U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
ARC Charter

Effective Date:
AUG 15 2011

SUBJ: 14 CFR Part 23 Reorganization Aviation Rulemaking Committee

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1. Purpose of this Charter. This charter creates the Title 14 Code of Federal Regulations (CFR) Part 23 Reorganization Aviation Rulemaking Committee according to the authority of the Administrator of the Federal Aviation Administration (FAA) under Title 49 of the United States Code (49 U.S.C.) § 106(p)(5). This charter also outlines the committee's organization, responsibilities, and tasks.

2. Audience. This charter applies to industry and government organizations involved in the part 23 reorganization effort to include employees within the Office of the Associate Administrator for Aviation Safety.

3. Where to Find this Charter. You can find this charter on the FAA website at http://www.faa.gov/about/committees/rulemaking.

4. Background. Historically, the FAA has hosted regulatory reviews for part 23 about every 10 years. The two most recent part 23 reviews were performed in 1974 and 1984. In 2008, the FAA initiated the current, ongoing review process by starting with the Part 23 Certification Process Study (CPS).

The CPS team reviewed part 23 and Civil Air Regulations, Part 3 (CAR 3) airplanes, considering their lifecycle, and made recommendations based on current and anticipated products. The challenge was to determine the future of part 23, considering current and anticipated products, twenty years from then. This led to one of the major recommendations from the study: reorganize part 23 using performance and complexity criteria instead of today's weight and propulsion-based divisions. When the Civil Aeronautics Administration adopted CAR 3 standards, airplane construction methods and operations were narrowly focused; likewise, their performance parameters were narrow. As aviation technology progressed, construction methods, performance, and complexity evolved yielding significant advances in the normal, utility, acrobatic, and commuter categories.

The CPS team's objective was to assess the adequacy of the various operations and airworthiness processes currently in place throughout the airplane's service life and to identify process improvements. The team has made recommendations for long-term improvements; and encouraged implementation of near-term, easy to address improvements.

The general aviation fleet is comprised of over 200,000 airplanes. Therefore, most recommendations focused on keeping the *existing* fleet safe. This includes upgrading and maintaining airplanes with better systems, newer avionics, and the latest safety equipment (e.g., ballistic parachutes and inflatable restraints). In addition, Part 23 revisions should make it easier to install safety-enhancing equipment in older airplanes. This concept carried into the public meetings that took place in 2010, the year following the release of the Part 23 Certification Process Study.

Public /Industry Meetings

In 2010, the FAA's Small Airplane Directorate hosted two public meetings. Embry-Riddle Aeronautical University hosted a third meeting in addition to industry and trade-group focused meetings. The objective of these meetings was to share the findings/recommendations from the certification process study and ask the public for feedback. Overall, the feedback was supportive of our recommendations and in some cases augmented the findings. One significant difference between the CPS findings and the public feedback was that the public focused on the need to address the light/simple airplanes in part 23. Over the past two decades, part 23 has been shifting in complexity towards complex, high performance airplanes, which has placed increasing burden on simple airplane certification. Therefore, the public focus was on reducing simple airplane certification costs and time burden through resetting requirements to an appropriate level based on safety risk. The safety risk for most simple, proven airplane designs is typically low. There was very little feedback regarding the high performance end of part 23.

The FAA has developed the following plan based on recommendations from the Part 23 Certification Process Study and the public/industry feedback meetings. This plan focuses on the major regulatory recommendation from the Part 23 Certification Process Study — reorganizing part 23.

5. Organization and Administration of the Part 23 Reorganization ARC. The FAA will establish a committee of members from the aviation community and other aviation airworthiness authorities. FAA participation and support will come from all affected lines-of-business. Where necessary, the committee may set up specialized work groups that include at least one committee member and invited subject matter experts from industry and government.

The charter is set up as follows:

a. The committee sponsor is the Manager, Small Airplane Directorate, who:

(1) Appoints members or organizations to the committee, at the manager's sole discretion;
(2) Receives all committee recommendations and reports;
(3) Selects industry and FAA co-chairpersons for the committee; and
(4) Provides administrative support for the committee through the Aircraft Certification Service.

b. The co-chairpersons will:

(1) Determine (with other committee members) when a meeting is required (a quorum is desirable at committee meetings, but not required);
(2) Arrange notification to all members of the time and place of each meeting;
(3) Draft an agenda for each meeting and conduct the meeting;
(4) Keep meeting minutes; and
(5) Provide quarterly status updates to the Manager, Small Airplane Directorate from the effective date of this charter.

6. Committee Membership

a. The committee will consist of members from the Federal Aviation Administration including members from the Small Airplane Directorate (ACE-100), Aircraft Certification (AIR-100 and AIR-200), and Flight Standards Service (AFS-200, AFS-300, and AFS-800). It will also consist of about 20 members, representing manufacturers of part 23 airplanes, part 23 equipment, light sport airplanes, aviation associations, and foreign aviation authorities. Foreign authorities will serve as observers only.

b. Each member or participant on the committee should represent an identified aviation community segment with the authority to speak for that segment. To promote discussions, membership on the committee will be limited. Active participation and commitment by members is essential for achieving the committee objectives and for continued membership on the committee. The committee may invite additional participants as subject matter experts to support specialized work groups.

7. Public Participation. Persons or organizations outside the committee who wish to attend a meeting must get approval in advance of the meeting from a committee co-chairperson.

8. Committee Procedures and Tasks.

a. The committee advises and provides written recommendations to the Manager, Small Airplane Directorate, ACE-100.

b. Committee tasks include, but are not limited to, the following:

(1) Consider the Part 23 Certification Process Study recommendations 1.1.1 and 1.1.2.

Recommendation 1.1.1 - reorganize part 23 based on airplane performance and complexity verses the existing weight and propulsion divisions.

Recommendation 1.1.2 – certification requirements for part 23 airplanes should be written on a broad, general and progressive level. A team should determine the exact number of tiers and which complexity and performance divisions to use for segmenting them.

a. The first tier should contain the requirements for low-complexity, low-performance airplanes and it should act as a basic starting point for all other categories. These basic requirements could be general with compliance methods maintained in industry and government standards referenced by regulation or policy. The simple product category would naturally fall in a lower oversight risk category allowing the FAA to perform more oversight on products in more complex, higher performance tiers.

b. The next tier(s) should incorporate the requirements of the previous tier and add unique requirements for medium-complexity, medium-performance airplanes. These requirements could also be general with compliance methods maintained in industry and government standards referenced by regulation or policy.

c. The highest tier should incorporate the requirements of the previous tiers and add unique regulatory requirements for high-complexity, high-performance airplanes. The highest product category would fall in an elevated oversight risk category that would require an increased level of oversight as compared to the more simple categories. Human factors standards related to maintenance and operation increase as the tier risk increases.

(2) The committee may propose additional tasks to the Manager, Small Airplane Directorate.

(3) The ARC will submit a report detailing recommendations for tasks (1) and (2) no later than 18 months from the effective date of this charter. The Manager, Small Airplane Directorate, may extend this deadline up to 6 months if it is in the FAA's interest to do so.

9. Cost and Compensation. The estimated conservative cost to the Federal Government is approximately $50,000. Initial plans call for face-to-face meetings every other month. Bi-weekly telecons and/or polycoms will supplement these face-to-face meetings. Most meetings will take place in Washington, DC, to maximize participation from AIR-100, AIR-200, and AFS. All travel costs for Government employees will be the responsibility of the employee's organization. Non-government representatives serve without government compensation and bear all costs related to their participation.

10. Availability of Records. Consistent with the Freedom of Information Act, Title 5, U.S.C., section 522, records, reports, agendas, working papers, and other documents that are made available to or prepared for or by the committee will be available for public inspection and copying at the FAA Small Airplane Directorate, 901 Locust, Kansas City, Missouri 64106. Fees will be charged for information furnished to the public according to the fee schedule published in Title 49 of the Code of Federal Regulations, part 7.

11. Committee Term. This committee becomes an entity on the effective date of this charter. The committee will remain in existence for a term of 24 months unless its term is ended sooner or extended by the Manager, Small Airplane Directorate.

12. Distribution. This charter is distributed to director-level management in the Office of the Associate Administrator for Aviation Safety, the Office of Aviation Policy and Plans, and the Office of Rulemaking.

Administrator

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Aviation Rulemaking Committee Charter

Effective Date: 08/15/11
Extended: 08/15/15

SUBJECT: 14 CFR Part 23 Reorganization Aviation Rulemaking Committee

1. **PURPOSE.** This charter extends the 14 CFR Part 23 Reorganization Aviation Rulemaking Committee (ARC) according to the Administrator's authority under Title 49 of the United States Code (49 U.S.C.) 106(p)(5). This charter also outlines the committee's organization, responsibilities, and tasks.

2. **BACKGROUND.**
Historically, the FAA has hosted regulatory reviews for part 23 about every 10 years. The two most recent part 23 reviews were performed in 1974 and 1984. In 2008, the FAA initiated the current, on-going review process by starting with the Part 23 Certification Process Study (CPS).

The CPS team reviewed part 23 and Civil Air Regulations, Part 3 (CAR 3) airplanes, considering their lifecycle, and made recommendations based on current and anticipated products. The challenge was to determine the future of part 23, considering current and anticipated products, twenty years from then. This led to one of the major recommendations from the study: reorganize part 23 using performance and complexity criteria instead of today's weight and propulsion-based divisions. When the Civil Aeronautics Administration adopted CAR 3 standards, airplane construction methods and operations were narrowly focused; likewise, their performance parameters were narrow. As aviation technology progressed, construction methods, performance, and complexity evolved yielding significant advances in the normal, utility, acrobatic, and commuter categories.

The CPS team's objective was to assess the adequacy of the various operations and airworthiness processes currently in place throughout the airplane's service life and to identify process improvements. The team has made recommendations for long-term improvements; and encouraged implementation of near-term, easy to address improvements.

The general aviation fleet is comprised of over 200,000 airplanes. Therefore, most recommendations focused on keeping the *existing* fleet safe. This includes upgrading and maintaining airplanes with better systems, newer avionics, and the latest safety equipment (e.g., ballistic parachutes and inflatable restraints). In addition, Part 23 revisions should make it easier to install safety-enhancing equipment in older airplanes. This concept carried into the public meetings that took place in 2010, the year following the release of the Part 23 Certification Process Study.

On August 15, 2011, the 14 CFR Part 23 Reorganization Aviation ARC became effective and gave 24 months for the committee to complete its assigned tasks in the form of a report. Over the last 22 months the committee conducted an evaluation of part 23 and submitted its final report on June 5, 2013, which the FAA accepted on June 10, 2013. In accepting the ARC's report, the FAA considers the original tasking issued on August 15, 2011, as completed. The FAA is currently reviewing the ARC's recommendations and is determining a strategy to address the

recommendations. However, based on the potentially large scope of the project and the resources needed to address the recommendations, it is determined that an extension to the ARC is necessary. The extension will provide a forum for the ARC and the FAA to discuss and clarify the recommendations in the report, to assist the FAA in developing the appropriate regulatory approach.

3. **OBJECTIVES AND TASKS OF THE ARC.** The ARC will provide a forum for the United States aviation community to discuss and provide recommendations to assist the FAA in developing the appropriate regulatory approach for addressing a potential reorganization of part 23.
   a. The committee advises and provides clarity on the basis for which the recommendations in the 14 CFR Part 23 Reorganization ARC report to the Manager, Small Airplane Directorate, ACE-100, were developed.
   b. Committee tasks include, but are not limited to, the following:

      i. Consider the Part 23 Certification Process Study recommendations 1.1.1 and 1.1.2.

         Recommendation 1.1.1 - reorganize part 23 based on airplane performance and complexity versus the existing weight and propulsion divisions.

         Recommendation 1.1.2 – certification requirements for part 23 airplanes should be written on a broad, general and progressive level. A team should determine the exact number of tiers and which complexity and performance divisions to use for segmenting them.

      ii. The committee may propose additional tasks to the Manager, Small Airplane Directorate.

   c. **Recommendation Report.** The ARC will submit a report, as appropriate, detailing recommendations for tasks (a) and (b).

4. **ARC PROCEDURES.**
   a. The ARC advises and provides written recommendations to the Manager, Small Airplane Directorate, ACE-100, and acts solely in an advisory capacity. Once the ARC recommendations are delivered to the Manager, Small Airplane Directorate, ACE-100, it is within his/her discretion to determine when and how the report of the ARC is released to the public.
   b. The ARC may propose additional tasks as necessary to the Manager, Small Airplane Directorate, ACE-100, for approval.
   c. The Industry Co-Chair of the ARC sends the recommendation report to both the Manager, Small Airplane Directorate, ACE-100, and the Director of the Office of Rulemaking.
   d. The ARC may reconvene following the submission of its recommendation report for the purposes of providing advice and assistance to the FAA, at the discretion of the Manager, Small Airplane Directorate, ACE-100, provided the charter is still in effect.
   e. The committee will discuss and present information, guidance, and recommendations that the members of the committee consider relevant to disposing of issues.

f. The Manager, Small Airplane Directorate, ACE-100, may issue additional taskings, including deliverable dates.

5. **ARC ORGANIZATION, MEMBERSHIP, AND ADMINISTRATION.** The FAA will set up a committee of members of the aviation community. Members will be selected based on their familiarity with 14 CFR part 23 reorganization, analysis, and regulatory compliance. Membership will be balanced in viewpoints, interests, and knowledge of the committee's objectives and scope. However, according to a June 18, 2010, memorandum "Lobbyists on Agency Boards and Commissions," a member must not be a federally registered lobbyist, who is subject to the registration and reporting requirements of the Lobbying Disclosure Act of 1995 (LDA) as amended, 2 U.S.C 1605, at the time of appointment or reappointment to an advisory committee, and has not served in such a role for a two-year period prior to appointment. Therefore, the FAA will not select any person that is a registered lobbyist. (For further information see OMB final guidance on appointment of lobbyists to federal board and commissions (76 FR 61756, October 5, 2011.)

Each member or participant on the committee should represent an identified aviation community segment with the authority to speak for that segment. To promote discussions, membership on the committee will be limited. Active participation and commitment by members will be essential for achieving the ARC objectives and tasks. Attendance is essential for continued membership on the committee.

When necessary, the ARC may set up specialized work groups that include at least one ARC member and invited subject matter experts from industry and government. The committee may invite additional participants as subject matter experts to support specialized work groups.

This ARC will consist of members from the Federal Aviation Administration including members from the Small Airplane Directorate (ACE-100), Aircraft Certification (AIR-100 and AIR-200), Office of Chief Counsel (AGC-200 or ACE-7), and Flight Standards Service (AFS-200, AFS-300, and AFS-800). It will also consist of about 20 members, representing manufacturers of part 23 airplanes, part 23 equipment, light sport airplanes, aviation associations, and foreign aviation authorities. Foreign authorities will serve as observers only.

The Manager, Small Airplane Directorate, ACE-100, is the sponsor of the ARC and will select an Industry Co-Chair from the membership of the ARC and the FAA Co-Chair. The FAA participation and support will come from all affected lines-of-business.

a. The ARC sponsor is the Manager, Small Airplane Directorate, ACE-100, who:
   1) Appoints members or organizations to the ARC, at the manager's sole discretion;
   2) Receives all ARC recommendations and reports;
   3) Selects industry and FAA members; and
   4) Provides administrative support for the ARC, through the Small Airplane Directorate.

b. Once appointed, the Industry Co-Chair will:
   1) Coordinate required committee and work group (if any) meetings in order to meet the ARC's objectives and timelines;
   2) Provide notification to all ARC members of the time and place for each meeting;

3) Ensure meeting agendas are established and provided to the committee members in a timely manner;
4) Keep meeting minutes;
5) Perform other responsibilities as required to ensure the ARC's objectives are met; and
6) Provide status update in writing to the Manager, Small Airplane Directorate, ACE-100, as requested, from the effective date of this charter.

6. **COST AND COMPENSATION.** The estimated cost to the Federal Government for the 14 CFR Part 23 Reorganization ARC is approximately $10,000. All travel costs for government employees will be the responsibility of the government employee's organization. Non-government representatives, including the industry co-chair, serve without government compensation and bear all costs related to their participation on the committee.

7. **PUBLIC PARTICIPATION.** ARC meetings are not open to the public. Persons or organizations outside the ARC who wish to attend a meeting must get approval in advance of the meeting from either the Industry Co-Chair or the FAA Co-Chair.

8. **AVAILABILITY OF RECORDS.** Consistent with the Freedom of Information Act, Title 5, U.S.C., section 552, records, reports, agendas, working papers, and other documents that are made available to or prepared for or by the committee will be available for public inspection and copying at the FAA Small Airplane Directorate, 901 Locust, Kansas City, Missouri 64106. Fees will be charged for information furnished to the public according to the fee schedule published in Title 49 of the Code of Federal Regulations, Part 7.

   You can find this charter on the FAA Committee Database website at: http://www.faa.gov/regulations_policies/rulemaking/committees/documents/.

9. **DISTRIBUTION.** This charter is distributed to director-level management in the Office of the Associate Administrator for Aviation Safety, the Office of the Chief Counsel, the Office of Aviation Policy and Plans, and the Office of Rulemaking.

10. **EFFECTIVE DATE AND DURATION.** This ARC continues to be effective upon the re-issuance of this charter. The ARC will remain in existence for 24 months, unless sooner suspended, terminated or extended by the Manager, Small Airplane Directorate, ACE-100.

The effective date of this charter is August 15, 2013.

Michael P. Huerta
Administrator

U.S. Department
of Transportation
**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, DC 20591

JUN 10 2013

Mr. Greg Bowles
Director, Engineering & Manufacturing
General Aviation Manufacturers Association (GAMA)
1400 K Street NW, Suite 801
Washington, DC 20005-2485

Dear Mr. Bowles:

This letter is in response to your submittal of the 14 CFR Part 23 Reorganization Aviation Rulemaking Committee (ARC) recommendation report on June 5, 2013 to the Federal Aviation Administration (FAA).

We wish to thank the 14 CFR Part 23 Reorganization ARC members who provided resources to develop, review, and approve the recommendation. The industry-wide cooperation and engagement achieved through your leadership was a necessary enabler to produce the innovative set of recommendations presented in your report.

The FAA accepts the 14 CFR Part 23 Reorganization ARC recommendation report and considers the original tasking issued on August 15, 2011 completed. The recommendation report and the related documents will be placed on the FAA Committee Database website at:
http://www.faa.gov/regulations_policies/rulemaking/committees/documents/, when appropriate.

Sincerely,

Earl Lawrence

Earl Lawrence
Manager, Small Airplane Directorate
Aircraft Certification Service

A Report from the

14 CFR Part 23 Reorganization Aviation Rulemaking Committee to the Federal Aviation Administration

Recommendations for increasing the safety of small general aviation airplanes certificated to 14 CFR part 23

June 5, 2013

Prepared for

Manager

Small Airplane Directorate

Federal Aviation Administration

Kansas City, MO

TABLE OF CONTENTS

Letter from the ARC Co-Chairs

Executive Summary

1.0 Introduction

2.0 Background

2.1 ARC Structure and Scope

3.0 Working Groups

3.1 Regulatory Structure

3.2 Type Certification / Production Certification

3.3 Alterations / Modifications

4.0 Regulatory Structures Working Group – Recommendations

4.1 14 CFR part 23 Revision and Reorganization

4.2 Part 23 Airworthiness Design Standards

5.0 Type Certification / Production Certification Working Group – Recommendation

5.1 FAA Conformity

5.2 Airplane Manufacturer Minor Change Approval Process

5.3 Applicant Showing Only Process

5.4 Use of Video Recording in Testing

5.5 Production Manual

5.6 Design Organization/Production Organization Handbook

6.0 Alterations / Modifications Working Group – Recommendations

6.1 Facilitation of Systems & Equipment

6.2 Critical Information for Alterations & Maintenance

6.3 14 CFR Part 43 Preventative Maintenance

6.4 Primary Non-Commercial Category

7.0 Certification Cost/Benefit Overview

7.1 Regulation and Standard Changes

7.2 Cost Estimates

7.3 Certification Plan Acceptance

7.4 FAA Sequence List

7.5 Foreign Validation Costs

7.6 Summary of Costs

8.0 Summary

TABLE OF APPENDICES

Appendix A – Team Members

Appendix B – Acronyms

Appendix C – ARC Charter

Appendix D – CPS Report Executive Summary

Appendix E – 14 CFR Part 23 Recommended Revision Language

Appendix F – Type Certification / Production Certification Working Group Papers and Proposals

Appendix G – Alterations / Modifications Working Group Papers and Proposals

LETTER FROM THE ARC CO-CHAIRS

June 5, 2013

Mr. Earl Lawrence
Manager
Small Airplane Directorate
Federal Aviation Administration

Dear Mr. Lawrence,

The Part 23 Reorganization Aviation Rulemaking Committee (ARC) has completed its analysis of part 23, Title 14 of the Code of Federal Regulations (CFR) including the 2009 Part 23 Certification Process Study recommendations to restructure the regulations based upon airplane performance and complexity and to write regulations in a broad, general, progressive manner. Currently, part 23 is prescriptive in nature, written to address out-of-date technologies and structured based upon broad assumptions, including airplane weight and propulsion type, which are becoming less accurate and more constraining as time progresses. The ARC also strived to assure recommendations would be acceptable to international regulators and the global industry to reduce the complexity and costs related to foreign validation.

The Part 23 Reorganization ARC presents its recommendations in this final report. The ARC members deliberated, collaborated and used their extensive first-hand experience with the aircraft certification process to produce recommendations that reorganize part 23 to maintain performance based safety requirements in part 23 complemented by acceptable consensus standards which provide more detailed means of compliance. The recommendations in this report meet the objectives of the ARC and include comprehensive reorganization of the design requirements. Additionally, it recommends changes to production, alterations and continued airworthiness regulations, orders, and policies to support our goal of twice the safety at half the cost.

On behalf of the Part 23 Reorganization ARC, it has been an honor to be selected to undertake this important initiative. We are confident the ARC recommendations, upon implementation as a complete package, will result in safer new airplanes, improvements in the safety of the existing fleet, and significant reduction of certification costs. We have written this recommendation in a manner so the new part 23 regulations can stand the test of time beyond the next 20-years. Furthermore, implementation of the ARC's recommendations will serve to revitalize the health and safety of general aviation on a global scale.

Sincerely,

Pat Mullen
FAA Co-Chair Part 23 Reorganization ARC

Greg Bowles
Industry Co-Chair Part 23 Reorganization ARC

EXECUTIVE SUMMARY

The FAA Small Airplane Directorate has been tasked with improving the safety of general aviation airplanes to be consistent with public expectations for the range of vehicles and operations covered by Title 14 of the Code of Federal Regulations, part 23. Over the past four decades, the health and vitality of the general aviation industry have faded significantly. The health and safety of general aviation are inseparably linked. A healthy industry drives a cycle of pilot proficiency, improved training, increased investment in new technology and enhanced safety. Unfortunately, public interest in general aviation is shrinking due to a lack of new products, high costs and lack of perceived value. These realities are highlighted by the 40-year old average age of the general aviation fleet and the steady loss of 10,000 private pilots each year over the last decade.

In order to improve general aviation safety and make it vibrant again, the FAA Administrator chartered the Part 23 Reorganization Aviation Rule Making Committee (ARC) in August 2011. Section 312 of the Federal Aviation Administration (FAA) Modernization and Reform Act of 2012 (Public Law 112–95) requires the FAA Administrator, in consultation with the aviation industry, to conduct an assessment of the aircraft certification and approval process. The Act specifically addressed updating airworthiness requirements, including implementing recommendations in the Administration's report entitled "Part 23--Small Airplane Certification Process Study."

This ARC was a follow-on to the Part 23--Small Airplane Certification Process Study (CPS), but the committee's tasks were not limited to implementing the recommendations from the FAA's Part 23 CPS report.

The Part 23 Reorganization ARC recommendations are comprehensive and unlike recommendations from many other ARCs, are not stand alone. The following recommendations are considered a package. Although partial implementation of these recommendations may offer modest improvement in some areas, any one recommendation alone or combination of recommendations short of the full package will not provide the transformational improvements in safety or reductions in cost that are desperately needed and driving this effort.

METHODOLOGY

The ARC established a committee of members from the global aviation community and the international aviation airworthiness authorities. FAA participation and support included all affected lines-of-business from design and production certification to continued airworthiness and alterations. Where necessary,

the committee set up specialized work groups that included at least one committee member and invited subject matter experts from industry and government to participate.

The ARC formed three working groups and some of these working groups had subgroups including:

- Regulatory Structure Working Group
  - Flight Test Subgroup
  - Propulsions Subgroup
  - Structures Subgroup
  - Systems Subgroup
- Type Certification & Production Working Group
- Alterations & Maintenance Working Group
  - Non-Commercial Use Subgroup

The above subgroups developed recommendations that were briefed to the ARC as a whole. Following these briefings, the ARC as a whole discussed the recommendations and once the discussion was completed, the ARC conducted a hand vote to accept or reject recommendations. All recommendations included in this report had overwhelming majority agreement.

The ARC recommendations are in the area of the design safety regulations for new and existing airplanes (part 23 and policies), in the area which dictates certification process (part 21 and policies) and in the area of continued airworthiness rules and policy (part 43 and policies).

Small Airplane Certification Regulations Summary

Initially the ARC planned to follow the CPS recommendation for tiering part 23 in the CFR's. This approach was rejected by the ARC, which included the foreign authorities. The reason for its rejection was the realization that tiering the requirements using current ideas for performance and complexity would eventually lead us to many of the same challenges we face today with weight and propulsion divisions -- tiers would become less accurate and more constraining as time and technology progress.

The ARC looked at how outdated design requirements and certification regulations affect both initial certification and alteration processes. The prescriptive and outdated rules are the major barriers to installing safety-enhancing modifications in the existing fleet and to fielding newer, safer airplanes because they inhibit innovation. The ARC also looked at harmonization of requirements between authorities that could improve safety and reduce costs. Adopting top level, safety based CFRs that facilitate international harmonization, coupled with internationally accepted airworthiness design standards, could play a significant role in cost savings and enabling safety enhancing equipment installations. These standards will be reviewed and voluntarily accepted by the authorities in accordance with a process established by them. Some authorities may reject all or part of a standard, but the intent is to have full civil authority participation in the creation of airworthiness standards.

The ARC recommendations address the reorganization of part 23 to maintain performance based safety requirements while moving prescriptive methods and technology dependent aspects from the CFRs into

Airworthiness Design Standards or other guidance. These new regulations make the retrofit of new technology more straightforward without the need for special conditions, equivalent methods of compliance or exemptions, and they also remove barriers to bringing new, safer airplane designs to market with similar benefits. The time and expense to the FAA and the industry of working in an overly prescriptive and outdated regulatory environment must be removed to improve the safety and health of GA in a meaningful way.

The recommended changes to part 23 assure the rules maintain the proper, performance based safety requirements while detailed, technology specific methods are moved to Airworthiness Design Standards or other guidance that has the agility to keep up with technological innovation. The ARC recommends these prescriptive methods to achieve the safety intent of part 23 be contained in consensus standards which the FAA will accept as methods to achieve the requirement of part 23. The international aviation industry, including representatives from the world's leading aviation authorities agree with this approach and that clear paths to compliance for a multitude of technologies are available through the consensus standards approach.

