United States Government Accountability Office

Report to Congressional Committees

November 2020

AVIATION CERTIFICATION

FAA Needs to Strengthen Its Design Review Process for Small Airplanes

GAO-21-85

GAO Highlights

Highlights of GAO-21-85, a report to congressional committees

November 2020

AVIATION CERTIFICATION

FAA Needs to Strengthen Its Design Review Process for Small Airplanes

Why GAO Did This Study

FAA is undergoing a major change in how it reviews and certifies the designs of small airplanes. The Small Airplane Revitalization Act of 2013 directed FAA to streamline its design reviews to improve safety, regulatory cost burden, innovation, and technology adoption. In 2016, FAA shifted from prescriptive design requirements to performance-based regulations. The FAA Reauthorization Act of 2018 directed GAO to review FAA's implementation of these regulations.

This report examines: (1) FAA's implementation of performance-based safety regulations for small airplanes and (2) FAA's efforts to measure the effect of these regulations on safety, regulatory cost burden, innovation, and technology adoption.

GAO reviewed FAA documents and interviewed FAA staff who perform design reviews in 4 of FAA's 8 certification offices, which handled the majority of projects FAA reviewed under the new regulations. GAO also interviewed industry stakeholders, including a selection of different types of manufacturers that have submitted an application under the new approach.

What GAO Recommends

GAO is making 7 recommendations to strengthen FAA's implementation of its new regulations, including that FAA provide staff with more information on how to implement the new approach and that FAA take steps to develop performance measures. DOT concurred with the recommendations.

View GAO-21-85. For more information, contact Heather Krause at (202)-512-2834 or krauseh@gao.gov

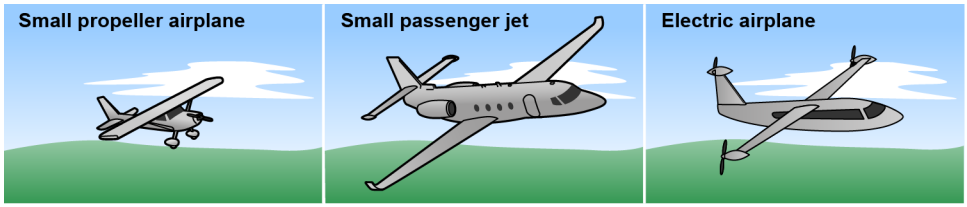
What GAO Found

The Federal Aviation Administration (FAA) has taken steps to implement new performance-based safety regulations when reviewing small airplane designs. Performance-based regulations specify required results but do not prescribe any specific method for achieving the required results. FAA began reviewing applications under these new regulations in 2017, so it is early in its implementation of this new approach. However, FAA has faced delays and challenges in its initial design reviews under this new approach. For example, FAA staff who perform design reviews expressed uncertainty about the level of detail that applicants need to provide when showing how their designs meet the new regulations. According to the staff and GAO's review, this and other challenges are partly due to a lack of guidance on how to address issues created by this new approach.

GAO has noted the importance of agencies' ensuring that staff have the information they need to achieve intended objectives. FAA officials stated that they provided training on the new process, but FAA staff described the training as high level and said more detailed information, including updated guidance, is needed. FAA officials stated they are planning to provide virtual training in November 2020 due to the COVID-19 pandemic. However, it is unclear whether the planned training will provide the information needed to address the previously mentioned challenges. Taking steps to provide additional information to FAA staff would help address the challenges staff are facing, reducing potential delays and inconsistencies in reviews and ensuring airplane designs fulfill FAA's safety requirements.

FAA has not developed performance measures for the revised regulations or a plan to develop such measures. FAA noted that the intent of its shift to performance-based regulations was to improve safety, reduce regulatory cost burden, and spur innovation and technology adoption for small airplanes. GAO has previously noted the importance of using performance measures to assess whether agencies' efforts are achieving their intended goals. FAA officials stated that they have not been directed to develop performance measures specific to the implementation of performance-based regulations for small airplanes and do not have a plan to do so. Without performance measures, FAA will face difficulties in determining the effects of the revised regulations. FAA officials and some industry stakeholders stated that performance-based regulations will lead to improved safety outcomes and provided examples of new technologies that would benefit from this approach.

Examples of Small Airplanes Subject to the Federal Aviation Administration's Regulation



Source: GAO. | GAO-21-85

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Abbreviations

AIR	Aircraft Certification Service
ASTM	ASTM International
CECI	Center for Emerging Concepts and Innovation
FAA	Federal Aviation Administration
SASB	Small Airplanes Standards Branch

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
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November 16, 2020

The Honorable Roger Wicker
Chairman
The Honorable Maria Cantwell
Ranking Member
Committee on Commerce, Science, and Transportation
United States Senate

The Honorable Peter DeFazio
Chairman
The Honorable Sam Graves
Ranking Member
Committee on Transportation and Infrastructure
House of Representatives

The Federal Aviation Administration (FAA) is in the midst of a major change in how it reviews new or modified designs for small airplanes. For decades, FAA required that designs for small airplanes meet requirements specified in federal regulations (contained in 14 C.F.R. Part 23 and referred to as Part 23 regulations).[1] However, as part of a regular review of its regulations, in 2009 and 2013, FAA sponsored two studies that raised concerns that the existing regulations were based on outdated technologies and that it was difficult and time-consuming to certify new designs and technologies that could improve safety. The Small Airplane Revitalization Act of 2013 (the Act) required that FAA issue a final rule to streamline FAA's approval process for small airplane designs, with the intended objectives of improving safety, reducing the regulatory cost burden for FAA and industry, and spurring innovation and technology adoption.[2] In response, FAA issued a final rule in December 2016 to replace its prescriptive design requirements with performance-based regulations, which state requirements in terms of required results but do not prescribe any specific method for achieving the required results. FAA

[1]For the purposes of our report, small airplane designs can include designs for the various parts of the airplane, (for example, the airframe or propulsion system installation, among other things), but our use of the term may also include designs for standalone airplane equipment that can be installed onto an airplane (for example, cockpit display systems).

[2]Pub. L. No. 113-53, § 3(a)-(b), 127 Stat. 584, 585.

stated that this shift would achieve the objectives outlined in the Act.[3] The rule became effective in August 2017. The FAA Reauthorization Act of 2018 included a provision for GAO to review FAA's implementation of the new certification process for small airplanes (Part 23-regulated airplanes).[4]

This report evaluates:

- the extent to which FAA has taken steps to implement its performance-based safety regulations for the design of small airplanes, and
- FAA's efforts to measure the effect of its performance-based regulations on safety, regulatory cost burden, innovation, and technology adoption for small airplanes.

To assess the extent to which FAA has taken steps to implement performance-based safety regulations for the design of small airplanes, we reviewed FAA's documents related to its implementation of the performance-based safety regulations for Part 23-regulated airplanes. These documents included FAA's final rule implementing revisions to Part 23, FAA's orders and advisory circulars governing how staff review applications for design certifications, and training materials provided to staff regarding implementation of the new regulations. We also interviewed officials in FAA's Aircraft Certification Service (AIR) regarding FAA's efforts to implement the new regulations. As part of this effort, we interviewed staff in four of the eight aircraft certification offices overseeing applications that rely on the new regulations: Chicago, Wichita, Los Angeles, and Seattle. We selected these offices to get insights from the staff handling the largest number of projects (22 of 29) that FAA identified as being reviewed under the new performance-based safety regulations.[5] We also interviewed officials and staff from the Small Airplanes Standards Branch (SASB), which develops certification policy for small airplanes,

[3]Revision of Airworthiness Standards for Normal, Utility, Acrobatic, and Commuter Category Airplanes, 81 Fed. Reg. 96572 (Dec. 30, 2016).

