submit your response electronically to correspondence@ntsb.gov.

[Original Signed]

By: Christopher A. Hart,
Chairman

⁷ For purposes of a waiver or authorization for an aviation event, FAA Order 8900.1; Vol 3, Chapter 6, 3-143 defines aerobatic flight as, “flight where the pitch attitude exceeds 60 degrees above or below the horizon and/or the angle of bank exceeds 75 degrees in reference to the horizon for all aircraft.” In addition, the waiver may allow aerobatic maneuvers at altitudes below 1500 ft msl.

⁸ Testimony of John Cudahy, President, International Council of Air Shows to the NTSB Public Hearing on Air Race and Air Show Safety, January 10, 2012. http://www.nts.gov/news/events/Documents/2012_Air_Race_Show_IHG-Panel1c_Cudahy.pdf.