CS23-5/PART 23-64

IMPLEMENTATION FEEDBACK AND RECOMMENDATIONS

Preface

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Questions on interpretation and proposed changes to this publication (including requests to provide additional clarification or scenarios) should be submitted to General Aviation Manufacturers Association, Suite 801, 1400 K Street, N.W., Washington, D.C. 20005 or emailed to comments@gama.aero.

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1.0 Executive Summary

This paper provides feedback and recommendations based on the experiences from both industry and authorities using the new rules from EASA in CS-23 Amendment 5 and FAA in Part 23 Amendment 64 (referred to as CS-23-5/Part 23-64), and from the use of industry consensus standards. Since it is still early in the implementation and use of the new rules, this paper reflects the experience to date.

The new rule language is performance-based, defining the desired safety outcome for certification of normal category airplanes, but the rules do not specify how to meet that safety outcome. The intent of performance-based rules is to provide greater flexibility in meeting the rule and allow safety improvements to be more easily and quickly accepted. This performance-based approach is different from the traditional use of prescriptive rules in the previous amendments that provided a narrower and +limited description of what was required to produce a compliant product. In many cases, the prescriptive requirements in the previous rules included what had to be done and how to do it; and only applied to a specific technology, resulting in a bias towards continued use of old technology.

Many of the CS-23-4/Part 23-63 requirements were based on 60-year-old technology and the use of new technology required the issuance of special conditions that could take 6 months to years to complete. For example, the first part 23 jet was certified in 1963 but it was not until 2012, 49 years later, that rules were published that included part 23 jets. In the meantime, part 23 jets had to be certified using special conditions. Issuance of special conditions involves a significant time and manpower commitment for the authorities and the industry and can delay the completion of a project. This approach was incompatible with the increasing pace of new technology, making it more challenging to certify new technology that could significantly improve safety.

Performance-based rules address the problems associated with prescriptive rules, allowing the use of means of compliance (MOC) for showing compliance to the rules. These MOC contain the prescriptive language needed to comply with the new rules and most MOC started with the language from the previous rules, CS-23-4/Part 23-63. ASTM was selected, and general aviation aircraft standards have been developed as MOC, using the prior amendment rules from Part 23, CS-23, and CS-VLA. While most standards started with the language that is in the previous rules, the language may have already evolved to address new technology and the safety continuum. To comply with §23.2010, an applicant can use any of the following MOC options;

- Authority-accepted industry standards
- The previous version of the rules (with exceptions)
- They can propose their own MOC based on their understanding of the rule's safety intent.
- They can propose a combination of the three options

The benefits of the new rule and MOC format allows faster adoption of new technology into small aircraft, resulting in safety improvements and potentially reduced certification costs. But this new rule format requires a slightly different certification process and, as with most change, this new process created challenges. As experience with the new rules and MOC evolves, and industry and the authority participants gain a better understanding of how to use these, the benefits of the new rules can also be used to introduce new aircraft and technologies faster and more efficiently. An example might be seen in EASA's SC-VTOL developed for new VTOL aircraft.

This paper offers recommendations intended to address the implementation challenges associated with introducing performance-based rules. A summary of the recommendations are provided here, with the

full explanation and associated rationale provided in Section 3. The topics are organized in order of priority (1 highest – 7 lowest), while the recommendations within a topic (e.g. SACC REC 3.1-1 – SACC REC 3.1-5.) are presented in the order they are discussed within their respective sections, and do not reflect a priority order.

1. Training and Education (Section 3.1)

SACC REC 3.1-1. Recommend that there is ongoing communications about changes to each ASTM standard. This effort is needed to keep engineers up to date with the standards allowing for typical personnel movements within and across organizations.

SACC REC 3.1-2. Encourage the legal organizations within authorities to allow specialists to participate in consensus bodies, including voting and commenting, especially allowing negative votes, where this is applicable. Authority engagement is critical for the standards working groups so that they know when and where an authority is going to accept, or not accept, a standard, and rationale why.

SACC REC 3.1-3. Per 23.2010(a), it should be emphasized that that the ASTM standards are not a regulation, but MOC. Furthermore, application of 23.2010(b) should not involve substantial use of processes such as use of certification review items (CRIs) or issue papers but should preferably take place in the normal course of determining the MOC during the early stages of the certification process and encourage development of consensus standards to replace the need for CRIs or issue papers.

SACC REC 3.1-4. FAA and industry leverage lessons learned during work on the initial programs to create more formal training. Development of this formal training needs to include industry, authority specialists, and designees, and it should include a stand-alone document to explain how to use performance-based rules in certification and validation that is applicable to all civil aviation authorities (CAAs). As part of the education effort, webinars from both authorities and industry should be used to explain the ASTM and other standards processes. The training and webinars might go beyond just performance-based rule and MOC processes to include periodic webinars that inform certification engineers of updates to the policy and standards. The committee recognized and commended both the FAA and EASA for starting virtual training for their compliance specialists and managers. We recommend however, that the authorities include industry in this training for consistency. Furthermore, this guidance could be referenced in the updated FAA-Industry Certification Process Guide (CPG) and a corresponding EASA/Industry document.

SACC REC 3.1-5. Authorities should review and provide guidance and training on the use of the Changed Product Rule (FAA 14 CFR Part 21.101 and EASA Part 21.A.101) as it relates to the new CS-23/Part 23 rules, addressing both TC and STC applications.

2. Understanding Industry Standards as Accepted Means of Compliance Concept (Section 3.2)

SACC REC 3.2-1. For the MOC to CS23-5/Part 23-64, the F44 standards document organization should be studied so that the most effective approach from the different types of ASTM standards[1] are used. The different disciplines under F44 are trying slightly different approaches

[1] https://www.astm.org/COMMIT/TEMPLATES/lead_template.htm

to their standards organization. Now that the initial work to capture the old prescriptive rules is done, the F44 committee should consider ways to streamline the organization of the standards such that there is a logical, clearer association between the new rules and the industry standards.

SACC REC 3.2-2. Encourage the ASTM F44 committee to evolve the standards towards more intuitive link to the CS-23/Part 23 rules.

SACC REC 3.2-3. A master cross-reference mapping needs to be developed that maps the specific ASTM F44 and other relevant standards sections to the new rule paragraphs. The master cross-reference mapping should track changes in the ASTM documents which might help with numbering changes and associated references. This mapping effort can leverage the annexes currently being introduced by ASTM F44 to ensure a consistent mapping.

SACC REC 3.2-4. Encourage participation in the standards efforts for both industry and authorities. This participation is crucial for standards development and evolution on existing airplanes and to address new technologies and should include certification specialists from both industry and the authorities.

SACC REC 3.2.5. Encourage participation in the standards efforts for both industry and authorities to develop new MOC appropriate for new and innovative designs in parallel to the existing MOC that is primarily based on previous Part 23/CS-23 regulations. In doing so, it is essential that applicants can continue to use existing MOC as long as it is reaching the acceptable level of safety.

SACC REC 3.2-6. In addition to the cross-reference mapping new rules to F44 Standards sections, mapping the old rule language to the new rules is needed because amended TC and STC projects use the older rules as airworthiness MOC. This mapping is needed to get the benefits of the new rules for existing airframes, including CS23-5/Part 23-64 and could leverage the cross-reference table in the Part 23-64 NPRM. For existing Approved Model List (AML) STCs that were originally approved to an older certification basis such as Amdt 63, this mapping would provide an easy means to increase the certification basis to Amdt 64 so that new production aircraft could be added to the AML. This mapping may also be necessary for validations where validating countries have not yet adopted performance-based rules.

3. Level of Detail Required in the Compliance Plan (Section 3.3)

SACC REC 3.3-1. Authorities need to agree on and provide suitable guidance on what the appropriate depth, level of detail, presentation/organization of MOC for showing compliance with 23.2010 and for mixed certification basis in STCs. The SACC recognizes there are efforts underway with the authorities that will address this.

SACC REC 3.3-2. Provide guidance for better understanding between means of compliance and methods of compliance. Historically, these terms have been used interchangeably and are addressed in the FAA Order 8110.4 which creates confusion because the new rule has a slightly different description of the term “means of compliance” as discussed in AC 23.2010.

SACC REC 3.3-3. The Authorities should provide education for both their specialists and industry on the process flexibility for using standards that have been approved by the standards development organization but not formally accepted yet by the authorities. An applicant may request a CAA to consider accepting such a standard.

