

NBAA REPORT

Business Aviation Compliance With Manufacturer-Required Flight-Control Checks Before Takeoff

In its final report on the May 31, 2014, Gulfstream G-IV accident at Laurence G. Hanscom Field in Bedford, MA, the NTSB recommended that NBAA work with existing business aviation flight operational quality assurance groups to analyze the extent to which noncompliance with manufacturer-required routine flight-control checks before takeoff exists. This NBAA report provides the results of this analysis to members.

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I. Executive Summary

On May 31, 2014, a Gulfstream G-IV was destroyed and seven people lost their lives after a rejected takeoff and runway excursion at Laurence G. Hanscom Field in Bedford, MA. The National Transportation Safety Board (NTSB) investigation determined that the gust lock was engaged, which prevented a successful takeoff, and that the flight crew did not perform a flight-control check prior to takeoff, which would have revealed that the flight controls were locked. The investigation further determined that the flight crew neglected to perform complete flight-control checks on 98 percent of the previous 175 takeoffs in the airplane.

In its final report on the accident, the NTSB recommended that the National Business Aviation Association (NBAA) work with existing business aviation flight operational quality assurance groups to analyze the extent to which noncompliance with manufacturer-required routine flight-control checks before takeoff exists, and provide the results of this analysis to the industry.

Detailed results of this analysis follow in the remainder of this report. Overall, 17.66 percent of the reviewed 143,756 flights in the years 2013, 2014 and 2015, have reason to give us pause. This overall noncompliance rate indicates that challenges are evident in regard to noncompliance with manufacturer-required routine flight-control checks before takeoff.

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

Finally, I would like to publicly acknowledge the industry-wide collaboration of the NTSB Recommendation Project Team, which conducted the research developed in this report. Operational and safety data sharing programs are essential to furthering our understanding of the risks that can lead to incidents and accidents. NBAA thanks the project team members for their service in addressing this NTSB Recommendation, and for their commitment to continually enhancing business aviation safety.

Sincerely,



Ed Bolen
President and CEO

II. Introduction

On May 31, 2014, a Gulfstream G-IV was destroyed after a rejected takeoff and runway excursion at Laurence G. Hanscom Field in Bedford, MA. The two pilots, a flight attendant and the four passengers were fatally injured. The NTSB investigation determined that the gust lock was engaged, locking the flight controls and preventing a successful takeoff. It was also discovered that the crew had not conducted a flight-control check prior to takeoff, which would have revealed that the flight controls were locked. The NTSB investigation discovered that the flight crew had neglected to perform complete flight-control checks on 98 percent of the previous 175 takeoffs in the airplane.

In its final report on the accident, the NTSB made several recommendations, including recommendation number A-15-034, to the National Business Aviation Association (NBAA).

“Work with existing business aviation flight operational quality assurance groups, such as the Corporate Flight Operations Quality Assurance Centerline Steering Committee, to analyze existing data for noncompliance with manufacturer-required routine flight-control checks before takeoff and provide the results of this analysis to your members as part of your data-driven safety agenda for business aviation.”

In response to this recommendation, the NBAA formed a project team to address the issue of noncompliance with manufacturer-required routine flight-control checks before takeoff. The team was made up of business aviation Flight Operations Quality Assurance (FOQA) groups and associated vendors, NBAA staff, members of the NBAA Safety Committee, industry safety leaders and relevant safety experts.

III. Methodology

The project team was divided into two working groups, a data group and a report group. The data group was tasked with obtaining and aggregating de-identified data from business aviation FOQA programs to determine the compliance with manufacturer-required routine flight-control checks before takeoff. The report group was tasked with analyzing the data provided by the data group, then organizing and writing this report to address the NTSB recommendation. The project team wanted to capture business aircraft noncompliance rates for control checks before takeoff, including trends prior to and after the Bedford accident. To accomplish this, the team looked at flights occurring between Jan. 1, 2013, and Dec. 31, 2015.

The following definitions were used in the organization and analysis of the data:

Definitions

- *Routine flight-control checks before takeoff:* The required movement of any control surface designated as manufacturer-required to be checked prior to takeoff. These included ailerons, rudder, elevator and spoilers (if equipped).
- *Full deflection:* A control surface movement beyond a minimum expected deflection. The analysis of the data included calculating the rigging tolerances and sensor accuracy for each surface to determine what minimum value was equivalent to a full deflection.
- *Valid flight-control check:* A full deflection control surface movement in each direction (i.e., stop to stop) was required to satisfy the requirement of a valid flight-control check on that surface (e.g., ailerons had to have full deflection up and down to be considered a valid check).

