



Boeing 737 MAX Crashes Shake Confidence in International Air Safety

March 14, 2019

Recent foreign air disasters involving [Boeing 737 MAX 8](#) airplanes have raised international concern about the safety of that aircraft and passenger airline safety in general. On October 29, 2018, [Lion Air flight 610](#) crashed shortly after departure from Jakarta, Indonesia, killing all 189 on board. While the investigation of the crash is still ongoing, it has been disclosed that pilots flying the same aircraft the previous day experienced some sort of navigation system failure and that maintenance records revealed ongoing problems with the aircraft's airspeed and angle-of-attack (AOA) sensors that monitor relative aircraft pitch. Aviation experts expressed concerns that faulty indications from these sensors could cause the aircraft's flight automation to command a pitch-down response. The investigation also revealed that aircraft documentation and pilot training may not have fully explained how the automation would respond under these circumstances. On March 10, 2019, [Ethiopian Airlines flight 302](#) crashed shortly after departure from Addis Ababa, Ethiopia, reportedly resulting in 157 fatalities.

The circumstances of these crashes led several airlines and several countries, including [China](#) and the [European Union](#), to immediately ground 737 MAX airplanes until a fix can be found to revise flight control software or otherwise address flight control difficulties that may have contributed to these crashes. Initially, [the Federal Aviation Administration \(FAA\)](#), [Boeing](#), and [U.S. air carriers](#) did not follow suit. One day after the Ethiopian Airlines crash, FAA instead gave [notification to international civil aviation authorities](#) anticipating mandatory design changes to be forthcoming no later than April 2019. However, on March 13, 2019, [President Trump announced](#) that FAA would issue an [emergency order](#) grounding all 737 MAX aircraft.

Noting external reports identifying similarities between the two crashes, FAA has focused on the AOA sensors and flight control logic contained in a [Maneuvering Characteristics Augmentation System \(MCAS\)](#), a flight control feature that is new to the 737 MAX. On November 7, 2018, FAA issued an [emergency directive](#) ordering U.S. operators of Boeing 737 MAX aircraft to apply runaway stabilizer procedures in situations potentially arising from erroneous high AOA indications that might trigger repeated nose-down trim commands by the MCAS. In December 2018, FAA expanded the scope of the [airworthiness directive](#), ordering the procedural change for all Boeing 737 MAX airplanes worldwide. Currently, three U.S. airlines fly 74 737 MAX aircraft, including the 737 MAX 8 variant involved in both crashes and the slightly larger 737 MAX 9 variant, both of which are covered under the emergency

Congressional Research Service

<https://crsreports.congress.gov>

IN11072

directives. Worldwide, 59 operators, including the three U.S. carriers, operate 387 737 MAX airplanes. Boeing has outstanding orders for the airplane totaling more than 5,000.

The global impact of the safety concerns surrounding the Boeing 737 MAX illustrates a need for international cooperation and coordination regarding air safety and aviation accident investigation. Under [Annex 13](#) to the Convention on International Civil Aviation, countries where aviation accidents and incidents occur have primary responsibility for investigating those mishaps, although they can delegate this responsibility or request assistance from other countries. Ethiopia has reportedly requested assistance from European experts to recover data from [flight 302's cockpit voice and flight data recorders](#). Under this international agreement, countries where an aircraft was designed and manufactured as well as countries of aircraft registry have the right to send accredited representatives to participate in the investigation. The [National Transportation Safety Board \(NTSB\)](#) designates staff to serve as accredited representatives of the United States in foreign accident investigations involving U.S.-manufactured or U.S.-operated aircraft. These accredited representatives may select advisers to assist in technical matters, such as individuals from airlines or manufacturers, like Boeing, who have specific technical knowledge and expertise to aid investigators.

In the course of international air safety investigations, input from differing perspectives is received, and disagreements sometimes occur. For example, [French investigators disagreed with NTSB findings](#) regarding the flight control characteristics of ATR 72 twin turboprop aircraft following in-flight icing encounters based on investigation of the October 31, 1994, crash of American Eagle flight 4184 near Roselawn, IN. In the aftermath of that crash, FAA issued directives ordering fixes to the aircraft's ice protection systems. However, the traveling public lost confidence in ATR turboprops, prompting U.S. carriers to avoid flying them along routes where they might be susceptible to icing and, ultimately, to phase the ATR turboprops out entirely. At least in the United States, those actions by FAA and the airlines to address safety concerns proved insufficient to sway public perceptions.

The fate of the Boeing 737 MAX may rest with global perceptions of how quickly and effectively Boeing can work with investigators and regulators to identify any root causes and implement appropriate fixes to prevent future accidents. Boeing faced similar challenges with earlier 737 models after rudder control system malfunctions were implicated in two major crashes: the March 3, 1991, crash of [United Airlines flight 585](#) and the September 8, 1994, crash of [USAir flight 427](#). In response, FAA ordered changes to 737 rudder controls and revised pilot training. While purchase orders for the jet did drop off in the early 1990s, it has remained a best-selling commercial airliner, recently [surpassing 10,000 production aircraft](#) over its five-decade history, including [580 aircraft delivered in 2018](#).

The 737 MAX crashes potentially raise broader concerns regarding the design of highly automated flight control systems and pilots' understanding of and interaction with those systems. Automation complexity and inadequate documentation and training were cited as factors in the July 6, 2013, crash of [Asiana Airlines flight 214](#) at San Francisco International Airport. Language in P.L. 114-190 directed FAA to ensure that airline training and pilot evaluation incorporate proper monitoring of automated systems and proficient manual flying skills. Congressional oversight may focus on the extent to which both FAA and the airlines have addressed these requirements and might further examine ongoing aircraft manufacturer and operational challenges associated with aircraft automation.

Author Information

Bart Elias
Specialist in Aviation Policy

Disclaimer

This document was prepared by the Congressional Research Service (CRS). CRS serves as nonpartisan shared staff to congressional committees and Members of Congress. It operates solely at the behest of and under the direction of Congress. Information in a CRS Report should not be relied upon for purposes other than public understanding of information that has been provided by CRS to Members of Congress in connection with CRS's institutional role. CRS Reports, as a work of the United States Government, are not subject to copyright protection in the United States. Any CRS Report may be reproduced and distributed in its entirety without permission from CRS. However, as a CRS Report may include copyrighted images or material from a third party, you may need to obtain the permission of the copyright holder if you wish to copy or otherwise use copyrighted material.