SACC REC 3.3-4. Authorities need to identify a way to publicly make information known in situations where it may not be obvious that installed equipment was required for certification, such as the points-based system approach used by F3180. This information should be sufficient so that modifiers and regulators can ensure the aircraft remains compliant after modification.

4. Harmonization (Section 3.4)

SACC REC 3.4-1. Work should continue at the regulatory level to resolve specific non-harmonized areas that cannot be addressed at the MOC level.

SACC REC 3.4-2. Leverage the Certification Management Team (CMT) to elevate the harmonization issue across authorities. The CMT should recommend all authorities work to accept the ASTM F44 industry consensus standards such that validation efficiencies can be achieved with the new rules, even where the rules are not completely harmonized. The goal needs to focus on changes that allow authorities to accept internationally accepted MOC to simplify validations in our global markets.

SACC REC 3.4-3 Authorities that have not yet published equivalent rule language to Part 23-64 / CS-23-5, do so as soon as possible. Furthermore, encourage increased participation from other regulators on the development of ASTM F44 MOC. As part of that effort, it is recommended that these authorities accept the same revisions of the ASTM standards accepted by FAA and EASA.

SACC REC 3.4-4. Provide examples of projects and advantages obtained from the use of industry consensus standards to other CAA. Possibly, a workshop should be created to discuss concerns of CAAs and identify possible solutions.

5. Process Improvement and Clarification for Changed Product Rule Applications (Section 3.5)

SACC REC 3.5-1. Authority guidance needs to be developed and published in the Performance-Based Rules Guidance recommended previously, to address situations where the weight and propulsion divisions from the previous rule have changed to occupant risk and performance divisions. Guidance should include situations involving gross weight increases and highlighting where using either the old rule or new rule is beneficial.

6. Implementation of the Safety Continuum Within the Means of Compliance (Section 3.6)

SACC REC 3.6-1. Industry and authorities should develop guidance explaining how to apply the safety continuum across the wide range of airplanes that fall within CS-23/Part 23. This will allow for more resolution in the MOC and can be addressed within F44 standards development. The safety continuum concept isn't well understood or consistently implemented outside of targeted guidance like AC 23.1309. Industry and authorities can benefit from a formal guidance document that addresses the multi-variable approaches appropriate for applying the safety continuum.

7. Forms and Processes (Section 3.7)

SACC REC 3.7-1. The FAA should consider rescinding the Policy Memo, AIR-600-17-6FO-PM01, and changing the requirement in Order 8110.37F as it is redundant and is no value added with the accepted MOC under the project number.

2.0 Background

The type certification process for all aircraft has essentially been the same for more than half a century. The slow change in engine, flight control, and systems technology in small aircraft meant that aircraft configurations were limited and equipment capabilities essentially consistent. Around the turn of the century, year 2000, a consumer digital electronics revolution started to benefit general aviation. The cost of complex sensors and electronics, once only affordable in transport and military aircraft, dropped to the point that general aviation became a potential application and platform for new developments; and aircraft manufacturers and suppliers could begin incorporating this technology in small aircraft. Historically, technology drifted down slowly from transport and military aviation; two decades into the new century, technology is migrating up from drones and experimental aircraft into normal category aircraft.

For civil aircraft, the regulatory process to allow new technology was slow, cumbersome, and costly, and requiring special conditions and/or issue papers to develop the certification requirements. It isn't unusual for special conditions and/or issue papers to take six months to two years to be issued. This lengthy and costly certification process favored incorporating new technology into transport airplanes where the added cost was not as significant a part of the certification cost and the 5-year time frame to complete certification on transport airplanes could accommodate the delays in getting the certification requirements established. While it still took time for rule changes to add new technology, transport rules had priority for the limited FAA resources to make these rule changes. Helicopter and small airplane rules lacked the priority for rule changes to keep up with technology. A moderate rule change for small airplanes frequently took 7 to 9 years. At the same time, technology for small airplanes was changing faster than any other certified market segment. Moreover, most of the new technology available or in development could address critical safety issues related to small airplane accidents. Combining this with the breakthroughs in electronics and flight controls made it clear to EASA and the FAA that a new approach that would allow for a faster incorporation of new technology in the rules was needed.

In 2009, an Aviation Rulemaking Committee (ARC) was formed to develop a new approach to the Part 23/CS-23 rules that would allow for faster incorporation of new technology in aircraft and certifying that new technology, without relying on a slow, cumbersome rulemaking process. Several approaches were considered, but the final ARC recommendation was that EASA and the FAA revise both rule documents to be performance-based. Instead of containing prescriptive design requirements, they would identify the safety intent and desired outcome an applicant would have to meet. The goal of revising the rule language to top-level safety intent or outcomes was to enable the rules to have more flexibility to allow for new technology without the need for rulemaking. The one downside with this approach is that the prescriptive pass/fail criteria that were historically, but not always, in the rule, were moved into means of compliance. This is a significant paradigm shift that many people have had difficulty grasping and determining what previous prescriptive requirements should be used as the means of compliance to a new rule paragraph because there is no clear linkage between the old rules and the new rules except as defined in the Old to New Cross Reference table in the Notice of Proposed Rulemaking (NPRM).

One of the desired benefits of adopting a performance-based rule approach was to make it easier to use alternative approaches for new technology to show compliance. Furthermore, use of the new CS-23/Part 23 going forward will address a wide variety of aircraft and allow for multiple approaches to the rule, not only allowing for new technology, but also allowing the authorities to apply the safety continuum concept where appropriate for normal category aircraft.

Part 21 for both EASA and the FAA requires that an applicant "show" compliance with the rule and the authority "finds" compliance with the applicant's showing. In showing compliance under the previous CS-23/Part 23, the prescriptive requirements were usually contained in the rule. This constraint is no longer true for the new rules and it is up to the applicant, working with the authority, to determine the means of compliance (MOC) to the rule. While the applicant has always had to determine a means of compliance to a rule and get that accepted by the authority, determining the MOC to a CS-23-5/Part 23-64 rule is more complex for the applicant to define the design specific details for the compliance showing process.

Since prescriptive criteria are still needed for compliance showing and compliance findings, FAA and EASA added a new rule, 23.2010, to their respective parts that requires the applicant use or define a means of compliance that needs to be accepted by the authority. An applicant, to comply with 23.2010, can use any of the following MOC;

- Authority-accepted industry standards,
- The previous version of the rules (with exceptions), or
- Can propose their own MOC based on their understanding of the rule's safety intent.
- The applicant also has the option of proposing a combination of the three.

The need for MOC to accompany the rules would be a problem if there weren't MOC options already available. These MOC approaches currently available are described as follows:

a. *ASTM F44.* During the rulemaking effort, there was a parallel effort to create a new set of industry consensus standards under ASTM F44 Committee for General Aviation Aircraft. This new set of industry consensus standards essentially moved and combined the existing Part 23-63, CS-23-4, and CS-VLA prescriptive language into a set of draft set of industry consensus standards.

b. *CS-23-4/Part 23-63*. Additionally, both authorities in their respective new rule preamble defined the previous amendment rule language to be accepted as MOC, except for two areas: low speed handling characteristics and icing. The rule change intended to maintain the existing level of safety in the previous rule except in those two areas. The level of safety was increased in these areas because the high number of accidents warranted it. This fact is important to understand because the level of safety required under any part can only be increased through a public process such as rulemaking.

c. The applicant can also propose their own MOC that is different from either of the two previously mentioned methods. For instance, this applicant-based MOC will be necessary for new technology since there probably will not be existing requirements. It will be the applicant's responsibility to make the proposal and justify how their proposed MOC satisfy the performance-based rule requirements. The authority specialists will need time to review and understand the proposed MOC.

Summarizing, this means that the applicant and authority must go through a MOC acceptance process on each rule to define:

- What Standards are going to be used, if any;
- What previous rule is going to be used, if any;
- What applicant-defined MOC will be used, if any; or

- A combination of the above.

The difficulty being experienced is that there is no direct correlation between the new rules and either the previous rules or the standards that either the applicant or the authority can rely on. So, a lot of time and effort is expended by both organizations in attempts to make that correlation and thus have a prescriptive MOC.