Using the definitions above, routine flight-control checks before takeoff were classified as follows:

Classifications of flight-control checks before takeoff

- Normal flight-control check before takeoff: A flight-control check before takeoff in which a valid flight-control check was conducted on all control surfaces required to be checked. This was classified as a **normal event**.
- Partial flight-control check before takeoff: A flight-control check before takeoff in which at least one, but not all, of the required control surfaces did not have a valid control check conducted. This was classified as a **caution event**.
- No flight-control check before takeoff: A flight-control check before takeoff in which there was no valid flight-control check of any of the control surfaces that were required to be checked. This was classified as **warning event**.
- Noncompliant flight-control check before takeoff: A flight-control check before takeoff in which at least one of the required control surfaces did not have a valid control check conducted (i.e., a caution or a warning event).

IV. Data

The data used in this report is based on 143,756 flights conducted by 379 business aircraft representing over 30 different types of aircraft. These flights were conducted over the three-year period between Jan. 1, 2013, and Dec. 31, 2015.

Figure 1 shows the number and percentages of noncompliant flight-control checks before takeoff for each month over the three-year period.

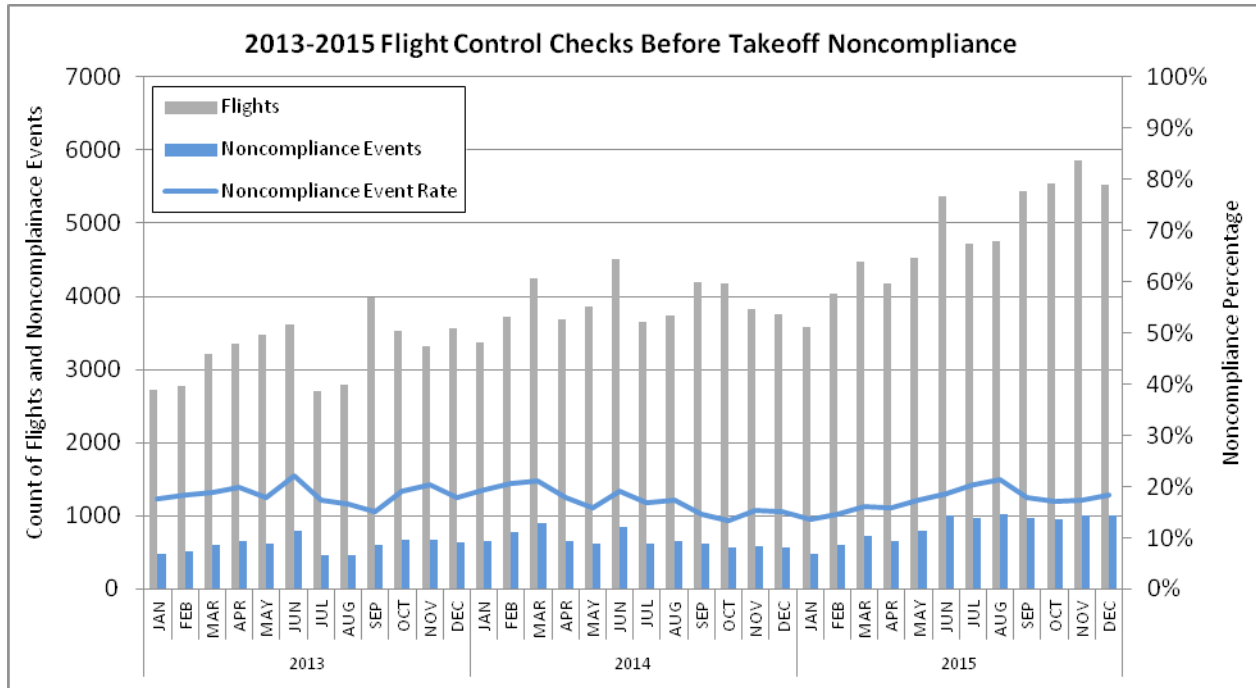
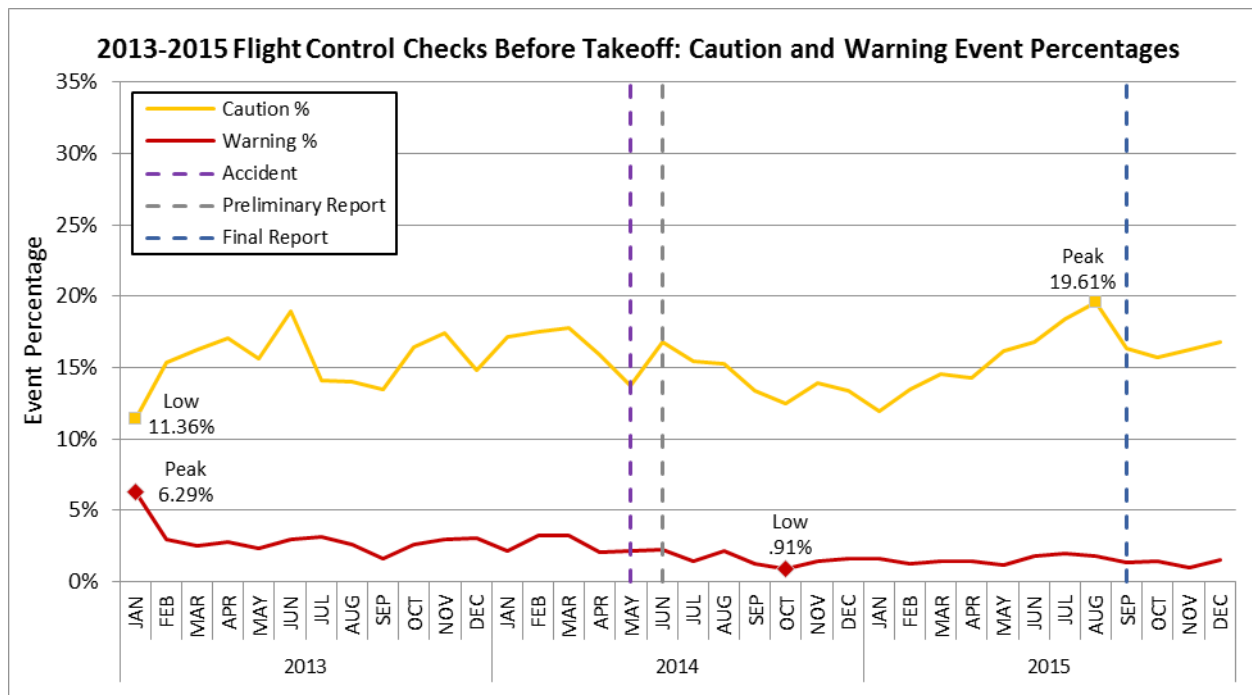


