Committee on Transportation and Infrastructure
U.S. House of Representatives
Washington DC 20515

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October 15, 2021

SUMMARY OF SUBJECT MATTER

TO: Members, Subcommittee on Aviation
FROM: Subcommittee staff
RE: Subcommittee Hearing on *Three Years After Lion Air 610: FAA Implementation of the 2020 Aircraft Certification, Safety, and Accountability Act*

PURPOSE

The Subcommittee on Aviation will meet on Thursday, October 21, 2021, at 10:00 a.m. EDT in 2167 Rayburn House Office Building to hold an oversight hearing titled, *Three Years After Lion Air 610: FAA Implementation of the 2020 Aircraft Certification, Safety, and Accountability Act*. The hearing will examine ongoing work within the Federal Aviation Administration (FAA) to implement provisions of the bipartisan *Aircraft Certification, Safety, and Accountability Act*.[1] For the Majority, the *Act* was the culmination of an 18-month investigation by Committee Majority staff[2]—the longest in the Committee's history. For both the Majority and the Minority, the *Act* addresses both the specific recommendations of the various non-partisan, expert safety reviews as well as the many factors that contributed to the tragic Boeing 737 MAX accidents (discussed below). FAA Administrator Steve Dickson is the only witness.

BACKGROUND

Two air disasters in 2018 and 2019 involving a new derivative of the Boeing 737, the Boeing 737 MAX, revealed numerous shortcomings in the FAA's process for certifying the safety of new airplane designs, including derivatives of 50-year-old airframes such as the 737.[3] In response to these two crashes, which resulted in the deaths of 346 passengers and crew, the FAA grounded the 737 MAX for a year and eight months, the longest grounding of a U.S.-built airliner in history. Numerous expert safety reviews and investigations discovered some limitations and failures of the

[1] Pub. L. No. 116-260, div. V (2020).
[2] Staff of the U.S. House Cmte. on Transp. and Infra., *The Design, Development, and Certification of the Boeing 737 MAX: Final Committee Report* (Sept. 2020), *at* https://transportation.house.gov/imo/media/doc/2020.09.15%20FINAL%20737%20MAX%20Report%20for%20Public%20Release.pdf.
[3] *See* Dep't of Transp. Office of Insp. Gen., *Weaknesses in FAA's Certification and Delegation Processes Hindered Its Oversight of the 737 MAX 8,* Rpt. No. AV2021020 (Feb. 21, 2021) (hereinafter "IG Report").

FAA's certification process, acts and omissions by Boeing, and areas to be addressed in pilot training.[4] Therefore, Congress enacted the *Aircraft Certification, Safety, and Accountability Act* in December 2020 to improve these processes and prevent similar deficiencies in the future.

I. THE CRASHES AND FAA RESPONSE

On October 29, 2021, more than 100 families in Indonesia and around the world will mark the third anniversary of the first 737 MAX crash: that of Lion Air flight 610. The airplane operating flight 610, a two-month-old 737 MAX 8, crashed into the Java Sea 11 minutes after takeoff from Jakarta bound for Pangkal Pinang, Indonesia, killing all 189 passengers and crew.[5]

The second crash occurred slightly more than four months later, on March 10, 2019, when Ethiopian Airlines flight 302 crashed six minutes after takeoff from Addis Ababa, Ethiopia, on a morning flight to Nairobi, Kenya.[6] All 157 passengers and crew (including eight Americans) were killed on impact.

Within weeks of the Lion Air crash, based on a preliminary readout from the flight data recorder recovered from the wreckage, investigators had a sense of what might have been a major contributing factor in the accident. A small vane called an "alpha vane," slightly smaller than a test tube, protrudes from each side of the airplane's nose and measures the angle between the airplane's flight path and the oncoming air, which is known as the "angle of attack." The alpha vane on the left side of the Lion Air airplane's nose had somehow been misaligned and registered an abnormally high nose-up pitch attitude, triggering operation of a new system called the maneuvering characteristics augmentation system (MCAS), which was designed to push the airplane's nose down in such circumstances.[7]

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[4] Boeing 737 MAX reviews and investigation reports include: Joint Authorities Technical Review, "Boeing's 737 MAX Flight Control System, Observations, Findings and Recommendations Report" (October 11, 2019); National Transportation Safety Board Safety Recommendation Report, "Assumptions Used in the Safety Assessment Process and the Effects of Multiple Alerts and Indications on Pilot Performance" (ASR-19-01; September 19, 2019); U.S. Department of Transportation Special Committee to review the Federal Aviation Administration's Aircraft Certification Process Report (January 16, 2020); and Safety Oversight and Certification Aviation Rulemaking Committee (SOC-ARC) Recommendation Report to the Federal Aviation Administration (December 2018).