[4]Pub. L. No. 115-254, § 215, 132 Stat. 3186, 3251.

[5]As discussed later in this report, FAA faces challenges identifying all of the projects under Amendment 64 and identified 29 as the estimated number of completed, in-process, or anticipated projects with Amendment 64 (in whole or in part) as the certification basis, as of February 2020 (the time in which we were selecting interviewees). As noted later in this report, FAA updated the number of total estimated projects in July 2020.

oversees implementation of the performance-based regulations, and assists staff in the aircraft certification offices with reviews. We assessed FAA's actions against key practices for agency reform efforts that we identified in prior work.[6] We also determined that federal internal control standards were significant to FAA's implementation of performance-based regulations and assessed FAA's efforts against two internal control components:

- control activities and the underlying principle that management should design control activities to achieve objectives and respond to risks, and
- information and communication and the underlying principle that management should use quality information to achieve the entity's objectives.[7]

We assessed FAA's design control activities to achieve objectives and respond to risks by reviewing FAA's efforts to provide staff with information on how to review projects under the new regulations. We assessed FAA's use of quality information by reviewing FAA's ability to identify the projects being reviewed under the new regulations. We interviewed representatives of aircraft and equipment manufacturers (13 companies) and representatives of pilots, including industry associations (4 associations), to obtain their views on FAA's progress in implementing the new regulations. We selected these stakeholders to include organizations that submitted comments on FAA's proposed shift to performance-based regulations as well as representatives for the projects noted above.[8] We interviewed representatives from ASTM International, a standards-development body, to understand their process for developing

[6]GAO, *Government Reorganization: Key Questions to Assess Agency Reform Efforts*, GAO-18-427 (Washington, D.C.: June 13, 2018). We focused on three of the four categories for key questions related to agency reform efforts, and excluded one category because it was focused on the development of reforms, which was outside our scope (we focused on FAA's implementation of the reforms).

[7]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: Sept. 10, 2014).

[8]We interviewed representatives for 17 of the 29 projects.

industry-consensus standards that manufacturers can use to demonstrate compliance with FAA's performance-based safety regulations.[9]

To identify FAA's efforts to measure the effect of its performance-based regulations, we reviewed FAA documents describing its goals for design certification reviews, including FAA's 2018 Comprehensive Strategic Plan for AIR Transformation. We interviewed officials from SASB and FAA's Organizational Performance Division as well as staff in each of the selected aircraft certification offices. We compared FAA's efforts against key practices for agency reform efforts.[10] We also interviewed the selected representatives of the aircraft and equipment manufacturers and representatives of pilots, including industry associations, to obtain their views on the effects of the new regulations.

We conducted this performance audit from September 2019 to November 2020 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

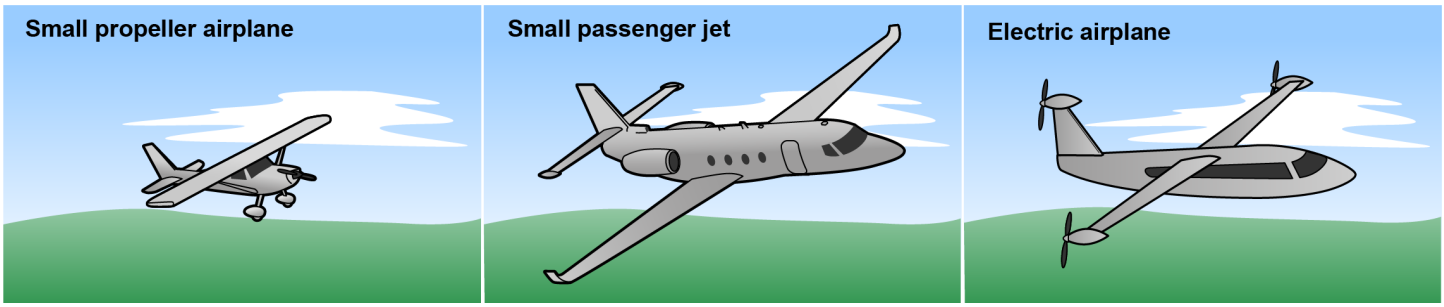
Background

Airplanes regulated under Part 23 are small airplanes weighing 19,000 pounds or less and carrying 19 passengers or less. These airplanes may be used for recreational or commercial purposes and can vary widely in their design (see fig. 1).

[9]ASTM International is a not-for-profit organization that provides a forum for the development and publication of international voluntary consensus standards for materials, products, systems, and services.

[10]GAO-18-427.

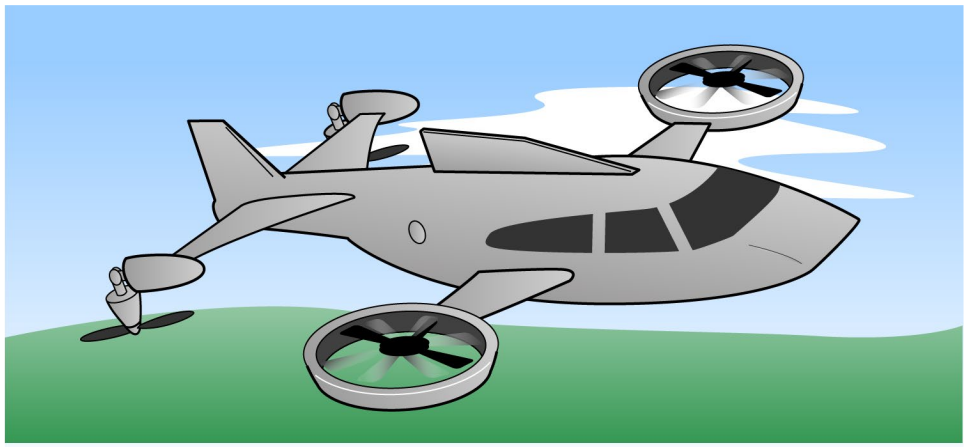
Figure 1: Examples of Small Airplanes Regulated by FAA



Source: GAO. | GAO-21-85

FAA is also in the midst of considering how to apply Part 23 regulations to urban air mobility aircraft, a term that encompasses a variety of new aircraft designs. Some of these designs combine the flight characteristics of airplanes and helicopters, such as allowing for vertical takeoff and landing (see fig. 2). FAA officials stated that while FAA is still determining which regulations they will use to certify the aircraft, they anticipate that some Part 23 regulations will apply.

Figure 2: Example of a Vertical Takeoff and Landing Aircraft



Source: GAO. | GAO-21-85

Generally, before a product can be manufactured for use in the United States, FAA must review the design. This includes reviewing the designs of the various components of an airplane (such as the structure and

power plant, among other components). FAA also reviews the designs of stand-alone equipment that can be installed into a plane, such as cockpit displays. If FAA approves the design, it issues one of the following certificates:

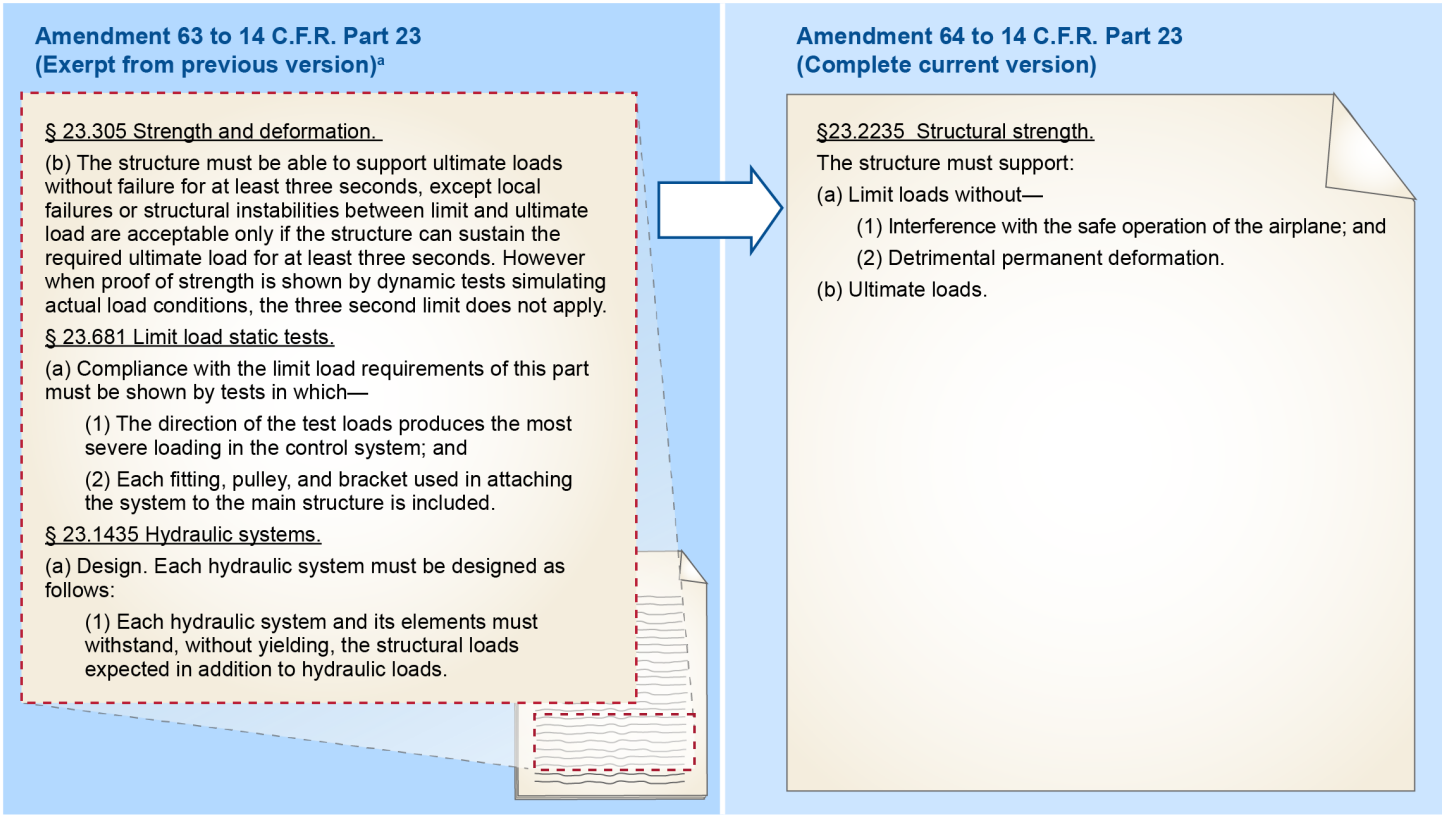
- **Type certificates** are issued to approve the design of new airplanes, engines, or propellers.
- **Amended type certificates** are issued to approve changes to existing designs by the certificate holder. These changes to the type design are typically implemented in production.
- **Supplemental type certificates** are issued to approve modifications to existing airplanes by the certificate holder or any member of the public. These modifications to the airplanes are typically implemented in the field after delivery.

FAA has revised Part 23 multiple times in the past, with each revision constituting an "amendment," and the most recent revision being Amendment 64, which replaced prescriptive technical requirements for the design of normal category planes with broadly worded performance-based regulations.[11] Performance-based regulations state requirements in terms of required results but do not prescribe any specific method for achieving the required results. For example, FAA condensed 32 regulations that provided specific instructions on the design and placement of various instruments and equipment to one regulation that states (generally) that instrument markings must be displayed in a conspicuous manner and clearly indicate their function.[12] See figure 3 for an example of the transition from prescriptive requirements to performance-based requirements. A number of other aviation regulators, including the European Aviation Safety Agency, are also shifting to performance-based regulations.

[11]81 Fed. Reg. 96572. Certification in the normal category applies to airplanes with a passenger-seating configuration of 19 or less and a maximum certificated takeoff weight of 19,000 pounds or less. 14 C.F.R. § 23.2005.

[12]14 C.F.R. § 23.2610.

Figure 3: Example of Shift from Prescriptive Requirements to Performance-Based Requirements



Source: Revisions to Operational Requirements for the Use of Enhanced Flight Vision Systems (EFVS) and to Pilot Compartment View Requirements for Vision Systems, 81 Fed. Reg. 90126 (Dec. 13, 2016)(Amendment 63) and Revision of Airworthiness Standards for Normal, Utility, Acrobatic, and Commuter Category Airplanes, 81 Fed. Reg. 96572 (Dec. 30, 2016)(Amendment 64). | GAO-21-85

[a]Selected examples for illustrative purposes. This is not a complete list of the relevant regulations.

When proposing the changes in Amendment 64, FAA noted that the prescriptive requirements in Part 23 led to situations in which applicants seeking to incorporate new or innovative technology had to provide additional documentation so that FAA could issue a special condition, exemption, or equivalent level of safety finding (which can require the use

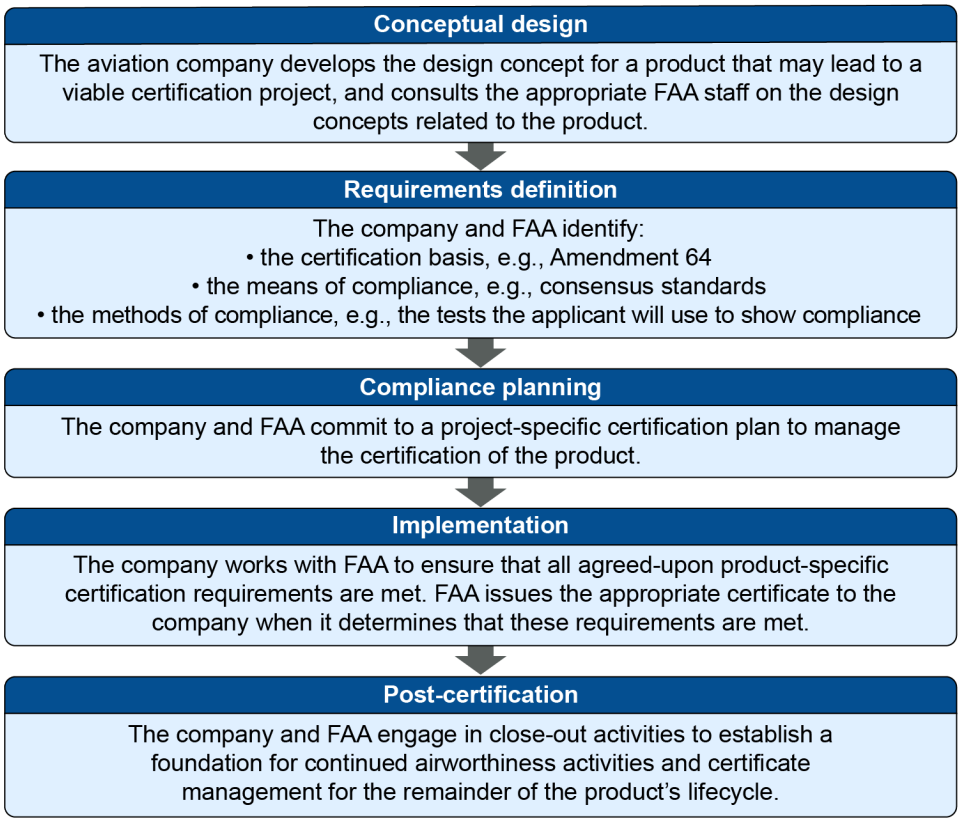
of issue papers to document and address concerns).[13] FAA stated that moving to performance-based regulations could reduce the need for these processes, which can be time-consuming.