Recommendations for Changes to Small Airplane Certification Regulations)

1. Retain the enforceable, performance based safety objectives in part 23 while moving the prescriptive and technology dependent provisions or methods of compliance out of regulatory text and into FAA accepted consensus standards.

2. Ensure the enforceable safety objectives of part 23 are written broad enough to address the full range of part 23 products and will remain applicable to foreseeable and unforeseeable technologies over the next 20 years.

3. Utilize FAA accepted consensus standards as methods of compliance to the safety objectives contained in the new part 23 and maintain a process for applicants to propose methods which are not contained in consensus standards.

4. Assure that accepted consensus standards include methods of compliance appropriate to the broad spectrum of airplanes and technologies governed by part 23.

5. Work with the international regulatory community on the part 23 reorganization recommendations to assure there is a globally acceptable approach to certifying part 23 airplanes.

6. Prioritize this rulemaking to assure that the health and safety improvements of general aviation can be realized as soon as possible.

7. Develop a means to track information on certification basis for both new and legacy airplanes to facilitate alterations and maintenance throughout the airplane's service life.

8. Apply the principles of double the safety at half the cost also be applied to the existing fleet of general aviation aircraft as well as new production aircraft. Cost effectively expediting

alterations involving non-required safety enhancing equipment (such as the incorporation of angle of attack indicators) is critical.

9. Ensure that guidance, policy, and agency culture align so as to support the new regulations and fleet-wide safety improvements.

Note: The purpose, scope, and suggested wording for the new rules have been included in Appendix E.

Certification Process Summary

In addition to reviewing the part 23 regulations and their effect on the certification costs and safety of the general aviation fleet, the ARC created the Type Design and Production Certification Working Group to review the certification processes related to 14 CFR 21.The Type Design and Production Certification Working Group focused on the certification processes that have significant impact on certification costs. These processes are largely driven by part 21 and the associated part 21 FAA Orders and policies. For the part 21 requirements evaluated, the group determined the current part 21 requirements were not significant cost drivers, but the Orders written by the FAA and for the FAA that have been applied to industry are significant cost drivers that have not kept pace with technology and do not allow industry to utilize more efficient processes. The changes described in this section, section 3 and recommended in section 5 do not require any changes to part 21 and could be accomplished quickly through:

- Issuance of policy papers,
- Relatively minor changes to existing Orders to allow alternative processes,
- Issuance of new Advisory Circulars, or
- Acceptance of aviation design standards addressing the issue.

Recommendations for Changes to Certification Process

1. Align the processes for demonstrating compliance and producing small airplanes with the complexity of the product being produced. This can be accomplished in the short term by the FAA developing or recognizing a design & production organization handbook that specifies the minimum content for an entry-level product producer. As currently envisioned, the handbook could be structured so it could expand as a company grows. In addition, the Design Organization/Production Organization Handbook for a mature company producing multiple products could satisfy all of the requirements for an Organization Designation Authorization (ODA) manual under 14 CFR 183, Subpart D.

2. Standardize configuration management process as an alternative to the traditional conformity processes. This recommendation should be coordinated with the FAA's Safety Management System (SMS)/Part 21 ARC currently underway.

3. Standardize the minor change process through the issuance of guidance material or policy. This recommendation should be coordinated with the FAA's SMS/Part 21 ARC currently underway.

4. Make better use of applicant showing of compliance in areas of low risk and the FAA develop guidance material and policy to standardize this activity. This recommendation should be coordinated with the FAA's SMS/Part 21 ARC currently underway.

5. Increase the use of remote video for test witnessing by issuing policy and guidance in this area. This recommendation should be coordinated with the FAA's SMS/Part 21 ARC currently underway.

Part 43 Summary (Continued Operational Safety Certification)

While the design, certification and production of an airplane are important to safety, the continued airworthiness of an airplane can only be assured by proper maintenance. As the current fleet of part 23 airplanes averages 40-years old, the ability to conduct proper and cost effective maintenance is of critical importance. The part 23 ARC Airworthiness and Maintenance Working Group reviewed current maintenance inconsistencies, especially in the area of preventative maintenance, which should be addressed by the FAA.

Recommendations for Changes to Continued Operational Safety Certification

1. Review 14 CFR part 43 preventative maintenance items to both clarify the current capabilities and to create a system whereby the FAA can expand these capabilities without the need for rulemaking.

New Aircraft Certification Category

At the FAA's ARC kick-off meeting, the FAA challenged the ARC members to be bold, creative, and non-traditional. A proposal for a new aircraft category similar to the Canadian Owner Maintenance Category, but with some significant safety enhancements reflects that challenge.

Recommendation for New Category

1. The ARC recommends the FAA adopt a new category of airworthiness certificate that would align maintenance and alteration requirements of older aircraft, not operated for hire, to a level more appropriate for a privately owned vehicle.

Summary

Upon implementation, the ARC recommendations will result in safer new airplanes and improvements in the safety of the existing fleet through the ability to more easily and rapidly incorporate new

technology that can reduce pilot workload, provide better situational awareness, and afford other safety enhancements. It also has the potential for a significant reduction of certification costs through reduced need for Special Conditions, Equivalent Level of Safety (ELOS) findings, or other activities.

The implementation projections of twice the safety and half the cost are based on these recommendations being implemented as a complete package. Safety, harmonization, and innovation all rely on a revision to part 23 as well as the development of accompanying airworthiness design standards. The cost savings and safety improvements necessary for new airplane certification, as well as the improved safety of the existing fleet, also depend on the implementation of the parts 21 and 43 recommendations in this report.

With the new part 23 and airworthiness design standards in place, it will be easier for FAA staff to determine the critical elements of a project and focus their time and resources to things that need more oversight. It will help the FAA reduce their workload and focus their attention on safety and more value added functions.

These recommended changes to part 23 are designed to make part 23 more stable, require less maintenance, reduce cost for the FAA, and stand the test of time for at least the next 20 years. Furthermore, because of the international nature of this ARC, the implementation of the ARC's recommendations will serve to revitalize the health and safety of general aviation on a global scale.

Finally, in addition to the technical solutions proposed in this report, the cultural issues involved must be addressed with both the FAA and the applicant. Many of the recommendations in this report require changes to long standing ways of doing business that must change if the recommendations in this proposal are to succeed. This will require training and a willingness to accept cultural change from both the authorities and industry so that new processes are accepted. Without a willingness on both sides to make changes, the chances of success are greatly diminished.

NEXT STEPS

Following are recommended next steps:

1. Stand up an FAA Small Airplane Directorate group to develop new part 23 language based on the suggested language and the intent expressed in this report.

2. Provide the white papers presented in this report to the appropriate FAA organizations and the part 21 ARC to determine the feasibility of implementing the proposals.

3. Work with industry in prototyping and implementing some of the proposals.

1.0 INTRODUCTION

This report will present the results of the 14 CFR Part 23 Reorganization Aviation Rulemaking Committee (ARC). The ARC's main objective was to propose changes to part 23 that would improve safety and reduce certification costs for new airplanes. Over the course of the first few meetings, the ARC determined that including improvements to the existing fleet was an absolute necessity to get the desired safety increase in a reasonable timeframe.

The approached taken by the ARC serves the goal of improving general aviation safety by:

1. Streamlining of part 23 to make new technology integration easier and more cost effective, and
2. Adding flexibility to the certification process by utilizing consensus based Airworthiness Design Standards as acceptable means of compliance, giving it a level of nimble adaptability never before seen.

To reduce costs the ARC looked at both initial certification costs and costs for making modifications to field aircraft. These costs are the barriers to both new airplanes and installing safety-enhancing modifications in the existing fleet. The ARC also looked at how harmonization between authorities could improve both safety and reduce costs.

The ARC team members were all people with significant experience in both the certification and maintenance areas and thoroughly evaluated the proposals brought forth in this report. The proposals represent a significant change in the organization of the certification requirements and the accompanying processes aimed at achieving improved safety and reduced costs to certify and maintain general aviation (GA) aircraft.

2.0 BACKGROUND

Historically, the FAA has hosted regulatory reviews for part 23 about every 10 years. The two most recent part 23 reviews were performed in 1974 and 1984. In 2008, the FAA initiated the current, on-going review process by starting with the Part 23 Certification Process Study (CPS).

The CPS team reviewed part 23 and Civil Air Regulations, part 3 (CAR 3) airplanes (looking at the whole lifecycle) and made recommendations based on current and anticipated products. Specifically, the team's challenge was to determine the future of part 23, given today's current products, and anticipated products twenty years from now. This forward thinking led to one of the major recommendations from the study: reorganize part 23 using "performance and complexity" criteria instead of today's "aircraft weight and propulsion type" criteria. When the Civil Aeronautics Administration adopted CAR 3 standards, airplane construction methods and operations were narrowly focused; likewise, their performance parameters were narrow. As aviation technology progressed, construction methods, performance, and complexity evolved. The normal, utility, acrobatic, and commuter categories have seen remarkable advances in capability in the last few years that were unanticipated by the current regulations.

The CPS team's objective was to assess the adequacy of the various operations and airworthiness processes currently in place throughout the airplane's service life and, if appropriate, to identify opportunities for process improvements. The team has:

- Made recommendations for long-term improvements; and
- Encouraged implementation of near-term, easy to address improvements.

Accident data historically shows that human performance that includes operators and maintenance personnel contribute to 70 to 80 percent of GA accidents. Given that the GA fleet comprises over 200,000 airplanes, the majority of the CPS recommendations focused on keeping the *existing* fleet safe. This includes upgrading and maintaining airplanes with better systems, newer avionics (for NextGen, navigation, information, or redundancy), and the latest safety equipment (e.g., ballistic parachutes and inflatable restraints). Requirements that make it easier to install safety-enhancing equipment in older airplanes will be interconnected to part 23 revisions. This interconnection concept was carried over into the public meetings that took place in 2010, the year following the release of the CPS.

The objective of these meetings was to share the findings/recommendations from the certification process study and ask the public for feedback. The purpose of this feedback was to confirm and/or challenge the findings/recommendations and add issues that might have been overlooked during the

study. Overall, the feedback was supportive of the CPS recommendations and in some cases augmented the findings. One significant difference between the CPS findings and the public feedback was that the public focused on the need to address the light/simple airplanes in part 23. Over the past two decades, part 23 has been shifting in complexity towards complex, high performance airplanes, which has placed increasingly unnecessary burden on simple airplane certification. Therefore, the public focus was on reducing simple airplane certification costs and time burden through resetting requirements to an appropriate level based on safety risk. The safety risk for most simple, proven airplane designs is typically low. There was very little feedback regarding the high performance end of part 23.

Section 312 of the Federal Aviation Administration Modernization and Reform Act of 2012 (Public Law 112–95) requires the FAA Administrator, in consultation with the aviation industry, to conduct an assessment of the aircraft certification and approval process. The Act specifically addressed updating airworthiness requirements, including implementing recommendations in the Administration's report entitled "Part 23--Small Airplane Certification Process Study."

In Aug, 2011, the Administrator chartered the 14 CFR Part 23 Reorganization Aviation Rulemaking Committee. The committee's tasks included, but were not limited to implementing the recommendations from the FAA's CPS report for reorganizing part 23. This final report responds to the Administrator's charter and addresses the requirements of the FAA's Modernization and Reform Act of 2012.

2.1 ARC Structure and Scope

The committee consisted of members from the Federal Aviation Administration including members from the Small Airplane Directorate (ACE-100), Aircraft Certification (AIR-100 and AIR-200), and Flight Standards Service (AFS-200, AFS-300, and AFS-800). It also consisted of about 50 members, representing manufacturers of part 23 airplanes, part 23 equipment, light sport airplanes, aviation associations, and foreign aviation authorities. Federal officials and foreign authorities served as observers. However in practice, the views, contributions, and opinions of all participants were considered in the development of the recommendations.

Each member or participant on the committee represented an identified aviation community segment with the authority to speak for that segment. To promote discussions and different perspectives, membership on the committee was open to a broad range of parties. Active participation and commitment by members was essential for achieving the committee objectives. The committee invited additional participants as subject matter experts to support specialized work groups. For additional information see the ARC Charter in Appendix C.

3.0 WORKING GROUPS

The 14 CFR Part 23 Reorganization ARC consisted of three primary working groups:

The ***Regulatory Structure Working Group*** performed the primary review of the part 23 code and made recommendations for the future structure and organization of this code as well as how these regulations can utilize international consensus standards in the future. The Regulatory Structures Working Group also had four subgroups that addressed propulsions, flight test, structures, and systems areas.

The ***Type Certification and Production Certification (TC/PC) Working group*** looked into the process of performing certification and production oversight (part 21) where part 23 aircraft have unique characteristics that could provide for more efficient and streamlined application of these methods.

The ***Alterations and Maintenance (A&M)Working Group (AMWG)*** addressed how existing and future aircraft can be better maintained and altered under the future structure of a proposed part 23.

The recommendations from these working groups are considered a package. The ARC objective of twice the safety and half the cost rely on these recommendations being implemented together. The chances

of success are greatly diminished or eliminated altogether if these recommendations are implemented in a piecemeal approach.

3.1 Regulatory Structure

3.1.1 Background

Part 23 today has grown out of the initial set of design standards which began back in the 1930's. As time progressed, the relatively simple regulations in CAR 3 evolved into increasingly comprehensive rules to address safety issues that emerged with the growing number of aircraft in service, as well as the increasing complexity due to incorporation of new technologies into aircraft. These new rules were only applicable to new aircraft entering the market or significant changes to existing aircraft that required accepting the latest rule. Any issues with existing aircraft in the field were dealt with through ADs or changes to operational rules.

Figure 1: Evolution of Part 23 Regulations

The regulations moved away from the simple basis of CAR 3, effectively leaving a gap in the bottom part of the certification spectrum (Figure 1). However, the reality is that most aircraft flying today are based on CAR 3 certification and would not be able to be certified under the current part 23 rules without significant additional costs. Yet these aircraft have proven an acceptable level of safety to fly over the last 50 to 60 years.

The structure and complexity of the current regulations also inhibits rapid introduction of new technologies that can enhance safety not only in new but also in existing aircraft. By incorporating very specific technical requirements into part 23, it has become difficult to introduce new technologies, as this requires rulemaking, which is a long tedious process.

The consequence of today's situation is that the certification costs are so high, entry level part 23 airplanes have little or no, chance of recovering the development/certification costs. This has two other side effects: first, the users will tend to retain or purchase older airplanes that are less expensive and

second, as it is hard to introduce new safety enhancing technologies into the current production aircraft and the existing fleet, the safety level of general aviation aircraft does not improve. Newer aircraft with advanced technology (that are possibly safer) are not introduced and older aircraft cannot be easily upgraded. This has already had a negative impact on general aviation aircraft and will continue to hurt general aviation significantly without substantive changes to the certification process.

In order to improve the GA fleet safety and the health of the industry, the certification cost needs to come down to allow more profitability and quicker introduction of safety enhancing features. Within industry and the FAA there is a strong desire to recapture the simple and low cost certification process previously used based on commonplace, proven engineering practices, requiring minimal FAA oversight.

3.1.2 Present State of Part 23

Part 23 is a large body of regulatory material that is complimented by a system of overlapping Advisory Circulars (AC) and, to a lesser extent, industry standards from SAE, RTCA, etc. to lay out the means by which an applicant complies with the safety requirements of part 23. A significant portion of the part 23 safety regulations prescribes design solutions which preclude manufacturers from finding more economical paths to provide acceptable safety. AC's provide interpretations of the regulations as well as one acceptable means of compliance (MOC). In practice, it has been found that the MOC presented in ACs have been treated as the *only* acceptable MOC, which again precludes manufacturers from proposing a simplified MOC intended to show equivalent safety more economically. Both the safety regulations within part 23 as well as the ACs are authored by the FAA and are historically revised infrequently, much slower than the pace of advances in technology.

Figure 2 depicts the current structure and interdependence of the regulations and other FAA documents and industry standards.

Figure 2: Current structure of regulations and standards

Section 23.1309, System Safety, was recognized as an example of the evolution of part 23 away from the original intent regarding simple, lower performance aircraft. Amendment No. 23-14 added § 23.1309 and provided general guidance related to installed systems and the hazardous effects of failures. A "minimization" approach was possible allowing manufacturers design freedom to find the most suitable and feasible solutions to design. Later amendments were added in reaction to increasing complexity of installed systems and increasing performance levels of part 23 aircraft. As a result, prescriptive analysis methods evolved that have limited the manufacturers' ability to implement new safety enhancing and cost reducing technologies due to the difficulty defining an acceptable means of compliance within the existing rules and guidance.

3.1.3 Analysis of Part 23 Requirements

The Regulatory Structure working group was tasked to review the current part 23 regulations and determine how to implement part of the CPS recommendations regarding performance based standards as well as dealing with the issues brought up during the public meetings on CPS in 2010. As discussed above, it was clearly recognized that part 23 had become too prescriptive and broad in scope, thereby making it difficult for new aircraft to enter the market or to modify aircraft to enhance their use or safety.

During the first two ARC meetings, the Regulatory Structure Work Group focused on the activities in the 14 CFR Part 23 Reorganization ARC resulting from the findings in the first major area of study within the CPS which recommended:

- Reorganizing part 23 based on airplane performance and complexity versus the existing aircraft weight and propulsion type divisions.
- Rewriting certification requirements for part 23 airplanes as a top-level safety regulation with more detailed implementation methods defined by reference to the airworthiness design standards and supported by other industry and government consensus standards.

The initial position of the ARC was to develop a new tiered structure that would address the need for reduced certification cost for entry level airplanes, as well as provide a means to increase safety significantly. As ideas were generated how to accomplish this, it became clear that the way the regulations are structured needs to be reviewed and that just defining new tiers using broad aircraft level differentiators would not address the underlying issues.

A high-level analysis of part 23 reveals the following:

- There are 4 categories of aircraft covering 0 to 19000 lbs., Maximum Take-Off Weight (MTOW), and 1 to 19 passengers
- Part 23 has variations to a requirement based on certain factors such as weight, engine type or number of engines.
- Changes to part 23 through amendment 62 have addressed advancements in technology (available features), lessons learned from accidents and other sources, occupant safety improvements and the addition of the Commuter Category

- Part 23 consists of 1293 individual sub-paragraphs (including the appendices)

While a few categories can be tied to airplane simplicity and/or performance levels, it is apparent that most are applicable to general configuration of aircraft or features on aircraft as is shown in Table 3.1.

Table 3.1 – Part 23 Sub-paragraph Applicability Table

Applicability of Part 23 sub-paragraphs	
# of paragraphs	**specific to:**
811	All Aircraft Types
29	< 6,000 lbs.
29	Piston engines
6	Single Engine
28	Propellers
24	Multi-engine
78	Commuter
13	> 6,000 lbs. & turbine
40	Turbine / Turboprop
10	Aerobatic
40	Seaplanes
17	Pressurized aircraft
168	Some other specific system or feature

3.1.4 Part 23 Future State

The Regulatory Structure Working Group proposed a future state for the regulations slightly different from that proposed by the CPS. Whereas the CPS proposed that the regulations be reorganized based on performance and complexity, the Regulatory Structure Working Group proposed the performance and complexity be addressed in the airworthiness design standards. The body of regulatory material and airworthiness design standards will thus be characterized by the following:

1. Define regulations for safety, not design solutions that are assumed to achieve an acceptable level of safety.

2. Define safety regulations in a way that is independent of aircraft performance level, complexity, or configuration (i.e. they define what is expected and enforceable, but not “how”.)

3. The new regulations should be written such that new technology can be easily integrated into aircraft while maintaining or improving safety for current or past technology with reduced, or at least no increase, in certification costs.

4. The new regulations must not contain any prescribed technical requirements but rather suitable safety requirements that will not require changing for the foreseeable future.

5. The new regulations must be general enough to apply across the full spectrum of part 23 airplanes.

6. Add scope and purpose in the rules to serve as guidance for showing new technologies (standards) meet the objective. The regulatory text is often too high level to fully understand the intent.

7. Make use of international airworthiness design standards for acceptable Means of Compliance to the new part 23 as well as guidance material to assist in the use of the standards. These standards would contain the requirements that would be based on performance level, aircraft complexity, configuration, and operational use, i.e. tiering of the requirements.

The idea behind the proposed change of part 23 is to separate the safety-oriented intent of the rule from any acceptable technical implementation details and means of compliance. The intent of the rule will remain in the regulatory text and the technical implementation requirements and means of compliance will be captured in ADS guidance documents.

It is important to note that direct showing of compliance to the rules by applicants is still supported. ADS and other identified acceptable means of compliance cannot, by law, add to or change rules. Nevertheless, the availability of these supporting materials provide "one means, but not the only means" of compliance will, as today, offer preferred compliance approaches.

The future structure and relationship between the new part 23 and ADS holding MOCs are shown Figure 3.

Figure 3: Future state of regulations and guidance

This will allow the rule to remain stable into the future, yet have a mechanism that provides a way to implement new, safety enhancing technology quickly without having to go through a lengthy rule-changing process.

The resulting body of safety regulations would require updating less frequently since updates driven by technology changes can be reflected in the ADS. Those standards are maintained by industry experts and regulatory participants and will be updated frequently as technology changes require, providing a level of adaptability to technical change not present in today's scheme. The referenced ADSs will also establish definitions of airplane simplicity/complexity tier boundaries, relevant to their particular technical areas and compliance approaches. Through collaboration on the ADS, the regulatory agencies will become a party to the establishment of acceptable ADS.

As such, through the work of the Regulatory Structure Working Group it became clear that a complete new approach needed to be taken to the definition of the regulations and the showing of compliance.

Figure 5 provides the high-level concept of how the transition from the current part 23 to the new part 23 and the international standards will occur.

Figure 4: Transition to New Rule Structure

3.1.5 Regulatory Structure Working Group Output

The Regulatory Structure working group has reviewed the current set of regulations to determine the safety intent of each. This involved review of the Notice of Proposed Rulemaking (NPRM) and Final Rule Notices for prior amendments. From this understanding, the working group had discussions on how to revise the language to capture the safety intent of the rule while addressing the underlying 14 CFR Part 23 Reorganization ARC charter.

Part of the exercise involved the grouping of the current regulations into areas where there was a common set of safety intents. This was captured in a spreadsheet that can be sorted by new or old regulations. The intent of the spreadsheet was to also provide the basis for the initial ADS. It provides a cross reference table detailing which old paragraphs supplied the intent of the new requirements. This spreadsheet can be maintained for as long as needed and will be available through either the FAA or a standards organization.

As this was accomplished, new part 23 requirements were drafted and refined. The criteria for the new part 23 language were as follows:

- There was no effort to establish a specific number of CFR rules reduction in establishing the new proposed rules, but to create the best balance of organization, clear requirements, broad reaching for future applications, and ability to enforce the current level of safety in part 23.
- Must be able to "stand on their own"
  - The Type Certificate will be based on showing compliance to the rules (not the standard), so the rules should contain enough content to be able to make a finding of compliance (i.e. pass/fail) that will show the safety intent is met. However, as in today's environment this is not done independent of acceptable means of compliance.
  - The Type Certificate Data Sheet (TCDS) will reference the rules only
- Must drive the safety objective
  - Safety objectives are captured in the rules
  - Design requirements to achieve those are captured in the ADS
- Should not prescribe a specific design solution or testing method to show compliance
  - Keep the path open for future technologies without having to rewrite the rules
- Shall use consistent philosophy, terminology and definitions across all paragraphs
  - Airplane/aircraft, engine/propulsion, etc.
- Should only contain "technical" requirements where specifically needed to drive the safety objective
- Should allow for all foreseeable future technologies
- The result of this work was the creation of the draft regulations for the new part 23 and is shown in Appendix E

3.1.6 International Standards Methodology

The second part of the process, after the new part 23 is published, is to create a new General Aviation aircraft certification environment. It is important to note that the Regulatory Structure working group saw the importance of having both the new safety intent regulations along with an accepted airworthiness design standard to meet the goals identified by the FAA and the ARC charter. Each could not exist without the other.

The chosen methodology for the development of the initial set of International Standards is to begin with the current part 23 regulations and then modify them to reflect the requirements in the new part 23 regulations. These standards will also take into account input from the other Civil Aviation Authorities (CAAs) involved to facilitate recognition by any regulatory authority as an acceptable means of compliance. The new airworthiness design standard language should be drafted using the existing part 23 language while removing redundant requirements and requirements that do not provide any safety benefit. The language also should be revised such that the new regulations are not repeated in the standard. A cross-reference table, similar to the one mentioned above, will assist in determining which part of a regulation is a standard, or part of a standard, and proved an addition link between the regulations and standards.

It should also be noted that although the standards may be developed by a consensus body made up of both industry and international authority representatives with the intent of harmonization, it remains the responsibility of each authority to determine if a standard approved by the consensus body is acceptable, either whole or in part to show compliance to their regulations. Each authority will determine their means of acceptance to the standards upon approval by the consensus body.

It is intended that there is no restriction on the number of standards that can be accepted to provide an acceptable means of compliance to a specific regulation. Any group or individual can propose a standard and have an authority accept it as an acceptable means of compliance provided it meets established guidelines for the creation and approval of a standard. These guidelines may follow requirements of the Issue Paper process or other designated process agreed to by the authorities.

Use of the accepted standards would not be mandatory, but would be encouraged to avoid the effort required to create and obtain approval of new standards. However, in the event that there is a desire to protect proprietary information, or other reasons, it may be desirable in some cases to propose a new standard.

Also, there needs to remain a distinction between the standard and guidance material. It is not intended that current ACs and other guidance (current SAE, RTCA or ASTM documents) become part of the ADS. In essence, the new standards should capture the “what”, “why”, “when” and “where”, to the extent possible, but should not restrict technical solutions; the guidance captures the “how”. However, in some cases a standard may be created that would incorporate the information in an FAA AC and other Civil Aviation Authority guidance such that the standard could replace multiple guidance documents from different authorities and significantly simplify the means of compliance. This may not occur immediately but over time.

As the ADSs are written, it should be determined if there is a need for any tiering to account for simple designs, well understood technologies, and/or simple (robust) analysis methods. Determine where there is need for different levels of requirements in the standard based on the aircraft performance, complexity, or operational risk. The ADS should provide an acceptable means of compliance with regard to the feature being considered and aircraft performance, complexity, and/or operational risk. This tiering structure would be developed for each functional area of the aircraft and not necessarily apply to the whole aircraft. Therefore tiering will be very different from one area to the next.

While the standard is being written, a review of the current guidance will be undertaken to determine if there is a need

for revised, new or additional guidance. A list of current guidance will be generated for each paragraph written, including current ACs that include material that can be considered as standard material (such as in ACs 23. 1419 or 23. 1309).

Once an ADS is completed and accepted, the standard should be continually reviewed and updated to keep it relevant to the changing technology. New ADS will not increase the compliance burden on an applicant unless there are new technology requirements.