Figure 2 shows the percentages of warning and caution events for each month over the three-year period. It also indicates the accident date, subsequent dates of the preliminary accident report and the final accident report.



V. Discussion

The data shows that out of 143,756 flights conducted during the 2013 to 2015 time period, flight crews conducted a partial flight-control check before takeoff (caution event) during 22,458 flights (15.62 percent). There was no flight-control check before takeoff (warning event) conducted on 2,923 flights (2.03 percent). For the three-year period covering 2013, 2014 and 2015, the overall noncompliance rate for manufacturer-required routine flight-control checks before takeoff was 17.66 percent, reflecting 25,381 events (**Figure 1**).

Caution events averaged 15.62 percent, with a low of 11.36 percent in Jan. 2013 and a high of 19.61 percent in Aug. 2015 (**Figure 2**). Warning events averaged 2.03 percent with a high of 6.29 percent in Jan. 2013 and a low of 0.91 percent in Oct. 2014 (**Figure 2**). The average non-compliance rate was 17.66 percent, with a high of 21.99 in June 2013 and a low of 13.35 percent in Oct. 2014 (**Figure 1**).

The project team sought to answer two additional questions:

- Would the noncompliance rate of control checks before takeoff change after the release of the NTSB preliminary report that indicated the accident crew did not perform a routine flight-control check before takeoff?
- Would the noncompliance rate of control checks before takeoff change after the release of the final NTSB report?

In the month prior to the final accident report issuance, there was a noticeable drop in caution events followed by a gradual increase again to 17.66 percent noncompliance rate – the average for the 2013 to 2015 period – by Dec. 2015. The noncompliance rate for warning events reached its low of 0.91 percent approximately five months after the accident occurred and returned to the average warning noncompliance rate of 2.03 percent by the end of Dec. 2015, three months after the final accident report was issued.

The average warning event percentage prior to the accident was 2.80 percent (**Figure 2**). After the accident on May 31, 2014, and the release of the preliminary report on June 13, 2014, the average warning event rate was reduced to 1.47 percent, a drop of 50 percent. That may indicate there was a positive reaction to the preliminary report finding that the Bedford crew did not perform any flight-control check before takeoff. The caution events are more variable, and there is not a significant difference in caution event rates between pre- and post-accident percentages. The noncompliance rate (**Figure 1**) exhibits some minor month-to-month variation, but overall the data indicates minimal effect of the accident report on crew actions in regard to compliance with the manufacturer-required routine normal flight-control checks before takeoff. In fact, the average noncompliance rate from Jan. 2013 to the release of the final accident report in Sept. 2015 was 17.66 percent and the rate from Oct. 2015 to Dec. 2015 was 17.58 percent.