Applicants must show how their design complies with each performance-based regulation by using a "means of compliance," which is a detailed design standard that, if met, accomplishes the safety intent of the regulation.[14] For example, to meet an occupant protection regulation, an applicant could propose one of a variety of designs for seat belt and shoulder harnesses, or other protection systems, as long as the applicant could prove that the design achieved the required results in the performance regulations. According to FAA officials, applicants can also use the prescriptive regulations in the previous Amendment 63 as means of compliance with the performance-based Amendment 64 regulations. As shown in figure 4, FAA staff must review and accept an applicant's proposed means of compliance, which includes determining that the means of compliance shows the design meets the safety intent of the regulations.

[13]Special conditions are used when the FAA finds that the airworthiness regulations do not contain adequate or appropriate safety standards for an aircraft, aircraft engine, or propeller because of a novel or unusual design feature of the product. See 14 C.F.R. § 21.16. A petition for exemption is a request to the FAA by an individual or entity asking for relief from the requirements of a current regulation. See 14 C.F.R. § 11.15. Equivalent level of safety findings are made when literal compliance with a certification regulation cannot be shown and compensating factors exist which can be shown to provide an equivalent level of safety. The issue paper process is a formal communications vehicle for describing and tracking the resolution of significant technical, regulatory, and administrative issues that occur during a certification project. An issue paper may also be used to address novel or controversial technical issues.

[14]14 C.F.R. § 23.2010.

Figure 4: Overview of the Federal Aviation Administration's (FAA) Amendment 64 Certification Process



Source: FAA. | GAO-21-85

While applicants can propose their own means of compliance for FAA review and acceptance, FAA's revised regulations also allow applicants to use industry consensus standards as their means of compliance.[15] Consensus standards are technical specifications developed by organizations such as ASTM International, an internationally recognized standards-development organization. ASTM International established a committee (Committee F44 on General Aviation Aircraft) to develop consensus standards for Part 23 regulations. The committee includes representatives from FAA, aviation regulators across the world, and from industry groups and manufacturers, as well as aviation experts. The committee—and subcommittees with specific focuses—periodically meet

[15]14 C.F.R. § 23.2010.

to develop, vote on, and update consensus standards for Part 23 regulations. FAA reviews and determines whether to accept the standards, as well as revisions to the standards. FAA provides a public list of FAA-accepted ASTM standards.[16] The use of consensus standards and standards development bodies is intended to allow for the faster development and updating of means of compliance for new and evolving technologies. In addition, since aviation regulators from around the world participate in ASTM, this approach is intended to support internationally harmonized regulatory approaches.

Various offices within FAA's Aircraft Certification Service (AIR), located in the Office of Aviation Safety, are involved in the review of designs for new and modified planes and equipment. Specifically, SASB, within the Policy and Innovation Division, develops policy related to design certification reviews, and reviews and accepts means of compliance, including ASTM consensus standards. In addition, according to FAA officials, SASB is responsible for overseeing implementation of Amendment 64. The geographic aircraft certification offices typically manage certification projects, which include determining whether a new product complies with applicable regulatory standards and approving products for certification.

During the course of our review, FAA officials noted that the Policy and Innovation Division is in the process of refining its organizational structure to more fully align functional capabilities with agency and industry needs. According to officials, this realignment will enable greater focus on FAA's approach to consensus standards development and implementation, optimization of FAA resources, and improved internal and external coordination. In addition, AIR officials told us they are in the process of establishing a Center for Emerging Concepts and Innovation (CECI), which would engage early with companies that want to certify new technologies such as urban air mobility aircraft. Officials explained that CECI intends to work with companies to determine which regulations would apply to the new aircraft, and what means of compliance the applicant will use to demonstrate that the design meets the regulations.

[16]FAA, *Part 23 Accepted Means of Compliance Based on ASTM Consensus Standards: Updated September 22, 2020*, accessed October 9, 2020, https://www.faa.gov/aircraft/air_cert/design_approvals/small_airplanes/small_airplanes_regs/media/part_23_moc.pdf.

FAA Has Taken Steps to Implement Performance-Based Regulations but Faces Challenges due to Resource Constraints and a Lack of Guidance

While still in the early stages of implementation, FAA has taken steps to implement performance-based regulations, such as accepting consensus standards and providing initial training to staff. However, FAA's reviews of design certifications to date have faced delays and challenges due to resource constraints and a lack of guidance for staff responsible for reviewing plane designs.

FAA Has Accepted Consensus Standards and Implemented Training but Is Still in the Early Stages of Conducting Reviews

FAA's performance-based regulations became effective on August 30, 2017, and FAA is relatively early in implementation. Design certifications can take years, and FAA started reviewing applications for new airplanes under the performance-based regulations in 2017. In addition, FAA accepted the first set of ASTM consensus standards in May 2018.

SASB provided in-person training to staff for each aircraft certification office shortly after FAA published Amendment 64. FAA also made an online version of the training available. Among other things, the training describes the differences between Amendment 64 and the previous, prescriptive amendment, defines key concepts—such as consensus standards and means of compliance—and reiterates that the goals of the amendment are to streamline design certifications, reduce regulatory burden, and to use consensus standards that keep pace with new and changing technologies.

FAA continues to process and complete design certifications under Amendment 64. SASB officials provided us with estimates of the number of project reviews in process or completed, as well as the number of anticipated applications, as shown in table 1 below.[17] FAA officials also said that there are various companies that are not captured in these data and that may not have imminent plans to submit an application, but that have contacted FAA to gather information on the design certification process under Amendment 64. As discussed later in the report, FAA faces challenges identifying all of the projects under Amendment 64.

[17]Anticipated applications are instances in which FAA has had preliminary discussions with prospective applicants that have not officially begun the type certification process.

Table 1: Federal Aviation Administration's Estimates of the Number of Project Reviews under Part 23, Amendment 64

Project type	Description	Completed	In-process	Anticipated applications
Type certificate	Issued to approve the design of new airplanes, engines, or propellers.	0	11	4
Amended type certificate	Issued to approve changes to existing designs by the certificate holder.	0	7	0
Supplemental type certificate	Issued to approve modifications to existing airplanes by the certificate holder or any member of the public.	11	3	0

Source: Federal Aviation Administration. | GAO-21-85

Note: Data are as of July 28, 2020.

Anticipated applications are instances in which FAA has had preliminary discussions with prospective applicants that have not officially begun the type certification process.

FAA Staff Have Faced Delays and Challenges in Reviewing Applications due to Resource, Guidance, and Communication Issues

Resource Issues

Industry stakeholders and aircraft certification office staff stated that SASB has faced delays in accepting ASTM consensus standards or unique means of compliance proposed by applicants. For example, after accepting ASTM's 2017 consensus standards in early 2018, FAA did not accept or reject any ASTM standards until September 2020. During this time period, ASTM released four subsequent updates to its standards. Industry stakeholders and aircraft certification office staff said that it has also taken FAA considerable time to accept unique means of compliance proposed by applicants, which in some cases may include ASTM standards that FAA has not yet accepted. For example, one applicant said that it took 2 years for FAA to fully approve its means of compliance. Industry stakeholders as well as aircraft certification office and SASB staff said that design certifications can take longer now than they did under the prior regulations. SASB officials stated that FAA's reviews of unique means of compliance has always been a time-intensive process, and as experience with Amendment 64 is gained, projects should be completed in less time.