This paper comprises two main sections, the first, Section 3, identifies challenges to implementing the new rules based on member experience, and makes recommendations to address them. The second section, Section 4, highlights what's working well and offers support in these areas.

3.0 Challenges

Applicants and authority specialists alike have experienced frustration using the new performance-based rules and determining means of compliance. Several factors have been identified that have created difficulties for both applicants and authorities. First, there is a lack of understanding and general discomfort with the industry standards process, which differs significantly from the authorities' process for previous changes to the design standards. Second, the process for establishing alternative MOC is unclear. Third, there is confusion with how Means vs. Methods of Compliance are defined within the performance-based rules. Finally, there is a lack of understanding on the use of the Changed Product Rule (CPR) within the performance-based rules framework. The following sections expand on the sources of frustration with the new rules and provides recommendations for applicants, authorities, and the ASTM F44 committee.

3.1 Training and Education

There is a lack of understanding of the development and amendment process used by ASTM for the Standard Specification for Normal Category Aeroplanes Certification, the preferred MOC for the new performance-based rules. Neither the ASTM committee nor the authorities provide an accepted mapping between the ASTM standards and the performance-based rules. This has led to confusion and disagreements on which MOC are intended for a given rule. While the standards were initially based on the Part 23-63, CS-23-4, and CS-VLA language, many have since evolved. Since many of the authority specialists do not participate in ASTM activities, they are not able to follow the evolution of the standard because the rationale for changes to the ASTM Standards may not be as thoroughly documented as occurs with changes to the rules. The changes and rationale for changes to ASTM Standards are documented in the Revision appendices and are available with each Standard.

Furthermore, the authority specialists involved in a project may not have the same background information about the standards that the policy branch staff has. They typically don't participate in the conversations that happen within the ASTM committees concerning the changes and additions. Accordingly, they often don't benefit from understanding what's in the Standard and its intent. For example, while the standards were based on the previous rule language, many have evolved. Since not all specialists have participated in ASTM activities, they have not kept up with the Standard's evolution. Even with policy branch staff acceptance, the language differences from the old rule create challenges because the authority specialists want to see the link to the old rule to make sure that they have not lost anything. Rationale for changes in ASTM need to be very clear and conveyed to authority specialists so

everyone understands why the language is changing from the old rule language they are used to. Many of the F44 revisions are adding alternatives and clarifying language instead of increasing the requirements. This situation, combined with the less thoroughly documented rationale, has made it difficult for authority specialists to ensure that the intent of the rule has not been lost.

The industry standards incorporate all common special conditions, exemptions, limitations, and even some Advisory Circular material. They are also fixing problems and trying to clarify language. As the standards continue to evolve, the traceability between a previous regulation, special condition, exemption, limitation, and a corresponding ASTM standard may become an apple-to-oranges comparison. This is of particular concern for changes to older airplane types. In many cases, the revisions are adding alternative MOC and clarifying language instead of increasing or reducing the certification burden or level of safety. Adding the rationale for changes to the MOC will be important for all parties to understand why the language may not match the original CS-23-4/Part 23-63 language, especially for modifications to older airplanes.

> **SACC REC 3.1-1.** Recommend that there are ongoing communications about changes to each ASTM standard. This effort is needed to keep engineers up to date with the standards allowing for typical personnel movements within and across organizations.

There is skepticism about the ASTM organization itself, including the misconception that the ASTM, like some other standards organizations, is US-focused. The ASTM F44 committee is an international organization that has representatives from many international civil aviation authorities including the U.S., Europe, Canada, Brazil, China, Australia, and New Zealand. These authority representatives participate in the F44 subcommittees and provide input into the Standards development. The ASTM F44 committee alternates between meetings in Europe and the US, having one meeting in each location each year. Also, some people may not realize that some Authorities “abstain” in ASTM voting because of legal issues within their organization and the concern that voting “positives” could give the perception that they officially accept the standard, which may not be completely true for numerous reasons. This lack of participation during the balloting does not mean that the Authorities do not support the ASTM standards, it’s just part of the process.

> **SACC REC 3.1-2.** Encourage the legal organizations within authorities to allow specialists to participate in consensus bodies, including voting and commenting, especially allowing negative votes, where this is applicable. Authority engagement is critical for the standards working groups so that they know when and where an authority is going to accept, or not accept, a standard, and rationale why.

The process for establishing alternative MOC that have not been accepted by authorities is unclear. The only guidance currently available is AC 23.2010 and CS-23 AMC&GM GM1/2 23.2010. The guidance makes vague references to use of MOC corresponding to earlier amendments of CS-23/Part 23. However, the criteria for determining that an MOC is "adequate" is lacking because it lacks guidance. The default regulatory position has been to follow the latest MOC, which would provide the most up-to-date and flexible options in the case of ASTM standards. The option for alternative MOC can add confusion to the process and needs to be included in any training and guidance developed.

Under the new rules, there may be several possible approaches for MOC on projects. The ASTM standards should not be regarded as the sole MOC with the rule. If an alternate approach is proposed, it should be evaluated under its own merit for compliance to the rule and should not require demonstration of equivalence to existing MOC. Part 23/CS-23 allows using previous amendments, or

other standards applicable to the type of aircraft under consideration, such as CS-VLA, except in the rules where the safety intent has been increased, namely flight into known icing and low speed handling characteristics. Instead, the adequacy of the proposed means of compliance should be examined vs. the rule, i.e., the FAR/CS-23.xxxx section(s) it is meant to demonstrate compliance to.[2]

> **SACC REC 3.1-3.** Per 23.2010(a), it should be emphasized that that the ASTM standards are not a regulation, but MOC. Furthermore, application of 23.2010(b) should not involve substantial use of processes such as use of CRIs or issue papers but should preferably take place in the normal course of determining the MOC during the early stages of the certification process and encourage development of consensus standards to replace the need for CRIs or special condition.

The problems identified above are where additional authority/industry training that is accessible, such as online training, would be beneficial. Furthermore, understanding the process for establishing an applicant-developed or applicant-proposed MOC relative to the new rule needs to be extended to both industry and authority certification engineers.

There has been a lot of confusion between means of compliance verses methods of compliance. Referring to prescriptive standards as MOC to performance-based rules has expanded the previously established definition. AC 23.2010 attempts to define a distinction between means and methods of compliance. However, these terms have been used interchangeably for decades and in some respects, the guidance has added to the confusion. Order 8110.4, defines a Means of Compliance as “ground test, flight test, analysis, similarity or other acceptable means.”

In contrast, Methods of Compliance are defined as the specific test planning, analysis methodology, or inspection criteria that are used in the showing of compliance. It may be beneficial to provide clear definitions of these terms. Since Order 8110.4 has been the primary guidance for decades and certification specialist are familiar with it, the committee’s recommendation is to default to the original 8110.4 guidance.

> **SACC REC 3.1-4.** FAA and industry leverage lessons learned during work on the initial programs to create more formal training. Development of this formal training needs to include industry, authority specialists, and designees, and it should include a stand-alone document to explain how to use performance-based rules in certification and validation that is applicable to all CAAs. As part of the education effort, webinars from both authorities and industry should be used to explain the ASTM and other standards processes. The training and webinars might go beyond just performance-based rule and MOC processes to include periodic webinars that inform certification engineers of updates to the policy and standards. The committee recognized and commended both the FAA and EASA for starting virtual training for their compliance specialists and managers. We recommend however, that the authorities include industry in this training for consistency. Furthermore, this guidance could be referenced in the updated FAA-Industry Certification Process Guide (CPG) and a corresponding EASA/Industry document.

Another source of confusion is determining when the performance-based rules should be used. This is a particularly relevant issue for amended TCs or STCs for example. The new rules have been perceived as

[2] This trend seems to be similar to what occurred in 2015-2017, when GAMA raised concerns regarding SAE Aerospace Recommended Practices (ARPs) being used as « the de facto means of compliance with regulation » (refer GAMA 17-13 letter)

unique and authorities have taken different approaches for modification projects. The initial round of Authority training highlighted that in some cases using the existing certification basis for an amended TC or STC or allowing the use of select older versions of the rule for a new project may be desirable for administrative efficiency and safety, but only in unique situations. The use of the Changed Product Rule (CPR) or 14 CFR Part 21.101/CS 21.A.101 as it relates to the new rule is not clearly understood. There needs to be a better understanding within the FAA and other authorities that face similar issues, and additional training for authorities and industry should be provided.