[5] Rep. of Indonesia, Nat'l Transp. Safety Cmte., *Preliminary Aircraft Accident Investigation Report: PT Lion Mentari Airlines*, *Boeing 737-8 (MAX); PK-LQP,* Rpt. No. KNKT.18.10.35.04, *available at* https://avherald.com/files/2018%20-%20035%20-%20PK-LQP%20Preliminary%20Report.pdf.

[6] Federal Democratic Republic of Ethiopia, Ministry of Transp., Aircraft Accident Investigation Bureau, *Aircraft Accident Investigation Preliminary Report: Ethiopian Airlines Group, B737-8 (MAX) Registered ET-AVJ*, Rpt. No. AI-01/19 (April 4, 2019), *at* http://www.ecaa.gov.et/Home/wp-content/uploads/2019/07/Preliminary-Report-B737-800MAX-ET-AVJ.pdf (hereinafter "ET302 preliminary report").

[7] *See, e.g.,* Nat'l Transp. Safety Bd., *Safety Recommendation Report: Assumptions Used in the Safety Assessment Process and the Effects of Multiple Alerts and Indications on Pilot Performance* (Sept. 19, 2019), at 3-4, *available at* https://www.ntsb.gov/investigations/AccidentReports/Reports/ASR1901.pdf (hereinafter "NTSB Safety Recommendation Report") ("During the preliminary design stage of the 737 MAX, Boeing testing and analysis revealed that the addition of the LEAP-1B engine and associated nacelle changes produced an ANU [airplane nose-up] pitching moment when the airplane was operating at high AOA and mid Mach numbers. After studying various options for addressing this issue, Boeing implemented aerodynamic changes as well as a stability augmentation function, MCAS, as an extension of the existing speed trim system to improve aircraft handling characteristics and decrease pitch-up tendency at elevated AOA.")

On November 7, 2018, shortly after the Lion Air accident, the FAA issued an emergency airworthiness directive to 737 MAX operators. The directive did not mention MCAS by name; instead, it advised air carriers that an erroneous angle-of-attack reading could cause "a potential for repeated nose-down trim commands" and ultimately "could cause the flight crew to have difficulty controlling the airplane, and lead to excessive nose-down attitude, significant altitude loss, and possible impact with terrain."[8] The directive instructed that crews who detect "uncommanded horizontal stabilizer trim movement" should follow a pre-existing memory item procedure for the broader scenario of a "runaway stabilizer."[9] But the Ethiopian Airlines accident demonstrated that further action was necessary. The day after the accident, civil aviation regulators worldwide began prohibiting the operation of Boeing 737 MAX airplanes in their jurisdictions. The FAA grounded the airplane on March 13, 2019, three days after the crash, after a link between the two accidents was established.[10]

The 737 MAX returned to service starting in December 2020, when the FAA approved a substantial number of design changes to ensure erroneous MCAS activation would not occur and that, if it did, the crew would be able to maintain control of the airplane.[11] This recertification followed more than a year of extensive aircraft design reviews by the FAA, NASA, the Air Force, the Volpe Center, foreign aviation safety regulators, and others.

II. THE CERTIFICATION PROCESS

All aircraft and aviation products are subject to FAA certification prior to their sale and use in the United States. The FAA is responsible for regulating aviation safety, which includes approving the design and manufacture of new aircraft and aviation products before they enter the National Airspace System.[12]

A. Organization Designation Authorization

Since even before the establishment of FAA's predecessor agency in 1958, the federal government has delegated some safety certification responsibilities to technical experts in the industry. As airplanes, engines, and their constituent systems became increasingly complex, Congress authorized the FAA to leverage the product-specific knowledge among appropriately qualified employees of manufacturers to determine a new product's compliance with the applicable provisions of the Federal Aviation Regulations. A designee may receive authority to examine, inspect, and test aircraft and persons for the purpose of issuing certificates.[13]

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[8] Fed. Aviation Admin., Emergency Airworthiness Directive No. 2018-23-51 (Nov. 7, 2018), *at* http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgad.nsf/0/83ec7f95f3e5bfbd8625833e0070a070/$FILE/2018-23-51_Emergency.pdf.