In addition to needing to review ASTM consensus standards, SASB's role has further increased under Amendment 64. Specifically, aircraft certification office and SASB staff noted that SASB's role in the review of applicants' proposed designs has significantly increased following the

implementation of Amendment 64. For example, under the previous, prescriptive regulations, aircraft certification staff were responsible for approving applicants' proposed designs, and they consulted with SASB to review applicants' proposed means of compliance in unique circumstances, such as on applications using novel technology. SASB continues to review applicants' unique means of compliance, but must do so more frequently in part because, (1) according to FAA staff, there has been an increase in innovative projects using unique means of compliance, and (2) SASB staff now must review and accept applicants' use of ASTM consensus standards if FAA has not already accepted them.

SASB management and staff said that they have experienced delays and challenges reviewing ASTM consensus standards and unique means of compliance due to resource constraints, and raised concerns regarding how resource constraints could affect reviews. For example:

- In April 2019, FAA reassigned the person responsible for leading the coordination of FAA's review of ASTM standards to assist with work in other areas, which FAA officials stated was one of the reasons that its review of ASTM standards was delayed. Officials also pointed to the degree of changes made to the standards. Another FAA staff member is now handling these duties in addition to the individual's existing responsibilities.
- FAA officials stated that they have not been able to send all of the staff who should participate in meetings of ASTM subcommittees—the bodies that develop the consensus standards—to these meetings due to the large number of subcommittees and FAA budget concerns. Industry officials and FAA staff noted the importance of FAA's attending these meetings in order to stay involved in the standards development process, provide technical expertise, and be aware of potential changes to the standards. This awareness aids FAA's review of consensus standards. For example, one SASB staffer said that he attends ASTM meetings in his capacity as an expert on specific technical sections of Part 23. Attending the meetings allows him to contribute to the development of consensus standards and remain aware of revisions. As a result, he said that he is able to promptly concur with the new and revised standards. Due to the COVID-19 pandemic, ASTM International canceled its April and October 2020 meetings but held virtual meetings in August and September 2020. FAA officials stated that they will be able to send sufficient staff to future virtual meetings. However, it is possible they will face this issue again when in-person meetings resume.

- Aircraft certification office staff said that there have also been delays in SASB's review of means of compliance proposed by applicants. Some staff raised concerns that SASB does not have sufficient resources to fulfill its increased responsibilities under Amendment 64 for reviewing means of compliance.

GAO has previously identified strategic workforce planning as a key practice for agency reform efforts. According to our prior work, as part of its strategic workforce planning, an agency should assess whether it has the needed resources and capacity for the proposed reforms.[18] While SASB now has a larger role in design reviews and staff may be required to review an increasing number of new and novel technologies, SASB officials said that they have not conducted a resource assessment to determine the resources needed for their ongoing implementation of Amendment 64. SASB officials acknowledged that FAA faced some challenges due to the fact that after Amendment 64 was issued, FAA staff were required to review a number of ASTM standards as well as applications for aircraft incorporating new and novel technologies. However, the officials said that they did not believe a resource assessment is currently necessary because now that the most recent version of ASTM consensus standards is available to applicants, applicants should not need—and SASB should not have to review—as many unique means of compliance (since applicants can use the FAA-accepted standards). However, FAA notes in its final rule implementing Amendment 64 that FAA believes that industry will continue to develop new consensus standards and means of compliance as technology for Part 23 aircraft evolves. FAA officials acknowledged that they may need to adjust resources to address the reviews of new and novel technologies but also stated that they believe they have the resources necessary to implement Amendment 64.

As ASTM continues to develop and revise consensus standards to address changes in technologies and FAA receives more Amendment 64 applications that may use unique means of compliance and present new and novel technologies, it will be increasingly important for FAA to identify the resources necessary for it to perform timely reviews of consensus standards and proposed means of compliance. Without identifying the level of resources needed for FAA's ongoing implementation of Amendment 64, FAA risks not having sufficient resources to fulfil the

[18]GAO, *Government Reorganization: Key Questions to Assess Agency Reform Efforts*, GAO-18-427 (Washington, D.C.: June 13, 2018).

goals of the Small Airplane Revitalization Act of 2013 and the subsequent Part 23 revisions: streamlining design certifications, reducing regulatory burden, and making available consensus standards and other means of compliance that keep pace with new and changing technologies.[19] In addition, FAA risks unduly delaying applicants' timelines to bring their products to market. Officials from the Policy and Innovation Division noted that the formation of a consensus standards management branch (as part of the planned organizational realignment previously mentioned) will ensure that appropriate FAA staff are engaged as needed in consensus standards development activities, including ASTM meetings. However, it is unclear when this reorganization will occur, and an assessment of resource needs could inform the division's reorganization efforts.

Guidance Issues

Aircraft certification office and SASB staff told us they have faced various challenges conducting certification reviews, due in part to a lack of guidance addressing issues created by Amendment 64's new approach. Amendment 64 represents a significant change in how FAA staff perform certification reviews. Aircraft certification office and SASB staff both said that they need additional guidance to consistently and efficiently perform reviews under Amendment 64. Aircraft certification office and SASB staff noted several challenges as a result of the lack of guidance:

- There is no document that maps FAA-accepted ASTM consensus standards to the Amendment 64 regulations they address. Applicants can use FAA-accepted ASTM standards as their means of compliance. However, the ASTM consensus standards do not always have a one-to-one relationship with Amendment 64 regulations. In addition, ASTM consensus standards may contain multiple subcomponents and cross references to other ASTM consensus standards. Thus, one section of Amendment 64 may be fulfilled by multiple consensus standards or by specific subparagraphs within a standard. However, when FAA formally accepts ASTM standards, FAA simply cites which regulations tie to the top-level standards, which do not contain any detail and instead reference sub-standards. As a result, several applicants told us they have spent a considerable amount of time and resources generating documents or "maps" demonstrating how the consensus standards they are using meet the regulations in Amendment 64. Similarly, staff at one aircraft certification office said that an applicant had to create 10 times more

[19]Pub. L. No. 113-53, § 3(a)-(b), 127 Stat. at 585; 81 Fed. Reg. at 96671.

documentation than it would have under the previous regulations due to this issue. FAA and ASTM officials stated that ASTM is in the early stages of developing a more in-depth map to show the relationship between Amendment 64 regulations and ASTM standards, and ASTM officials anticipate completing this effort in 2021.

- Many aircraft certification office and SASB staff we interviewed said additional guidance is needed regarding how to review applicants' proposed means of compliance, including how the means of compliance should be documented, what level of detail is needed, and who should be responsible for approving the proposed means of compliance in various scenarios (SASB or the aircraft certification office staff). For example, as noted above, ASTM consensus standards do not always have clear one-to-one links with regulations, and staff are unsure of the level of detail applicants need to provide when citing which ASTM standards (or which portions of a standard) they are using for a means of compliance. Some aircraft certification office and SASB staff stated that additional guidance regarding the use of consensus standards would be helpful as well, with some stating that capturing how different applicants are using means of compliance and what a full set of standards for a Part 23 project looks like could help ensure consistency in FAA's reviews.
- Aircraft certification office and SASB staff also expressed uncertainty about how to document concerns or issues that arise during the review process. In part, these concerns related to the use of issue papers, which are a vehicle for describing and tracking the resolution of significant technical, regulatory, and administrative issues that occur during a certification. Issue papers may also be used to address novel or controversial issues. Some staff noted that they use issue papers to document and address issues and concerns that arise when reviewing an applicant's proposed means of compliance. However, some of the staff we interviewed indicated that they were told to reduce the use of issue papers, as part of a streamlining initiative, and thus they were uncertain how to document and resolve issues that arose during their certification reviews. In addition, one staff member stated that FAA had introduced a new streamlined issue-paper process that was not understandable and overly cumbersome. SASB officials said that they still expect staff to use the issue paper process to document and track significant issues that arise during a certification review, but that they expected issue papers to be reduced in certain cases. For example, they stated that SASB is developing policy to address issues that come up consistently, thereby eliminating the need for issue papers in such instances. SASB officials also said that they have encouraged staff to use the

certification plan, rather than an issue paper for scenarios in which the applicant and FAA agree on how an issue should be addressed.[20] Officials said that this approach is more efficient than going through the resource-intensive issue paper process simply to confirm that there is no issue for which to account. SASB officials also noted that the intent of Amendment 64 was to reduce the need for special conditions and equivalent level of safety findings, which generate issue papers.