3.1.7 Notes on Tiering

The tiering begins by assessing the simplest individual airplane elements that is envisioned to determine how it could most easily comply with the rule that it services in part 23. These methods should be captured so they can be included in a specification that would be a means of compliance for that kind of airplane. Additionally, the features and characteristics that defined that simplest product should be noted.

Next, a less simple airplane should be evaluated (the next level of airplane for which the method of compliance just documented isn't fully appropriate) and determine what additional methods of compliance are necessary and what features define that kind of airplane. This exercise should be continued through the envisioned spectrum of airplanes.

Safety impact and risk should be evaluated, i.e. what are the risks and outcomes of a failure. Figure 5 provides a diagram that can be used to help determine tiers and specific compliance rigour.

Figure 5 Tiering and Risk Evaluation

Tier definitions are likely to be different for the various areas of the standard. Structures tiers may have natural transitions to more certification rigor that do not coincide with tiers in propulsion or systems. The envisioned result may be more like a matrix addressing the different means of compliance for the elements or systems of the airplane taking different operational characteristics in consideration.

This means that an aircraft that has basic characteristics will be simple to certify, except for one specific system or type of operation that may require different substantiation. This is conceptually shown in Figure 6 and Figure 7.

Figure 6 Tiered means of compliance by subsystem

Figure 7: Different MOC levels across one aircraft

3.1.8 Conclusion

Based on the numerous discussions and work prepared by the Regulatory working group a feasible path forward for the new Part 23 was developed. This involved the breakdown of Part 23 at Amendment 62 into appropriate safety intent regulations using the guidelines identified above. The resulting language is shown in Appendix E. These draft rules have been reviewed and vetted by all participants in this ARC

working group, including many different aviation authorities, and recommended as a starting point for the FAA and other authorities to draft a final set of regulations to be proposed by each authority.

With the draft language developed for the new part 23, the Regulatory Structure working group then developed a set of guidelines and instructions to pass to the ADS group. This ensured the concepts and ideas from the Regulatory Structure working group are crafted so that the new part 23 and accepted airworthiness design standards complement each other. This will provide industry with a set of requirements that is: useable; effective; changes as quickly as technology; allows the new rules to be used with older designs; reduces cost; increases safety; and reduces the workload of all regulatory agencies across the world.

3.2 Type Certification / Production Certification

3.2.1 Background

In response to the 14 CFR Part 23 Reorganization ARC Charter to reduce simple airplane certification cost and time burden, the TC/PC working group set out to identify improvements in both the type design certification process and the production certification process. These improvements would cut the cost of certifying new part 23 airplanes, modifying airplanes, and also cut the costs of production through changes to the certification process. Furthermore, opportunities to improve safety were also considered. These safety improvement opportunities were expected to be realized by incentivizing the installation of new safety enhancing technology thru lower certification costs.

The initial activity of the working group was to identify cost drivers in the certification process (Appendix F.2). For each cost driver, comments were identified along with suggested changes or solutions. In addition, suggested solutions included noting when a decrease in costs for industry would apply to the FAA as well. Safety improvements were also identified.

After considerable discussion about this list of cost drivers and possible solutions, the working group decided to focus their efforts on several key areas and develop supporting white papers. These white papers would explain the issue and then provide a suggested solution for FAA consideration. White papers were developed for the following:

- FAA Conformity
- Minor Change Approval
- Applicant Showing Only
- Use of Video Recordings in Testing
- Design Organization/Production Organization Handbook including Simplified Production Certification

For each of the above items cost savings estimates were made in the white papers and those estimates are included in section 7 of this report.

The following sections will summarize the proposals at a high level and section 5 includes the recommendations for each. Appendix F.1 contains the TC/PC Work Group Report Out that contains more detail on each of the proposals and the white papers on each of the proposals.

3.2.2 FAA Conformity Process Summary

There was unanimous agreement by the working group that the FAA conformity process was the number one cost driver in certification. The FAA conformity process is essentially a double check of the applicant process, as the applicant is required to do 100% company conformity. It is interesting to note that the FAA conformity process is unique to the FAA. For example, two of the other major certification authorities, European Aviation Safety Agency (EASA) and Transport Canada Civil Aviation (TCCA), do not require this second check of configuration.

In addition, as currently required, individual test article conformities often require a test article to be completely opened up and inspected in order to satisfy a Request for Conformity. Whereas with configuration management, the exact configuration of the test article is known at all times from the

beginning of a program and the configuration can be quickly checked against the test requirements. This opening up of the test article can sometimes delay starting a test by several hours or days. On a program with several different test articles, or large test articles such as an airplane, this can result in significant program costs due to the added man-hours and delays in testing.

Travel costs involved with sending FAA designees to do a second conformity can add several thousands of dollars in direct travel costs plus additional delay costs when designees aren't immediately available or have to conduct several inspections at different locations during a trip. Eliminating or reducing the number of articles that a designee must personally inspect would significantly reduce direct and indirect costs to the program. Also, with an electronic configuration management system, some FAA conformity verifications could be conducted from the designee's or FAA inspector's home base without the need for travel.

The working group outlined the following objectives for a new process:

- Replace individual component-based conformity with a systematic approach to test article configuration management that satisfies FAA conformity and safety requirements in accordance with 14 CFR 21.33 and 21.53.
- Streamline the test article inspection and conformity process to eliminate unnecessary and redundant activities.
- Maintain or improve safety for flight test pilots.
- Consolidate and integrate records for as-designed, as-built, and as-tested configurations to improve assurance that the as-tested configuration is representative of the approved type design, or serves the intended purpose of the test.
- Consolidate and integrate records showing a company's progression towards production approval readiness for a new airplane model as well as facilitate expedient issuance of applicable airworthiness certificates.
- Utilize Configuration Management as an integral part of the production process.

The proposed solution was for the FAA to allow adoption of modern configuration management practices. Configuration Management (CM) can be used to track the design throughout the life of the test article and provides the same information as conformity about the as-designed, as-built, and as-tested configurations, including any deviations and their disposition, at any time during the project. This approach ensures the article is properly controlled through a CM system versus the current conformity process that is only capable of managing configuration at the individual component level. This is because a CM system manages the complete lifecycle of the article through an integrated system whereas the FAA conformity process manages build configuration in discrete packages that require manual reconciliation of configuration, which is often overly burdensome to manage. Further, under FAA conformity, the business systems for managing as-designed, as-built and as-tested configurations are often separate systems (e.g., design and test configuration changes are often tracked separately following the as-built conformity inspection), which makes reporting difficult during the reconciliation process.

Benefits of this process for the applicant would be reductions in:

1. Direct expenses caused by FAA conformity,
2. Indirect expenses caused by program delay, and
3. Operating expenses for designees or FAA inspectors to travel to witness FAA conformity inspections.

The white paper details direct type certification conformity expense savings on the order of 2 to 8 full time personnel depending on the complexity of the project as well as travel savings of $40,000 per year during routine times to $200,000 per month during peak type certification efforts.

While the FAA also benefits from reduced cost of oversight and travel, some of the more intangible benefits the FAA may see include:

1. Advisory Circular guidance that will standardize the CM procedure across applicants that is created by industry participants to assure grounding in current practice (note there is significant disparity between applicants implementing the FAA conformity process today).
2. More accurate revision control of test article configuration for applicants and Aircraft Certification Offices (ACO) that allow use of "…or later FAA approved revision" statements on Request For Conformity (RFC). The CM process would allow the applicant or FAA to query article configuration and compare to the required configuration at any time during the test program rather than leaving an open-ended conformity request. In order to avoid having to continually revise RFCs when a configuration changes during a certification testing program, it has been accepted practice for the RFC to specify a particular configuration, or a later configuration if it has been approved by the appropriate Designated Engineering Representative (DER), AR, or other authorized engineer. Under a CM process, when a configuration changes, the appropriate engineer(s) will review the configuration and determine if it meets the requirements for the applicable tests and will approve the configuration in the configuration management database as being acceptable for the applicable tests. If it is not acceptable for certain tests, that will also be identified and noted in the CM database by the engineer. Therefore, the database records the appropriate engineer(s) conscious decision to accept the revised configuration for the applicable tests. This process actually provides a better, more robust process for ensuring the correct configuration is used for testing than the current conformity request process.
3. Configuration management systems that enable documentation of the evaluation of mid or late program design changes on previously accomplished testing. With the configuration management process, the exact configuration tested for any test is recorded in the database. Thus, it is easy to review configuration changes made after a test has been successfully completed and determine if a new configuration is acceptable without re-testing. This new configuration may be the result of changes during the open project or actually may be changes

made as a result of a later project. This evaluation will be recorded in the configuration management database and can be retained in the database and exported directly to a compliance report. It is also possible to use this information to evaluate more easily whether testing may be required on subsequent projects involving the same test article.

Three sections of 14 CFR part 21 apply to the conformity process: §§ 21.33, 21.35(a) and 21.53. The white paper provides a brief discussion of each and the impact of this proposal. In summary, the proposal to use configuration management meets the requirements of part 21 without further rule change. FAA conformity is not discussed anywhere in the regulation, but instead has been used as one method to meet the intent of § 21.33(a). This proposal would enable an alternative method to the current conformity process to meet the inspection and configuration management requirements of part 21.

The white paper proposes new guidance should be developed to provide a configuration management and inspection standard that can be referenced by applicants and FAA personnel and provide the minimum requirements by which to approve and audit the applicant's program. An AC should be developed to provide a complete description of the CM process as follows:

1. Draft AC 21-xx Configuration Management System for Control of Certification Test Articles, Production, and other appropriate article configuration relevant areas (this will be drafted by industry through the ASTM process and proposed to the FAA)

2. This AC should consider:

    a. The controlled data listed in FAA Order 8110.4C, Para 5-3.d,

    b. The controlled data listed in FAA Order 8110.49, Para 4-3 and 4-4,

    c. Description of Compliance Verification Engineer qualifications, functions, and limitations and,

    d. Improving guidance for completing Request for Conformity Special Instructions that addresses the issue of generic Special Instructions that are insufficient to determine the specific issue of concern to the requesting FAA ACO Engineer or designee.

To avoid burden for applicants already using FAA approved inspection procedures for type certification, the guidance should allow for inclusion of inspection procedures in the Quality Assurance Manual (QAM), Organizational Designation Authorization (ODA) manual or other FAA approved manual held by the applicant.

3.2.3 Minor Change Approval Summary

The working group compared the minor change approval process that each ARC member company used and noted a lot of variation, with some companies having a very onerous process and others a more streamlined process. The working group compared each manufacturer's processes and then selected

best practices from each to develop a proposed method for approval of minor changes to type design by an airplane manufacturer. It should be noted the Alterations and Maintenance Working Group also addressed this issue, but from an alteration perspective. The two groups worked together to develop common definitions to the extent possible.

Applicable Rules:

1. Sec. 21.93 - Classification of changes in type design.

   (a) In addition to changes in type design specified in paragraph (b) of this section, changes in type design are classified as minor and major. A "minor change" is one that has no appreciable effect on the weight, balance, structural strength, reliability, operational characteristics, or other characteristics affecting the airworthiness of the product. All other changes are "major changes" (except as provided in paragraph (b) of this section).

2. Sec. 21.95 - Approval of minor changes in type design.

   Minor changes in a type design may be approved under a method acceptable to the [FAA] before submitting to the [FAA] any substantiating or descriptive data.

Section 21.95 states that minor changes in a type design may be approved under a method acceptable to the FAA before submitting to the FAA any substantiating or descriptive data. Further, § 21.93 defines a minor change as one that has no appreciable effect on the weight, balance, structural strength, reliability, operational characteristics, or other characteristics affecting the airworthiness of the product.

A significant area of concern to both working groups was the definition of “appreciable” in § 21.93. The white paper proposes what “appreciable” means for each of the six characteristics identified in the rule (weight, balance, etc.). The paper also offers guidance as to the types of changes that affect different engineering disciplines. Lastly, the paper proposes a process for approval of a minor change to type design.

The proposed process relies on qualified personnel to determine if a change to type design is major or minor based on § 21.93 and the guidelines in the white paper which supplement § 21.93 (i.e. the definition of appreciable). The decision of major or minor for the change is determined for each affected discipline, including consideration for the cumulative effect of minor changes. For the change to be minor, it must be determined to be minor for all affected disciplines. The change evaluation rationale is documented and retained.

The company completes any engineering activities associated with the minor change, including that:

1. Any analysis is complete and company approved,

2. Any company testing required to confirm no appreciable effect at the airplane level is complete, documented, and company approved, and

3. The changes to the type design drawing(s) are company approved.

After completing these activities, the minor change is considered approved through this process. The company retains evidence of completion of this process for every minor change. This evidence may be reviewed during FAA audit activities.

One company with a more onerous minor change approval process than other companies stated they review approximately 2000 minor changes per year. This company believes they could save over $100,000 per year by implementing this proposed process.

It is the working group's expectation that the FAA will find the process described here as acceptable and issue a policy memo or other statement supporting it as a "method acceptable to the FAA." Each company then has the option to either stay with their currently approved process or adopt this new one.

3.2.4 Applicant Showing Only Summary

The goals of the 14 CFR Part 23 Reorganization ARC were to improve safety for the part 23 aircraft and to reduce the cost of certification. This paper, described in Appendix F.5, proposes a method to do both through:

1. Use of Safety Management tools the FAA is implementing, and
2. Less direct involvement of the FAA in determining compliance to the regulations as allowed by part 21.

A number of the FAA Safety Management Processes and Orders were considered when developing the risk-based process proposed in this paper, which determine when an applicant can simply show compliance without the FAA, a DER, or ODA unit member finding of compliance.

A recent change to part 21 is the addition of the Statement of Compliance requirement of §§ 21.20(b) and 21.97(a)(3) that increases the accountability of the applicant's management to ensure that compliance is properly shown as described in AC 21-51. Consequently, in addition to there being economic incentive, there is further legal incentive for applicant management to ensure compliance is properly accomplished without having to rely on the FAA, a DER, or ODA unit member to find compliance.

There are varieties of applicants for type certification projects. At one end is the applicant who is very competent, has successfully completed multiple certification programs, and holds an Organization Designation Authorization (ODA). At the other end is a company lacking proven processes and organizational competency relevant to the certification process and everything in between. All applicants, no matter what level of experience or competency, have a responsibility when executing a part 21 type certification project to:

1. Conduct all inspections and tests to show the compliance of the design and product (§ 21.33(b)),
2. Make all flight tests that the Administrator finds necessary (§ 21.35(b)),
3. Submit all data showing compliance (§ 21.21(b)), and

4. Provide a statement certifying compliance (§ 21.20(b)).

As the applicant completes the showings of compliance detailed in steps 1 through 4 above, the FAA or its designees:

1. Find upon examination of the type design that applicable requirements have been met (§ 21.21(b)1)

2. Make any inspections and tests necessary to determine compliance of applicant's design and product (§ 21.33(a))

This paper proposes a structure for when applicant showing only is sufficient as a function of the type of applicant, the risk of improper test conduct/data analysis, and their resulting potential impact on safety. This proposal evaluates applicants based on three criteria:

1. Staff Competency – What is the skill level of the individual staff members of the company working the certification activities? Are there sufficient DER's or ODA Unit Member's (UM's) on staff to support a complete aircraft design and certification project? Does the company have ready access to specialists at suppliers or consultants as necessary to complement staff?

2. Company Competency – What internal organization and resources does the company have in place to facilitate certification programs? Does the company management fully support the staff training and access to resources necessary to keep the staff current with FAA policies, regulations, and guidance related to certification activity?

3. Procedural Effectiveness – Does the company have adequate internal processes to ensure that work product is thorough, consistent, well-documented, etc.? Are the processes in place proven, industry best practices? Do the internal processes include a continuous improvement process to evaluate the procedures on a regular basis and take corrective action as needed?

For each of three criteria, the paper details the characteristics for being rated low, medium, or high. An applicant would work with the FAA to determine their rating for each of the three criteria. This rating could be re-evaluated on a regular basis as the company improves or concerns are raised. Either the FAA or the applicant may request a re-evaluation of the company's rating. Based on the ratings for the three criteria, an overall classification is established for the company based on the following:

1. Tier 1 would rank low in two or more of the criteria.

2. Tier 2 would rank medium in at least two of the criteria and high in the other.

3. Tier 3 would rank high in all three criteria.

For each of these company classifications, analysis and testing methods have been reviewed to assess the risk of improper test conduct and the resulting potentially inaccurate data or potential errors in analysis. The various analysis and tests were selected based on:

1. Analyses where:

    a. The analysis method is well defined and understood – the method has been validated and is proven; and

    b. The likelihood that the analysis method will not adequately show compliance to the requirements is very low.

2. Tests where:

    a. Testing methods are well defined by either an Airworthiness Design Standard, Advisory Circular, or other accepted standard including company test procedures that are proven;

    b. Testing methods are well understood and have little subjectivity;

    c. Testing methods are repeatable – all variables that could affect the test are known and are controllable and repeatable;

    d. There are clear pass/fail criteria; and

    e. The likelihood that the test method will not adequately show compliance to the requirements is very low.

Table 3.2 provides the proposed work split between the applicant and the FAA.

Table 3.2 – Work Split Definition

Type	Category of Applicant		
	Tier 1	**Tier 2**	**Tier 3**
Analysis	Data Analysis Performed by Applicant Analysis Approval Approved by FAA (or DER)	Data Analysis Performed by Applicant Analysis Approval Approved by Applicant	Data Analysis Performed by Applicant Analysis Approval Approved by Applicant
Testing	Test Procedure Approved by FAA Conformity Conformed by applicant, may have FAA oversight (or DAR) Test Conduct Conducted by Applicant Test Witness Witnessed by FAA (or DER) Test Data Approval Approved by FAA (or DER)	Test Procedure Approved by Applicant Conformity Conformed by Applicant Test Conduct Conducted by Applicant Test Witness Witnessed by Applicant Test Data Approval Approved by FAA (or DER)	Test Procedure Approved by Applicant Conformity Conformed by Applicant Test Conduct Conducted by Applicant Test Witness Witnessed by Applicant Test Data Approval Approved by Applicant

Note 1: Table 2 of the white paper identifies 24 types of analysis covered by this proposal.
Note 2: Table 3 of the white paper identifies 87 types of testing covered by this proposal.

3.2.5 Use of Video Recording in Testing Summary

Objectives:

1. Acknowledge validity of utilizing video recording techniques for capturing key testing information.
2. Improve quality and/or integrity of captured test data.
3. Improve utilization of FAA resources and designees by enabling remote witnessing.
4. Define parameters necessary for the successful utilization of video recordings for data capture.

Background Information:

The current primary method of data capture during certification testing is via real-time witnessing by appropriately delegated individuals. While this method of witnessing is sometimes augmented with video recordings, the use of video is typically viewed as a "back-up" to the physical presence and real-time witnessing of a human being. (Note that there are precedent instances where video has been

utilized as the sole means of witnessing, but these have been rare and have required "special dispensation.")

FAA designees perform the vast majority of test witnessing, which places a burden on the applicant to either hire consulting Designated Engineer Representative (DER)/UMs or obtain delegation of company DER/UMs. Regardless of the nature of the designee, minimizing the time required of that person will have a direct corollary effect on the financial impact experienced by the applicant.

For testing that takes place at or near the applicant's place of business, direct travel expenses for the applicant already will be minimal. However, if the applicant is utilizing consulting DER/UMs it is likely that such individuals will need to travel in order to witness the test. In addition to the "base fee" for the consultant's time, the applicant will also incur travel, lodging, and meal expenses. Also, many consultants will charge for their on-location time based on full-day increments, even if the actual witnessing efforts consume only a few hours. Even if company DER/UMs are utilized, some testing requires travel to lab locations for witnessing; thus, the associated travel costs remain.

These effects can also significantly consume FAA resources when the option is exercised to witness tests with FAA personnel. Exercising this option normally involves traveling some distance to the test site, incurring similar expenses to those discussed above due to either the distance traveled or the length of the testing in question. This eventuality is more likely in the case of startup companies when confidence in the company personnel, processes, and procedures is still being assessed.

FAA test witnessing is conducted for one primary reason: To provide confidence in the validity of the test setup, the test execution, and the ensuing results. It is possible to accomplish all of these requirements through an alternate means to personal, real-time witnessing through utilization of video witnessing or recording.

The white paper described in Appendix F.6:

1. Details many potential uses of video recording and the advantages.
2. Details the benefits to both the applicant and the FAA.
3. Identifies three primary areas that must be considered to make the use of video witnessing a viable proposition. These are:
    a. Adequate coverage,
    b. Video fidelity, and
    c. Data integrity.
4. Discusses various requirements to consider when the FAA establishes the guidelines for video witnessing.

5. Concludes based on a part 21 review, that the use of video as described in the white paper would not violate any part 21 requirements; therefore, no modifications to the Federal Aviation Regulations (FARs) are necessary to allow the use of video witnessing.

A brief search of the available guidance material was conducted to see if any language was currently being used that would preclude the use of video as described in the document; none was found. However, two lines of reasoning were discovered that lend credence to the idea that video witnessing is in line with the current philosophy underlying witnessing.

a. In FAA Order 8110.37E, paragraph 2-6.b, it states:

> *"…DERs may be authorized to witness tests outside their area of authority provided that the DER (1) is authorized to do so by the ACO, and (2) does not make the final compliance finding."*

The implication here is that physically observing the test-taking place is not necessary to find the data valid. The importance is in monitoring the activity to ensure that the test plan was followed, no critical errors were introduced, the data was appropriately collected, etc. Employing video witnessing as described in the white paper can accomplish these same goals, enabling properly authorized individuals to make final compliance findings although they were not physically present for the test.

b. Additionally, FAA Order 8110.37E, paragraph 4-4.a states:

> *"…Before witnessing the test, the DER must verify that the necessary FAA conformity inspections have been accomplished, that the test article is in conformity, or that all unsatisfactory conditions have been dispositioned. A DER is not required to witness an entire test to approve the test data. However, the DER must coordinate with the ACO to determine which conditions are critical and must be witnessed in order to ensure that all the data are valid. When DERs approve test data, they indicate that they witnessed those portions of the test dealing with critical conditions, the test was conducted in accordance with the FAA approved test plan, and the data are official test results that satisfy the test criteria for compliance."*

The proper use of video witnessing would provide the ability to not only "witness those portions of the test dealing with critical conditions", but also the ability to review these critical events in detail. In addition, non-critical portions that may otherwise go un-witnessed would be available for review at the DER's discretion. The utilization of video witnessing would not only meet the intent of the existing guidance, but could be leveraged to actually enhance the witnessing coverage.

The white paper concludes with the recommendation that new guidance should be developed to provide a video witnessing standard that can be referenced by applicants and FAA personnel, and to provide the minimum requirements by which video witnessing can be successfully utilized. An Advisory Circular should be developed to provide a complete description of the video witnessing process to include:

1. Update policy to endorse the use of video technology in test witnessing,
2. Endorse an ADS on Video Witnessing of Certification Tests,
3. This standard should consider:
    a. The types of testing that could most benefit from the use of video witnessing; and
    b. The minimum parameters discussed above regarding coverage, fidelity, and integrity.

3.2.6 Production Manual Summary

Many new startup companies struggle with creating basic guidance for their workers that will help them ensure that they are accomplishing the major requirements necessary to produce an aircraft.

The intent of the Production Manual found in Appendix F.7 is to satisfy the minimum requirements for a Quality Assurance Manual of a new startup company but in such a way that it will integrate with the more comprehensive requirements of a Design Organization (DO)/Production Organization (PO) Handbook without major changes, should one be desired in the future. The basis of this Production Manual is the requirements in 14 CFR 21.137.

Several airplane manufacturers of this working group provided a copy of their Quality Manual to show how the 14 elements of § 21.137 are satisfied to establish and maintain a production certificate. These manuals were compared to identify best practices with emphasis on simplicity. The result is a draft quality manual that provides new aviation business entrants with a detailed starting point in developing and obtaining their own production certificate. This draft manual could then be integrated as part of the DO/PO handbook described in the next section.

The Production Manual is organized so a new company with only a few employees could start with it and easily modify it to be integrated with a more comprehensive DO/PO Handbook to accommodate company growth as needed.

The Production Manual provides only the basic general information and each company must determine how much to add to or modify to satisfy their needs.

3.2.7 Design Organization/Production Organization Handbook Summary

Today's typical aviation manufacturing company is segmented into different activities (e.g., engineering, production, quality, etc.). Each of these segmented activities normally use separate handbooks to meet their specific requirements. Most companies maintain separate Design Organization Type Certificate and Production Organization Production Certification handbooks or manuals, and when operating in different countries, sometimes slightly varying versions of these handbooks.

The FAA currently asks for handbooks covering each operational segment such as certification or production. Significant effort is spent to establish and maintain separate handbooks resulting in high administrative burdens, especially for small companies that maintain both TC and PC handbooks for one

product, for one company, and under one roof. This gets more complicated when the same company acts as a component supplier under AS/EN 9100 approval with a third set of requirements and a third handbook. The situation leads directly to potentially conflicting information in the different handbooks because of process disconnects. This increases the opportunity for process errors in daily work.

By comparing the requirements basis for existing accepted handbook samples, including the ODA manual, a harmonized approach is identified that allows small companies to set up one single, integrated quality management process satisfying all typical requirements, as an alternative to today's interpretation indicated by the FAA Orders such as FAAO 8110.4, 8100.15, and 8130.2.

The harmonized approach is manifested in a standard handbook template that can be utilized and adopted to the individual company conditions.

The harmonized standard handbook approach implements several recommendations from the list of 17 cost drivers the TC/PC Working Group identified that are listed in Appendix F.2. Topics identified as having significant potential for optimizing processes in terms of time, effort, cost, and safety are included in these recommendations. By including these results within a standard handbook, a level playing field is established with limited room for local FAA interpretation that might have negative impact for an individual company.

Throughout the process of generating the standard handbook approach, the ability for this handbook to comply with the regulations of different major agencies, such as the FAA and EASA was verified. This levels the playing field even beyond the limits of FAA jurisdiction.

3.3 Alterations and Maintenance

3.3.1 Background

The stated objective of the 14 CFR Part 23 Reorganization ARC is to improve safety within the fleet by reducing the average cost of certifying, maintaining and operating part 23 airplanes and facilitating safety-related upgrades. The preferred approach is to:

1. Define the regulations at a higher level that maintains the original intended safety requirement and eliminate prescriptive requirements within the regulations according to as-yet to be determined criteria, and

2. Modulate the part 23 requirements by tiering through standards to create a more rational and economical relationship between the certification requirements and the characteristics of each airplane.

Part 23, however, is not used in isolation; other regulations and standards are also applied. While part 23 provides structural, performance, and systems requirements (for example), these requirements are applied under procedures governed by part 21 for both initial manufacture and for alterations approved

by STC. Alterations and maintenance for these airplanes are performed under part 43. Airplanes certified under "old" (amendment 62 or earlier) part 23 and the even older CAR 3 will continue to be flown, altered, and maintained for many, many years.

The full benefits of changes to part 23 may not be realized if they are applied with a traditional view of other CFR parts. Some level of coordinated change to these regulations (or to the policy, guidance, and culture that govern their application to part 23 airplanes) may be desirable.