> **SACC REC 3.1-5.** Authorities should review and provide guidance and training on the use of the Changed Product Rule (FAA 14 CFR Part 21.101 and EASA Part 21.A.101) as it relates to the new rule, amended TC, STC and amended STC applications.

Finally, EASA and the FAA have started training within their respective organizations, which is appreciated. This committee would like to recognize, support, and encourage the authorities to not only continue this effort and expand this to include industry and designees.

3.2 Understanding Industry Standards as Accepted Means of Compliance Concept

One of the challenges that applicants and authority specialists have experienced with the new rules and consensus standards is that there is no clear logical connection or explicit mapping from the new rule wording to the consensus standards that can be used to develop means of compliance needed to show compliance quickly. To understand this issue and its resolution's complexity, it is essential to understand how these consensus standards were developed and why.

In regulation 23.2010(a), the FAA and EASA allowed for previously accepted industry consensus standards to be used as a means of compliance to CS23-5/Part 23-64. After evaluating the various Standards Development Organizations, ASTM was selected by the industry for several reasons:

- The committee utilizes limited in-person meetings and relies on virtual meetings to develop, discuss, and reach consensus on standards content,
- International industry and authority presence and involvement,
- Reasonable cost for membership with access to published standards, and
- Experience developing and maintaining whole airplane standards with the Light-Sport Aircraft (LSA) standards.

Work with ASTM and the creation of the F44 Committee began immediately after the submittal of the ARAC report to the FAA. Since the new rule wording was not yet available, ASTM F44 had to devise how to begin the standard development activity. The F44 Committee elected to create subcommittees aligned essentially with the rule subparts as follows:

- Subpart B – Flight ---------- F44.20 Flight Subcommittee
- Subpart C – Structures ---------- F44.30 Structures Subcommittee
- Subpart D – Design and Construction --- F44.50 Systems Subcommittee
- Subpart E – Powerplant ---------- F44.40 Powerplant Subcommittee
- Subpart F – Equipment ---------- F44.50 Systems Subcommittee

- Subpart G – Flight Crew Interface -------- F44.10 General Subcommittee (includes separate Icing Task Group)

Although these Subcommittees are aligned with the rule subparts, most are also organized and staffed in a more discipline-oriented manner to make the committees' creation and organization more cohesive.

In the transition from the old prescriptive rules to the new performance-based rules, the decision was made to maintain the current level of safety from the old rules except in two specific areas; low-speed characteristics and icing. The decision followed that the accident rate, except in those two areas, was acceptable. By maintaining the current level of safety ASTM F44 was able to basically copy and paste each rule from CS-23 Amendment 4, Part 23 Amendment 23-63, and CS-VLA and assign them to various subcommittees for inclusion in the initial draft standards. For the two exception areas, low-speed characteristics and icing, the FAA and EASA decided that the level of safety needed to be increased from the previous rule amendments. Accident rates in these areas justified the increase the safety level, which was addressed in the NPRM and Notice of Proposed Amendment (NPA) preambles.

The alignment of the rules to the ASTM F44 standards started out logically, but several factors complicated the traceability between the new rules and the new consensus standard wording:

- To ensure that a version of the standards existed to support the NPRM/NPA process, the F44 subcommittees had to begin the task of correcting and clarifying the old rule language immediately after submittal of the ARAC report to the FAA.
- Many early decisions on how to organize these new standards were made without knowing how the FAA and EASA would organize the new rules. Assumptions on organization were made based on the recommendations provided in the ARAC report.
- As the FAA rulemaking process moved into ex parte, the FAA was legally unable to share their developing rule language. This lack of communication between industry and FAA meant that the F44 subcommittees and EASA had to move forward, assuming that the FAA's rule language would be harmonized with EASA's proposed rule language. But the FAA's rule language, while close, was not completely harmonized with EASA's language. The non-harmonized areas created even more confusion in aligning the industry standards (MOC) with the new rules.
- ASTM document requirements and processes meant that the new standards could not use or publish references to old regulation numbers. Also, because the standards are international and not just FAA and EASA, they cannot directly reference the FAA and EASA new rules.
- Most of the subcommittees elected to use smaller documents that applied to specific requirements, or similar requirements, rather than large documents that covered multiple requirements in order to get standards written and approved quicker, as well as faster approval of changes.
- Because of how the committees were organized, the standards are generally organized by engineering discipline, while the rules are organized by subject. The standards were organized by discipline because it's necessary to have all of the subject matter experts focused within their area of expertise. This is the most efficient way for committee members to participate in standards development. Since the organization between the standards and the rules are different, it complicates the traceability between the standards and the rules.

- As previously noted, the standards are generally organized by engineering discipline, while the rules are typically organized by subject. For some rules, a single discipline may provide all the input necessary for the development of a standard. However, doing this can complicate the traceability between the rules and the standards when a rule is applicable to multiple disciplines and only one discipline writes the standard around their application. For some rules, multiple disciplines may need to be involved with the same standard to ensure that it will address the broader application of the standard.
    - For instance, the Flight rules in Subpart B are nearly all related to the flight disciplines, so there is little, if any, need for other disciplines to participate in the development of the flight standards for traditional aircraft.
    - While others, such as Subpart C, 23.2265 Special Factors of Safety, could require input from multiple engineering disciplines, including airframe structures, interior structures, and mechanical systems. These standards could require disciplines to work together to create a standard acceptable standard to all disciplines.
- Because of how the rules are organized and how the committees are staffed, this can also potentially result in one MOC associated with a rule being defined differently in another discipline's standards.

SACC REC 3.2-1. For the MOC to CS23-5/Part 23-64, the F44 standards document organization should be studied so that the most effective approach from the different types of ASTM standards[3] are used. The different disciplines under F44 are trying slightly different approaches to their standards organization. Now that the initial work to capture the old prescriptive rules is done, the F44 committee should consider ways to streamline the organization of the standards such that there is a logical, clearer association between the new rules and the industry standards.

ASTM F44 committee created a Top-Level Standard (TLS), F3264, that combines all the specification documents in F44 and identifies the standards that F44 believes are related to specific rule at the highest paragraph level and are ready for regulator acceptance. The TLS provides a high-level mapping of these standards to the rules. The TLS intended to provide a means for the authorities to efficiently accept the F44 standards. However, the TLS was not created at a level that could be used to build a detailed compliance matrix and was never intended to do so. As the standards are currently written, the resolution of the mapping between the TLS and the rules is not sufficiently detailed to provide the desired mapping; however, some standards are being reorganized so that the TLS could provide all the linkage from the rule to the Standard that is needed at a sufficient level, and a separate cross-reference table would not be needed.

SACC REC 3.1-2. Encourage the ASTM F44 committee to evolve the standards towards more intuitive link to the CS-23/Part 23 rules.

From a legal perspective, it's important to note that applicants "show" compliance and regulators "find" compliance. When a regulator makes a finding of compliance, that is an approval that is only allowed legally at the regulation level, not at the means of compliance level. For applicants to develop a certification plan that allows a finding of compliance to be made at the regulation level, the MOC must be identified for those rules at a level of detail necessary for the regulator to make the finding. Authority

[3] https://www.astm.org/COMMIT/TEMPLATES/lead_template.htm

specialists and applicants have attempted to map the objective rules and the standards for each project. These efforts resulted in mappings that frequently differed from each other, Authority specialists and from applicant to applicant. Not only is a mapping between the Standards and the rules required, but it needs to be done in a manner that can be accepted by all authorities. ASTM F44 has started adding an annex to each standard that maps the standard text to the regulation paragraphs. Currently this mapping is planned for both CS-23 Amdt 5 and Part 23 Amdt 64. By including this mapping in the Standard, it is hoped that regulator acceptance of the mapping will occur as part of the Standard acceptance process.

> **SACC REC 3.2-3.** A master cross-reference mapping needs to be developed that maps the new rule paragraph to the specific ASTM F44 and other relevant standards sections. The cross-reference mapping should track changes in the ASTM documents which might help with numbering changes and associated references. This mapping effort can leverage the annexes currently being introduced by ASTM F44 to ensure a consistent mapping.
>
> **SACC REC 3.2-4.** Encourage participation in the standards efforts for both industry and authorities. This participation is crucial for standards development and evolution on existing airplanes and to address new technologies and should include certification specialists from both industry and the authorities.
>
> **SACC REC 3.2.5.** Encourage participation in the standards efforts for both industry and authorities to develop new MOC appropriate for new and innovative designs in parallel to the existing MOC that is primarily based on previous Part 23/CS-23 regulations. In doing so, it is essential that applicants can continue to use existing MOC as long as it is reaching the acceptable level of safety.