- Some staff raised concerns about the difficulty of conducting reviews under the new approach and how to ensure airplane designs achieve the same level of safety without prescriptive requirements to compare the designs against. Some aircraft certification office staff and company representatives said that since Amendment 64 is written at such a high level, they also check projects' means of compliance against the prior, more prescriptive version of Part 23, to ensure that the applicant's proposed means of compliance do not inadvertently overlook important technical specifications identified in the previous amendments.

In its final rule amending Part 23, FAA noted that to ensure performance-based standards were implemented consistently and correctly, FAA needed to develop guidance materials and provide sufficient information for staff. The final rule also delayed the effective date of the rule specifically so that FAA could develop the necessary guidance to implement Amendment 64.[21] GAO has noted the importance of agencies' ensuring that staff have the information they need to achieve the agencies' objectives.[22] Providing guidance to staff to enable them to fulfil their duties could take a variety of forms; for example, federal internal control standards, which provide standards for effective management of programs, note the importance of procedures and training in achieving an agency's objectives.[23] SASB officials said that they did not revise the existing order that outlines the design review process because the

[20]Each type certification project has a certification plan that includes information such as the proposed design, the applicable regulations—including exemptions and special conditions—a description of how compliance will be demonstrated, and a description of tests used to generate compliance data, among other things.

[21]81 Fed. Reg. at 96574.

[22]GAO-14-704G.

[23]GAO-14-704G.

process did not change; the only change is the standards against which FAA judges applications.[24] However, FAA did issue an advisory circular related to the use of means of compliance and provided initial training on Amendment 64.[25]

SASB officials also stated that they planned to conduct additional in-person training in 2020, but this training was canceled due to the COVID-19 pandemic. SASB officials also stated that they are planning to provide virtual-training options to FAA staff in November 2020, and provided GAO with a prototype of the planned training. However, this training is still in development and staff we interviewed identified challenges and areas where additional guidance is needed, but FAA has not developed guidance on these issues. Thus, it is currently unclear whether additional training will address these issues.

Aircraft certification and SASB staff noted that FAA needs to take action to address the challenges they are facing. Some staff stated that FAA's initial training was too general and they need more in-depth guidance and information on how to handle specific situations, such as case studies in performing certification reviews using consensus standards or proposed means of compliance. Some staff said that the lack of guidance has led to difficulties, delays, and possible inconsistencies in processing applications, and increased uncertainty for both staff and applicants. Similarly, several industry representatives told us they felt that FAA staff were uncomfortable with the new approach and needed additional training and guidance. For example, one representative stated that aircraft certification office staff seemed to need to contact SASB staff at every step of the process. Taking steps to provide additional direction to FAA staff would help address the challenges staff are facing, thereby reducing potential delays and inconsistency in reviews while helping ensure new designs and modifications fulfill FAA's safety requirements.

Communication Issues

While FAA is still early in implementing Amendment 64, aircraft certification office and SASB staffs' interest in receiving additional guidance demonstrates the importance of ensuring that SASB management is aware of and responds to issues that these staff identify.

[24]FAA, *Type Certification,* Order 8110.4c, March 28, 2017.

[25]FAA, *FAA Accepted Means of Compliance Process for 14 CFR Part 23*, Advisory Circular No: 23.2010-1, March 27, 2017.

According to SASB officials, while there is not a formal feedback mechanism to gather input from aircraft certification office staff and others on the implementation of Amendment 64, the officials are able to identify and respond to concerns identified during the course of the type certification reviews. Aircraft certification office management told us they are able to communicate concerns to SASB officials as well.

GAO has previously noted that when implementing agency reforms, one leading practice is to develop a two-way continuing communications strategy that enables management to collect and respond to employee feedback regarding the effects of potential reforms.[26] SASB officials explained that while there is no formal feedback process, staff can contact them with questions and that SASB officials participate in Amendment 64 reviews to identify and address difficulties FAA staff identify in implementing the new process. SASB officials stated that they are aware of certain issues identified by aircraft certification office staff and applicants, such as the need for maps between FAA-accepted ASTM consensus standards and the Amendment 64 regulations they address. FAA officials have articulated that the agency is working on guidance, in cooperation with ASTM, to address the lack of maps; however, as discussed, this effort may not be complete until 2021. In addition, aircraft certification office staff and SASB staff said that they have not received responses from SASB management on certain issues they have raised, while others stated that it would be helpful if SASB provided lessons learned across the aircraft certification offices. Since it is early in implementation, it is likely that the aircraft certification office and SASB staff will identify additional areas for clarification.

Developing a strategy to regularly solicit and respond to employee feedback regarding implementation of Amendment 64 would enable FAA to continuously address emerging issues and share information with staff tasked with implementing Amendment 64. With such a communications strategy in place, SASB could help ensure that aircraft certification office staff have the necessary direction to implement Amendment 64 consistently and efficiently.

FAA Cannot Comprehensively Identify Amendment 64 Projects

Although SASB officials said that they oversee and standardize implementation of Amendment 64 by being aware of and assisting aircraft certification office staff with all Amendment 64 design certifications, SASB does not have a method to identify all reviews under Amendment 64.

[26]GAO-18-427.

SASB officials told us they become aware of Amendment 64 design certifications through FAA's Certification Project Notification system (notification system). This notification system informs FAA offices of applications for type certificates, supplemental type certificates, and amended type certificates. However, the notification system does not identify the certification basis for applications. The certification basis defines the applicable amendment to 14 C.F.R. Part 23 for which the applicant must show compliance, e.g., Amendment 64 or another amendment.

FAA officials can identify the certification basis for type certificates based on the date the application was submitted: all applications for new type certificates submitted after August 30, 2017, are automatically under Amendment 64. However, SASB cannot identify the certification basis for supplemental type certificates and amended type certificates without contacting staff across the various offices to manually compile this information. Applicants for these type certificates can use either Amendment 64 or the certification basis of the original type certificate that they are modifying.[27]

GAO has previously noted the importance of agencies' identifying and collecting data to monitor the progress of reform efforts.[28] In addition, *Standards for Internal Control in the Federal Government* states that management should design a process that uses the entity's objectives and related risks to identify the information requirements needed to achieve the objectives and address the risks.[29]

Without reliable information on the number of Amendment 64 supplemental type certificates and amended type certificates—which SASB estimates make up more than half of the in-process and completed certifications—SASB lacks awareness of all Amendment 64 design certifications and thus cannot be sure it is providing assistance to all design certifications. As previously discussed, during the course of our review, we observed that FAA faced difficulties identifying Amendment 64 projects in response to our requests for a list of all such projects. SASB officials acknowledged that they may not be aware of all amended and supplemental type certifications but stated that they believed FAA staff or

[27]14 C.F.R. § 21.101.

[28]GAO-18-427.

[29]GAO-14-704G.

applicants would contact them if problems arose. However, without SASB's awareness, design certifications could proceed inefficiently and inconsistently because SASB would not be able to provide the oversight it has identified as important as it continues to implement Amendment 64. Further, without awareness of all Amendment 64 projects, FAA may miss the opportunity to identify lessons learned that could improve the implementation of performance-based rules in the future. In addition, as more companies submit applications over time, FAA will likely have an increasingly difficult time tracking all ongoing Amendment 64 projects and risk missing lessons learned from those projects.