The goal of the Alterations and Maintenance working group was to identify issues related to post-production activities under the "new" (post amendment 62) part 23. These issues may apply to airplanes certified under "new" part 23, the "old" part 23 or CAR 3, and may involve part 21 and part 43 considerations. For each identified issue, the working group made recommendations whereby the issue might be addressed. Solutions should be seamless for any previous certification process.

The working group considered and wrote reports (each of which included specific recommendations) on the following subjects:

- Simplified certification of systems and equipment for use on in-service airplanes
- Procedural issues associated with STCs and alterations under the new Part 23
- Preventive maintenance

In addition, the working group supported development of a proposal for the creation of a new Primary Non-Commercial category of airplanes.

Recommendations made by the working group are listed in Section 6. The reports written on each topic can be found in Appendix G.

3.3.2 Certification of Systems and Equipment

Background

This section summarizes Alteration & Maintenance Working Group's analysis and recommendations of the Certification of Systems and Equipment.

Installed systems and equipment have the potential to contribute greatly to the safety of flight, both as installed at the time of manufacture of the airplane and as installed throughout the airplane's service life. The cost of the articles and their installation; however, tend to inhibit their installation on airplanes at all levels. If these cost barriers can be lowered without compromising safety, increased adoption rates can result in safety improvements within the fleet.

In many cases, the costs associated with design, manufacture, and installation of systems and equipment are largely determined by the applicable certification requirements. Much of the cost of airborne systems results from the requirements of §§ 23.1306, Electrical and electronic system lightning protection, 23.1308, High-intensity Radiated Fields (HIRF) Protection, and 23.1309, Equipment, systems, and installations. If these certification requirements can be reduced without posing a direct threat to safety, the resulting cost reduction may actually result in an overall safety improvement because of increased adoption of newer equipment that can provide better situational awareness as well as other safety features. The costs arise not only as a result of the rules themselves but also as a result of the policy, guidance and culture that influence the application of the rules. Even in the absence of rule changes, changes in the way the rules are applied can greatly influence the ease or difficulty and cost of development and installation of these articles.

Comparative risk

The existing guidance describes safety-related certification requirements in relation to the risk associated with deployment of a given system into the fleet. That risk is estimated based on a functional hazard assessment and mitigated based on the results of a design and installation appraisal or system safety assessment, depending on the level of risk.

The existing guidance, however, fails to address the risk associated with a *failure* to deploy. Specifically, safety related functions may have the potential to reduce the accident rate associated with the specific flight hazards that they address. Any risk associated with the deployment of systems that assist the pilot in avoiding specific hazards may be offset by the avoided risk to operators and their passengers associated with those hazards in the absence of the systems.

Thus, an appropriate way to judge the net safety impact of a given system would be by assessing the comparative risk associated with its deployment and non-deployment. Systems that have the potential to address hazards that are especially significant in GA (such as loss of control) would merit consideration at lesser-estimated reliability (i.e., higher risk) than might be considered for less significant hazards.

Exposure

The present guidance grants no credit for hazard exposure in the assignment of development assurance levels.

Exposure describes the fraction of overall flight time during which a given failure would result in a hazard. The failure of an attitude indicator, for example, is hazardous only in instrument meteorological conditions (IMC) when the pilot cannot maintain attitude by reference to the actual horizon. Exposure

is used in the estimation of failure rates for comparison with the numerical reliability requirements (i.e. using guidelines that are, some would argue, excessively conservative, such as the guideline that an airplane certified for IFR use should be assumed to be in IMC at all times) but is not made a factor in determining the appropriate DALs.

Alternate means of compliance (AMOC)

The FAA assists applicants by a number of means, including publishing Advisory Circulars that both clarify the often abstract rules, providing specific compliance criteria, and offer means of compliance by which the applicant can show that those criteria have been met. As noted previously, these acceptable means of compliance are often supported by ADSs, such as RTCA DO-160(), DO-178() and DO-254(). Indeed, some ACs serve no purpose other than to identify an industry standard as acceptable means by which compliance with some rule, or some aspect of a rule, may be shown.

Notwithstanding the potential difficulty, an applicant proposes an AMOC ordinarily because it is more appropriate to the situation than the usual means and this normally implies it will be more efficient overall, whether within the course of the project in which it is first used or successive projects. For efficiencies to be realized, the FAA must be a willing – or even enthusiastic – partner in the endeavor and reason must prevail on both sides. Even though a given applicant's AMOC is proprietary, the experience gained in evaluating it and approving it has significant value to the FAA.

Use of service history for certification credit

Service history should not only be creditable for new systems but should also be creditable for previously developed systems, primarily as a means of allowing systems shown to be reliable on less complex airplanes to be used on more complex airplanes as well. Historically, the FAA has had very limited ability to evaluate and accept service history arguments for DAL upgrades, thereby blocking this path. For many systems, this has the effect of denying access to highly reliable and functional equipment due to the economic barriers associated with DAL upgrades.

Use of functional standards for DAL credit

At Level D, both DO-178B and DO-254 essentially require only functional verification (with some additional documentation, configuration management, and quality assurance requirements). It has been observed that compliance with third party functional standards (e.g., TSO MOPS) could be regarded as equivalent to compliance with Level D. Since the step function of cost from "no compliance required" to Level D is very large, especially for companies not yet selling certified products, there are correspondingly large advantages to be gained by formally recognizing such compliance as sufficient.

Cultural issues

In the end, the single most important factor in determining the success or failure of a regulatory structure is the culture in which it is applied. If the regulations are thoroughly understood, if the supporting guidance is clear, and if those in the culture embrace the regulations, abiding by the requirements and using permissions granted to them to their advantage, great successes are possible.

If, however, the regulations are largely ignored, if the supporting guidance is unclear or unsubstantiated in terms of the regulations, and if those in the culture operate on the basis of tradition and uninformed intuition rather than on the basis of the true regulatory intent, the results are sure to be negative, frustrating, and costly to all involved.

For any changes to regulations, policy, or guidance to succeed, it is imperative that they be fully and clearly supported in guidance and policy. Moreover, they must be publicized and training must be available to FAA personnel, designees, and applicants in order to ensure their proper use. In certain cases (e.g., the use of service history, for example), it may prove desirable to identify specific pilot projects in which the concepts can be tested for both efficacy and efficiency.

3.3.3 Supplemental Type Certificate (STC) and Alterations under the New Part 23

After manufacture, airplanes may be altered by means of Supplemental Type Certificates (STCs) developed under part 21 and by means of major and minor alterations under part 43. With the introduction of the new part 23, it is essential that these means be maintained for both new and legacy airplanes in order to insure continuing access to safety improvements.

Background

Irrespective of the path by which an alteration is defined and approved, the airplane must continue to comply with the applicable rules under which it was certified or, in some cases, newer or added rules applicable to the specific alteration.

To improve the safety of the existing fleet it is imperative that operational airplanes be upgraded to meet the needs of an evolving operational environment. The revised regulations, supporting guidance, and resulting changes in behavior of all involved parties could result in the emergence of unanticipated safety issues or (and, potentially, more likely) unacceptable impediments to the use of the new rules and standards.

As the new part 23 and supporting guidance are developed, sensitivity to the needs of the aftermarket must be shown to address owners' ability to make safety related improvements to their airplanes after delivery. These needs include:

- Workable establishment of the boundary between compliance requirements (i.e. the regulations) and means of compliance (i.e. ADSs and others),
- Clear and appropriate establishment of the certification basis for the airplane as manufactured,
- Provision of essential information facilitating alterations in the TCDS and aircraft service records, and
- Publication of guidance for applicants and FAA personnel on the proper interpretation and application of it all.

Certification Basis and TCDS for Newly Manufactured Airplanes

The certification basis of an airplane describes the airworthiness regulations and other provisions – exemptions, (ELOS) findings, and special conditions – that apply based on the airplane's configuration, powerplant, equipment, intended use, and other characteristics (Order 8110.4C, paragraph 2-3d(4)). This process for establishing the certification basis and means of compliance should continue with no significant change.

Because the certification basis is strictly regulatory and is not dependent on the means of compliance, it follows that it must contain only rules, exemptions, ELOS findings, and special conditions. Thus, under the new part 23, the certification basis cannot, and should not, identify either the ADS(s) employed or particular provisions of the ADS(s) that are found to be applicable – any more than would be done for Advisory Circulars or existing industry standards today.

The TCDS as defined by § 21.41 is a key input to determine the certification basis for subsequent alterations. As the certification requirements contained in part 23 are simplified, and as aspects are moved into ADSs, it is important that sufficient information remain in the TCDS to permit STC applicants and the FAA to clearly and accurately identify the certification basis for the alteration.

The current TCDS essential characteristics requirements from FAA Order 8110.4 may not suffice and the order may require revision to incorporate additional items that lead to certification basis determination and compliance path choices within the ADSs, particularly when tiering within a standard is applicable.

Certification Basis and TCDS Information for Alterations

When airplanes are altered after initial delivery, whether under an STC or not, the same range of airworthiness concerns may arise as in the original certification. Consequently, compliance with the relevant provisions of the airworthiness regulations must be assured on the altered airplane.

Identification of airworthiness compliance issues can become complicated as an airplane ages. It's rare for an airplane of any substantial age to maintain its original configuration. As these alterations are made, it is often the case that there is no single reliable data source regarding the airplane's configuration and aggregate certification basis.

One potential solution would be the creation of the altered configuration of the airplane, in a form that is more conducive to maintenance and existing recordkeeping requirements. This reorganization of existing information can be used as the sole detailed record in this regard, directly in support of regulatory recordkeeping requirements, with references to its contents from the primary airplane logs as needed for clarity.

New Regulations, Airworthiness Design Standards (ADSs) and Their Application to STCs and Alterations

As noted in the discussions of the activities of the Regulatory Structure subgroup, as the new part 23 is developed, it is anticipated that portions of it will be restructured and that some of the more detailed requirements will be moved into one or more industry-maintained ADSs that effectively form the top-

level means of compliance with the regulations. As these regulations, ADSs, and accompanying guidance documents are developed, it is important their structure and content continue to support effectively the development of STCs and the alteration of individual airplanes.

If multiple standards are recognized as means of compliance with particular regulations, an applicant must be permitted to choose from among them without regard to the ADS chosen for other regulations. Use of one particular standard in a project must not obligate the applicant to use that ADS in any other aspect of the project.

Approved Model List Supplemental Type Certificates

The use of Approved Model List (AML) STCs as described in AC 23-22 is crucial to the efficiency of alterations in the aftermarket. This is especially true for avionics systems, where support of many airplane types by a single system is normal and the potential for safety improvement is high. Beyond accommodations of the new part 23, modest changes to existing AML practices would add flexibility and reduce cost.

Because the airplanes listed in an AML will inevitably have differing certification bases. The common practice is to develop the STC to the latest regulation amendment level or, depending on the classification of the change under § 21.101, to the latest amendment appearing in the certification bases of the listed airplanes and to the most stringent requirements applicable to the listed airplanes. This practice must still be applicable under the new part 23.

In particular, compliance with the new part 23, if elected by the applicant, irrespective of the chosen means of compliance, must be regarded as sufficient with regard to airplanes originally certified under any previous small airplane regulation at any amendment level.

In some cases, airplanes may have met more stringent certification basis than the latest amendment level of part 23. In these cases, it is envisioned that future alterations of those aircraft could be performed to the latest certification basis, which might no longer include a particular requirement because of certain characteristics or simplicity of a particular design.

Field Approvals

At present, there are many cases where concerns about the categorization of proposed alterations result in minor alterations being treated as major and major alterations are required to be made under STCs. As the new part 23 is introduced, the conservatism currently found in the system could very well increase, negating the hoped-for increases in efficiency. If efficiency is to be improved, a combination of updated guidance and targeted training for both FAA and industry personnel will be required. In

addition, close coordination between Flight Standards, the ACOs and SAD will be required to facilitate minimum-cost resolution paths for common introduction problems.

Alternate Means of Compliance

The industry-developed ADSs are expected to constitute top-level means of compliance with the new part 23. As with any recognized means of compliance, the use of alternate means, including direct compliance with the rules, has to be permitted. As is now the case, alternate means of compliance must be permitted at lower levels as well.

In the current culture, the use of alternate means of compliance tends to be mostly impossible. Even though it's permitted in principle and supported, typically, by the ubiquitous "one means but not the only means" clause in the Advisory Circulars, the FAA often has difficulty accepting concrete proposals.

As the transition toward greater and greater reliance on ADSs occurs, this situation will certainly persist. Just as a genuine and effective openness to the efficient use of alternate means of compliance to presently accepted means (e.g., RTCA DO-160G, RTCA DO-178B, RTCA DO-254, SAE ARP 4754, various ACs, etc.), is needed, so is alternate means for the new standards and future supporting documents will be required.

Role of the Aircraft Manufacturer

Certain aspects of the development of the new part 23 are loosely modeled on the experience gained in the development of the Light Sport Aircraft (LSA) approval process. In particular, the establishment and maintenance of Airworthiness Design Standards has a direct analog in LSA. There are, however, significant differences as well.

LSA are not type certificated under part 21. All airworthiness standards are maintained by industry and recognized by the FAA. Many LSA manufacturers are relatively inexperienced and the majority are foreign. Since there is no type certification, nor supplemental type certification process for LSA.

As a consequence of these and other factors, it is a requirement that all alterations to LSA be approved by the aircraft manufacturer.

It might be tempting to impose this same requirement for airplanes certificated under the new part 23 based on the fact that a portion of the detailed airworthiness requirements are expected to move into ADS. However, such a move is unnecessary because the essential airworthiness requirements will continue to reside in part 23. Moreover, an extensive infrastructure of STC developers and shops is already in place to support part 23 airplanes.

Imposition of a manufacturer approval process for alterations to part 23 airplanes would substantially inhibit development and use of safety related improvements to airplanes in the fleet.

3.3.4 Preventive Maintenance

The part 43 provisions on preventive maintenance are outdated, inflexible, and confusing, resulting in a reduction of pilot performance of preventive maintenance below optimal levels.

Background

14 CFR 43.3(g) permits certificated pilots, with the exception of sport pilots, to perform specific preventive maintenance (PM) operations on aircraft that they own or operate under part 91. These PM operations are limited to those listed in part 43 Appendix A Section (c). Other sections of part 43 permit the pilot to return the airplane to service following performance of PM and record keeping requirements. In addition to the rules, there are also two Advisory Circulars with content on PM: AC 43-9C, *Maintenance Records* and AC 43-12A, *Preventive Maintenance*.

Permitted Preventive Maintenance Operations

At present, part 43 does not include "other operations acceptable to the Administrator" in its definition of preventive maintenance. This language is often included in the regulations in order to grant the FAA flexibility in dealing with rapidly changing or extraordinary circumstances. It is difficult and time consuming for the FAA to adapt to technological and other changes because "other means" is not included in the regulations and the list of authorized preventive maintenance operations is contained within the regulations.

With the introduction of sweeping new content in a revised part 23, the FAA will face such a change situation. Moreover, the incorporation of new technology on airplanes has already led to difficulties in this area. Additional advances in technology may be inhibited if the regulatory criteria governing preventive maintenance are not modernized. The stated objective of the part 23 rewrite is to improve the safety of small airplanes. A supporting objective is the reduction of the cost of airplane acquisition and ownership, allowing owners to more readily afford the purchase of safety-related components and systems. Thus, changes to part 43 that increase the safe availability of pilot-performed preventive maintenance are supportive of the ARC's goals.

Authorization of Additional Preventive Maintenance Operations

At present, the only means by which the list of authorized preventive maintenance operations can be modified is through rulemaking. There is no allowance for additional authorizations in guidance or by policy, nor is there any allowance for authorization of type- or installation-specific preventive maintenance. This poses a substantial impediment to the safe and effective conduct of an increased variety of PM operations in the field.

Once appropriate language is added to part 43, additional PM items can be authorized for general use in guidance or policy documents. Furthermore, type- or installation-specific items can be accepted based on manufacturer's procedures, perhaps in an ICA. The AMWG sees numerous attractive opportunities for safe and economical additions to existing PM authorizations by this route, including installation of

databases other than those authorized in part 43 itself and installation of software, where procedural simplicity and aircraft configuration allow.

Preventive Maintenance Guidance

The FAA has issued two pilot-directed guidance documents with content pertaining to preventive maintenance (PM): AC 43-12, *Preventive Maintenance* (last modified in 2007) and AC 43-9, *Maintenance Records* (last modified in 1998). While these documents are reasonably good at describing the basic regulations that authorize the performance of PM operations by pilots and the approval for return to service, along with the attendant documentation requirements, they do little to address the lack of clarity in the regulations, and specifically the basic list of authorized PM operations in part 43 Appendix A. For example, as noted earlier, AC 43-12A, Change 1, specifically avoids addressing the issue of what constitutes "complex assembly operations", stating, "Owners and pilots must use good judgment when determining if a specific function should be classified as preventive maintenance."

The Working Group believes that this lack of clarity and the delegation of responsibility to the pilot are likely to intimidate and inhibit the performance of PM operations by pilots as intended. The AC, rather than merely quoting the regulations and stating all of the conditions that apply to their use, which is acknowledged to be an important contribution by itself, should strive to *clarify* both the basic regulations and most importantly, the list of authorized PM operations.

As was noted earlier, the provision of clarifying these operations may serve to expand some readers' understanding of the regulations and narrow the understanding of others. Both may prove problematic in terms of acceptance in the field. Nevertheless, the AMWG feels the advantages that accrue from increased numbers of pilots taking advantage of these regulations as a result of improved understanding outweighs any potential disadvantage.

In addition, if other AMWG recommendations are followed, the AC would be an appropriate place to introduce new universally authorized PM operations without the overhead of rulemaking, perhaps to be introduced to the rule after a trial period, and to establish that aircraft and equipment manufacturers may propose PM operations for FAA acceptance as part of their service documents.

3.3.5 Primary Non-Commercial Category

Background

The 14 CFR Part 23 Reorganization ARC was tasked with doubling aircraft safety while reducing certification costs by half. Currently, there are almost 200,000 General Aviation aircraft registered in the United States; however, production of new aircraft averages less than 1 percent of this per year. Consequently, it may be decades before this ARC's improvements for new aircraft design will yield any measurable safety improvements or cost reductions for the General Aviation Fleet as a whole.

One way to realize the safety and cost goals is by leveraging the concepts this ARC developed for use in new aircraft certification in a manner that would have an immediately felt positive safety effect on the existing General Aviation fleet.

This section will summarize the ARC's recommendation to implement a Primary Non-Commercial Category (See Appendix G for complete paper) that is similar to the Canadian Owner Maintenance Category, but with some significant safety enhancements to address some concerns with that program. This recommendation is bold, but reflects the challenge posed to industry at the FAA's ARC kick-off meeting. At that meeting, the FAA challenged the ARC members to be bold, creative, and non-traditional.

The Primary Non-Commercial Category is intended for the private owner to operate their aircraft in a substantially less burdensome and costly manner by reducing the level of FAA maintenance and alteration requirements to a level appropriate for a privately owned vehicle.

This proposal has two precedents that support the concept. First, this class follows international precedent by leveraging the concepts of the Canadian Owner Maintenance Category, which has a proven safety record over the last decade. For more information on the Canadian system requirements and safety results experience see the complete recommendation in Appendix G. Secondly, this concept uses the maintenance training principles of the highly successful LSA program that has a proven safety record. Incorporation of this new category will offer the FAA a rare opportunity for implementation of sound safety continuum principles paired with international harmonization.

In addition, by allowing a practical and workable path to return Non-Commercial aircraft to Standard Category through dual airworthiness certificates, owners will have a large financial incentive to keep their aircraft near type design to avoid devaluing their aircraft. This is a significant safety advantage over the Canadian system where it is nearly impossible to return to Standard Category; therefore, affording no incentive for owners to keep aircraft compliant to safety proven type design.

Finally, the principles set forth in the "Primary Non-Commercial Category" proposal exclusively leverage existing US regulations with proven safety records. The recommendation simply takes successful existing regulatory practices and combines them into the new Primary Non Commercial Category. For example, maintenance training and certification comes from LSA, airworthiness certification comes from dual certificated Standard/Restricted Category aircraft and Non-Commercial use from Experimental Aircraft. There is nothing new or novel proposed, except for the potential for safety and cost improvements that would be available for users of the Primary Non Commercial class.

3.3.5.1 Primary Non-Commercial Category Recommendation

Applicability

The owner of a fixed wing, non- turbine powered part 23 aircraft or part 23 glider, 20 years or older, may elect to redesignate their aircraft as a Primary Non-Commercial.

Privileges

1. Aircraft in this category can be maintained by the owner with a repairperson's certificate, similar to currently established procedures for LSA aircraft repairpersons.

2. Replacement or alteration parts should be appropriate for aircraft use; however, such parts need not be PMA/TSO authorized.

3. Owners can alter their own aircraft without the requirement for FAA approved data; however, some alterations may require "phase 1" flight testing similar to Experimental Amateur Built (EAB) requirements.

Limitations

1. Primary Non-Commercial Category Aircraft are required to observe the FAA Approved Aircraft Flight Manual Operational Limitations and/or required placard limitations established for the Standard Category.

2. Aircraft cannot be used to carry persons for hire, this includes aircraft rental, but allows an owner to receive flight instruction in their own aircraft.

3. Airworthiness Directives are only applicable as currently allowed for EAB.

4. Aircraft owners must maintain a list in the aircraft logbook of all applicable ADs and their compliance status. This list will be used to highlight the owners' awareness of the ADs existence and document their choice of compliance. This list will also be used to facilitate the conversion of the aircraft back to normal category.

5. Aircraft owners must maintain a list in the aircraft logbook of all alterations performed that are not FAA approved and all non PMA/TSO parts installed. This list will be used to facilitate the aircraft conversion back to normal category.

6. Incomplete or fraudulent maintenance logbook entries result in the revocation of the aircraft's standard airworthiness certificate.

Requirements

1. Before original conversion, the aircraft must have a current annual inspection – all applicable ADs must be complied with at the current annual inspection.

2. Airplane owners must either add the prefix of "NC" to the aircraft registration number or affix a "Non-Commercial" placard readily visible to all passengers.

3. The aircraft must have a yearly condition inspection by an A&P mechanic certifying that the aircraft is "in condition for safe operation."

4. Upon transfer of aircraft ownership, the Non-Commercial Airworthiness Certificate must be reissued in the new owner's name.

Conversion Back to Normal Category

1. Aircraft operated in the Non-Commercial type certification class would be dual certificated in both the Normal and Non-Commercial categories, as is commonplace for Restricted Category aircraft.

2. Aircraft in the Non-Commercial TC category can be operated in the Standard Category, provided the aircraft meets it type design data including compliance with all ADs, removal of all Non-PMA/TSO parts and replacement with certified units and the removal of all non-certified alterations.

3. The conversion can be accomplished by an Inspection Authority (IA) mechanic with a complete and thorough annual inspection and logbook audit. Upon successful completion, the aircraft could be operated under its Standard Airworthiness Certificate. The procedure is very common with Restricted Category aircraft and proven to be safe and successful.

Regulation and Order Changes

The following regulations would need to be revised to accommodate the Primary Non-Commercial Category.

1. New Regulation § 21.24 establishing the Primary Non-Commercial Category

2. Revised Regulation § 21.184 issue of airworthiness certificates for primary category aircraft and primary (non-commercial) aircraft

3. New Regulation § 91.328 Operating Limitations for Primary Non-Commercial Aircraft

4. Revised Regulation § 45.22 for markings on Primary Non-Commercial Aircraft

5. New Regulation § 65.108 establishing Primary Non-Commercial Repairmen Certificates

6. Revised FAA Order 8130.2 Airworthiness Inspector's Handbook

7. New Order 800-ANC-ARC defining required training for Primary Non-Commercial Repairman Courses and Evaluation

3.3.5.2 Conclusion

The intent of the Primary Non-Commercial Category is to reduce the level of FAA maintenance and alteration requirements to a level more appropriate for a privately operated vehicle while simultaneously improving safety and reducing owner costs.

This recommendation follows the international precedent of the Canadian Owner maintenance class. Analysis of a decade of Transport Canada data indicates that this class has been fully successful in maintaining (and in some cases enhancing) the safety of the Canadian GA fleet. It is reasonable to conclude that similar US Primary Non-Commercial Category would have safety results equivalent to the

Canadian success. Thus, incorporation of this new category will offer the FAA a rare opportunity for international harmonization by the application of sound safety continuum principles.

It is important to note that there is *absolutely nothing new or novel in this recommendation* – the "Primary Non Commercial Category" consists exclusively of regulations and procedures used to certify and operate other categories of aircraft. These "borrowed" regulations are simply recombined in a way that preserves the individual safety checks in a streamlined manner that is substantially less burdensome for a private owner.

In order for general aviation to remain viable in the United States, it is essential that a way be found to both lower costs and improve safety. The Primary Non-Commercial Category offers the FAA a chance to accomplish both goals, using existing regulatory language, while decreasing oversight requirements and expenditures.

4.0 Regulatory Structures Working Group – Recommendations

4.1 Part 23 Revision and Reorganization

The regulatory structures working group took the part 23 recommendations from the CPS and began the process to implement them. During the bi-monthly face-to-face meetings, the working group revised the approach to the part 23 re-organization from what was in the CPS. The working group determined that the problem was more complicated than what CPS addressed.

As the working group members converged on a better approach to the part 23 re-organization, the leadership tasked four subgroups to work on specific part 23 revised language. The four subgroups followed the disciplines in part 23: flight, structures, propulsion, and systems.

Each subgroup developed revised CFR language. In addition to the CFR language, the working group learned from FAA legal that the option of using "scope" and "purpose" statements was available. The subgroups were tasked with adding purpose statements. The idea behind the purpose statement is to augment the safety rational in the actual requirement.

The recommendations from the working group are the revised part 23 text, which is extensive. For that reason, the complete proposed CFR language, including the proposed scope and text is in Appendix E.

4.2 Part 23 Airworthiness Design Standards

The 14 CFR Part 23 Reorganization ARC recommended that initial Airworthiness Design Standards (ADS) start with part 23, amendment no. 23-62, as the basis for the detailed design specifications and means of compliance. The ARC accepted that one set of consensus standards would be created and maintained by ASTM International and would follow their processes for standards development that would satisfy the FAA. Their consensus standards process ensures the standards are agreed to by a balanced group of representatives from the regulators, industry, operators, and others. The ADS are not limited to ASTM International standards and there is no limit on how many consensus standards could be accepted. Other consensus standards developed by other organizations or individuals would follow the applicable processes necessary to satisfy the FAA or other regulatory agency requirements for consensus standards. Other consensus standards may be required to follow the FAA Issue Paper process that can take a significant amount of time to develop and approve. This process might be used when a company wishes to use a standard as a means of compliance but to retain it as proprietary information.

A primary goal is to make all consensus standards internationally accepted so that any civil aviation authority could accept them as a means of compliance.

5.0 Type Certification / Production Certification Working Group – Recommendations

This section contains the recommendations of the Type Certification/Production Certification Working Group.