[9] *Id.*

[10] Fed. Aviation Admin., Emergency Order of Prohibition to Operators of Boeing Company Model 737-8 and Boeing Company Model 737-9 Airplanes (March 13, 2019).

[11] *Airworthiness Directive, The Boeing Company Airplanes,* 85 Fed. Reg. 74560 (Nov. 4, 2020).

[12] *See* 49 U.S.C. §§ 44702, 44704; GAO, *Aviation Manufacturing: Status of FAA's Efforts to Improve Certification and Regulatory Consistency* (July 31, 2014), GAO-14-829T, at 1.

[13] GAO-14-829T at 4.

The organization designation authorization (ODA) program allows the FAA to leverage limited resources to focus on the areas of highest risk. The program was envisioned to allow qualified individuals or organizations to certify, on behalf of the FAA, that well-understood, non-critical, or low-risk designs comply with applicable Federal requirements, thereby freeing up some of FAA's resources to focus on and remain directly involved in the review and approval of higher-risk items, such as safety-critical or "novel or unusual" designs.[14] Regardless of delegation decisions, the FAA bears ultimate responsibility for ensuring new aircraft designs are safe and comply with design requirements.

B. Certification of the 737 MAX

Since the original 737 aircraft was certified in 1967, the FAA has approved numerous new models of the aircraft, all through amendments to the original 737's type certificate. With regard to the FAA certification of the 737 MAX, the process to issue an amended type certificate, from initial application to final certification, took five years, with the final amended type certificate issued in March 2017, according to the FAA.[15] The process included 297 certification flight tests, including tests of the MCAS functions. Although the system should have been considered safety-critical, as the FAA acknowledged before the Subcommittee in 2019, the FAA years earlier had delegated certification of MCAS to Boeing as part of a larger delegation of certification of the flight control system pursuant to Boeing's ODA.[16] In 2015, the FAA delegated some key safety assessments of the flight control system, which contained MCAS, back to Boeing based on the risk rating of "major" (under this rating, flight crews are the redundancy for a system failure).[17]

In a review of the process for certifying the 737 MAX, the Department of Transportation inspector general ultimately found that

> limitations in FAA's guidance and processes that impacted certification and led to a significant misunderstanding of [MCAS] . . . . First, FAA's certification guidance does not adequately address integrating new technologies into existing aircraft models. Second, FAA did not have a complete understanding of Boeing's safety assessments performed on MCAS until after the first accident. Communication gaps further hindered the effectiveness of the certification process. In addition, management and oversight weaknesses limit FAA's ability to assess and mitigate risks with the Boeing ODA.[18]

The latter risks included the risk that Boeing employees would place undue pressure on their colleagues who work as ODA unit members on the FAA's behalf.[19] In fact, the inspector general

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[14] *See* FAA, Airworthiness Certification, https://www.faa.gov/aircraft/air_cert/airworthiness_certification/; U.S. House Cmte. On Transp. and Infra., "Status of the Boeing 737 MAX," Testimony of Daniel Elwell, FAA Acting Administrator (May 15, 2019), at 28-29 (hereinafter "Elwell Testimony").

[15] *See* Boeing Commercial Airplanes, "Boeing 737 MAX 8 Earns FAA Certification" (March 9, 2017), *at* https://boeing.mediaroom.com/2017-03-09-Boeing-737-MAX-8-Earns-FAA-Certification.

[16] Dep't of Transp. Insp. Gen. staff briefing for Committee staff on work to date investigating FAA's certification of the 737 MAX and MCAS (October 7, 2019).

[17] *Id.*

[18] IG Report, *supra* note 3.