FAA Has Not Determined How to Assess the Effects of Performance-Based Regulations for Small Airplanes

FAA Has Not Developed Performance Measures to Assess the Effect of Performance-Based Regulations

FAA officials told us they have not developed performance measures to evaluate the effects of performance-based regulations with respect to increasing safety, reducing regulatory cost burden, and increasing innovation and technology adoption for small airplanes. The Small Airplane Revitalization Act of 2013 provides that these are to be the objectives of FAA's new regulations for small airplanes. Also, the FAA Reauthorization Act of 2018, Section 211, requires FAA to establish aircraft-certification performance objectives and measures.[30] However, according to FAA officials, the Act requires performance objectives and measures for aircraft certification services in general and the requirement is not specific to small airplanes.

We have previously reported that it is critically important that FAA develop outcome-based performance measures to determine what is actually

[30]Pub. L. No. 115-254, § 211, 132 Stat. 3186, 3246.

being achieved through current and future initiatives.[31] Performance measures enable the ongoing monitoring and reporting of progress toward pre-established goals, and may include the level of activities conducted (process), the services delivered (outputs), or the results of those services (outcome).[32] In addition, when developing regulatory reforms, one of the key considerations is developing a regulatory evaluation plan that includes a means of monitoring the performance of new regulations based on clear outcome-oriented goals and performance measures.[33]

FAA officials told us they are working to develop performance objectives and measures for aircraft certification services in general in response to the 2018 Act. While such measures may provide insight into FAA's performance on aircraft certification, they do not provide insight into small airplane certification. FAA has not indicated any plan to break out the data for small airplane certifications. In addition, FAA has not established performance measures specific to the Amendment 64 performance-based regulations and does not have a plan to do so. SASB officials stated that they have not been directed by FAA to develop performance measures for the Amendment 64 regulations. In addition, they noted that FAA has not received enough applications subject to the new regulations to allow them to identify good measures of the regulations' effects.

While we recognize that FAA is still early in is implementation of Amendment 64, there are some performance measures that it could establish now to obtain an early indicator of the effects of FAA's implementation, as well as to assess the effects over time. For example, FAA could determine whether review timeframes are reduced after it addresses the initial challenges that staff are facing conducting reviews. As FAA receives more applications and its implementation of the regulations progresses, it could establish additional measures. Without performance measures, FAA cannot determine whether its implementation of performance-based regulations under Amendment 64 is achieving the requirements and goals provided by the Small Airplane

[31]GAO, *Aviation Safety: FAA Efforts to Implement Recommendations to Improve Certification and Regulatory Consistency Face Some Challenges*, GAO-14-728T (Washington, D.C.: July 23, 2014) and GAO, *Aviation Certification: FAA Has Made Continued Progress in Improving Its Processes for U.S. Aviation Products*, GAO-17-508T (Washington, D.C.: Mar. 23, 2017)

[32]GAO, *Performance Measurement and Evaluation: Definitions and Relationships,* GAO-11-646SP (Washington, D.C.: May 2, 2011).

[33]GAO-18-427.

Revitalization Act of 2013 and the FAA Reauthorization Act of 2018. In addition, performance measures would better enable FAA to inform Congress about FAA's progress toward meeting the goals.

Representatives we interviewed from industry groups and general aviation companies suggested various performance measures FAA could use to measure the effects of the new rules. Such measures include:

- certification cycle times, the number of staff hours spent on a given project, and comparisons against similar projects;
- changes in general aviation accident rates;
- the number of applications submitted for new designs; and
- acceptance of consensus standards and means of compliance (timeliness and number accepted).

FAA officials and industry stakeholders cautioned that it can be hard to determine the causal relationship between certain factors. For example, one stakeholder noted that the number of applications for new designs often depends on market factors. In addition, FAA staff noted that some application reviews take longer due to the complexity of the design or applicant priorities (for example, an applicant may have several projects at FAA for review and may prioritize one over another). FAA officials also noted that it could be difficult to determine the link between Amendment 64 regulations and the general aviation accident rate. While establishing such linkages could be difficult, FAA has used such data in the past to assess the effectiveness of its regulations. For example, FAA cited accident data when demonstrating the need to add requirements to prevent accidents caused by an operator's loss of control.

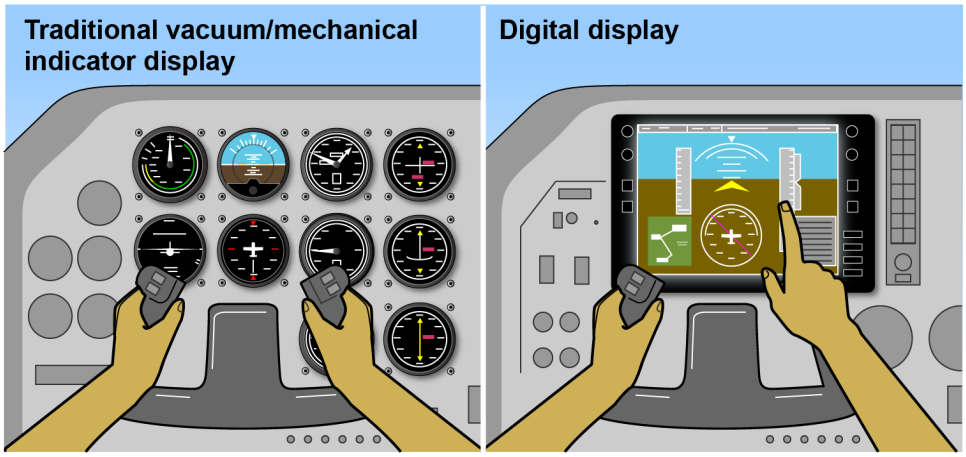
Stakeholders Cited Some Potential Benefits of Performance-Based Regulations but Also Stated That It Was Too Early to Fully Assess the Effects of Amendment 64

Industry and FAA representatives we spoke with told us it is too soon to determine the full effects of the new regulations on safety, regulatory cost burdens, innovation, and technology adoption. As previously noted, as of July 2020, FAA had not completed a type certificate review under Amendment 64. FAA officials said it could take several years to see the effects of the regulations. However, industry representatives and FAA staff were generally supportive of the new approach and provided examples of how it could lead to improvements in safety, regulatory cost burden, innovation, and technology adoption.

Industry representatives and FAA officials and staff noted that since implementation of the Amendment 64 regulations, FAA has certified a few

new products that could improve safety. For example, when vacuum-based instruments used for navigation purposes fail in bad weather, the pilot has no visibility or reference to the horizon. One company was approved to install electronic avionics and display systems that pilots can use to replace the old cockpit and flight display instruments (see fig. 5). According to FAA, research indicates that electronic instruments are less likely to fail and less expensive to maintain than vacuum-based instruments.

Figure 5: Example of Mechanical and Digital Cockpit Displays



Source: GAO. | GAO-21-85

In addition, companies are developing innovative new aircraft designs, including electrically powered aircraft and aircraft with vertical takeoff and landing capabilities. While FAA is still determining the extent to which Part 23 regulations will apply to these aircraft, FAA officials and manufacturers pointed to the flexibility afforded by Amendment 64 as beneficial to the development of these designs. One company is undergoing the FAA certification process for an urban air mobility aircraft that incorporates electronic propulsion, fly-by-wire technologies, and vertical takeoff and landing capabilities.[34] Company representatives told us that Amendment 64 regulations allowed them to develop and pursue certification of the aircraft more quickly than if performance-based certification regulations were not in effect in the United States. They added that if such

[34]Fly-by-wire flight control systems replace the physical connection between pilot controls and the flight control surfaces with an electrical interface.

regulations had not been in effect, then their company would have sought initial certification of the aircraft in another country.