5.1 FAA Conformity

The Type Design and Production Certification Working Group of the 14 CFR Part 23 Reorganization ARC compared the current conformity process against a proposed configuration management system that would allow the applicant and the FAA to ensure that the article being tested satisfied the requirements in the applicable test plan(s). The current conformity process is very labor intensive and disjointed by the fact that individual Requests For Conformity (RFC) are frequently required for different tests on the same test article. Coordinating these RFCs requires significant manual effort, spreadsheets, or even software for complex aircraft programs. This can be accomplished more quickly and efficiently using an integrated data management system that links the test plan requirements directly to the test article configuration and test schedule.

The following FAA Orders were evaluated for applicability to FAA conformity: FAAO 8110.4C, FAAO 8110.41A, FAAO 8110.49, FAAO 8110.105, and FAAO 4040.26A.

The analysis of the current conformity requirements and a description of the configuration management process are found in the TC/PC ARC Report Out and Conformity White Paper found in Appendix F.3. The ARC recommends that the appropriate policies, Orders, or other guidance be created or revised to allow implementation of the configuration management process in lieu of the current conformity requirements described in FAA Orders. No changes to part 21 would be required to allow for the use of the configuration management process. In addition, this ARC recommends the following changes to specific FAA Orders.

> *Recommendation*: It is recommended FAAO 8110.4C, Section 5, be revised to allow use of a configuration management system as an alternative to the current conformity.
>
> The white paper originally proposed this CM process be described in an Advisory Circular. However, the current thinking is that it should be a standard similar to the other standards being proposed for showing compliance. The CM process should consider the following:
>
> - Conformity requirements of part 21
> - The controlled data listed in FAAO 8110.4C, paragraph 5-3.d
> - The controlled data listed in FAAO 8110.49, paragraph 4-3 and 4-4
> - Description of Compliance Verification Engineer qualifications, functions, and limitations
> - Requirements called out on current FAA forms:
> - Request for Conformity, FAA Form 8120-10

- Conformity Statement, FAA Form 8130-9
- Conformity Record, FAA Form 8100-1
- Type Inspection Authorization, FAA Form 8101-1
- Type Inspection Report, FAA Form 8110-5,

Recommendation: It is recommended FAAO 8110.49 be revised to remove the specific conformity requirements found in section 4 and replace it with a reference to FAAO 8110.4 for acceptable conformity management procedures. This, combined with the recommendation for FAAO 8110.4, will allow either the existing FAA conformity process or the new FAA approved CM system as methods for controlling test article configuration.

5.2 Airplane Manufacturer Minor Change Approval Process

The Type Design and Production Certification Working Group minor change review is summarized in section 3.2 and the complete review and recommendation is found in Appendix F.4. Because of the significant differences in the procedures that have been accepted from different ACO's, this would be an area that the FAA could help industry and the FAA without significant effort. This could provide significant relief for those companies whose approved processes are particularly onerous.

Recommendation: The FAA should evaluate the Minor Change Approval process defined in the white paper and issue a policy memo or other statement supporting it as a "method acceptable to the FAA." Each company can then decide to either stay with their currently approved process or adopt this new one.

5.3 Applicant Showing Only Process

The testing and analysis activities that make up a typical certification project vary in difficulty and risk. In 2007, the FAA proposed via Order IR 8110.102, Implementing Risk Based Resource Targeting (RBT), that their level of involvement, or that of their designees, could be minimized based on the level of risk, making use of a tool called RBRT (Risk Based Resource Targeting). The type of risk considered in this paper is due to either improper test conduct or data analysis and the possibility of compromised data

fidelity. In low-risk projects or low-risk activities within a project, it may be acceptable from a risk perspective to accept the applicant's showing only with no further findings by either the FAA or their designees.

The TC/PC Applicant Showing Only paper in Appendix F.5 proposes a structure for when applicant showing only is sufficient considering both the applicant capabilities and the risk of improper test conduct/data analysis and the resulting potential impact on safety.

> *Recommendation:* The ARC recommends the FAA issue a policy memorandum, Advisory Circular, or FAA Order to endorse the concept in the Applicant Showing Only white paper with any adjustments as required.

5.4 Use of Video Recordings in Testing

Just as part 23 has not adequately kept up with technology, neither have some of the certification processes. When the test witness requirements were written many years ago, the capability to witness tests real-time at a location distant from the place of the actual test did not exist as they do today. In addition, there are numerous examples where today, for safety reasons or inaccessibility, it is possible to install video equipment to observe and record a test. These latter situations have all been deemed acceptable. The use of Video Recordings in the Testing white paper Appendix F.6 simply proposes this capability be extended to any testing unless there is a specific reason provided for not allowing it on specific tests.

> *Recommendation:* The ARC recommends that new guidance be developed to provide a video witnessing standard that can be referenced by applicants and FAA personnel, and to provide the minimum requirements by which video witnessing can be successfully utilized. The following Advisory Circular should be developed to provide a complete description of the video witnessing process:
>
> - Update policy to endorse the use of video technology in test witnessing
> - Endorse ADSs on Video Witnessing of Certification Tests
> - A video test witness standard should consider:
> - The types of testing that could most benefit from the use of video witnessing; and
> - The minimum parameters discussed in the white paper (Appendix F.5) regarding coverage, fidelity, and integrity.

5.5 Production Manual

Creation of the Production Manual (Appendix F.7) was an attempt to help new startup aircraft companies gain an understanding of some of the basic requirements for such a company. It provides a template that can be used as a starting point from which the company can expand the guidance as necessary. It is designed to lead a company to having the necessary procedures in place to obtain a Production Certificate meeting the requirements of § 21.137. The draft copy provided in Appendix F.7

has the basic requirements but could use further refinement to create a standard that could be used by any new startup company.

> *Recommendation:* The ARC recommends that the Production Manual in Appendix F.7 be turned over to a group to finalize a standard that can be adopted as guidance for new startup companies.

5.6 Design Organization/Production Organization Handbook

Although DO/PO handbooks may not be recognized by many as having a direct cost impact on the certification process, experience has shown that they do in fact have a significant impact. Experience has shown that those organizations with clear and well organized handbooks can perform the same certification activities faster and more efficiently than those companies where the handbooks are incomplete or vague in their guidance. Unclear and/or poorly organized handbooks frequently result in activities not being accomplished in a consistent manner with regular rework as a consequence. Additionally, with unclear and/or poorly organized handbooks there are continual questions and differences of opinions on how things should be accomplished that delay completion of activities. This adds both time and direct cost to the programs. In addition, although the ODA Order 8100.15 provides guidance on what should be in an ODA manual there is still a significant amount of local interpretation that decides what is appropriate.

The Working Group made significant progress on this handbook but it still needs finished. The level of completion of this task is such that the activity can be handed over to an Airworthiness Design Standards body for completion.

> *Recommendation:* The ARC recommends that work to date as shown in Appendix F.8 be transferred to a standards body for completion.

6.0 Alterations and Maintenance Working Group - Recommendations

6.1 Facilitation of Systems & Equipment

Recommendations

Systems and Equipment component and installations certification costs are major impediments to more widespread installation of new equipment that can provide significant safety improvements. Reducing this burden could significantly increase the installation of such equipment and help improve the safety of all general aviation aircraft. Refer to Appendix G.2 for the complete paper discussing Systems and Equipment concerns.

The ARC recommends the following for Systems and Equipment:

1. Existing guidance should be revised or new guidance written to simplify certification requirements for non-required, replacement and emergency-use-only systems and equipment. The emphasis should be on improvement in overall fleet safety from the prevailing level, not attainment of any arbitrary level of reliability or system function.

2. Certification requirements as expressed in guidance should specifically consider the adverse effects that accrue from failure to install to offset risk exposure from potential systems and equipment failure.

3. Guidance should recognize "simple" software and provide simplified compliance criteria not based on DO-178().

4. Consideration should be given to amendment of AC 23.1309-1() to generally relax the DO-178() and DO-254() development assurance level requirements applicable to part 23 airplanes.

5. Guidance should recognize an accepted relationship between probability requirements and development assurance levels and permit their use interchangeably in the system safety assessment process.

6. Realistic credit should be given for all factors related to hazard exposure in showing compliance with probability and Design Assurance Level (DAL) requirements.

7. The existing lightning and HIRF requirements should be re-evaluated in light of current historical data and projected installation trends and re-justified in terms of the environmental exposure of GA airplanes.

8. Consideration should be given to the provision of standard protective circuits for lightning protection as acceptable means of compliance.

9. Guidance should be introduced providing a framework for the use of both aviation and non-aviation service history for certification credit.

10. A suitable showing of compliance with an established functional standard should be regarded as equivalent to compliance with DO-178() or DO-254 Level D.

11. Alternate means of compliance (AMOC) must be allowed in practice, not just in theory. The FAA must foster a culture and a process whereby an AMOC can be encouraged and realistically evaluated with regard to the basic regulations, not just in comparison to existing acceptable means.

12. The FAA must ensure that regulations, guidance, training, and management combine to create a culture that is focused on safety, not process, as the goal. Application of judgment must be encouraged and supported at all levels. Owners, operators, maintainers, manufacturers, designees, and FAA personnel must all be able to determine from clear guidance what is permitted with what level of compliance effort.

6.2 Critical Information for Alterations & Maintenance

To improve the existing fleet's safety, it is imperative that operational airplanes be upgraded to meet the needs of an evolving operational environment. Regardless of the path by which an alteration is defined and approved, the airplane must continue to comply with the applicable rules under which it was certified or, in some cases, newer or added rules applicable to the specific alteration. With the introduction of the new part 23, it is essential that these means be maintained for both new and legacy airplanes in order to insure continuing access to safety improvements. Refer to Appendix G.2 for the complete paper discussing this issue.

Recommendations:

1. Recognized industry-maintained Airworthiness Design Standards (ADS) must be strictly regarded as acceptable means of compliance. All compliance showings are made only with respect to the regulations.

2. ADS and other means of compliance are not included in the certification basis and need not be listed in the TCDS.

3. Airplane specifications, performance, operating limitations, etc., that lead to compliance decisions within the ADS and supporting documents, including tiering, must be listed in the TCDS. Conversely, ADS and other documents must wherever possible base alternative compliance paths on data that are listed in the TCDS.

4. Comparable information with regard to alterations, particularly alterations made under STCs, should be available as part of the airplane's permanent records.

5. An STC or alteration must be shown to comply with the regulations by means of any acceptable means of compliance. Use of the specific ADS and/or other documents of the unaltered airplane is not required.

6. If an existing design approval (i.e. TC, STC) is amended, use of the ADS previously used to establish compliance with the regulations may be preferred, to the extent that it is applicable to the change, but is not required. Upgrade to the latest revision of an ADS may be required only under the conditions that would require a cert basis upgrade under § 21.101.

7. ADS should be regarded as separable. If multiple standards are recognized in overlapping areas, compliance with the regulations may be shown using them in any combination as long as all of the compliance requirements applicable to any particular regulation within the chosen standard are fully met.

8. ADS must be written in such a way as to make it clear what portions address which part 23 requirements. Portions of an ADS that address different part 23 requirements must be kept separate as much as possible.

9. The approval of an aircraft's manufacturer must not be required in order that an STC or alteration can be approved.

10. Guidance must clearly indicate that the new part 23 is acceptable for all changes to any airplane certified under part 23 or any predecessor regulations. Section 21.101(a) indicates that the most recent amendment can always be used if the applicant so elects. In particular, if a rule in the certification basis of an airplane has been dropped from the new part 23; continued compliance cannot be required, though compliance with its replacement or equivalent can. If there is a new rule that supersedes the old rule, the applicant can use the old part 23 to new part 23 cross reference table to determine what new part 23 regulation(s) is applicable in a situation like this. If there is no superseding rule for a rule in the certification basis of a product, then there is no longer a requirement to comply with the old rule on new projects on that product.

11. A process must be available by which an AMOC to a recognized standard can be proposed and accepted.

6.3 14 CFR PART 43 PREVENTATIVE MAINTENANCE

The part 43 provisions on preventive maintenance are outdated, inflexible and confusing, resulting in a reduction of pilot performance of preventive maintenance below optimal levels. Section 43.3(g) permits certificated pilots, with the exception of sport pilots, to perform specific preventive maintenance (PM) operations on aircraft that they own or operate under part 91. These PM operations are limited to those listed in part 43 Appendix A Section (c). Other sections of part 43 permit the pilot to return the airplane to service following PM performance PM and record keeping requirements. In addition to the rules, there are also two Advisory Circulars with content on PM: AC 439C, *Maintenance Records* and AC 43-12A, *Preventive Maintenance*.

At present, part 43 does not include "other operations acceptable to the Administrator" in its definition of preventive maintenance. This language is often included in the regulations in order to grant the FAA flexibility in dealing with rapidly changing or extraordinary circumstances. Because "other means" is not included in the regulations and because the list of authorized preventive maintenance operations is contained within the regulations, it is difficult and time consuming for the FAA to adapt to technological and other changes.

With the introduction of sweeping new content in a revised part 23, the FAA will face such a situation of change. Moreover, the incorporation of new technology on airplanes has already led to difficulties in this area. Additional advances in technology may be inhibited if the regulatory criteria governing preventive maintenance are not modernized. Thus, changes to part 43 that increase the safe availability of pilot-performed preventive maintenance are supportive of the ARC's goals. For the complete paper on Preventive Maintenance, see Appendix G.1.

Recommendations

1. Part 43 should be changed to include "other operations acceptable to the Administrator" as preventive maintenance under § 43.3(g).
2. The basic list of preventive maintenance operations contained in part 43 Appendix A should remain in the regulations to guarantee availability of a well-defined minimum set of authorized operations.
3. AC 43-12() should be revised to:
    a. emphasize the availability of preventive maintenance operations to pilots,
    b. clarify the basic list of authorized PM operations,
    c. establish conditions under which aircraft and equipment manufacturers may propose additional PM operations and procedures for their safe performance for FAA acceptance, and
    d. encourage manufacturers to propose such operations and procedures.

6.4 PRIMARY NON-COMMERCIAL CATEGORY

The Primary Non-Commercial Category is intended for the private owner to operate their aircraft in a substantially less burdensome and costly manner by reducing the level of FAA maintenance and alteration requirements to a level appropriate for a privately owned vehicle.

Recommendation: The FAA create a Primary Non-Commercial Category under 14 CFR part 21.

> The Primary Non-Commercial Category is intended for the private owner to operate their aircraft in a substantially less burdensome and costly manner by reducing the level of FAA maintenance and alteration requirements to a level appropriate for a privately owned vehicle.

7.0 CERTIFICATION COST / BENEFIT OVERVIEW

7.1 REGULATION AND STANDARD CHANGES

Today, each national authority adopts either the FAA's part 23 or EASA's CS-23 or they develop their own requirements that are largely equivalent. The different requirements translate into a cumbersome comparison process when importing into or exporting from the US. Not only is this process time consuming for applicants, but it also has to be validated by the authorities, which also takes time and resources.

The ARC's proposal for harmonization of part 23 with other CAA's small airplane regulations such as EASA CS 23, Canada's AWM 523, National Civil Aviation Agency (ANAC) – Brazil's RBAC 23, Civil Aviation Agency of China's (CAAC) part 23, New Zealand's (NZ) part 23 and other CAA's small airplane regulations should reduce the costs associated with validation after the initial transition. The proposal should make it easier for the US to harmonize top-level language with foreign authorities. Furthermore, the development of consensus standards that are accepted by the FAA and other regulatory authorities could significantly reduce the validation burden on the applicant. They should no longer be required to have authority-by-authority differences that are unpredictable and add cost and time to getting their airplane to the market. The current lack of harmonization between authorities can add delays in certification validation and add compliance and/or test costs to both the applicant and the regulatory agencies involved. This added time can easily range from 1-6 months.

Domestically, the long-term benefit of harmonizing part 23 is the reduced numbers of special conditions (SC), exemptions and equivalent ELOS findings that need to be processed internally by the FAA. A set of special conditions can easily take the FAA up to one year to develop, and during that time, the applicant is not able to bring their product to market. An ELOS finding or exemption can take the FAA between 4-12 months to develop and approve. The applicant will spend roughly the same amount of time as the FAA in proposing what they need and responding to FAA questions and proposal a SC, exemption, or ELOS. Clearly, there is a cost to industry due to this "loitering" time. For a complicated set of Special Conditions, the FAA might commit, on average, half to three-quarters of a man-year to seeing the item through completion. That time consists of the actual technical work as well as management and legal review. Generally in these situations the applicant is forced to proceed at risk with the understanding that when the final rule is issued, they may have to do additional analysis or tests. Ultimately, this may result in a delay for the applicant of potentially 1-4 months, or even more for complex special conditions, and 2 to 6 weeks for ELOS or exemptions.

Table 7.1 highlights the past 7 years of special conditions, exemptions, and equivalent safety findings.

Table 7.1 – Special Conditions, Exemptions, Equivalent Safety Findings

	2006	2007	2008	2009	2010	2011	2012	2006-2012 Totals	2006-2012 Average
Proposed Special Conditions	7	5	5	3	3	2	1	26	4
Final Special Conditions	22	21	15	9	8	4	2	81	12
Exemptions	1	4	5	9	11	1	5	36	5
ELOS	6	17	21	18	26	19	9	116	17
Total	36	47	46	39	48	26	17	259	37

Note 1: Using the average number of special conditions, exemptions, and ELOS from the above table, it is seen that on average these items are costing the FAA approximately the following:
Note 2: Final Special Conditions – (12/year)(3 months/special condition) = 4 man-years of work per year for the FAA
Note 3: Exemptions – (5/year)(6 months est.)/(12 months/year) = 2.5 man-years of work for the FAA
Note 4: ELOS – (17/year)(3 months avg./ELOS)/(12 months/year) = 4.25 man-years of work for the FAA
Note 5: The FAA total man-years effort is thus estimated to be approximately 10.74 man-years of work per year.

7.2 COST ESTIMATES

Following are some of the potential certification cost benefits that could be realized from the proposed revision to part 23 and the other proposals. Table 7.2 summarized the savings for the proposals put forth by the TC/PC Working Group. Table 7.3 in section 7.6 summarizes potential certification cost Savings Estimates.

Typical development costs for a new airplane or a derivative can run from $1M to $3M per month while typical development and certification costs for major changes can run from $250,000 to $500,000 per month.

Revising the regulations to make them basic safety regulations to allow changes in technology without the necessity to change the regulations can reduce costs and should result in:

1. Fewer, if any, special conditions, ELOSs, and exemptions, since the standards can be revised quickly to provide an acceptable means of compliance for any new technology and that standard becomes available for all to use.

2. Eliminating, or significantly reducing, applicant time to obtain a means of compliance agreement with the authority.

3. Eliminating inconsistency in interpretation of the rules across any one authority, or between authorities.

Table 7.2 – Summary of TC/PC Cost Savings Estimates

TC/PC Proposed Change	Description of Cost Savings
FAA Conformity	Direct type certification conformity expense savings for the applicant is approximately 2.8 to 8 full time personnel depending on the complexity of the project. Travel savings of $40,000 per year during routine times to $200,000 per month during peak type certification efforts. Savings for the FAA were estimated to be from 0.9 to 3 people if the FAA does not have to review RFC paperwork and can be even more if the FAA makes full use of designees for inspections. Since the Configuration Management process does not rely on issuing a Request for Conformity (RFC) for each test, but links the configuration directly to the test requirements, it provides a continuous test article status and identifies what tests may be run at any time. On configuration-managed projects the FAA would simply monitor the test condition requirements and the configuration rather than reviewing RFCs against the test conditions and test article configuration if they felt the need to do so. This would then eliminate the need for the FAA to manage any RFCs on configuration-managed projects and only review the information as part of an audit and potentially save the FAA time and money.
Minor Change Approval	One company that has a more onerous minor change approval process agreed to by their ACO stated they review approximately 2000 minor changes per year. They expect to save over $100,000 per year through this proposed process. Another company has a process that their ACO, which is different from the first company's ACO, has agreed to for which the proposed process would not provide any significant savings.
Applicant Showing Only	For a company with a single product line, this is estimated to be approximately $50,000 per program. For a company with multiple product lines, savings approximately $250,000 per year are anticipated. Additional savings due to the ability to use critical designee resources for higher-level safety enhancing activities were not quantified. For the FAA, this could mean reviewing fewer compliance reports for those things they have agreed the applicant has demonstrated the ability to show compliance adequately.
Use of Video Recordings in Testing	Travel expenses for applicants easily could be reduced by $40,000 or more per project depending on the quantity of tests. This includes designee travel and remote third party testing. For the FAA this could mean watching testing from their office rather than having to travel to the test site when they have indicated they

TC/PC Proposed Change	Description of Cost Savings
	wish to observe the test.
Design Organization / Production Organization Handbook including Simplified Production Certification	This handbook is essentially a template that guides the applicant on how to structure their procedures manual. It is designed to allow a company to start out with only minimum requirements and grow it as needed. A new entrant to the aviation field could save $200,000 in their initial development of manuals and processes using this handbook. Additional savings for routine maintenance were not quantified. Since the handbook provides the same basic requirements for all applicants, it could mean the FAA spends less time reviewing each applicant's handbook and more consistency across all the applicants.

7.3 Certification Plan Acceptance

Another area that has not been discussed previously is certification plan acceptance. It is not unusual for a certification plan to wait for FAA approval for 3-5 months on relatively small planes to over a year for new airplanes or major derivatives. Certification plan approval is frequently held up while waiting for special conditions, exemptions, or ELOS issues to be resolved. But they are also frequently held up because the FAA has continued to ask for more and more detailed compliance information on individual sections of the airplane to be provided before they will grant approval on the certification plan. The adoption of this ARC recommendations and their use by the applicants and the FAA should help reduce this wait time.

7.4 FAA Sequence List

The FAA sequencing list is another area that is very costly to the industry. The delays in getting approval to work on a project with the FAA can take up to several months to over a year. This forces the applicant to go into a holding mode or to proceed at risk and hope that the FAA will approve the project in a reasonable time. As in the certification plan approval process, the ARC recommendations, if enacted, could help relieve the FAA of some burden that is forcing projects to go onto the sequencing list and perhaps allow more projects to be approved sooner; eliminating the need for them to go on the sequence list at all.

7.5 Foreign Validation Costs

Harmonization of the part 23 regulations across all international CAAs along with the internationally accepted standards has the potential to have a significant positive impact on both the time and cost involved with foreign validation. For instance, a new clean sheet design can easily cost $0.5-2M to validate in the different countries, depending on the aircraft. Harmonization could potentially cut this cost by 85-90%.

The time it takes to obtain validation delays potential sales into that country adding more delay costs, or loss of income, to the manufacturer. Harmonization and concurrent certification and validation could potentially eliminate this additional cost.

Validation of subsequent changes to an airplane cost could also potentially be reduced by 65-75%.

7.6 Summary of Costs

The costs shown in Table 7.3 are estimated costs for one item or one applicant and in most cases are probably conservative. When these numbers are multiplied by the total number of projects the FAA is involved in each year, the FAA required manpower and costs become significant. For the applicant, the costs must be multiplied by the numbers of each of the items affecting the applicant each year. For the applicant this frequently translates into, not only direct operating costs, but delayed delivery of product to market costs.

For simplicity, the estimated average cost per hour will be assumed to be $100.00 per hour for both the FAA and industry. This will include direct pay plus benefits.

Table 7.3 Cost Summary

Item	Range	Directorate Dollars/Each	ACO Dollars/Each	Applicant Dollars	Total Dollars/Each
Applicant New Airplane Special Condition Delay Costs	High	N/A	N/A	$12,000,000.	$12,000,000.
	Low	N/A	N/A	$1,000,000.	$1,000,000.
Applicant New Airplane ELOS/ Exemption Delay Costs	High	N/A	N/A	$4,500,000.	$4,500,000.
	Low	N/A	N/A	$500,000.	$500,000.
Applicant Major Change Special Condition Delay Costs	High	N/A	N/A	$2,000,000.	$2,000,000.
	Low	N/A	N/A	$250,000.	$250,000.
Applicant New Airplane ELOS/ Exemption Delay Costs	High	N/A	N/A	$375,000.	$375,000.
	Low	N/A	N/A	$125,000.	$125,000.
Special Condition Man-hour Costs	High	$156,000.	$78,000.	$156,000.	$390,000.
	Low	$104,000.	$52,000.	$104,000.	$260,000
ELOS/Exemption	High	$96,000.	$48,000.	$96,000.	$240,000.

Item	Range	Directorate Dollars/Each	ACO Dollars/Each	Applicant Dollars	Total Dollars/Each
Man-hour Costs	Low	$32,000.	$16,000.	$32,000	$80,000
Configuration Management Man-hours/Year	High	N/A	$624,000.	$1,664,000.	$2,288,000.
	Low	N/A	$187,000.	$499,000.	$686,000.
Configuration Management Travel/Year	High	N/A	$150,000.	$200,000.	$350,000.
	Low	N/A	$25,000.	$40,000.	$65,000.
Minor Change Process/year	High	N/A	$100,000.	$100,000.	$200,000
	Low	N/A	$25,000.	$0.	$25,000.
Applicant Only Showing/year	High	N/A	$150,000.	$250,000.	$400,000
	Low	N/A	$25,000.	$50,000.	$75,000
Video Test Witnessing/year	High	N/A	$50,000.	$150,000	$200,000.
	Low	N/A	$0.	$40,000.	$40,000.
DO/PO Handbook/Initial Handbook without Updates	High	N/A	$100,000.	$100,000.	$200,000.
	Low	N/A	$50,000.	$50,000.	$100,000.
Certification Plan Wait Time/Plan	High	N/A	N/A	$250,000.	$250,000.
	Low	N/A	N/A	$0.0	$0.0
FAA Sequence List Wait	High	N/A	N/A	$1,000,000.	$1,000,000.
	Low	N/A	N/A	$150,000.	$150,000.
Foreign Validation	High	N/A	$150,000	$2,000,000	$2,150,000
	Low	N/A	$50,000	$500,000	$500,000

8.0 SUMMARY

The 14 CFR Part 23 Reorganization ARC participants have worked diligently for the past year and a half to develop recommendations for revision to part 23 that have the potential to significantly improve the safety of the general aviation fleet while at the same time reducing the time and cost involved in the certification process. In addition to the recommended changes to part 23, there are proposals to help reduce the certification costs through more standardization of certification processes and reducing or eliminating activities that provide no added value. Much of the latter can be accomplished without requiring changes to the existing regulations, but rather through better guidance that allows more flexibility in showing compliance to the requirements of parts 21, 23, and 43.

The recommended changes to part 23 are the cornerstone to achieving the underlying safety goals of this ARC effort, but if the changes are done in isolation or piecemeal fashion, the safety improvement and cost savings goals of the ARC will not be achieved. Cost savings encourage not only new airplanes but the modernization of the existing fleet. Airworthiness design standard development will drive the innovation needed for safety and international buy-in to this approach. All of these efforts are needed, as a package, to achieve the goals of this ARC.

The following list includes things that could be implemented quickly and relatively easily with no changes to parts 21, 23, or 43, but simply with policy letters or changes to FAA Orders or ACs that could potentially save the industry and the FAA considerable time and money.

1. Configuration Management in place of the current conformity requirements in FAA Order 8110.4 and other FAA Orders. See section 5.1.