[19] *Id.* at 35-36.

reported that, in a 2016 survey of ODA unit members, 40 percent of respondents said they had experienced undue pressure from other Boeing employees.[20]

MCAS was a feature of the 737 MAX because Boeing determined that the system was necessary to ensure that the 737 MAX would exhibit the same control characteristics as the 737NG during certain maneuvers in flight.[21] MCAS may have also created new training requirements for pilots, but Boeing's chief technical pilot for the 737 MAX program asked the FAA to remove references to MCAS from the flight crew operating manual on the premise that the system would not operate under normal flight conditions and later boasted that he had lied to regulators.[22] On October 14, 2021, a federal grand jury returned an indictment against that Boeing employee for six counts of fraud stemming from his communications with two U.S. 737 MAX customers about the 737 MAX flight control system.[23]

In addition, to preserve commonality between the 737 MAX and its prior model, Boeing received 11 exceptions from FAA design regulations promulgated after the 1967 type certificate was issued. For example, Boeing obtained an exception from the FAA that relieved Boeing of the requirement that the 737 MAX must be equipped with a caution, alert, and advisory system that "[p]rovide[s] timely attention-getting cues through at least two different senses by a combination of aural, visual, or tactile indications" and that "[p]revent[s] the presentation of an alert that is inappropriate or unnecessary."[24] Instead, the 737 MAX largely uses legacy cautions, warnings, alerts, and advisories grandfathered from the previous 737 generation.[25] That design makes it more likely for pilots to become task-saturated or fail to timely diagnose safety-critical failures in time to recover the aircraft during rare but extreme failure scenarios like those that confronted the pilots of Lion Air flight 610 and Ethiopian Airlines flight 302.[26]

III. SUMMARY OF INVESTIGATIONS

In the wake of the crash of Ethiopian Airlines flight 302, the Committee launched an investigation at the direction of Chair DeFazio and Chair Larsen into the certification of the 737 MAX and related issues.[27] As part of the 18-month-long investigation, the Committee held five public hearings; wrote nearly two dozen oversight letters; obtained an estimated 600,000 pages of documents from Boeing, the FAA, and others; received information and insight from former and

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[20] *Id.* at 35.
[21] *See, e.g.,* NTSB Safety Recommendation Report, *supra* note 7, at 8.
[22] David Gelles and Natalie Kitroeff, "Boeing Pilot Complained of 'Egregious' Issue with 737 Max in 2016," NEW YORK TIMES (Oct. 18, 2019), *at* https://www.nytimes.com/2019/10/18/business/boeing-flight-simulator-text-message.html.
[23] Indictment, *U.S. v. Mark A. Forkner*, No. 4-21CR-268-0 (N.D. Texas Oct. 14, 2021).
[24] 14 C.F.R. § 25.1322(c), (d); *see* Dominic Gates, "Boeing pushed FAA to relax 737 MAX certification requirements for crew alerts," SEATTLE TIMES (Oct. 2, 2019), *at* https://www.seattletimes.com/business/boeing-aerospace/boeing-pushed-faa-to-arelax-737-max-certification-requirements-for-crew-alerts/.
[25] The Boeing 737 Technical Site, "737-MAX Flightdeck," *at* http://www.b737.org.uk/flightdeck737max.htm.
[26] *See, e.g.,* NTSB Safety Recommendation Report, *supra* note 7.
[27] *Chairs DeFazio, Larsen Respond to Grounding of Boeing Aircraft,* Press Release (Mar. 13, 2019), available at https://transportation.house.gov/news/press-releases/chairs-defazio-larsen-respond-to-grounding-of-boeing-aircraft.

current employees; and interviewed dozens of current and former Boeing and FAA employees.[28] In September 2020, the Committee issued a Majority staff report detailing its investigative findings.[29]

In addition, there were many other investigations and reviews, including the National Transportation Safety Board safety recommendations report in 2019; a review by a U.S.-led international panel, the Joint Authorities Technical Review; a separate review by a panel of current and former U.S. aviation leaders, convened as the Special Committee to Review FAA's Aircraft Certification Process; a review of the technical changes to the airplane by a team of aviation industry experts from FAA, NASA, the Air Force, and the Volpe Center, convened as the B737 MAX Technical Advisory Board; and reviews by the U.S. Department of Transportation Office of Inspector General. These investigations and reviews underscored the need for the 2020 *Aircraft Certification, Safety, and Accountability Act*.