A similar situation exists to a lesser extent in the retrofit arena. To date, few modifications to existing aircraft have stepped up to CS-23-5/Part 23-64 except in a few areas such as HIRF/Lightning and system safety. There is limited benefit currently to stepping up from the existing certification basis in the other areas. Some avionics STC holders are already being asked by new aircraft applicants to step up the certification basis of their STCs to allow them to be applicable to new airplanes certified to the new rules. While the FAA's NPRM and the EASA's NPA did include a mapping of the old rules to the new objective rules, they are inconsistent and not always mapped at the level that would easily allow the use of compliance data created for CS-23 Amdt 4/Part 23 Amdt 23-63 to be used to meet the new rules. For this reason, an additional mapping effort from the old rule to the new rule would be helpful.

> **SACC REC 3.2-6.** After the cross-reference mapping new rules to F44 Standards sections, there needs to be a second effort to map the old rule language to the new rules because amended TC and STC projects use the older rules as MOC, and this mapping is needed to get the benefits of the new rules for existing airframes, including CS23-5/Part 23-64. For existing AML STCs that were originally approved to an older certification basis such as Amdt 63, this mapping would provide an easy means to increase the certification basis to Amdt 64 so that new production aircraft could be added to the AML. This mapping may also be necessary for validations where validating countries have not yet adopted performance-based rules.

3.3 Level of Detail Required in the Compliance Plan

There is no consensus within the authorities yet on the depth or level of detail needed for a certification plan or compliance matrix to be acceptable under 23.2010. Its new to most certification/compliance engineers too, including some Policy Branches, so they do not feel comfortable until they see the mapping down to a level within the MOC standards that looks like the wording from the previous prescriptive rule amendment or compliance checklist. This mapping can result in a very large compliance matrix that can be a much larger task to prepare than traditional certification plans, more complex to obtain concurrence, and provides more opportunity for error. In this way the starting point seems to be the familiar "old" rule text, which is generally found in the ASTM standards. Authorities working with industry should provide a compliance matrix guidance to aid in developing the certification plan.

The depth of the compliance matrix mapping between the rules and the standards should only be as deep as necessary to understand that compliance will be shown. Since there is a lack of familiarity of the new standards, regulators are pressing for compliance matrices to be mapped at an extremely detailed level. The absence of an accepted mapping between the rules and the standards complicates this further. Additionally, the expectations for the appropriate level of detail varies between individuals within the authorities and there is not one accepted level of detail.

The challenges associated with the language in ASTM F44 and the level of detail needed for MOC, impact the time it takes to get an agreement on the compliance plan. If an agreed mapping existed that defined which standards or sections thereof, can be used to show compliance for each regulation, the level of detail in the certification plan would naturally be established at the level of that mapping. Due to inexperience and mistrust of the ASTM standards, some authority specialists have spent time dissecting the proposed standards to ensure all the requirements they are used to have been addressed. If the consensus standard has been previously accepted by the authority and the mapping of that standard to the rule has been agreed, then no further review should be required by the authority specialist other than to ensure that the standard is in fact applicable to the project.

The compliance plan may not be accepted if there is a lack of understanding at the authority specialist level about the use of more recent revisions of ASTM standards that have not (yet) been formally accepted by the authority. The authorities can accept a manufacturer proposed MOC using standards, if those standards have been approved by the standards organization even if the authority has not formally accepted the standard yet. If it is authority accepted, a review for applicability is performed and once acknowledged as applicable no further review of the content is required. However, many authority specialists do not understand this process, so they have been asking for more detail and justification be included in the certification plans, or simply taking much longer to approve them. Part of the reason for this could be that the use of newly developed industry standards will take time to determine if they establish a proper level of safety and so the authorities want to work several projects before formally accepting a specific standard.

> **SACC REC 3.3-1.** Authorities need to agree on and provide suitable guidance on what the appropriate depth, level of detail, presentation/organization of MOC for showing compliance with 23.2010 and for mixed certification basis in STCs. The SACC recognizes there are efforts underway with the authorities that will address this.
>
> **SACC REC 3.3-2.** Provide guidance for better understanding between means of compliance and methods of compliance. Historically, these terms have been used interchangeably and are

addressed in the FAA Order 8110.4 which creates confusion because the new rule has a slightly different use of the term "means of compliance."

SACC REC 3.2-3. The Authorities should provide education for both their specialists and industry on the process flexibility for using standards that have been approved by the standards development organization but not formally accepted yet by the authorities. An applicant may request a CAA to consider accepting such a standard.

It is important that aircraft certified at amdt 64 / amdt 5 can be maintained and modified as necessary during the lifetime of the aircraft. Some of the new means of compliances introduced in new consensus standards may have inadvertently complicated the ability of a modifier to make design changes to the aircraft without additional information not currently available. For example, ASTM F3180 introduces a points-based approach for certification of low-speed characteristics of Part 23 / CS 23 subpart B rules. This approach includes the ability to take points credit for safety enhancing systems that protect the aircraft in some way during low-speed operations. Such systems include enhanced indications or enhanced envelope protection systems. The issue becomes that post-certification, modifiers will not have the information available to them to know that a particular system was used for credit to meet F3180 and hence Part 23 Subpart B. For example, consider an OEM who takes credit for the enhanced envelope awareness function of an autopilot to meet F3180. Years later, a modifier wants to do an STC to replace this autopilot with a more modern, potentially safety enhancing system. Neither the modifier nor the regulator/designee approving the design change would have any way to easily know that removing the autopilot would also remove the enhanced envelope awareness function that was used for Subpart B compliance. Similar point-based approaches are being considered for other areas such as crashworthiness. It is recommended that the regulators determine a means to publicly provide the information necessary to allow safe and compliant modifications and ensure that inevitable modifications do not inadvertently make an aircraft non-compliant to the regulations. If the modifier is properly informed, then the modification can be designed to ensure compliance is properly maintained.

SACC REC 3.3-4. Authorities need to identify a way to publicly make information known in situations where it may not be obvious that installed equipment was required for certification, such as the points-based system approach used by F3180. This information should be sufficient so that modifiers and regulators can ensure the aircraft remains compliant after modification.

3.4 Harmonization

While the EASA and FAA new rules are very close between CS-23-5 and Part 23-64, some titles and rule language are still different. For most differences, the ASTM standards still meet the requirements of both CS-23 and Part 23 and are thus harmonized. This is one of the distinct advantages of performance-based rules, in that they rely on MOC. And while the best approach is for rule harmonization, harmonization within the ASTM MOC will significantly benefit industry and authorities working on validation projects. Validation agreement is the critical component to the harmonization of the means of compliance. The EASA and the FAA have started developing a process for accepting consensus standards. This is an opportunity going forward, to use an acknowledged procedure for both Airworthiness Authorities that recognizes ASTM Consensus Standards (MOC) to streamline acceptance and use. Furthermore, there are still some regulations where the non-harmonized requirements have

caused difficulty in reaching consensus under the ASTM process. The SSD (Significant Standard Differences) pairing list for Part 23-64 and CS-23-5, published on the FAA website, does not specify exactly the difference between FAA and EASA rules. Efforts to clarify the differences would be helpful until they can be resolved. A good example of this is HIRF and Lightning where the regulations are different and additionally, the FAA has a policy that EASA does not currently accept. Work should continue at the regulatory level to resolve these non-harmonized areas.

> **SACC REC 3.4-1.** Work should continue at the regulatory level to resolve specific non-harmonized areas that cannot be addressed at the MOC level.

Currently, ASTM is developing alternative standards that are only applicable to specific airplanes on the safety continuum and offer more appropriate MOC to be used. These alternative MOC didn't exist prior to the new rule. Harmonization of new ASTM alternatives should promote new technology and safety-enhancing equipment development internationally. These alternate MOC will not be as effective if they cannot be used when the applicant intends to market a product globally. International acceptance of these alternate means would benefit the industry significantly.