2. Minor Change process using a consistent process across all ACOs as proposed in section 5.2.

3. Applicant Showing Only following recently approved changes to part 21 that have not been understood or accepted by all FAA or industry participants. See section 5.3.

4. Video test witnessing as described in section 5.4.

5. Use of the Standard DO/PO Handbook as an acceptable means of meeting the requirements for an ODA or other manuals required by the FAA for approved organizations. See section 5.5.

The future of general aviation depends on the FAA taking bold action to implement the recommendations contained in this report. Without such action general aviation will continue to decline. With it will go many jobs and an important means of transportation that benefits the entire country. General aviation provides exports that significantly help the U.S. balance of trade.

VH-RGG

APPENDIX A – TEAM MEMBERS

Name	Organization
Allen Lyon	Transport Canada
Andrew Barker	TruTrak
Andy Supine	Cessna
Anne Guisen	EASA
Blake Cheney	TCCA (AARTC)
Boudewijn Deuss	EASA
Boyd Rodeman	Cessna
Brian Hancock	FAA
Brian Richardet	Cessna
Bruce Mahone	SAE
Bruno Rigaud	Socata
Cesar Hess	ANAC - Brazil
Charlie Fellows	FAA
Chris Durkin	Honeywell
Chris Mitchell	Cirrus
Christophe Robin	Socata
Chuck Swanson	Sensenich Propeller
Clay Barber	Garmin
Cristiano Villa	ANAC – Brazil
Cyrille Rosay	ANAC
Damian Hischier	Top-View Aerospace
Dan Schultz	ASTM
Dan Schwinn	Avidyne
Dave Gill	NZCAA
Dave Magruder	FAA
David Armstrong	Garmin
David Gribble	Rockwell-Collins
David Leedom	Rockwell-Collins
David Stevens	Quest Aircraft
Dieter Koehler	Flight Design
Don Wernert	Hawker Beechcraft
Doug Edwards	FAA
Edilson Manacero	ANAC - Brazil
Edmond Boullay	Dassault Falcon
Eric Leaver	Cub Crafters
Eric Tucker	Rotax
Fausto Enokibara	ANAC - Brazil
Frank Keefer	Hawker Beechcraft

Appendix A

Name	Organization
Fred Barber	Avidyne
Frederic Darcy	Socata
George Braly	GAMI
George Zografos	EASA – Germany
Greg Bowles	GAMA
Gu Baodong	Chinese CAA
H.G. Frautschy	EAA
Henk Pruis	EASA
Jacqueline Jambor	FAA – SAD
Jamie Slippy	Quest Aircraft
Jean Rene Lepage	Transport Canada
Jim Brady	FAA
Joel Heck	Cessna
John Wiseman	Transport Canada
Joost List	Diamond Aircraft
Keith Chatten	Continental Motors
Kerri Hinton	Kestrel
Kevin Bruce	Diamond Aircraft
Kristine Hartzell	AOPA
Ky Ngo	FAA
Larry Van Dyke	Consultant
Les Taylor	FAA-SAD
Lowell Foster	FAA-SAD
Luca Ciccolari-Micaldi	Hawker Beechcraft
Manfred Reichel	EASA
Marcos Rama	ANAC - Brazil
Mark Giron	FAA
Mark James	FAA
Matthias Betsch	Flight Design
Mike Reyer	FAA-SAD
Nick Bogner	Bendix-King Avionics
Nick Guida	Tamarack Aero
Nick Roe	EASA
Oliver Reinhardt	Flight Design
Pat Mullen	FAA-SAD
Paul McLoughlin	Hawker Beechcraft
Pedro Donato	ANAC - Brazil
Pete Rouse	FAA-SAD
Peter Buck	Lockheed Martin
Peter Lyons	Avionyx S.A.

Appendix A

Name	Organization
Plinio Ribeiro	ANAC - Brazil
Randy Griffith	Honda
Randy Shields	Hawker Beechcraft
Ray Best	Hawker Beechcraft
Ric Peri	AEA
Ricardo Dupont	ANAC - Brazil
Robert Grove	Garmin
Robert Hackman	AOPA
Robert Murray	Garmin
Romain Mbwang Sepoh	SOCATA
Scott Fohrman	NATCA (FAA)
Sean Elliott	EAA
Sidney Bauguess	Cessna
Stephane Jacques	Socata
Steve Flanagan	FAA: AIR-110 (Cert Proc)
Steve Litke	NATCA (FAA)
Steve Serfling	Kestrel
Steven Rosenfeld	NATCA (FAA)
T Jetheri	Rockwell Collins
Tom Peghiny	Flight Design
Wang Peng	CAAC
Wes Ryan	FAA-SAD
Wulf-Ingo Goesling	EASA
Yves Borgeaud	Socata
Zhu Xuefeng	CAAC

APPENDIX B – ACRONYMS

A&M	Alterations and Maintenance
AEO	All Engines Operating
AOPA	Aircraft Owners and Pilots Association
AC	Advisory Circular
ACO	Aircraft Certification Office
AD	Airworthiness Directive
ADS	Airworthiness Design Standards
AEA	Aircraft Electronics Association
AFS	Flight Standards Service
AML	Approved Model List
AMOC	Alternate Means of Compliance
AMWG	Alterations and Maintenance Working Group
ARC	Aviation Rulemaking Committee
ASTM	American Society for Testing and Materials
CAA	Civil Aviation Authority
CAM	Civil Aeronautics Manual
CAR	Civil Air Regulation
CFIT	Controlled Flight Into Terrain
CFR	Code of Federal Regulations
CG	Center of Gravity
COSM	Continued Operational Safety Monitoring
CPS	Part 23 Certification Process Study
CVR	Cockpit Voice Recorder
DAL	Design Assurance Level
DER	Designated Engineering Representative
DOT	Department of Transportation
DO/PO	Design Organization/ Production Organization
EAA	Experimental Aircraft Association
EAB	Experimental Amateur Built
ELOS	Equivalent Level of Safety
ELT	Emergency Locator Transmitter
EMI	Electromagnetic Interference
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FDR	Flight Data Recorder
GA	General Aviation
GAMA	General Aviation Manufacturers Association
GPS	Global Positioning System
HF	High Frequency
HIRF	High Intensity Radio Frequency
IA	Inspection Authority
ICA	Instructions for Continued Airworthiness
ICAO	International Civil Aviation Organization
LSA	Light Sport Aircraft
M_D	Dive speed in Mach
MTOW	Maximum Take-off Weight

Appendix B

ODA	Organization Designation Authorization
OEI	One Engine Inoperative
OEM	Original Equipment Manufacturers
QMS	Quality Management System
PC	Production Certification
PO	Purchase Order
SC	Special Condition
SMS	Safety Management System
STC	Supplemental Type Certificate
TC	Type Certification
TCDS	Type Certification Data Sheet
UM	ODA Unit Member
U.S.	United States
V_A	Maneuvering speed
V_D	Dive speed in knots

APPENDIX C – 14 CFR PART 23 REORGANIZATION ARC CHARTER

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
ARC Charter

Effective Date:
AUG 15 2011

SUBJ: 14 CFR Part 23 Reorganization Aviation Rulemaking Committee

1. Purpose of this Charter. This charter creates the Title 14 Code of Federal Regulations (CFR) Part 23 Reorganization Aviation Rulemaking Committee according to the authority of the Administrator of the Federal Aviation Administration (FAA) under Title 49 of the United States Code (49 U.S.C.) § 106(p)(5). This charter also outlines the committee's organization, responsibilities, and tasks.

2. Audience. This charter applies to industry and government organizations involved in the part 23 reorganization effort to include employees within the Office of the Associate Administrator for Aviation Safety.

3. Where to Find this Charter. You can find this charter on the FAA website at http://www.faa.gov/about/committees/rulemaking.

4. Background. Historically, the FAA has hosted regulatory reviews for part 23 about every 10 years. The two most recent part 23 reviews were performed in 1974 and 1984. In 2008, the FAA initiated the current, ongoing review process by starting with the Part 23 Certification Process Study (CPS).

The CPS team reviewed part 23 and Civil Air Regulations, Part 3 (CAR 3) airplanes, considering their lifecycle, and made recommendations based on current and anticipated products. The challenge was to determine the future of part 23, considering current and anticipated products, twenty years from then. This led to one of the major recommendations from the study: reorganize part 23 using performance and complexity criteria instead of today's weight and propulsion-based divisions. When the Civil Aeronautics Administration adopted CAR 3 standards, airplane construction methods and operations were narrowly focused; likewise, their performance parameters were narrow. As aviation technology progressed, construction methods, performance, and complexity evolved yielding significant advances in the normal, utility, acrobatic, and commuter categories.

The CPS team's objective was to assess the adequacy of the various operations and airworthiness processes currently in place throughout the airplane's service life and to identify process improvements. The team has made recommendations for long-term improvements; and encouraged implementation of near-term, easy to address improvements.

The general aviation fleet is comprised of over 200,000 airplanes. Therefore, most recommendations focused on keeping the *existing* fleet safe. This includes upgrading and maintaining airplanes with better systems, newer avionics, and the latest safety equipment (e.g., ballistic parachutes and inflatable restraints). In addition, Part 23 revisions should make it easier to install safety-enhancing equipment in older airplanes. This concept carried into the public meetings that took place in 2010, the year following the release of the Part 23 Certification Process Study.

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Public /Industry Meetings

In 2010, the FAA's Small Airplane Directorate hosted two public meetings. Embry-Riddle Aeronautical University hosted a third meeting in addition to industry and trade-group focused meetings. The objective of these meetings was to share the findings/recommendations from the certification process study and ask the public for feedback. Overall, the feedback was supportive of our recommendations and in some cases augmented the findings. One significant difference between the CPS findings and the public feedback was that the public focused on the need to address the light/simple airplanes in part 23. Over the past two decades, part 23 has been shifting in complexity towards complex, high performance airplanes, which has placed increasing burden on simple airplane certification. Therefore, the public focus was on reducing simple airplane certification costs and time burden through resetting requirements to an appropriate level based on safety risk. The safety risk for most simple, proven airplane designs is typically low. There was very little feedback regarding the high performance end of part 23.

The FAA has developed the following plan based on recommendations from the Part 23 Certification Process Study and the public/industry feedback meetings. This plan focuses on the major regulatory recommendation from the Part 23 Certification Process Study — reorganizing part 23.

5. Organization and Administration of the Part 23 Reorganization ARC. The FAA will establish a committee of members from the aviation community and other aviation airworthiness authorities. FAA participation and support will come from all affected lines-of-business. Where necessary, the committee may set up specialized work groups that include at least one committee member and invited subject matter experts from industry and government.

The charter is set up as follows:

a. The committee sponsor is the Manager, Small Airplane Directorate, who:

(1) Appoints members or organizations to the committee, at the manager's sole discretion;
(2) Receives all committee recommendations and reports;
(3) Selects industry and FAA co-chairpersons for the committee; and
(4) Provides administrative support for the committee through the Aircraft Certification Service.

b. The co-chairpersons will:

(1) Determine (with other committee members) when a meeting is required (a quorum is desirable at committee meetings, but not required);
(2) Arrange notification to all members of the time and place of each meeting;
(3) Draft an agenda for each meeting and conduct the meeting;
(4) Keep meeting minutes; and
(5) Provide quarterly status updates to the Manager, Small Airplane Directorate from the effective date of this charter.

6. Committee Membership

a. The committee will consist of members from the Federal Aviation Administration including members from the Small Airplane Directorate (ACE-100), Aircraft Certification (AIR-100 and AIR-200), and Flight Standards Service (AFS-200, AFS-300, and AFS-800). It will also consist of about 20 members, representing manufacturers of part 23 airplanes, part 23 equipment, light sport airplanes, aviation associations, and foreign aviation authorities. Foreign authorities will serve as observers only.

b. Each member or participant on the committee should represent an identified aviation community segment with the authority to speak for that segment. To promote discussions, membership on the committee will be limited. Active participation and commitment by members is essential for achieving the committee objectives and for continued membership on the committee. The committee may invite additional participants as subject matter experts to support specialized work groups.

7. Public Participation. Persons or organizations outside the committee who wish to attend a meeting must get approval in advance of the meeting from a committee co-chairperson.

8. Committee Procedures and Tasks.

a. The committee advises and provides written recommendations to the Manager, Small Airplane Directorate, ACE-100.

b. Committee tasks include, but are not limited to, the following:

(1) Consider the Part 23 Certification Process Study recommendations 1.1.1 and 1.1.2.

Recommendation 1.1.1 - reorganize part 23 based on airplane performance and complexity verses the existing weight and propulsion divisions.

Recommendation 1.1.2 – certification requirements for part 23 airplanes should be written on a broad, general and progressive level. A team should determine the exact number of tiers and which complexity and performance divisions to use for segmenting them.

a. The first tier should contain the requirements for low-complexity, low-performance airplanes and it should act as a basic starting point for all other categories. These basic requirements could be general with compliance methods maintained in industry and government standards referenced by regulation or policy. The simple product category would naturally fall in a lower oversight risk category allowing the FAA to perform more oversight on products in more complex, higher performance tiers.

b. The next tier(s) should incorporate the requirements of the previous tier and add unique requirements for medium-complexity, medium-performance airplanes. These requirements could also be general with compliance methods maintained in industry and government standards referenced by regulation or policy.

c. The highest tier should incorporate the requirements of the previous tiers and add unique regulatory requirements for high-complexity, high-performance airplanes. The highest product category would fall in an elevated oversight risk category that would require an increased level of oversight as compared to the more simple categories. Human factors standards related to maintenance and operation increase as the tier risk increases.

(2) The committee may propose additional tasks to the Manager, Small Airplane Directorate.

(3) The ARC will submit a report detailing recommendations for tasks (1) and (2) no later than 18 months from the effective date of this charter. The Manager, Small Airplane Directorate, may extend this deadline up to 6 months if it is in the FAA's interest to do so.

9. Cost and Compensation. The estimated conservative cost to the Federal Government is approximately $50,000. Initial plans call for face-to-face meetings every other month. Bi-weekly telecons and/or polycoms will supplement these face-to-face meetings. Most meetings will take place in Washington, DC, to maximize participation from AIR-100, AIR-200, and AFS. All travel costs for Government employees will be the responsibility of the employee's organization. Non-government representatives serve without government compensation and bear all costs related to their participation.

10. Availability of Records. Consistent with the Freedom of Information Act, Title 5, U.S.C., section 522, records, reports, agendas, working papers, and other documents that are made available to or prepared for or by the committee will be available for public inspection and copying at the FAA Small Airplane Directorate, 901 Locust, Kansas City, Missouri 64106. Fees will be charged for information furnished to the public according to the fee schedule published in Title 49 of the Code of Federal Regulations, part 7.

11. Committee Term. This committee becomes an entity on the effective date of this charter. The committee will remain in existence for a term of 24 months unless its term is ended sooner or extended by the Manager, Small Airplane Directorate.

12. Distribution. This charter is distributed to director-level management in the Office of the Associate Administrator for Aviation Safety, the Office of Aviation Policy and Plans, and the Office of Rulemaking.

Administrator

APPENDIX D – CPS REPORT EXECUTIVE SUMMARY

Executive Summary

Background

The primary objective of the part 23 Certification Process Study (CPS) was to assess the adequacy of the current airworthiness standards throughout a small airplane's service life while anticipating future requirements. Working groups comprised of various members of the aviation industry were assigned to the five areas of this study to identify issues and develop recommendations. The study was not limited to certification standards; study team members reviewed other topics affecting general aviation including pilot training, operations, and maintenance.

The study offers a variety of short-term and long-term recommendations. These recommendations will serve as the basis for a part 23 regulatory review (currently scheduled for FY10). It has been over 20 years since the last part 23 regulatory review. Not only is it time for a complete review of part 23, it is also time to review the original assumptions for part 23, including operations and maintenance. The airplanes being certified today have changed significantly since the inception of part 23 and this evolution will likely continue.

Summary of the Findings and Recommendations

Performance Based Standards for part 23

This section of the report addresses performance-based standards for part 23 airplanes. Part 23 currently differentiates airplane requirements based on engine type and airplane weight which does not address the operational capabilities of today's high-performance small airplane. Historically, part 25 airplanes had technologies that for cost and weight reasons were not practical for part 23 airplanes. Smaller part 23 airplanes were typically simple and slow while bigger airplanes were more complex and faster. Consequently, the existing approach to standards based on weight and engine type was effective. While the existing approach has produced safe airplanes for decades, technological advances have changed the original assumptions of the part 23 divisions. The new small turbine engines, composite airframes, and lightweight digital electronics offer part 23 airplanes the operational capability and performance of traditionally larger part 25 airplanes. Part 23 standards have evolved beyond their original intent to address the increasing performance and complexity. Unfortunately, the slow, simple part 23 airplanes have suffered as the standards have shifted towards more complex airplanes. These findings led to two major recommendations:

- Reorganizing part 23 based on airplane performance and complexity versus the existing weight and propulsion divisions.

- Rewriting certification requirements for part 23 airplanes as a top level regulation with more detailed implementation methods defined by reference to industry and government standards.

Design Certification

This section describes the challenges in meeting procedural requirements for the issue of type certificates. It also addresses changes to those certificates and changes affecting the type design of type-certified products and aviation articles like avionics.

The bulk of this section and the associated recommendations address the challenges of keeping older airplanes operating safely. This includes upgrading airplanes with better systems (e.g., alternators), newer avionics (e.g., NextGen, navigation, information, or redundancy), and safety gear (e.g., ballistic parachutes and inflatable restraints). A parallel set of recommendations address maintenance of new equipment that the original manufacturer never envisioned being installed on their airplane.

The recommendations from this section include but are not limited to the following:

- Updating the Approved Model List (AML) Supplemental Type Certificate (STC) process to include system interface considerations.
- Developing training for the AML/STC process.
- Replacing equipment for "part 23 required equipment" as "approved" equipment.
- Defining major/minor alteration criteria. Developing a regulatory approach to evaluate changes to the type design consistent for part 21 though part 43.

Continued Airworthiness

This section addresses problems associated with airframes staying in service for half a century or more. Considering lengthy service lives, what needs to be done for composites, life-limited parts, and increasingly integrated electronic airplanes? A growing concern for owners of older airplanes involves knowing the service history of parts and components that are sold as airworthy. Few parts have life-limits and even fewer small airplane parts have in-service hours tracked. Existing rules and guidance for the maintenance of part 23 airplanes do not account for the actual age of the airplanes and how the maintenance needs change as the airplanes age.

Furthermore, human performance is a dominant factor in general aviation accidents. Accident data historically shows that human performance that includes operators and maintenance personnel attribute to 70 percent to 80 percent of general aviation (GA) accidents. Updating older airplanes with new equipment can address some of these human performance issues, but the FAA needs a vehicle to make addressing the thousands of modifications necessary to the aging fleet of 200,000 GA airplanes easier. The recommendations from this section include but are not limited to the following:

- Revising CFR part 23 to include requirements that consider degradation of airplanes, airplane parts, and airplane systems in the Instructions for Continued Airworthiness (ICA).

- Issuing policy that would allow the use of accepted industry or government standards (ASTM, DOT, etc.) in an alternation or modification of a product that exceeds the original standards created under CAR 3. This policy would also accept the declaration of the material manufacturer with regard to the accepted standard.

- Amending 43.15 to create a hierarchy for the maintenance data used to maintain part 23 airplanes.

- Reducing repair and modification mistakes by improving the clarity and usability of all technical documentation.

Data Management

This section focuses on existing data management tools and our involvement in their evolution. The Data Management working group built on several existing data efforts. A major safety concern is that the average fleet age for part 23 airplanes is already over 40 years old. Furthermore, as newer airplanes age, they will include technologies we have no long term experience maintaining. These technologies include composite airframes and integrated avionics and engine controls that use large numbers of microprocessors. The Service Difficulty Reporting (SDR) program needs improvement. Currently, this program has limited success. Unfortunately, it was built when technology in aviation was limited. So today, many new critical areas need to be added where problems should be reported.

Additionally, one of the important elements of the FAA Safety Management System (SMS) effort is developing better tools to conduct Continued Operational Safety (COS) tasks. The Monitor Safety Analyze Data (MSAD) team designed an application to address this need. The MSAD tool relies upon various databases such as the SDR database for both maintenance and operational in-service data to perform quantitative-based analysis to determine the level of risk and appropriate mitigation actions. This requires a more progressive approach to data collection and management. The recommendations in this section include greater involvement with these and evolving programs.

Pilot Interface

This section addresses sharing information with pilots from both the airplane certification and the training and operations disciplines. The Pilot Interface working group was composed of representatives from the flight test, flight operations, and flight training segments of the industry and FAA.

As the findings show, this working group uncovered several disconnects between the certification and operations world. The recommendations address how to share more pertinent information from the flight test process with pilots. The intent is to increase pilot awareness of the data provided through flight testing to ensure pilots understand the information and its limitations. The recommendations from this section include but are not limited to the following:

- Clarifying between FAA Aircraft Certification Service (AIR) and Flight Standards Service (AFS) the understanding of one engine inoperative (OEI) climb performance development and how it is conveyed during training in weight/altitude/temperature (WAT) performance limited airplanes.

- Agreeing on explanatory language between FAA Flight Standards, flight test, and structures for pilots to understand published speeds and what protection is actually available to the pilot when complying with these airspeeds.

- Requiring pilot type training to include landing experience on minimum field length runways, preferably in the simulator, and expose pilots flying small jets to landing on both minimum dry field length and contaminated runways.

- Re-emphasizing the difference between stall warning and aerodynamic stall. Pilots may fly an airplane for years and never stall the airplane or even feel the stick pusher. Most small airplanes can not recover from an actual stall without pushing the nose down and flying out, which is not currently emphasized in type training.

    a. Current FAA training focuses on maintaining pitch attitude and adding power.

    b. Even in high-performance jets, there may be some parts of the envelope where the airplane will not recover from the stall with power only.

APPENDIX E – 14 CFR PART 23 RECOMMENDED REVISION LANGUAGE

Subpart A General

23.1 Applicability

Scope.

Purpose.

Application.

Requirement.

(a) This part prescribes the airworthiness requirements for the issuance of type certificates, and changes to those certificates, for airplanes that are limited to seating configurations, excluding pilot seats, of 19 or less and a maximum certificated takeoff weight of 19,000 lbs. or less.

(b) For each aircraft the intended operations and flight envelope must be determined. Throughout the entirety of this part, this aircraft definition shall be the basis for determining applicability. The aircraft definition shall include sufficient information such that the applicable requirements of this part can be determined.

(c) Each person who applies under part 21 for such a certificate or change must show compliance with the applicable requirements of this part.

Embodies the safety intent of: §§ 23.1 and 23.2 (Amdt 62).

23.3 Special Retroactive Requirements.

Scope.

Purpose.

Application.

Requirement.

(a) Notwithstanding §§ 21.17 and 21.101 of this chapter and irrespective of the type certification basis, each aircraft having a passenger seating configuration, excluding pilot seats, of nine or less, manufactured after December 12, 1986, or any such foreign airplane for entry into the United States must provide a safety belt and shoulder harness for each occupant which will protect the occupant from serious head injury when subjected to emergency landing loads.

(b) For the purpose of this section, the date of manufacture is:

(1) The date the inspection acceptance records, or equivalent, reflect that the airplane is complete and meets the FAA approved type design data; or

(2) In the case of a foreign manufactured airplane, the date the foreign civil airworthiness authority certifies the airplane is complete and issues an original standard airworthiness certificate, or the equivalent in that country.

Embodies the safety intent of 23.2 (Amdt 62).

23.5 Acceptable Standards.

Scope.

Purpose.

Application.

Requirement.

(a) Compliance to the requirements specified in this part can be accomplished through standards or other means that are acceptable to the Administrator.

(b) The standards may include a tiered structure to allow requirements appropriate to the aircraft design, construction and intended use.

(c) Acceptable standards may be developed by an industry organization or by an individual applicant.

Subpart B – Flight

23.21 Proof of compliance.

Scope. This section ties the operating characteristics defined "as required" by Subpart A to the requirements of this Subpart.

Purpose. The purpose of this section is to ensure that all parameters that influence performance and stability and control be considered in the showing of compliance within all of Subpart B. Beginning at Amdt xx, a requirement is added in Subpart A to define all these relevant parameters. Certain values of these parameters are defined as operating limitations and flight testing requirements.

Application. This section applies to all part 23 airplanes.

Requirement.

Each requirement of this Subpart must be met throughout the operating envelope of the airplane, defined "as required" by Subpart A. This must be shown:

(a) By tests upon an airplane representative of the type for which certification is requested, or by calculations based on, and equal in accuracy to, the results of testing; and,

(b) By systematic investigation of each probable combination of flight parameters within the operating envelope to be approved, if compliance cannot be reasonably inferred from combinations investigated.

23.45 Performance.

Scope. This section establishes overall criteria for the showing of compliance with performance requirements.

Purpose. The purpose of this section is to clarify the particular criteria for the determination of all performance data required to be determined or achieved by this Subpart. Additionally, the intent is to ensure that when using procedures established as required by Subpart A, a pilot with typical skills can achieve the performance determined under the requirements of this Subpart and presented to the pilot as required by Subpart G.

Application. This section applies to all part 23 airplanes.

Requirement.

(a) The performance requirements of this part must be met for the ambient atmospheric conditions appropriate for the type of airplane for which certification is requested.

(b) In determining the performance data of this part, the conditions and procedures appropriate for the type of airplane for which certification is requested must be followed.

(c) The performance data of this part must be determined in such a manner that their reproduction shall not require exceptional pilot skill or strength, or exceptionally favorable conditions.

23.49 Stalling speed.

Scope. This section establishes a requirement to determine stall speeds to be used throughout this part.

Purpose. Stall speeds are used as the basis for many operating speeds and limiting speeds in the development of various elements of airplane performance and also provide a basis for determining energy in emergency landing conditions. Therefore, it is required to determine these speeds as a part of showing compliance with the requirements of this Subpart.

Application. This section applies to all part 23 airplanes.

Requirement.

For the configurations appropriate for each stage of flight (e.g., take-off, en route, approach, and landing), the stalling speeds or the minimum steady flight speeds at which the airplane is controllable must be determined.

23.53 Takeoff.

Scope. This section addresses to All Engines Operating (AEO) and One Engine Inoperative (OEI) takeoff and takeoff flight path performance.

Purpose. Takeoff distance and procedures information are necessary for safe operation of all airplanes. Therefore, both distance and procedures data are required to be developed for use in takeoff planning. The effects of airplane weight, field temperature and elevation, winds, runway gradient and runway surface need to be included because of their affect on performance. Additionally, engine failures must be considered for multi-engine airplanes. Conservative takeoff distance and takeoff path data are acceptable since they increase safety.

Application. This section applies to all part 23 airplanes.

Requirement.

The following must be determined:

(a) The distance required for safe takeoff operations;

(b) Takeoff speeds and procedures that allow safe takeoff operations considering margins to the stall speeds and, in case of the sudden failure of the critical engine on a multi-engine airplane, to the minimum control speeds.

23.63 Climb.

Scope. This section addresses all the requirements for climb including all engines operating, engine failures, enroute climb and descent, glide, and balked landing.