IV. NOTEWORTHY PROVISIONS OF THE SAFETY LEGISLATION

According to the numerous safety expert reviews and investigations, unfortunately the FAA's certification process failed to detect or properly account for the possibility that a single alpha vane failure—which normally would not result in a crash—could set in motion a series of events, including erroneous MCAS activation, that would create a situation from which the pilots could not recover. Accordingly, the bipartisan safety law includes 35 provisions that collectively address the shortcomings and limitations of the process and require regulatory action on the FAA's part; imposes civil penalties upon manufacturers for providing the FAA or airlines with incomplete or misleading information on important systems; requires FAA approval of new ODA unit members to prevent conflicts of interest and to ensure their competence; requires the FAA to address international pilot training standards, the safety benefits of flight deck automation, and the concurrent need for strong manual flying skills; and penalizes the exertion of undue pressure on those unit members, among other things.

The following are the most significant of such provisions.

A. Safety Management Systems

MANDATE	DEADLINE	STATUS
Directs the FAA to require aircraft and other aerospace industry manufacturers to adopt safety management systems, which allow them to identify, manage, and eliminate safety risks through a variety of mechanisms and internal processes, consistent with international standards and practices.	Jan. 26, 2021	**IN PROGRESS:** FAA expects issuance of proposed rule in September 2022.

[28] *See The Design, Development & Certification of the Boeing 737 MAX*, Majority Staff of the Committee on Transportation and Infrastructure Final Committee Report Prepared for Chair DeFazio and Chair Larsen (Sept. 2020), p. 6, *available at* https://transportation.house.gov/imo/media/doc/2020.09.15%20FINAL%20737%20MAX%20Report%20for%20Public%20Release.pdf.

[29] *Id.*

B. Expert Review of Boeing's Safety Culture

MANDATE	DEADLINE	STATUS
Convenes an independent expert review panel to review The Boeing Company's exercise of its ODA privileges, the company's safety culture, and capability to perform FAA-delegated functions.	Jan. 26, 2021	**IN PROGRESS:** FAA has taken internal steps to prepare, but the panel won't be convened before 2022. The charter is expected in fall 2021.

C. More Experts for Certification Activities

MANDATE	DEADLINE	STATUS
▪ Authorizes $27 million in annual appropriations for the FAA to recruit and retain engineers, safety inspectors, human factors specialists, software and cybersecurity experts, and other qualified technical experts who perform duties related to the certification of aircraft, engines, and other components.	N/A	
▪ Also directs the FAA to conduct a review of its workforce responsible for aircraft certification to determine whether the agency has the necessary expertise and capability to certify new technologies and materials.	Jan. 26, 2021	**IN PROGRESS:** FAA began the review in February 2021. The review is ongoing.

D. Requirement for Disclosure of Safety-Critical Information to the FAA and Airlines

MANDATE	DEADLINE	STATUS
Requires manufacturers to disclose to the FAA, and to airlines and pilots via airplane flight manuals and flight crew operating manuals, all safety-critical information related to an aircraft, including information regarding systems that manipulate flight controls without direct pilot input and whose failure or erroneous activation would present a risk with an outcocome rated hazardous or catastrophic. Imposes up to a $1 million civil penalty for a violation of the disclosure requirements.	Effective at enactment	**IN PROGRESS:** FAA is preparing three policy documents for FAA employees and aerospace manufacturers outlining the agency's enforcement of this provision. Completion expected in 2022.

E. Limitation on Delegation

MANDATE	DEADLINE	STATUS
Prohibits the FAA from delegating to a manufacturer the authority to certify on behalf of the agency that a critical system design feature, including a "novel or unusual design feature," complies with the Federal Aviation Regulations until the FAA Administrator has validated any underlying assumptions related to human factors.	Effective at enactment	**IN PROGRESS:** FAA has taken a number of internal steps and will issue the final FAA policy documents in 2023.