There tends to be a focus on the FAA and EASA; however, harmonization within TCCA, ANAC, CAAC, and other authorities is essential in our global market. Many authorities, including TCCA, ANAC, CAAC, New Zealand and Australia CAAs, and others participated in the Part 23 Airworthiness Rulemaking Committee that led the way to FAA and EASA rule changes. Their participation continues to be necessary. There are already STC validations in work that have experienced some challenges because of the absence of an equivalent rule. This will only be more challenging if rule language or certification approaches differ between the authorities. All authorities are encouraged to continue efforts to adopt a new rule language that allows for the use of the same revisions of internationally accepted MOC because this will significantly simplify validations.

> **SACC REC 3.4-2.** Leverage the Certification Management Team (CMT) to elevate the harmonization issue across authorities. The CMT should recommend all authorities work to accept the ASTM F44 industry consensus standards such that validation efficiencies can be achieved with the new rules, even where the rules are not completely harmonized. The goal needs to focus on changes that allow authorities to accept internationally accepted MOC to simplify validations in our global markets.
>
> **SACC REC 3.4-3** Authorities that have not yet published equivalent rule language to Part 23-64 / CS-23-5, do so as soon as possible. Furthermore, encourage increased participation from other regulators on the development of ASTM F44 MOC. As part of that effort, it is recommended that these authorities accept the same revisions of the ASTM standards accepted by FAA and EASA.
>
> **SACC REC 3.4-4.** Provide examples of projects and advantages obtained from the use of industry consensus standards to other CAA. Possibly, a workshop should be created to discuss concerns of CAAs and identify possible solutions.

Most of these other authorities do participate in a more limited fashion in the development of the ASTM means of compliance than the FAA and EASA. However, on occasion the absence of specific authority members within ASTM F44 sub-committees has made it more challenging to address concerns raised by specialists of those authorities.

Finally, ASTM developed a Top-Level Specification (TLS) that aligns rule section level with ASTM F44 standards to make authority acceptance easier. This TLS was arranged using titles because of disharmonies with the rule numbers. The TLS, in some cases, simplifies the challenge of aligning MOC with the rules because there might be multiple rules associated with a single section in the standards. In other cases, the opposite is true, as there are several sections in different standards related to a single rule paragraph. A detailed cross-reference table is currently being developed within each working group responsible for a single ASTM document. Once approved, these cross references will be combined to build a master cross-reference table that aligns new rules with paragraph-level sections in the ASTM F44 documents. It is essential that ASTM continue this effort and that the authorities accept the master cross reference table once it is finalized. A harmonized mapping will benefit both industry and regulators.

3.5 Process Improvement and Clarification for Changed Product Rule Applications

The application of Changed Product Rule (CPR) principles to legacy aircraft that straddle the boundaries of CS23-4/Part 23-63 is uncharted territory. Complex CPR and MOC situations arise involving an airplane that does not change its maximum number of passengers under its legacy type design but increases weight over 12,500 pounds for example. There is no guidance regarding how this situation would correlate to certification level and how it would be applied in CPR. Currently this is expected to be handled at a project level and on a case-by-case basis.

Issues show up in larger CS-23/Part 23 airplanes that create confusion when applying the §21.101 CPR process. These issues are different from using the new rules for modifications on small airplanes, where leveraging the new rule can streamline the installation of safety-enhancing equipment. The CPR issues are a challenge for larger airplanes where the historic 6000 lb. (2725 kg) or the 12,500 lb. (5700 kg) demarcation now uses number of passengers, or performance in what are referred to as “levels.” These CS-23/Part 23 levels were not intended to create new airplane categories, but to define occupant risk levels. Where weight was historically connected to safety levels, the new rules decouple weight from the requirements and MOC. Situations where a weight increase doesn’t change the number of occupants should not change the level of the airplane in the certification requirements.

Conversely, the preamble in the NPRM for FAA’s Part 23 amendment 64 addressed the use of a previous amendment where it makes sense. This can be used when making a case for using (applying) a previous amendment safety requirement instead of the latest amendment. If there is no benefit from the new rule, applicants would be better to use the original certification basis or the CS23-4/Part 23-63 language.

> **SACC REC 3.5-1.** Guidance needs to be developed and published in the Performance-Based Rules Guidance recommended previously, to address situations where the weight and propulsion divisions from the previous rule have changed to occupant risk and performance divisions. Guidance should include situations involving gross weight increases and highlighting where using either the old rule or new rule is beneficial.

3.6 Implementation of the Safety Continuum Within the Means of Compliance

The new rule for normal category airplanes included an increase in the scope by expanding the bottom of CS-23/Part 23 to include EASA’s CS-Very Light Aircraft (VLA). One of the goals for rewriting the rule

was to simplify the step from Light-Sport Aircraft (LSA), VLA, and kit-built airplanes into a type-certified product under CS-23/Part 23. For decades, CS-23/Part 23 added rules to accommodate larger, more complex turbine airplanes to the detriment of simple, entry-level airplanes. One crucial aspect associated with entry-level airplanes is that while LSA, VLA, and kit-built airplanes are typically 1 or 2-place airplanes, the concept of simple, entry-level airplanes realistically can expand into slightly larger 2+1, 2+2, and light four-place airplanes.

As stated above, the intent was to improve or expand the bottom of Part 23/CS-23 to decrease the step from purely recreational (experimental, microlight, and light sport) airplanes into TC'd airplanes. Many of the CS-VLA prescriptive requirements have already been captured in ASTM standards, but these ASTM standards are limited in scope to airplanes with the original CS-VLA stall speed, weight, and other limitations; very simple level 1 airplanes. While this is an appropriate starting point for the ASTM F44 standards, it creates a gap for Level 1 aircraft that exceed the very simple CS-VLA limitations. Additionally, few standards address the needs of airplanes at the bottom end of low-speed, level 2. Level 1 and simple, low-end level 2 airplanes are typically used for training, rentals, flying clubs, and personal use, which is why they remain simple. The Levels were intended to help identify occupant risk and therefore are a good starting point, but the range of airplanes in these levels highlight the need to address the risks across the safety continuum. Fortunately, the new rules are flexible enough to address this issue once there are standards in place that appropriately account for the safety continuum. This could be reinforced with guidance that explains the safety continuum.

Another essential aspect of entry-level airplanes is that when rulemaking started in 2009, electronic displays were still in the process of becoming commonplace in small airplanes. Today, the most basic airplanes are installing electronic displays for primary flight, navigation, and engine instruments. These same electronic instruments are also being retrofitted into a substantial percentage of the existing 2 and 4-place airplane fleets in the U.S. and Europe. For these reasons, it is important to complete development of appropriate MOC for these airplanes and for their acceptance by the authorities.

To that end, MOC are currently being developed as alternatives to the traditional approaches used with the previous amendments to the rule to address these airplanes. Initial efforts are focusing on systems, structures, and crashworthiness. The last amendment of the rule allowed for a de facto safety continuum approach in systems safety. This was found in AC 23.1309. ASTM F44.50 has quickly incorporated this safety continuum into the MOC. Still, the effort needs to expand to other disciplines, as noted above, to encourage manufacturers continued interest to move up into TC'd products.

The US has extensive knowledge and service history of simple metal structures as many of the airplanes in the US fleet are upwards of 60 years old. Furthermore, Europe also has extensive knowledge and service history with simple composite structures. Experience with numerous research efforts going back to the 1960s like Germany's Akaflieg Stuttgart centre developing composite structures for sailplanes and more recently with thousands of microlight and VLA airplanes using composite structures. Service history and engineering criteria should be considered to establish appropriate MOC scoping to support the safety continuum approach.

> **SACC REC 3.6-1.** Guidance needs to be developed explaining how to apply the safety continuum across the wide range of airplanes that fall within CS-23/Part 23. This will allow for more resolution in the MOC and can be addressed within F44 standards development. The safety continuum concept isn't well understood or consistently implemented outside of targeted guidance like AC 23.1309. Industry and authorities can benefit from a formal guidance

document that addresses the multi-variable approaches appropriate for applying the safety continuum.

3.7 Forms and Processes

3.7.1 FAA specific issues

FAA Policy Memo AIR-600-17-6F0-PM01 was issued in 2017 for ODAs. In parallel, FAA Order 8110.37F was issued in 2017 for DERs. Both FAA papers contain a new requirement on designees related to Part 23 Amendment 64 projects. Once the applicant shows compliance to the regulation(s), the ODA UM uses form 8100-9, or the DER uses form 8110-3, to find compliance on behalf of the FAA. The new requirement is that the ODA UM or the DER must include a description of the MOC or a reference to the project's MOC on the form 8100-9/8110-3.