Some FAA staff and industry officials noted that regulatory burden has increased due to some of the challenges previously discussed in this report. Specifically, some applicants told us they have spent a considerable amount of time and resources generating documents mapping ASTM consensus standards to the relevant sections of the Amendment 64 regulations. However, FAA officials and staff, as well as some industry representatives, stated that they expected that some of the initial challenges would subside as FAA and industry gained more experience with the certification process under Amendment 64. In addition, FAA officials and staff also noted that Amendment 64 would reduce regulatory burden and enable innovation by minimizing the need for time-intensive special conditions and similar processes that FAA had to use to review novel designs prior to Amendment 64.

Some FAA staff voiced concerns regarding how Amendment 64 would affect companies that modify and repair airplanes approved under Part 23 regulations. Specifically, staff noted that since applicants using Amendment 64 can propose their own means of compliance to show the design meets the safety intent of the regulations—proprietary information that would not be made publicly available—then companies that modify and repair products would face difficulties determining how the original applicants complied with regulations and how their modifications could affect that compliance. Some of the staff also stated that this situation could make it harder for FAA staff to review certification applications from airplane modifiers. FAA officials acknowledged this issue but indicated that they have not sought to address it because Amendment 64 allows applicants that want to modify existing products to develop and use their own means of compliance. SASB officials also noted that an applicant's means of compliance has always been proprietary information. However, prior to implementation of Amendment 64, the original applicants' means of compliance might have been easier to determine because the regulations included specific design requirements.

Conclusions

By shifting from prescriptive to performance-based regulations, FAA is implementing a major change in how it reviews the designs of small airplanes. FAA has stated that its new regulations will streamline the approval process for small airplane designs, thereby improving safety, reducing the regulatory cost burden for FAA and industry, and spurring innovation and technology adoption. We identified challenges that have led to delays and difficulties for staff and applicants in FAA's transition to

performance-based regulations. FAA's Policy and Innovation Division is planning an organizational realignment that may lead to changes in its management of small-airplane design reviews. However, FAA risks that the delays and difficulties we identified will continue if it does not identify the resources needed to implement performance-based regulations and ensure that staff have the information they need to conduct reviews under the new regulations. In addition, developing a strategy to collect and respond to employee feedback and a method to identify and track Amendment 64 projects would enable FAA to more effectively identify and address issues as they arise. Further, establishing performance measures for the Amendment 64 regulations would enable FAA to assess over time whether it is realizing the goals of the regulations—improving safety, reducing regulatory cost burden, and spurring innovation and technology.

Recommendations for Executive Action

We are making the following seven recommendations to FAA:

The Executive Director of the Aircraft Certification Service should assess the resources needed to efficiently implement Amendment 64. (Recommendation 1)

The Executive Director of the Aircraft Certification Service should provide information to help staff link ASTM consensus standards to Amendment 64 regulations. (Recommendation 2)

The Executive Director of the Aircraft Certification Service should develop procedures for staff's review of applicants' proposed means of compliance under Amendment 64, including how the means of compliance should be documented, what level of detail is needed, and who should be responsible for approving the proposed means of compliance in various scenarios. (Recommendation 3)

The Executive Director of the Aircraft Certification Service should provide information to staff to address their uncertainty regarding (1) the circumstances in which an issue paper is required, and (2) how to ensure staff's concerns are documented and resolved in situations in which staff are not to use an issue paper. (Recommendation 4)

The Executive Director of the Aircraft Certification Service should implement a strategy to regularly collect, address, and share information and guidance resulting from employees' feedback regarding implementation of Amendment 64. (Recommendation 5)

The Executive Director of the Aircraft Certification Service should implement a method to track Amendment 64 projects by certification basis. (Recommendation 6)

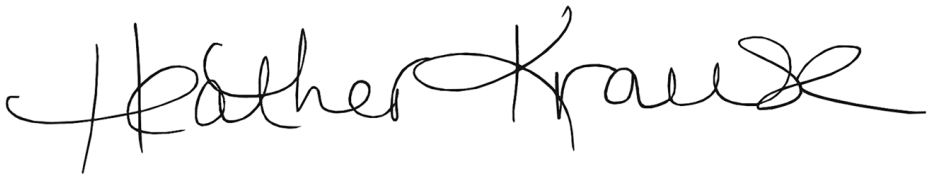
The Executive Director of the Aircraft Certification Service should take steps to develop performance measures to evaluate the effects of Part 23 performance-based regulations on safety, regulatory cost burden, innovation, and technology adoption for small airplanes. (Recommendation 7)

Agency Comments

We provided a draft of this product to the Department of Transportation for comment. In its comments, reproduced in appendix I, DOT concurred with the recommendations and noted that it has taken actions to address the dynamic nature of small airplane products within DOT's regulatory framework. DOT also noted that it is taking steps to provide additional staff training related to Amendment 64 and that this training will align with key issues identified in our report. DOT also provided technical comments, which we incorporated as appropriate.

We are sending copies of this report to the appropriate congressional committees, the Secretary of the Department of Transportation, and other interested parties. In addition, the report is available at no charge on the GAO website at https://www.gao.gov.

If you or your staff have any questions about this report, please contact me at (202) 512-2834 or krauseh@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix II.



Heather Krause
Director, Physical Infrastructure Issues

Appendix I: Comments from the Department of Transportation

U.S. Department of Transportation
Office of the Secretary of Transportation

Assistant Secretary for Administration

1200 New Jersey Avenue, SE
Washington, DC 20590

October 28, 2020

Heather Krause
Director, Physical Infrastructure
U.S. Government Accountability Office (GAO)
441 G Street NW
Washington, DC 20548

Dear Ms. Krause:

The Federal Aviation Administration (FAA) supports the creation of Performance Based Rule language, such as 14 CFR Part 23 Amendment 64 (Part 23-64) for small airplane certification, as a crucial element in support of certification projects and enabling safety improvements. Its release has been instrumental in the accelerated development of the innovative and unconventional designs and technologies that are characteristic of the new, rapidly emerging, Urban Air Mobility aircraft market.

Today's small airplane products are dynamic in nature, and the full scope of the activities that the FAA has underway to address these developments within the regulatory framework, does not seem to be captured in the GAO's draft report. By focusing regulatory language, like Part 23-64, on performance-based safety outcomes, designers now have greater flexibility to incorporate a variety of safety enhancing technologies and concepts in their products. The new Part 23-64 requirements have streamlined the deployment of innovative safety enhancements, such as inflatable passenger restraints, digital engine displays, and advanced avionics for traditional general aviation.

The FAA completed initial employee training on Part 23-64 soon after the rule was published; however, we determined additional recurrent training is needed due to our experience with implementation of Part 23-64 and the rapid growth of innovative products. The additional training will focus specifically on the implementation of the new rule structure and align with key issues identified in the GAO draft report, such as improved rule implementation, feedback mechanisms, and performance metrics.

Upon review of the draft report, the Department concurs with the seven recommendations and will provide a detailed response to the recommendations within 180 days of the final report's issuance. We appreciate the opportunity to respond to the GAO's draft report. Please contact Madeline Chulumovich, Audit Relations and Program Improvement, at (202) 366-6512 with any questions.

Sincerely,

Keith Washington
Deputy Assistant Secretary for Administration

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

Heather Krause, (202) 512-2834 or krauseh@gao.gov

Staff Acknowledgments

In addition to the contact named above, Heather MacLeod (Assistant Director); Crystal Huggins (Analyst-in-Charge); Amy Abramowitz; Melissa Bodeau; David Hooper; Ethan Levy; Michael Mgebroff; Danielle Novak; Josh Ormond; Madhav Panwar; and Rachel Stoiko made key contributions to this report.

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