F. Reform of the ODA System to Add Accountability and Prevent Undue Pressure on ODA Unit Members

MANDATE	DEADLINE	STATUS
▪ Requires the FAA Administrator, beginning on January 1, 2022, to approve each new individual selected by an ODA holder engaged in the design of an aircraft, aircraft engine, propeller, or appliance before they become an authorized representative (or "ODA unit member") to act on the FAA's behalf in validating compliance of aircraft systems and designs with FAA requirements. Requires new ODA unit members to meet qualifications issued by the FAA Administrator, and that at a minimum, such individuals must possess the requisite knowledge and technical skills and be of good moral character. Allows for conditional designations of ODA unit members and requires the FAA to approve or reject those designations within 30 days. Reinforces the FAA Administrator's authority to rescind an approval for an individual to serve as an ODA unit member at any time, for any reason. ▪ Directs the FAA to review each current Boeing ODA unit member to ensure each individual meets the agency's minimum qualifications. ▪ Imposes a civil penalty for any supervisor of an ODA holder that manufactures transport category airplanes who interferes with (e.g., harasses, berates, or threatens) an ODA unit member's performance of authorized functions on behalf of the FAA and requires all ODA unit members to promptly report any cases of interference experienced or witnessed at a company.	Jan. 1, 2022	**IN PROGRESS:** FAA expects to issue final policy documents for manufacturer and FAA employees in February 2022.

MANDATE	DEADLINE	STATUS
▪ Directs the FAA to perform periodic audits of each manufacturing ODA unit and its procedures at least once every seven years. ▪ Directs the FAA to assign aviation safety advisors to ODA unit members at certain aircraft and engine manufacturers to ensure unit members are knowledgeable of FAA policies and to monitor their performance. ▪ Prohibits the FAA and ODA holders from prohibiting ODA unit members from communicating with FAA personnel and vice-versa.		

G. Voluntary Safety Reporting Program

MANDATE	DEADLINE	STATUS
Directs the FAA, in collaboration with labor groups, to implement a confidential voluntary safety reporting program for FAA engineers, safety inspectors, systems safety specialists, and others to report safety issues to FAA management.	Dec. 27, 2021	**COMPLETE**

H. Consideration of How One Failure Causes Others

MANDATE	DEADLINE	STATUS
Directs the FAA to require an applicant for an amended type certificate for a transport airplane, such as Boeing in the case of the 737 MAX, to perform a system safety assessment (SSA) with respect to each proposed design change the FAA determines is significant, and to review each SSA for sufficiency and adequate consideration of the airplane-level effects of failures, including pilot responses to those failures.	Dec. 27, 2022	**IN PROGRESS:** FAA is working to develop an implementation plan and expects to issue a notice of proposed rulemaking in 2022.

I. New Global Standards for Evaluating Changes to Existing Airplane Designs

MANDATE	DEADLINE	STATUS
Directs the FAA to exercise leadership in the creation of international policies and standards relating to the issuance of amended type certificates for new airplane design, and requires the FAA to conduct a rulemaking to revise and improve the process for issuing amended type certificates.	Dec. 27, 2023	**IN PROGRESS:** FAA has engaged with other civil regulators and is leading a working group on pilots' reliance on automation as part

MANDATE	DEADLINE	STATUS
		of broader engagement at the International Civil Aviation Organization. Policy and regulatory documents expected in 2024.

J. Whistleblower Protections

MANDATE	DEADLINE	STATUS
Adds aviation manufacturing employees to existing laws protecting airline employees from whistleblower retaliation for reporting safety issues or violations.	Effective at enactment	**COMPLETE:** FAA is monitoring and addressing claims of retaliation against whistleblowers.

K. Domestic and International Pilot Training

MANDATE	DEADLINE	STATUS
▪ Expands the FAA's role in reviewing and approving pilot training requirements for commercial aircraft, by initiating several reviews examining human factors, increased aircraft automation, pilot skills, crew resource management, and FAA pilot certification standards. ▪ Authorizes $5 million in annual appropriations for expanded FAA programs to assist foreign aviation authorities to improve international aviation safety.	Jan. 26, 2021, to initiate an expert safety review of assumptions regarding pilot training	**IN PROGRESS:** Expert panel's final report with recommendations to improve pilot training requirements expected in 2022.

WITNESS

The Honorable Steve Dickson
Administrator
Federal Aviation Administration