Purpose. Climb performance data is necessary for the safe operation of all airplanes. This section requires certain climb performance data be provided to the pilot and that the airplane be capable of certain climb capabilities. The effect of weight, as well as altitude, temperature and other atmospheric conditions must be considered. Conservative data is acceptable since it results in greater safety. Metric performance requirements can be a function of the operational risks encountered by the airplane in service.

Application. This section applies to all part 23 airplanes.

Requirement.

(a) The airplane must meet the minimum climb performance requirements appropriate for the type of airplane for which certification is requested.

(b) The takeoff flight path must be determined, if applicable to the characteristics of the airplane as required to be defined by Subpart A.

23.75 Landing.

Scope. This section addresses landing distance performance.

Purpose. Landing distance information is necessary for safe operation of all airplanes. The resolution of that data, however, may be variable based on conservatism demonstrated to exist in the data.

Additionally, the effects of airplane weight, field temperature and elevation, winds, runway gradient and runway surface need to be included in the performance date because of their affect on performance. Clearly conservative landing distance data are acceptable since they lead to increased safety.

Application. This section applies to all part 23 airplanes.

Requirement.

The following must be determined:

(a) The horizontal distance necessary to land and come to a complete stop from the screen height above the landing surface.

(b) Speeds and procedures that allow a safe landing considering margins to the stall speeds and, in case of the sudden failure of the critical engine on a multi-engine airplane, to the minimum control speeds.

23.143 Controllability and maneuverability.

Scope. This section addresses the safety related airplane flight characteristics which allow a pilot to safely maneuver the airplane and control flight path.

Purpose. The intent of this section is to ensure that the maneuvering flight characteristics are safe and appropriate throughout the flight envelope and the maneuverability results in repeatable and smooth transitions between turns, climbs, descents and level flight. It is also intended that configuration changes, such as flap extension and retraction, landing gear extension and retraction and spoiler extension and retraction, along with asymmetric thrust due to engine failure, will result in safe characteristics owing to the airplane's controllability characteristics.

Application. This section applies to all part 23 airplanes.

Requirement.

(a) The airplane must be safely controllable and maneuverable during all flight phases.

(b) It must be possible to make a smooth transition from one flight condition to another.

(c) The requirements of paragraphs (a) and (b) of this section must be met, without requiring exceptional piloting skills, alertness, or strength, throughout, but within, the operating envelope defined as required by Subpart A (including configuration changes and, for multi-engine airplanes, the sudden failure of the critical engine).

23.161 Trim.

Scope. This section pertains to cockpit flight control forces during steady, unaccelerated flight.

Purpose. The intent of this requirement is to provide for cockpit flight control force characteristics that do not require excessive concentration by the pilot to maintain a desired speed and flight path to the detriment of other tasks the pilot must perform for safe flight operations.

Application. This section applies to all part 23 airplanes.

Requirement.

When taking into account the stage of flight:

(a) The airplane must be able to maintain longitudinal, lateral, and directional trim without further force upon, or movement of, the primary controls or its corresponding trim controls by the pilot, or

(b) If residual forces are exceeding those for prolonged application considered appropriate for airplanes certificated under this part, those forces shall not be fatiguing or distracting to the pilot.

23.171 Stability.

Scope. This section addresses the airplane's characteristics associated with airplane stability, or the tendency to return to steady, unaccelerated flight after being perturbed.

Purpose. The intent of this section is to ensure the airplane has a tendency to remain in, or return to, a flight condition after it is caused to deviate from that flight condition either by pilot actions or by atmospheric conditions, unless these deviations are benign. This intent may be achieved by inherent stability characteristics of the airplane or through augmentation by aircraft systems. It is also intended that cockpit control stick and pedal forces provide intuitive feedback to the pilot when maneuvering away from steady, unaccelerated flight.

Application. This section applies to all part 23 airplanes.

Requirement.

The airplane must meet the minimum required longitudinal, lateral and directional stability throughout its operating envelope. In addition, the airplane must provide suitable stability control "feel" (static stability) in any condition normally encountered in service, if necessary for safe operation.

23.201 Stall characteristics and stall warning.

Scope. This section addresses indications to the pilot of an impending stall and to post-stall flight characteristics.

Purpose. The purpose of this section is to require adequate stall warning and docile stall characteristics, since some flight operations are conducted at a small margin above stall speed. These characteristics should account for varying degrees of pilot skill, training and experience.

Application. This section applies to all part 23 airplanes.

Requirement.

The airplane must demonstrate satisfactory stall characteristics in both straight and turning flight, and with sufficient stall warning to the pilot.

23.221 Spin characteristics.

Scope. This section presents requirements for recovery characteristics following an unintentional or intentional spin, or the resistance to depart controlled flight and enter a spin.

Purpose. The purpose of this section is to provide an airplane that can be recovered from an inadvertent or intentional spin. However, since most spin accidents take place following spin entry while in an airport traffic pattern and too close to the ground to recover, the purpose of this section is also to provide airplanes that do not have a tendency to enter a spin during maneuvering that is typical while preparing to land. This capability can be achieved through aerodynamic means or by using specific systems that will help the pilot to avoid unintentional spins.

Application. This section applies to all part 23 airplanes.

Requirement.

(a) A single engine airplane must not have a tendency to inadvertently enter a spin.

(b) If a single engine airplane cannot comply with (a), or if intentional spins are approved, it must be demonstrated that safe recovery can be made using defined recovery procedures.

23.231 Ground handling characteristics.

Scope. This section addresses ground handling characteristics for all taxi, takeoff and landing surfaces.

Purpose. The purpose of this section is to require that operating characteristics be safe and predictable while operating on the surface, whether that surface is pavement, turf, water, snow or ice.

Application. This section applies to all part 23 airplanes.

Requirement.

The airplane must demonstrate satisfactory longitudinal and directional ground handling characteristics during taxi, takeoff and landing operations.

23.253 High speed characteristics.

Scope. This section pertains to the requirements addressing high speed characteristics.

Purpose. This section is intended to address the flight characteristics of airplanes at and near their maximum operating speed, particularly if those speeds reach Mach numbers where compressibility effects become a factor. Experience shows that aerodynamics can breakdown more quickly in the

transonic range resulting in sudden changes in flight characteristics. This requirement addresses various aspects of safety when operating at or above this regime.

Application. This section applies to all part 23 airplanes.

Requirement.

(a) Vibration and buffeting.

(1) The airplane must demonstrate satisfactory vibration and buffeting characteristics.

(2) If compressibility effects are a factor, the boundary of perceptible buffet must be determined in the cruise configuration. The airplane must demonstrate that probable inadvertent excursions beyond this boundary do not result in unsafe conditions.

(b) Upsets. If a maximum operating speed V_{MO}/M_{MO} is established as an operating limitation, the airplane must demonstrate satisfactory recovery characteristics following an inadvertent speed increase at any likely cruise speed up to V_{MO}/M_{MO}.

(c) Out of trim characteristics. Airplanes with an M_D greater than 0.6M and that incorporate a trimmable horizontal stabilizer must demonstrate satisfactory maneuvering stability, controllability, and recovery characteristics.

23.257 Flight in icing conditions.

Scope. This section provides flight characteristics requirements for airplanes whose definition as required by Subpart A includes flight into known icing.

Purpose. The purpose of this section is to show safe flight characteristics for operations in various levels of icing conditions. For conditions for which certification is not requested, it has been shown that a means of exiting icing conditions has resulted in safe operations.

Application. This section is only applicable to airplanes whose definition as required by subpart A includes flight into known icing.

Requirement.

If certification for flight in certain icing conditions is requested, the following apply:

(a) The airplane must be shown to operate safely, as appropriate for the icing conditions, and

(b) There must be a means to avoid, or to detect and safely exit, those icing conditions for which certification is not requested.

Subpart C Structures

23.301 Structures General

***Scope*.** This section addresses the strength requirements that apply to all portions of the airframe the failure of which would seriously endanger the safety of the airframe.

***Purpose*.** This rule provides the top level airframe strength requirements. This rule encompasses the intent of the current Subpart C General Section. Subpart C has historically been prescriptive and has specific design solutions defined in the rule. These design solutions are moved to the ADS (Airworthiness Design Standard) where future technology changes can be readily adopted into the regulatory framework. The requirements listed in g) were previously defined in Subpart B 23.251. Historically 23.251 has been shown compliance by both flight and structures DERs/Ums. Therefore a structural rule has been added to the new Subpart C.

Application. CFR 14 part 23 Subpart C

Requirement.

a) Strength requirements are specified in terms of limit loads (the maximum loads to be expected in service) and ultimate loads (limit loads multiplied by applicable factors of safety). Unless otherwise provided, prescribed loads are limit loads. *[301(a), 303]*

b) The structure must be able to support limit loads without detrimental, permanent deformation for each critical load condition. At any load up to limit loads, the deformation may not interfere with safe operation. *[305(a)]*

c) If deflections under load would significantly change the distribution of external or internal loads, this redistribution must be taken into account. *[301(c)]*

d) The structure must be able to support ultimate loads. Local failures or structural instabilities between limit and ultimate load are acceptable only if the structure can sustain the required ultimate load. *[305(b)]*

e) Compliance with the strength and deformation requirements of this section must be shown by tests or analysis. Structural analysis may be used only if the structure conforms to those for which experience has shown this method to be reliable. *[302(a)(b),307(a)(b)]*

f) Compliance with loads determined in this section must be shown in a rational or conservative manner. *[301(b)(d)]*

g) The airplane must be designed to withstand any vibration and buffeting that might occur in any likely operation condition. *[251(a)]*

23.303 Mass and Mass Distribution

***Scope*.** This section addresses mass and mass distribution for structural loads on the airframe.

***Purpose*.** This rule incorporates the intent of the current §§ 23.301(b) and 23.23(b)(2). In current industry practice, airframe mass distribution are in the details of the structural loads documents. Structural loads are a result of load factor, distribution and weight. This rule provides a mechanism for administrator approval of the mass and mass distribution used in the calculation of the airframe structural loads.

Application. CFR 14 part 23 Subpart C

Requirement.

All loads requirements must be complied with when the mass is varied over the applicable weight and C.G. envelope and is distributed in the most adverse manner, within the operating limitations. *[301(b);23(b2)]*

23.321 Flight Loads

***Scope*.** This section defines the flight loads to be used for the strength requirements of the airframe.

***Purpose*.** This rule provides the non-prescriptive flight loads used for structural substantiation of the airframe. In combination with Design Airspeeds, these rules encompasses the intent of sections of the current Subpart C Flight Loads, Horizontal Stabilizing and Balancing Surfaces, Vertical Surfaces, Ailerons and Special Devices Sections. Flight loads requirements such as acceleration factors and gust velocities of Subpart C has historically been prescriptive. These and other prescriptive requirements are moved to the ADS (Airworthiness Design Standard) where future technology changes can be readily adopted into the regulatory framework.

Application. CFR 14 part 23 Subpart C

Requirement.

a) Flight load requirements for symmetrical and asymmetrical loading must be determined and shown:

    (1) At each critical altitude within range in which the airplane is permitted to operate. When significant the effects of compressibility must be taken into account;

    (2) At each weight from the design minimum weight to the design maximum weight; and

    (3) For each required altitude and weight, for any practicable or conservative distribution of disposable load within the operating limitations; and

(4) For all combinations of airspeed and load factor on and within the boundaries of a flight envelope that represents the envelope of the flight loading conditions specified by the maneuver spectrum and gust environment. Variations in mission profiles and loading configurations must be accounted for.

[301(b), 321(a)(b)(c), 331(a)(b)(c), 333(a)(b)(c)(d), 337(a)(b)(c), 341(a)(b)(c), 343(a)(b)(c), 347(a)(b), 349(a)(b), 351, 365(a)(b)(c)(d)(e), 367(a)(b), 369(a)(b), 373(a)(b), 421(a)(b), 423(a)(b), 425(a)(b)(c)(d), 427(a)(b)(c), 441(a)(b)(c), 443(a)(b)(c), 445(a)(b)(c)(d), 455(a)(b), 459]

b) And in combination with any other loads, such as flight control loads, cabin pressurization loads or engine loads. *[351, 361(a), 365(a), 371(a)(b)(c), 391, 395(a)(b)]*

23.335 Design Airspeeds

***Scope*.** This section defines the airspeeds used for determining the flight loads.

***Purpose*.**

In combination with Flight Loads, these rules encompasses the intent of sections of the current Subpart C Flight Loads, Horizontal Stabilizing and Balancing Surfaces, Vertical Surfaces, Ailerons and Special Devices Sections. Airspeed requirements of Subpart C has historically been prescriptive. These and other prescriptive requirements are moved to the ADS (Airworthiness Design Standard) where future technology changes can be readily adopted into the regulatory framework.

Application. CFR 14 part 23 Subpart C

***Requirement*.**

Design airspeeds shall be established for which the airplane structure is designed to withstand the corresponding maneuvering and gust loads. To avoid inadvertent exceedances due to upsets or atmospheric variations, the design airspeeds shall provide sufficient margin for the establishment of practical operational limiting airspeeds. In addition, the design airspeeds shall be sufficiently greater than the stalling speed of the airplane to safeguard against loss of control in turbulent air. Consideration shall be given to a design maneuvering speed, a design cruising speed, a design dive speed, and any other design airspeeds necessary for configurations with high lift or other special devices. *[335(a)(b)(c)(d)]*

23.361 Engine Mount Loads

***Scope*.** This section addresses the engine mount structural load requirements for the airframe which have not been previously addressed by flight, ground and water loads.

***Purpose*.** This rule provides the non-prescriptive engine mount load requirements used for the structural substantiation of the airframe. In combination with Flight Loads, these rules encompasses the intent of sections of the current Subpart C Flight Loads Section. Engine mount loads of Subpart C has historically been prescriptive. These and other prescriptive requirements are moved to the ADS (Airworthiness

Design Standard) where future technology changes can be readily adopted into the regulatory framework.

Application. CFR 14 part 23 Subpart C

Requirement.

In addition to flight, ground and water loads, each engine mount and its supporting structure must be designed for forces and moments generated by the operation of the engine in combination with applicable flight loads. *[361(a)(b)(c), 363(a)(b), 371(a)(b)(c)]*

23.391 Flight Control Loads

***Scope*.** This section addresses the flight control structural load requirements for the airframe.

***Purpose*.** This rule provides the non-prescriptive flight control load requirements used for the structural substantiation of the airframe. This rules encompasses the intent of the current Subpart C Control Surface and System Load Section. Flight control loads of Subpart C has historically been prescriptive. These and other prescriptive requirements are moved to the ADS (Airworthiness Design Standard) where future technology changes can be readily adopted into the regulatory framework

Application. CFR 14 part 23 Subpart C

Requirement.

Control surface, control system and supporting structure must be designed by loads assuming to occur in addition to those prescribed in 23.321, except when limited by applicable pilot forces. *[659(a)(b)(c), 391, 393(a)(b), 395(a)(b)(c), 397(a)(b), 399(a)(b), 405, 407, 409, 415(a)(b)(c)]*

23.471 Ground and Water Loads

***Scope*.** This section addresses the ground and water structural load requirements for the airframe.

***Purpose*.** This rule provides the non-prescriptive ground and water load requirements used for the structural substantiation of the airframe. This rules encompasses the intent of the current Subpart C Ground Loads and Water Loads Sections. Ground and water loads of Subpart C has historically been prescriptive. These and other prescriptive requirements are moved to the ADS (Airworthiness Design Standard) where future technology changes can be readily adopted into the regulatory framework.

Application. CFR 14 part 23 Subpart C

***Requirement*.**

Ground and water loads, including taxi, landing, take-off and handling loads expected in service under the anticipated operating conditions must be considered in the design of the airplane.

[471, 473(a)(b)(c)(d)(e)(f)(g), 477, 479(a)(b)(c)(d), 481(a)(b), 483, 485(a)(b)(c)(d), 493(a)(b)(c), 497(a)(b)(c), 499(a)(b)(c)(d)(e), 505, 507(a)(b)(c), 509(a)(b)(c)(d), 511(a)(b)(c), 523(a)(b), 525(a)(b)(c)(d), 527(a)(b)(c), 529(a)(b)(c), 531(a)(b), 533(a)(b)(c), 535(a)(b)(c)(d)(e)(f)(g), 537, 753]

23.551 Aeroelasticity

Scope. This section addresses the aeroelasticity requirements of the airplane.

***Purpose*.** This regulation was originally located in Subpart D. Industry deemed it to be more applicable to structural loads than design and construction and was therefore moved to Subpart C. This rule provides the non-prescriptive aeroelasticity requirements used for the structural substantiation of the airplane. Aeroelasticity requirements of Subpart D has historically been prescriptive. These and other prescriptive requirements are moved to the ADS (Airworthiness Design Standard) where future technology changes can be readily adopted into the regulatory framework.

Application. CFR 14 part 23 Subpart C

***Requirement*.**

> (a) It must be shown that the airplane is free from flutter, control reversal, and divergence at all speeds within the design envelope and sufficiently beyond the flight envelope for any condition of operation, considering any critical failures.

[629(a)(b)(c)(d)(e)(f)(g)(h)(i), 677(c)]

(b) Tolerances must be established for quantities which affect flutter. *[629(a)]*

23.561 Emergency Conditions

Scope.

This section addresses the loading conditions on the airplane that must be taken into account during an emergency landing.

Purpose.

This requirement covers the loads that the airplane structure must be able to sustain during an emergency landing. These loads can be defined by static ultimate load factors, appropriate to the emergency landing scenario. Damage to the airplane is acceptable, as long as every occupant has a reasonable chance of escaping without serious injury. The occupants must be protected from items of mass coming loose during a crash landing.

Application. CFR 14 part 23 Subpart C

Requirements.

The airplane, although it may be damaged in emergency landing conditions, must be designed to provide reasonable protection to the occupants. Specific emergency landing conditions that are likely to occur shall be taken into consideration. *[23.561(a)(b)(c)(d)(e), 23.785(c)(n), 23.787(a3)(b)]*

23.571 Fatigue Evaluation

Scope.

This section requires that effects of fatigue loading must be considered where appropriate.

Purpose.

The purpose of this section is to ensure that the effects of repeated loading and damages on the aircraft structure are taken into consideration over the operational life of the aircraft. Regular inspections can be used as a means to prevent damages to grow to a point where they could lead to catastrophic failures.

Application. CFR 14 part 23 Subpart C

Requirements.

a) The structure of the airplane must be designed to avoid catastrophic failure during the operational life taking into account the expected repeated loads applied in service. *[23.571(a)(b)(c)(d), 23.572(a)(b), 23.573(a)(b), 23.574(a)(b), 23.627]*

b) The applicant must prepare inspections and procedures required by (23.571a) to preserve the structural integrity of all primary structural elements for the operational life-in the event/presence of:

(1) Fatigue Damage;

(2) Environmental Damage including likely corrosion or other degradation;

(3) Manufacturing, Accidental or In Service Damage;

(4) Maintenance Damage;

(5) Specified Maintenance; and

(6) Structural Repairs.

[23.575]

Subpart D Design and Construction

23.601 General

***Scope*.** This section addresses the general design and construction requirements that apply to all parts and assemblies.

***Purpose*.** The original intent of Subpart D as described in CAM 4a is primary structure and all mechanisms essential to the safe operation of the airplane must not incorporate design features which experience has shown to be unsatisfactory. Furthermore, the suitability of all design features must be established, and certain design features which have been found to be essential to the airworthiness of an airplane are specified and must be observed. Subpart D has historically been prescriptive and has specific design solutions defined in the rule. These design solutions are moved to the ADS (Airworthiness Design Standard) where future technology changes can be readily adopted into the regulatory framework. Historically Subpart D has also created specific testing requirements for those design solutions. These testing requirements have been imposed on design details which have been deemed to have "an important bearing on safety". Rather than requiring testing in the rule, the rule will require that the suitability must be determined, and determination methods will be specified in the ADS. Paragraph 601(b) establishes that design data must provide adequate definition. The interpretation of § 23.601 creates this requirement even though the verbiage does not exist in the current amendment level.

Application.

a) Each part or assembly must be designed for the anticipated operating conditions. *[601, 657(b), 675(c), 729(a), 731(a)(b), 733(a1)(a2), 737, 775(b)(d)(g)(h1), 787(a1)(a2),]*

b) Design data must provide adequate definition of configuration, design features, and materials and processes. *[601]*

c) The suitability of each design detail and part having an important bearing on safety in operations, must be determined. *[601, 641, 651(a)(b), 681(a)(b), 683(a)(b), 723(a)(b), 725(a)(b)(c)(d)(e)(f), 726(a)(b), 272(a)(b), 775(c), 843(a), 307(b)]*

Requirement.

(a) Each part or assembly must be designed for the anticipated operating conditions.

(b) Design data must provide adequate definition of configuration, design features, and materials and processes.

(c) The suitability of each design detail and part having an important bearing on safety in operations, must be determined.

23.603 Materials and Processes

***Scope*.** This section addresses materials, processes and methods of fabrication.

***Purpose*.** The original intent of "Materials, Workmanship, and Fabrication Methods" as described in CAM4a is to insure the primary structure is constructed from materials that are "uniform in quality and strength." Furthermore, fabrication methods must "be such as to produce a uniformly sound structure." From the original inception of the regulatory requirements, design solutions such as adhesive gluing or welding have been included in the regulations. These design solutions are removed and prescriptive requirements related to those specific methods are found in the ADS (Airworthiness Design Standard). In order to design structure that is "uniform in quality", it also requires that the structure has consistent strength and other properties assumed in the design. Insuring consistent strength requires the generation of material strength properties and design values. The prescriptive nature of how material strength properties and design values are generated are moved to the ADS and meets the original safety intent of the rule.

Application.

a) The suitability and durability of materials and processes used for parts, the failure of which could adversely affect safety, must—

(1) Be determined;

(2) Ensure consistent strength and other properties assumed in the design and;

(3) Take into account the effects of environmental conditions.

[603(a), 613(a)(b)(c)(d)(e)]

b) The methods of fabrication and assembly used must produce consistently sound structures. *[603(b), 605(a)]*

c) Each new aircraft fabrication and assembly method must be substantiated by a test program. *[605(b)]*

Requirement.

(a) The suitability and durability of materials and processes used for parts, the failure of which could adversely affect safety, must--

(1) Be determined;

(2) Ensure consistent strength and other properties assumed in the design and;

(3) Take into account the effects of environmental conditions.

(b) The methods of fabrication and assembly used must produce consistently sound structures.

(c) Each new aircraft fabrication and assembly method must be substantiated by a test program.

23.609 Protection of Structure

***Scope*.** This section addresses the protection of structure from deterioration and loss of strength.

***Purpose*.** The original intent of "Protection" as described in CAM4a is to insure the primary structure is suitably protected against deterioration or loss of strength in service. This could be caused by several sources. CAM 4a specified corrosion, abrasion, vibration, or other causes. The actual causes of the deterioration are prescriptive in nature, and are not necessary to define the original safety intent of the rule. The prescriptive causes of deterioration are moved to the ADS (Airworthiness Design Standard). Other rules in Subpart D that use the original intent of "Protection" are § 23.607 and § 23.611. Protecting the structure also requires proper maintenance, inspection, and servicing. There must be an appropriate means incorporated into the aircraft design to accomplish servicing. Section 23.607 addresses fasteners and design features of fasteners that must be incorporated to protect the structure from loss of strength. Describing fasteners in the regulation is a design solution and prescriptive in nature. These requirements are moved to the ADS and meet the safety intent of this rule.

Application.

a) Each part or assembly must be suitably protected against deterioration or loss of strength in service; and *[607(a)(b)(c), 609(a)]*

b) Have adequate provisions for ventilation and drainage. *[609(b)]*

c) For each part that requires maintenance, inspection, or other servicing, appropriate means must be incorporated into the aircraft design to allow such servicing to be accomplished. *[611]*

Requirement.

(a) Each part or assembly must be suitably protected against deterioration or loss of strength in service; and

(b) Have adequate provisions for ventilation and drainage.

(c) For each part that requires maintenance, inspection, or other servicing, appropriate means must be incorporated into the aircraft design to allow such servicing to be accomplished.

23.619 Special Factors

***Scope*.** This section addresses the special factors of safety that must be established for certain aspects of the structure.

***Purpose*.** As described in CAM 4a, the original intent of requiring special factors of safety for certain structural aspects was to "minimize the possibility of loosening of the joint in service, progressive failure due to stress concentration, and damage caused by normal servicing and field operations". For certain prescriptive design solutions as described in the regulation, acceptable factors are provided. In subsequent revisions to regulation, this was rewritten to include structure whose strength is uncertain,

likely to deteriorate in service, or as a means to account for variability. These factors are provided in several rules in Subpart D, and include castings, bearings, fittings, and control surface hinges. Since these are prescriptive design solutions, they are moved to the ADS (Airworthiness Design Standard), and meet the original safety intent of the rule.

Application.

a) Special factors of safety must be established; and

b) The factor of safety must be multiplied by the highest pertinent special factors of safety for each part of the structure whose strength is –

(1) Uncertain;

(2) Likely to deteriorate in service before normal replacement; or

(3) Subject to appreciable variability because of uncertainties in manufacturing processes or inspection methods.

[619(a)(b)(c), 621(a)(b)(c)(d)(e), 623(a)(b), 625(a)(b)(c)(d), 657(a)]

Requirement.

(a) Special factors of safety must be established; and

(b) The factor of safety must be multiplied by the highest pertinent special factors of safety for each part of the structure whose strength is –

(1) Uncertain;
(2) Likely to deteriorate in service before normal replacement; or
(3) Subject to appreciable variability because of uncertainties in manufacturing processes or inspection methods.

23.671 Cockpit Controls

Scope. This requirement accomplishes the objective as stated in the purpose.

Purpose. This rule embodies the requirements for layout, look, and feel of the controls in the cockpit, other than those related to propulsion and fuel systems.

Application. This requirement applies to pilot compartment, automatic pilot systems, flight director systems, circuit protective devices, master switch arrangement, switches, cockpit controls, and cockpit control knob shape.

Requirement.

The design of the flight crew compartment shall take into account the possibility of incorrect or restricted operation of the controls by the crew, due to fatigue, confusion or interference.

23.773 Flight Crew Exterior Visibility

Scope. This requirement accomplishes the objective as stated in the purpose.

Purpose. This rule embodies the requirements for the arrangement of the pilot compartment to ensure appropriate visibility for safe operation of the aircraft.

Application. This requirement applies to pilot compartment view, windshields, and windows.

Requirement.

The arrangement of the pilot compartment shall be such as to provide sufficient visibility to enable the pilot to safely taxi, takeoff, approach, land, and perform any maneuvers within the operating limitations of the airplane.

23.783 Doors

Scope. This requirement accomplishes the objective as stated in the purpose.

Purpose. This rule embodies the requirement that all doors including cargo doors, service/maintenance doors, oil doors, or occupant access doors, need to be designed such that they will provide an appropriate function and not cause a hazard to the aircraft. This rule is intended to capture the requirements for safe door function and not emergency requirements.

Application. This requirement applies to all aircraft doors including cargo doors, service/maintenance doors, oil doors, or occupant access doors.

Requirement.