It is unclear why the 8100-9/8110-3 must specify the MOC used to show compliance for Part 23-64 (and only Part 23-64). The Policy Memo gives rationale that 23-64 safety-focused performance requirements no longer include the details of the MOC that the former prescriptive rules contained. However, the applicant is required under 23.2010 to use a MOC accepted by the Administrator, in a form and manner acceptable to the Administrator. The certification plan for the project would detail the proposed MOC. If a MOC other than that already accepted under 23.2010(a) is proposed, there most likely will be an issue paper that documents the acceptance of the proposed MOC. The applicant must then present design and compliance data consistent with this accepted MOC. The 8100-9/8110-3 is a finding of compliance, confirming that the data shows compliance with the regulation. The UM/DER is also required to include the Project Number on the 8100-9/8110-3. The substantiating data submitted under the Project Number would consist of the accepted MOC, so adding the MOC, either by description or reference, is redundant and adds no value. If someone wanted to historically determine what MOC was used for a given project, the 8100-9/8110-3 would generally not be where most people would look.

This requirement is different from any other FAA Part or even for any other Part 23 amendment level. Many ODAs and DERs work projects from various parts and amendment levels. This requirement, unique to Part 23-64, is often forgotten by UMs, resulting in extra rework to correct paperwork and/or audit findings for what seems to be no added value.

The committee members believe this policy was introduced shortly after 23-64 was first approved. The policy infers that the UMs/DERs will not take the time to follow the full context of the regulation, the MOC, and the supporting data to determine that the showing of compliance can be approved. The discussion earlier in this paper highlights that the UMs and DERs are more hesitant to sign the 8100-9/8110-3 until they do have the proper understanding. The issue is likely related more to training and understanding.

SACC REC 3.7-1. The FAA should consider rescinding the Policy Memo and changing the requirement in Order 8110.37F as it is redundant and is no value added with the accepted MOC under the project number.

3.7.2 EASA specific issues

The implementation of CS-23 Amendment 5 did not require adjusting the certification process or the related forms used by EASA. A form equivalent to 8100-9/8110-3 does not exist in the EASA process. Still, forms do exist to record the experts' statement of satisfaction based on the review of the retained verification of the compliance shown by the applicant according to the EASA Level of involvement (LOI). The expert's Statement of Satisfaction may list requirements but typically lists documents that have been retained as part of the EASA LOI. Therefore, the issue expressed above for FAA forms does not apply to EASA.

4.0 What's Working Well

4.1 Performance-Based Rules Enable Innovation

The adoption of performance-based rules is a significant change, and that change comes with expected challenges. But even though early in the transition process, the concept is already proving to be an effective method to accommodate emerging technologies because of the flexibility enabled with the use of MOC. The new rules are designed to stimulate innovation and the introduction of new technologies. Performance-based rules and MOC using industry consensus standards should facilitate progress with all new technologies including electric, highly augmented, and autonomous airplanes. Some specific areas working well are highlighted below.

4.1.1 Effectiveness of Industry Standards Process

The performance-based rules have already shown that they will be tolerant to new and changing technologies and innovation. Compared to rulemaking and other formal requirements developed by CAAs, consensus standards development happens relatively fast even though the pace of consensus standards development may not meet the expectations of those new to the process. A notable example is F3083-20, "Standard Specification for Emergency Conditions, Occupant Safety and Accommodations". The -20 revision of F3083 included an alternative means of compliance for dynamic seat conditions. While it took about 3 years for the committee to gain consensus and publish the standard, that timeframe is dramatically shorter than CAA formal requirements development. Consider that the time between the last two major amendments of part 23 (amendment 62 and amendment 64) was about 6 years. Typically, major revisions to part 23 averaged about 10 years.

Even though the -20 revision to F3083 took 3 years, that doesn't mean every revision takes that long. F3083-20 was a major revision which incorporated a new means of compliance that has never been used in certification before. It takes time, collaboration, and working with not only CAAs but with academic institutions to utilize new research to substantiate use of the new MOC. Smaller revisions such as clean-up revisions or revisions that incorporate already utilized MOC (for example from issue papers) have been balloted and published in a matter of months.

The regulatory processes under the previous rule amendment could not keep pace with new technology development. For that reason, one of the important objectives of the new performance-based rules was the use of industry standards. Industry standards can be developed that address new technology; but perhaps more importantly, industry standards can be developed to provide alternative means of compliance that are more appropriate for the safety continuum of airplanes. The range of airplanes possible between the bottom end of level 1 and the top end of level 2 alone warrant a number of

alternative approaches to MOC to address the safety continuum effectively. The speed and agility to agree on an alternative approach to MOC was not possible under the previous rule. The previously mentioned -20 revision of F3083 which incorporated an alternative MOC for dynamic seat requirements is a good example.

The new process has already demonstrated the capability to generate alternate MOC in the areas of HIRF/Lightning, avionics and electronics, structures, crashworthiness, and system safety. Going forward, these alternatives can be refined further across the safety continuum to better match the MOC with specific airplanes and even operations, which is a new concept being used in VTOL aircraft.

Another reason for the effectiveness of industry standards is that they are generally developed using the consensus approach and including not just industry, but aviation authorities and academia. Bringing technical experts from each of these areas together and working collaboratively yields benefits in

- Sharing expertise and experience
- Understanding not just immediate technical issues, but also the bigger picture issues that might help each side understand the other's concerns.
- Getting to know the experts from the different organizations. This is significant for relationship building between industry and authorities.
- Emerging technology where standards can be developed to address immediate needs with a view towards future technology.

4.1.2 Safety Continuum

What is particularly attractive to encouraging innovation and safety improvements is explicitly introducing a safety risk management approach in the performance-based rules. This approach is not done as a function of the weight or propulsion, but starts as a function of number of occupants or passengers *and* performance. In effect, this approach brings to the whole aircraft design and certification level what systems engineers have been doing for a long time. This approach brings formal recognition that the safety continuum exists within CS23/part 23 aircraft.

The most significant benefit to small airplanes recognizes that a long-standing safety continuum has existed within part 23 and moving away from a Part 25 or "one-size-fits-all" mindsets has yielded lower-cost safety-enhancing avionics on aircraft. This change in mindset has benefited avionics manufacturers' efforts more than just the CS23-5/Part 23-64 rule change or the standards. The result has been an overall improvement in operational safety as new equipment is being installed in small airplanes. The CFIT accident rate decreased almost 60% between 2001-2010, mainly from handheld and panel mount technologies that show weather and terrain relative to the airplane.[4] But the safety continuum concept is not well understood or consistently implemented outside of targeted guidance. Industry and authorities could still benefit from a formal guidance document that addresses different aspects of the safety continuum.

The new rule allows for broader use of the safety continuum and this can be enabled via MOC. The concept can be used starting with very simple level 1 airplanes and growing the idea up to level 4, high-

[4] General Aviation Joint Steering Committee (GAJSC) System Component Failure – Powerplant Report, June 23, 2016. Figure 2. GAJSC GA Accident Rate CY 2001-2010, CFIT, page 4.

speed airplanes and is expected to allow for increased safety in these aircraft as authorities accept this continuum.

4.1.3 Reduced Cost for Safety-Enhancing Equipment

The new performance-based rules can allow for alternate means of compliance to be proposed for a specific safety-enhancing system that potentially reduces the certification requirements from the historically high levels of rigor. The potential for a slight increase in risk to each aircraft by new alternate means is expected to be offset by an increase in the level of safety across the entire fleet. Several companies in the industry have used this approach, especially with EASA who historically has been much less willing to adopt the simplified methods across the board. Even so, EASA has been discussing this approach. The FAA has recognized this approach in their fleet modernization program. This new approach, based on the safety continuum, should expand to new aircraft as applicable; allowing new safety-enhancing equipment to migrate upward.

One example of using this alternative approach is the use of service history credit. This is attractive to manufacturers and there needs to be guidance on how to use service history. This could be an enabler for lower cost avionics that can improve overall fleet safety. This approach would not have been possible under the previous rule amendment because the new rule allows a broader formalization and use of alternative approaches like credit for service history.