The overall noncompliance rate of 17.66 percent is very disturbing, and indicates that despite the post-accident reduction in the rate of warning events, there is still a significant challenge concerning noncompliance with manufacturer-required routine flight-control checks before takeoff. It is troubling to find that nearly 18 of every 100 business aircraft flights included in the data were not in compliance with manufacturer-required routine flight-control checks before takeoff, and that two of those 100 flights conducted no flight-control check before takeoff at all.

VI. Conclusions

The tragic Gulfstream G-IV accident at Bedford, MA, on May 31, 2014, provided ample stimulus to probe deeper into business aviation procedural noncompliance. This report specifically highlights the rates at which aircrews are not performing manufacturer-required, checklist-directed flight-control checks before takeoff. As confirmed by the FOQA data over the three-year period, there was a consistent trend of incomplete or neglected manufacturer-required flight-control checks before takeoff. As perplexing as it is that a highly experienced crew could attempt a takeoff with the gust lock engaged, it is equally disturbing that the data highlights a lack of professional discipline among some crews in not accomplishing manufacturer-directed checklists – particularly safety-of-flight critical items. The NTSB was prudent in directing a recommendation to the NBAA to conduct a data-driven approach regarding compliance with mandatory flight-control checks before takeoff. This report to the NBAA membership is not only intended to provide closure action to the NTSB recommendation, but also to raise awareness to the broader business aviation community that complacency and lack of procedural discipline have no place in our profession.

VII. Recommendations

Business Aircraft Operators

- Ensure you have a standard operating procedure (SOP) addressing manufacturer-required flight-control checks before takeoff
- Establish a flight data monitoring program (currently only one percent of business aircraft operators have one) to enhance safety assurance of your flight department's safety management system
- Participate in data sharing of flight data monitoring information in a formal data sharing program (e.g., Aviation Safety Information Analysis and Sharing System [ASIAS])

Business Aircraft Aircrews

- Conduct flight-control checks before takeoff in accordance with manufacturers' AFM/POH

Part 142 Training Centers

- Emphasize the importance of, and specific procedures for, manufacturer-required routine flight-control checks before takeoff

Business Aircraft Manufacturers

- Provide aircraft operators clear requirements and procedures for flight-control checks before takeoff (the project team noted a variance in how flight-control checks before takeoff are described across OEMs and models)

NBAA

- Facilitate a council of data collection/sharing experts to inform and guide the business aviation community concerning this safety program

VIII. Further reading

[NTSB Accident Report](http://www.nts.gov/investigations/AccidentReports/Reports/AAR1503.pdf) (<http://www.nts.gov/investigations/AccidentReports/Reports/AAR1503.pdf>)

[NTSB Accident Docket](http://dms.nts.gov/pubdms/search/hitlist.cfm?docketID=57175) (<http://dms.nts.gov/pubdms/search/hitlist.cfm?docketID=57175>)

[Skybrary Accident Synopsis](http://www.skybrary.aero/index.php/GLF4,_Bedford_MA_USA,_2014) (http://www.skybrary.aero/index.php/GLF4,_Bedford_MA_USA,_2014)

[Code 7700 Bedford Case Study](http://www.code7700.com/case_study_bedford.html) (http://www.code7700.com/case_study_bedford.html)

[BCA Magazine – Gulfstream IV Accident at BED](http://aviationweek.com/bca/update-gulfstream-iv-accident-bed) (<http://aviationweek.com/bca/update-gulfstream-iv-accident-bed>)

[BCA Magazine – Lessons from The Bedford Gulfstream Accident – Part 2](http://aviationweek.com/bca/lessons-bedford-gulfstream-accident-part-2) (<http://aviationweek.com/bca/lessons-bedford-gulfstream-accident-part-2>)

[NBAA - Using FOQA in Business Aviation: Enhancing Safety by Examining Flight Data](https://www.nbaa.org/news/insider/2012/03/flight-data.php) (<https://www.nbaa.org/news/insider/2012/03/flight-data.php>)

[Flight Safety Foundation AeroSafety World – C-FOQA Takes Root](http://www.flightsafety.org/asw/aug07/asw_aug07_p11-15.pdf?dl=1) (http://www.flightsafety.org/asw/aug07/asw_aug07_p11-15.pdf?dl=1)

[Flight Safety Foundation AeroSafety World – Peripheral Vision](http://flightsafety.org/aerosafety-world-magazine/october-2015/peripheral-vision) (<http://flightsafety.org/aerosafety-world-magazine/october-2015/peripheral-vision>)



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ABOUT NBAA

Founded in 1947 and based in Washington, DC, the National Business Aviation Association (NBAA) is the leading organization for companies that rely on general aviation aircraft to help make their businesses more efficient, productive and successful. Contact NBAA at 800-FYI-NBAA or info@nbaa.org. Not a member? Join today by visiting www.nbaa.org/join.