4.1.4 Target Safety Areas

Target safety areas addressed in the new rules will make new CS-23 and Part 23 airplanes safer. The target safety areas are those that have proven to be responsible for most small airplane accidents. These areas are stall related loss of control and flight into icing. The new CS-23 and Part 23 both maintained the level of safety intended at the CS-23-4 and Part 23-63 amendment levels except stall characteristics and icing protection. Both areas raised the new rule's expected level of safety from the previous levels in CS-23-4/Part 23-63. As new airplanes enter the fleet, the accident rates in these new airplanes are expected to show significant reductions compared to the current fleet. EASA has already certified two new level 1 airplanes using the new CS-23-5 and applying the ASTM F44 standards, including the F3180-18/19 standards for departure resistance as MOC. After completing the projects, the expectation is that the rules sets a new level of safety for small airplanes when compared to the previous rules.

4.2 Improved Collaboration Between Industry and Authorities

Collaboration between regulators and industry is necessary when developing design and safety standards that consider the related certification costs. This balance encourages applicants to incorporate new safety-enhancing technologies that provide an overall safety benefit to the general aviation community. Without balance, the industry could face adopted standards that provide insufficient consideration for safety, or cost barriers that prohibit adopting the latest technologies.

The consensus standards approach enabled by CS-23-5/Part 23-64 creates an environment for experts from the general aviation community to gather and collaborate on approaches to design and

certification that consider traditional and new compliance methods. The ASTM F44 consensus standard committee provides a forum for regulators, industry, and other general aviation stakeholders such as academia, consultants, and operators to meet regularly. This is the first time in the history of general aviation that this collaboration level has been enabled and fostered across the entire industry. This greatly enhances communication between all stakeholders and provides a valuable exchange of information regarding new technology, academic research, and safety-related topics. These collaborative discussions have successfully resulted in standards accepted by FAA, EASA, and industry while also identifying gaps and opportunities for improvement.

Many applicants face multiple challenges during certification projects which can include:

- Gaps in the means of compliance
- New technology that isn't addressed in the old means of compliance
- Cost-efficient methodologies that haven't yet been adopted
- Lack of understanding how a means of compliance is implemented in a certification project.
- Harmonization issues between certification authorities

The consensus standards process allows for these challenges to be addressed and improvements to be developed and incorporated more efficiently than the procedures previously provided by the regulators. The collaboration among the general aviation community stakeholders allows applicants and regulators to understand the foundation for new compliance methods accurately documented in the standards and executed adequately during the certification process. New MOC applied by multiple applicants and approved by the CAA are being published (MOC common to most projects and not proprietary) and this promotes harmonization among global CAAs.

Continued participation by all general aviation stakeholder is foundational to maintain this dialog. There are three main groups of participants playing key roles within the committee:

- *Authority Participation* - Participation by authorities should be promoted and should include appropriate technical experts, including those directly involved in overseeing applicants in product certification, who can provide working knowledge of the execution of new standards in the certification process. This participation includes essential information regarding how new standards are interpreted and where further improvements are needed.
- *Industry Participation* – Aircraft certified under CS23-5/Part 23-64 include a wide universe of configurations and missions. It's vital to promote diverse and comprehensive industry representation to ensure the safety continuum is appropriately addressed from both a safety and cost-efficiency standpoint for all applicants. This includes OEM producers, operators, and consultants.
- *Academia/Research Participation* – Industry standards are data-driven and require research to support the definition of acceptable methodologies for showing compliance. Academia and Research organizations play an essential role in providing research to support adoption of new technology and new standards. Promoting academia/research engagement is crucial for the adoption of new technology.

The framework provided by CS23-5/Part 23-64 encourages collaboration between all certification stakeholders – from seasoned experts to new market entrants. This forum enables innovation leaders to

share new certification methods and openly discuss safety enhancements to benefit the general aviation community. Expanded participation within all general aviation segments, with a focus on individuals with direct working experience of this new framework, will lead to further improvements in this new approach to general aviation safety.

4.3 Easier Entry into CS-23 / Part 23

The previous versions of CS-23 and Part 23 had evolved over the past 3 decades to address commuter and multiengine jet airplanes. While this was important for manufacturers designing larger business and commercial airplanes and opened the door for several great new airplanes, the unintended consequence was that lower end of the rules rose with them. This created a gap between CS-23/Part 23 and experimental, microlight, light sport, and Very Light Aircraft (VLA); and the gap grew larger over time.

A major objective of the new rules was to expand the lower end for entry airplanes to reduce the gap. The goal was to make the step from non-TC'd airplanes into the TC'd realm much smaller than in the past. The reason for this was straightforward and a win-win for safety, industry, authorities, and pilots/operators. The idea was that by encouraging manufacturers to build in CS-23/Part 23, the level of safety in the airplane would be higher than the other non-TC'd options without making the move cost prohibitive. The airplane would have more utility, without limitations, and would be more appealing for rental, training, clubs, etc. Additionally, it could be exported and used for commercial operations. The benefits of certifying in CS-23/Part 23 were coming from the flexibility in the new rules, and are a win-win for safety, industry, authorities, and pilots/operators.

4.4 More Efficient Regulatory Process

The regulatory process for introducing changes to the CS-23/Part 23 rules is different but contains the same challenges. It requires that a formal process is followed to prioritize a rulemaking activity and execute that process.

The new process, where changes can be introduced in ASTM standards, has allowed industry and authorities to make an incomparable number of changes and additions to the measures. The "old" regulatory process would have taken many years if it had been possible at all. The aim to create a stable rule with the reorganization of CS-23-5/Part 23-64 has been achieved.

Adopting the revised or new standards is either through the Notice of Availability (NOA) publication on the FAA side and through a Direct Decision on the EASA side. Further synchronization of these publications, aiming to accept ASTM standards, will improve harmonization and reduce time and costs in validating certificates.

In addition to the formal adoption process of revised or new ASTM standards, revisions to standards that have not yet gone through the formal adoption and publication process have also been applied in projects, and due to the authority involvement in ASTM have led to an even earlier use than only after the publication of the NOA or Direct Decision.

5.0 Conclusions

This paper provides feedback and recommendations based on the initial experiences from both industry and authorities using the new rules from EASA in CS-23 and FAA in Part 23 (referred to as CS-23-5/Part 23-64), and from the use of industry standards. Since it is still early in the implementation and use of the new rules, this report reflects the experience to date.

The new rule language is performance-based, defining the desired safety outcome for certification of normal category airplanes, but the rules do not specify how to meet that safety outcome. The intent of performance-based rules is to allow for flexibility in meeting the rule. The desired outcome is for innovation and safety improvements to be easily and quickly accepted.

This performance-based approach is different from the traditional method in the previous amendments of prescriptive rules, that provided a narrower, limited description of what was required to produce a compliant product. In many cases, the prescriptive requirements in the previous rules included not only what had to be done, but how to do it, and only applied to a specific technology; thus, defining the design and limiting innovation.

Moving to performance-based rules and the use of industry standards jointly created by industry and the authorities allows for faster and broader based means of compliance to support the authorities' desire to move to the Safety Continuum approach to certification and aviation safety. Use of performance-based rules can eliminate most of the Special Conditions and other regulatory requirements that significantly delay the adoption of new technology.

Performance-based rules allow for flexibility by requiring means of compliance (MOC) for showing compliance to the rules in §23.2010. These MOC contain the prescriptive language needed to comply with 23.2010. While most standards started with the language in previous amendment of the rules, the language may have already evolved to address new technology and the safety continuum. To comply with §23.2010, an applicant can use any of the following MOC options—

- Authority-accepted industry standards
- The previous version of the rules (with exceptions)
- They can propose their own MOC based on their understanding of the rule's safety intent
- They can propose a combination of the three

The benefits of the new rules and MOC format allows faster adoption of new technology into small aircraft, resulting in innovation and safety improvements. But this new rule format requires a slightly different certification process and, as with most change, has created challenges.

As experience with the new rules and MOC evolve, and industry and the authority will gain a better understanding of the process and the benefits of the new rules, which can then be used to introduce new aircraft and technologies faster and more efficiently. An example is EASA's SC-VTOL developed for new VTOL aircraft. This paper provides support for current implementation efforts and offers recommendations to improve the implementation and establish long term processes for performance-based rules.