Each door must be designed such that the function does not affect the ability of the aircraft to operate safely and must be protected from opening inadvertently in flight.

23.785 Occupant Safety

Scope. This rule provides safety requirements during emergency situations for the airplane occupants, including the crew and passengers.

Purpose. Occupants must be provided a safe environment during emergencies such as off-airport landings, fires and other emergencies. This environment may be provided by a number of different approaches.

Application.

Requirement.

Each airplane must be designed such that, each occupant is provided reasonable protection from injury during an emergency event. This shall be accomplished through providing design elements in order:

(a) to provide protection from inertia forces acting on the occupant during an emergency landing.
(b) to allow for timely evacuation of the occupants.
(c) to protect the occupant from fire and smoke.
(d) to meet the emergency equipment requirements defined in operational rules.
(e) To provide occupant protection from a splintering windshield.
(f) To provide a means of communication from flight crew to the passengers.

23.865 Fire protection of structure

Scope. This section addresses fire protection of structure.

Purpose. The original intent of § 23.865 is to protect flight controls, engine mounts, and other flight structure from the effects of fire. The current rule language provides both safety intent as well as design related solutions and prescriptive information. The design solutions and prescriptive information are removed from the rule and defined in the ADS (Airworthiness Design Standard).

Application.

Flight structure located in designated fire zones, or in adjacent areas that would be subjected to the effects of fire in the designated fire zones, must be capable of withstanding the effects of a fire. *[23.865]*

Requirement.

Flight structure located in designated fire zones, or in adjacent areas that would be subjected to the effects of fire in the designated fire zones, must be capable of withstanding the effects of a fire.

23.867 Lightning protection

Scope. This section addresses lightning protection of the aircraft.

Purpose. This rule embodies the requirement to protect the aircraft against catastrophic effects from the direct attachment of lightning to the structure and to aircraft components. The design solutions and prescriptive information are removed from the rule and defined in the ADS (Airworthiness Design Standard).

Application. This requirement applies to aircraft structure and components that are exposed to direct attachment of lightning.

Requirement.

The airplane must be protected against catastrophic effects from the direct attachment of lightning considering the operational envelope required in Subpart A.

Subpart E - Powerplants

23.901 Powerplant Installation Requirements

Scope. This section addresses the powerplant installation requirements. The term powerplant is used to address both propulsion systems and APUs.

Purpose. The rule provides the basic framework necessary for the powerplant installation. The definitions of what constitutes the powerplant system is included in order to take a systems level approach to the installation, rather than a strictly isolated, component requirement approach. The intent is to ensure that the powerplant system is suitable for installation into a part 23 airplane, and that the installation complies with the installation requirements for the powerplant system components. There are additional certification requirements for aircraft engines, propellers and powerplant emissions that are contained within other subchapters.

Application. Rule applies to applicants who are proposing a new or change to the powerplant system on an aircraft certified to part 23.

Requirement.

a) For the purpose of this part, the airplane powerplant installation includes each component that is necessary for propulsion or for providing auxiliary power for the aircraft (APU); and affects the safety of the major propulsive units.

b) Each engine and propeller must be approved. For specific classes of aircraft, the engine and fuel/energy system shall meet the requirements as defined in part 34. The engine, propeller, and APU installation must comply with installation instructions provided by the manufacturer and the other applicable provisions of this subpart.

c) Each powerplant installation must ensure safe operation and be accessible for preflight inspection & maintenance.

d) An automatic power reserve (APR) system that automatically advances the power or thrust on the operating engine(s), when any engine fails during takeoff, must comply with the applicable requirements of the subpart.

23.905 Propellers

Scope. This section addresses the propeller installation requirements.

***Purpose*.** The rule provides the basic framework necessary for the propeller installation. The intent is to ensure that the propeller is suitable for installation into a part 23 airplane. In addition, if there are propeller features, other than the basic function to provide propulsive thrust, those features are installed in a manner that does not pose a hazard to the aircraft.

***Application*.** Rule applies to applicants who are proposing a new or change to a propeller system installed on an aircraft certified to part 23.

Requirement.

The applicant must evaluate the propeller throughout the operational envelope of the airplane and show that:

a) The propeller shall not experience the harmful effects of flutter and failure due to fatigue will be avoided throughout the operational life of the propeller as installed.

b) All areas of the airplane forward of the pusher propeller that are likely to accumulate and shed ice into the propeller disc during any operating condition must be suitably protected to prevent ice formation, or it must be shown that any ice shed into the propeller disc will not create a hazardous condition.

c) The propeller speed and pitch are limited to values that will assure safe operation under normal operating conditions.

d) Each featherable propeller shall have a means to un-feather in flight. If the propeller feathering system uses engine oil (or any other fluid) and that fluid supply can become depleted or can be contaminated due to failure of any part of the system, there is a means incorporated to accomplish feathering with reserved fluid.

e) Each propeller shall be marked so that the disc is conspicuous under normal daylight ground conditions.

f) Installation considerations unique to the specific installation such as propeller clearance and exhaust gas impingement shall be addressed to insure safe operation throughout the entire operating envelop.

g) The propeller-drag limiting systems installed on a turbopropeller-powered are designed so that no single failure or malfunction or likely combination of failures, or inadvertent operation of the systems during normal or emergency operation will result in propeller drag in excess of that for which the airplane was designed.

23.906 Powerplant Hazard Mitigation

***Scope*.** This section addresses the powerplant installation hazards and mitigation.

***Purpose*.** The rule provides the basic framework necessary to minimize the hazards associated with the powerplant installation. The intent is to ensure that the powerplant system is a fault tolerant and any hazards from any powerplant system failure are minimized.

***Application*.** Rule applies to applicants who are proposing a new or change to a powerplant system installed on an aircraft certified to part 23.

Requirement.

a. The propulsion system shall minimize the resultant hazard from any powerplant system failure.
b. There must be a means to allow the appropriate flight crew members to rapidly shut off, in flight, any source of fuel/energy to each engine individually.
c. The powerplants must be arranged and isolated from each other to allow operation, in at least one configuration, so that the failure or malfunction of any powerplant system will not:
    i. Prevent the continued safe operation of the remaining powerplant system; or
    ii. Require immediate action by any crewmember for continued safe operation of the remaining powerplant system.
d. All designated fire zones must be identified.
e. Each engine, auxiliary power unit, fuel burning heater, and other combustion equipment must be isolated from the rest of the airplane by firewalls, shrouds, or equivalent means.
f. Each firewall or shroud must be constructed so that no hazardous quantity of liquid, gas, or flame can pass from the compartment created by the firewall or shroud to other parts of the airplane.
g. There must be means that ensure prompt detection of a fire in an APU or in an engine compartment.
h. Fire extinguishing systems must be installed in all airplanes with engine(s) embedded in the aft fuselage or in pylons on the aft fuselage, and for Auxiliary Power Unit if installed. The systems must not cause a hazard to the rest of the aircraft.
i. In each area or component where flammable fluids or vapors might escape by leakage of a fluid system, there must be means to minimize the probability of ignition of the fluids and vapors, and the resultant hazard if ignition does occur and prevent the introduction of hazardous toxic gases into the cabin.

23.933 Reversing Systems

***Scope*.** This section addresses reversing systems (systems that provide thrust in the opposite direction of flight) installation and hazard mitigation requirements.

***Purpose*.** The rule provides the basic framework necessary to minimize the hazards associated with systems that provide thrust in the opposite direction of flight. The intent is to ensure that the reversing system is a fault tolerant and any hazards from any reversing system failure are minimized.

***Application*.** Rule applies to applicants who are proposing a new or change to a reversing system installed on an aircraft certified to part 23.

Requirement.

(a) For turbojet and turbofan reversing systems and corresponding controls –

(1) Each system intended for ground operation only must be designed so that, during any reversal in flight, the engine will produce no more than flight idle thrust and that no inadvertent operation by flight crew of the system will result in unwanted reverse thrust under any operating condition. In addition, it must be shown by analysis or test, or both, that each operable reverser can be restored to the forward thrust position; or the airplane is capable of continued safe flight and landing under any possible position of the thrust reverser.

(2) Each system intended for in-flight use must be designed so that no unsafe condition will result during normal operation of the system, or from any failure, or likely combination of failures, of the reversing system under any operating condition including ground operation. Failure of structural elements need not be considered if the probability of this kind of failure is extremely remote.

(3) Each system and each control system must have a means to prevent the engine from producing more than idle thrust when the reversing system malfunctions; except that it may produce any greater thrust that is shown to allow directional control to be maintained, with aerodynamic means alone, under the most critical reversing condition expected in operation, and for each control for reverse thrust below the flight regime to prevent its inadvertent operation.

(4) Each system must meet the requirements of § 33.97 of this chapter or it must be demonstrated by tests that engine operation and vibratory levels are not affected.

(b) Each propeller reversing or pitch setting system must be designed so that no single failure or malfunction or likely combination of failures, or inadvertent operation of the systems during normal or emergency operation, will result in unwanted reverse thrust under any operating condition.

23.939 Powerplant Operational Characteristics

***Scope*.** This section addresses the powerplant installation operating characteristics requirements.

***Purpose*.** The rule provides the basic framework necessary for the powerplant operating characteristics. The intent is to ensure that the powerplant system operates as intended when installed in the aircraft, and that there are no adverse powerplant characteristics during normal and emergency operations within the range of operating limitations of the aircraft.

***Application*.** Rule applies to applicants who are proposing a new or change to a propulsion system installed on an aircraft certified to part 23.

Requirement.

(a) The powerplant operating characteristics must be investigated in flight to determine that no adverse characteristics or vibration are present that would create a hazard during normal and emergency operations within the range of operating limitations of the airplane and of the engine.
(b) No hazardous malfunction of an engine, auxiliary power unit, or any component or system associated with the powerplant or auxiliary power approved for use in flight may occur when the airplane is operated at the negative accelerations within the prescribed flight envelope.
(c) The powerplant and auxiliary power unit provisions must maintain the temperature of each component and fluid within the limits established for these items under the most adverse ground, water, and flight operations throughout the operational envelope.
(d) It must be possible to stop and restart an engine in flight. Any techniques and associated limitations for engine starting and stopping must be established and included in the Airplane Flight Manual, approved manual material, or applicable operating placards. In addition:
    1) An altitude and airspeed envelope must be established for the airplane for in-flight engine restarting. Each installed engine must have a restart capability within that envelope.
    2) The design of the installation must reduce the risk of fire or mechanical damage to the engine or airplane as a result of starting the engine in any conditions in which starting is to be permitted to a minimum.
    3) It must be demonstrated in flight that when attempting to restart an engine following a false start, all fuel or vapor is discharged in such a way that it does not constitute a fire hazard
    4) Following the in-flight shutdown of all engines, if the minimum wind milling speed of the engines is insufficient to provide the necessary electrical power for engine ignition, a power source independent of the engine-driven electrical power generating system must be provided to permit in-flight engine ignition for restarting.
    5) If continued engine rotation would cause a hazard to the airplane, there must be means provided for stopping combustion and rotation within any engine. Each component of the engine stopping system located in any fire zone must be fire resistant including the components of a hydraulic propeller feathering system.

23.951 Fuel / Energy System – General

Scope. This section addresses the powerplant energy storage and delivery system installation requirements.

Purpose. The rule provides the basic framework necessary for the powerplant energy storage and delivery system installation. The intent is to ensure that the system that provides energy used to provide propulsive thrust is a suitable for installation into part 23 airplanes, is fault tolerant and any hazards from any energy storage and delivery system failure are minimized.

Appendix E

***Application*.** Rule applies to applicants who are proposing a new or change to a fuel system installed on an aircraft certified to part 23.

Requirement.

a) Each system must be designed, arranged, and installed to:
    1) Ensure proper engine and auxiliary power unit functioning under each operating condition and maneuver for which certification is requested.
    2) Meet the applicable fuel / energy venting requirements of part 34 of this chapter based on the class of aircraft being certified.
    3) Prevent the ignition of fuel / energy vapor within the system caused by lightning.
    4) Provide the applicable fuel / energy rates as required to achieve maximum power / thrust with acceptable margin for all the other purposes for which the fuel is used.
    5) Have at least one drain to allow safe drainage of the entire fuel / energy system with the airplane in its normal ground attitude.

b) Each fuel / energy tank must be designed, arranged and installed in order to:
    1) Withstand the loads and pressures it may be subjected to in operation, prevent hazards to personnel, be isolated from fire zones, and be capable of retaining fuel / energy when subject to inertia loads and when landing on a paved runway with landing gear retracted or one landing gear collapsed.
    2) Have provisions for expansion space and venting to function as a rapid pressure relief system that prevents excessive loss of fuel during any maneuver.
    3) Have a drainable sump and allow drainage of any hazardous quantity of water to the sump with the airplane in the normal ground attitude.
    4) Have fuel tight filler connections suitable for the type of fuel / energy used with acceptable electrical bonding.
    5) Provide provisions to prevent contamination of the fuel / energy supply.
    6) Withstand acceptable pressures without failure or leakage throughout its operational envelope. This must be shown by test.
    7) Be able to establish the unusable fuel/energy supply considering effects due to any supply system failure.
    8) Prevent fuel overflow or structural damage when transferring fuel.

(c) If fuel pumps are required they must have independent power supplies, and not adversely affect engine operation under any condition.

(d) If pressure refueling systems are used, they must have a means to prevent the escape of hazardous quantities of fuel, include an automatic shutoff means, and have means to prevent damage to the fuel system in the event of failure of the automatic shutoff means and include an indication of the failure at the fueling station.

(e) If a fuel jettisoning system is installed, it must be free from hazards due to any probable single malfunction, and control must be demonstrated throughout the operating envelope.

23.1091 Powerplant Induction and Exhaust Systems

***Scope*.** This section addresses the powerplant induction and exhaust system installation requirements. These systems are typically associated with air breathing propulsion systems.

***Purpose*.** The rule provides the basic framework necessary for the induction and exhaust system installation. The intent is to ensure that the system that provides induction air and evacuates any powerplant waste products is a suitable for installation into part 23 airplanes, is fault tolerant and any hazards from any the induction and exhaust system failure are minimized.

***Application*.** Rule applies to applicants who are proposing a new or change to an exhaust or induction system installed on an aircraft certified to part 23.

Requirement.

(a) The air induction system for each engine and auxiliary power unit and their accessories must supply the air required by that engine or auxiliary power unit and their accessories under the operating and vibration conditions for which certification is requested and be appropriate for withstanding the installation, operational, and environmental effects.
(b) Air intakes and exhaust systems must be properly segregated from fire sources, be made of an appropriate material, and must not cause a hazard in the event of a backfire.
(c) Air intakes must minimize the ingestion of foreign matter.
(d) Each reciprocating engine installation must have an alternate air intake source.
(e) Each exhaust system, including exhaust heat exchangers, must be suitable for the specific installation, be designed for continued operation at high temperatures, fireproof, resistant to corrosion, and blockage due to internal system failures.
(f) The system that supplies air to the cabin must be suitably constructed or isolated to prevent hazardous quantities of toxic gases from entering the cabin, and the exhaust system must ensure safe disposal of exhaust gases.

23.1093 Powerplant Ice Protection

***Scope*.** This section addresses the installation requirements necessary to protect the powerplant for the hazards associated with icing.

***Purpose*.** The rule provides the basic framework necessary for the icing protection requirements of the powerplant system. The intent is to ensure that the powerplant system will continue to function when exposed to icing conditions.

***Application*.** Rule applies to applicants who are proposing a new or change to a powerplant system installed on an aircraft certified to part 23.

Requirement.

a) The powerplant system must be protected against the accumulation of ice as necessary to enable satisfactory functioning without appreciable loss of thrust when operated in icing conditions.

23.1101 Powerplant Bleed Air

***Scope*.** This section addresses the air used for cabin ventilation and pressurization that is provided by the powerplant system.

***Purpose*.** The rule provides the basic framework necessary for the air used for cabin ventilation and pressurization. The intent is to ensure that the powerplant system that provides the air used for cabin ventilation and pressurization does not introduce harmful or hazardous gases or vapors during normal and abnormal operation.

***Application*.** Rule applies to applicants who are proposing a new or change to a bleed air system installed on an aircraft certified to part 23.

Requirement.

The following applies to powerplant systems used for cabin pressurization:

(a) The supply air must be taken from a source where it cannot be contaminated by harmful or hazardous gases or vapors during operation under all intended operating conditions.

(b) The cabin air system may not be subject to hazardous contamination following any probable failure of the powerplant system used to provide cabin pressurization.

23.1141 Engine Controls

***Scope*.** This section addresses the control the propulsive thrust of the powerplant system.

***Purpose*.** The rule provides the basic framework necessary for the powerplant propulsive thrust control system installation. The intent is to ensure that the control system is a suitable for installation into part 23 airplanes, is fault tolerant and any hazards from any control system failure are minimized.

***Application*.** Rule applies to applicants who are proposing a new or change to a engine control system installed on an aircraft certified to part 23.

Requirement.

(a) Each powerplant control necessary for and setting power/ thrust including fluid injection systems, must give a positive and immediate responsive means of controlling its powerplant function. The powerplant controls shall be installed, located, arranged, and provide adequate independent control so that the pilot has full and unrestricted movement without interference. Inadvertent operation shall not result in loss power or control.

(b) When more than one primary control type is required, the control location and order from left to right shall be power (thrust), propeller (rpm) and fuel /energy control. Identical controls for multi-engine installations shall be located to prevent confusion as to the engines that they control.

(c) Each flexible control must be shown to be suitable for the particular application, without the need for constant attention without the tendency to creep.

(d) For each engine control system installations -.

1) It must be established that no single failure or malfunction or probable combinations of failures of control system components will have an effect on the system, as installed in the airplane, that causes the LOTC/LOPC probability of the system to exceed those allowed in part 33 certification.
2) For electronic engine controls it must be evaluated for environmental and atmospheric conditions, including lightning. The EEC system lightning and HIRF effects that result in LOTC/LOPC should be considered catastrophic.
3) The components of the installation must be constructed, arranged, and installed so as to ensure their continued safe operation between normal inspections or overhauls.

(e) The portion of each power plant control located in the engine compartment that is required to be operated in the event of fire must be at least fire resistant.

(f) Mechanical valve controls located in the cockpit used for propulsion or fuel management must have positive stops or detents, in the open and closed position.

(g) For power-assisted or electronic valves used for propulsion or fuel management, the indication must be clearly marked and identify when the valve is in the fully open, fully closed position, or is in transit.

(h) For APU's a means must be provided to the flight crew for the starting, stopping, monitoring, and emergency shutdown.

(i) Ignition switches must control and shut off each ignition circuit on each engine and must have a means to prevent inadvertent operation.

23.1163 Powerplant Accessories & Components

***Scope*.** This section addresses the powerplant accessories and components installation requirements. Typically, these are pumps, generators, ducts, hoses, etc.

***Purpose*.** The rule provides the basic framework necessary for the powerplant accessories and components installation. The intent is to ensure that the accessories and components necessary for powerplant operation, or powerplant driven and necessary for aircraft operation are suitable for installation into part 23 airplanes. In addition, that those accessories and components do not pose a hazard during normal and abnormal operation.

***Application*.** Rule applies to applicants who are proposing a new or change to a powerplant accessory or component installed on an aircraft certified to part 23.

Requirement.

(a) For the purpose of this part, powerplant accessories and components include those items that are not included with the type certificated engine or APU, but are:
    (1) Necessary for engine or APU operation
    (2) Necessary for the transfer of fuel or energy
    (3) Powerplant driven and necessary for aircraft operation.
(b) Each powerplant accessory and component must be constructed and arranged to insure safe operation under all intended operating conditions, including continuous operation for normal operating conditions and limited operation for abnormal operating conditions, and be accessible for necessary inspections and maintenance.
(c) Design precautions must be taken to minimize the hazards to the airplane in the event of a powerplant accessory and component failure, incorrect installation, or inadvertent operation.

23.1225 Powerplant Instruments, and Indicators

***Scope*.** This section addresses the information requirements necessary to operate the powerplant system.

***Purpose*.** The rule provides the basic framework necessary for the information requirements for the operation of the powerplant system. The intent is to ensure that there is adequate procedural information, as well as instrumentation, available to the aircrew in order to safely operate the powerplant system normally and safely mitigate any powerplant system failure.

***Application*.** Rule applies to applicants who are proposing a new or change to a powerplant instrument or indicator installed on an aircraft certified to part 23.

Requirement.

(a) Required information, as defined per the appropriate installation manual and the type certificate, from each aircraft powerplant and auxiliary power unit must be made available to the operator for continued safe operation including the type certificated limits for engines, APU's, and propellers.
(b) Each indicator must be shown in sufficient detail to indicate readily and accurately indicate the magnitude of the parameter under all operational conditions.
(c) Each powerplant fuel or energy control / valve —
    (1) Must be marked to indicate the position corresponding to each source of fuel or energy and to each existing feed position;
    (2) Must be marked on or near the selector for those sources of fuel or energy where safe operation requires the use of any source of fuel or energy in a specific sequence;

(3) Must be marked on or near the selector with the full amount of usable energy and any restricted usage conditions under which the energy can safely be used;
(4) Installed on any engine of a multiengine airplane must be marked to indicate the position corresponding to each engine controlled.

Subpart F - Equipment

23.1300 Aircraft Level Systems Requirements.

Scope.

This requirement accomplishes the objective as stated in the purpose.

Purpose.

The purpose of this requirement is to ensure:

a) airplane systems are appropriately designed to safely operate in the kinds of operations and conditions for which the airplane is approved, and

b) airplane systems are designed to support continued safe flight and landing in the event of all but the most unlikely of failures.

Application.

This requirement applies to aircraft equipment and systems other than propulsion and auxiliary power systems, also excluded are propulsive and auxiliary power energy storage and distribution (aka fuel) system

Requirement.

(a) The required equipment and other systems necessary for an airplane to operate safely in the kinds of operations (VFR, IFR, Day, Night, Known Icing), must—

(1) Be installed.

(2) Perform their intended function throughout the operating and environmental limits specified as required by Subpart A.

(3) be designed and installed to meet the minimum level of safety and reliability intended for the type of airplane.

(b) The required and non-required airplane systems considered separately and in relation to other systems, must be designed and installed so their operation or failure does not cause a hazard to the airplane or occupants.

23.1301 Function and Installation

Scope.

This requirement accomplishes the objective as stated in the purpose.

Purpose.

The purpose of this requirement is to ensure:

a) Equipment used in the design airplane systems have performance appropriate to the application
b) Airplane systems are designed such that human interaction is unlikely to result in an unsafe operating condition.
c) Crew members are provided with the information necessary to safely operate the airplane
d) Crew members are provided with the information necessary to respond appropriately to any unsafe system condition.

Application.

This requirement applies to aircraft equipment and systems other than propulsion and auxiliary power systems, also excluded are propulsive and auxiliary power energy storage and distribution (aka fuel) system

Requirement.

(a) Each component of a system must—
  (1) Be of a kind and design appropriate to its intended function.
  (2) Be installed according to limitations specified for that component.
(b) Systems must be designed to minimize errors which could contribute to the creation of hazards.
(c) There must be means to provide, to the appropriate flight crew members, the systems operating parameters required to safely operate the airplane
(d) Information concerning an unsafe system operating condition must be provided in a timely manner to the crew to enable them to take appropriate corrective action. Presentation of this information must be designed to minimize crew errors which could create additional hazards.

23.1302 Flight Information

Scope.

This requirement accomplishes the objective as stated in the purpose.

Purpose.

The purpose of this requirement is to ensure the crew is provided with the flight attitude, airspeed, altitude and direction information necessary to safely operate the airplane.

Application.

This requirement applies to all airplanes certified under this part.

Requirement.

There must be means to provide, to the appropriate flight crew members, the flight parameters required to safely operate the airplane.

23.1304 Flight Controls

Scope.

This requirement accomplishes the objective as stated in the purpose.

Purpose.

The purpose of this requirement is to ensure flight controls, stability augmentation and automatic and power-operated systems, stops, trim systems, control system locks, spring devices, cable systems, artificial stall barrier systems, control system joints, wing flap controls, wing flap position indicator, flap interconnection, and takeoff warning systems are design to operate safely.

Application.

This requirement applies to all flight control systems required to satisfy subpart B of this part.

Requirement.

Required Control Systems:

(a) The design of the controls and control systems shall be such as to minimize the possibility of jamming, inadvertent operation including prevention of mis-assembly, and unintentional engagement of control surface locking devices.
(b) Each control and control system shall operate with ease, smoothness and precision appropriate to its functions.

23. 1308 Taxi, Take-off and Landing equipment

Scope.

This requirement accomplishes the objective as stated in the purpose.

Purpose.

The purpose of this requirement is to ensure that airplanes have the equipment and systems necessary to safely taxi on, take-off from and land on surfaces for which the airplane is approved.

Application.

This requirement applies to general landing gear equipment, landing gear extension/retraction system, tires, brakes, nose/tail wheel steering, main float buoyancy, hulls, and auxiliary floats.

Requirement.

Equipment for safe taxi, take-off and landing on the intended surface, must be provided.

23.1311 Integrated Indication Systems.

Scope.

This requirement accomplishes the objective as stated in the purpose.

Purpose.

The purpose of this requirement is to ensure integrated indication systems are designed to

a) simultaneously provide all the information needed to safely operate the airplane

b) be easily readable over the service live of the displays

c) be sufficiently reliable or contain sufficient backup to ensure safe flight and landing

d) easily provide required backup information in the event of a failure

Application.

This requirement applies to integrated indication systems

Requirement.

Indication systems which integrate the display of primary attitude, airspeed, and altitude, or powerplant parameters needed by any pilot to set power within established limitations, must:

(a) Not inhibit the primary display of attitude, airspeed, altitude, or powerplant parameters needed by any pilot to set power, in any normal mode of operation, nor inhibit the primary display of engine parameters needed by any pilot to control starting, during the any starting mode of operation.

(b) Have criteria for replacement established, if the visibility of the display degrades with use or age.

(c) Have reliability or redundancy of determination and display of direction, altitude airspeed, and attitude, appropriate to approved kinds of operation

(d) Be designed so that one display of information essential for continued safe flight and landing will be available within one second to the crew by a single pilot action or by automatic means for continued safe operation, after any single failure or probable combination of failures.

23.1351 Power Generation, Storage and Distribution

Scope.

This requirement accomplishes the objective as stated in the purpose.

Purpose.

The purpose of this requirement is to ensure aircraft power generation and the related distribution systems are designed for safe operation.

Application.

The requirement applies to all types of aircraft power generation, except propulsive power, and the related distribution systems.

Requirement.

The power generation, storage and distribution for any system,

(a) shall enable it to supply the power required for proper operation of connected loads during all intended operating conditions.

(b) shall be such that no single failure or malfunction will impair the ability of the system to supply essential loads required for safe flight and landing.

(c) shall have enough capacity to power loads essential for safe flight and landing should the primary power generation source(s) fail.

(d) shall be such that any storage of power will be safe during all intended operating conditions and in the event of probable failures of the system.

(e) shall be such that the distribution of power will be safe during all intended operating conditions and in the event of probable failures of the system.

23.1383 External Lighting

Scope.

This requirement accomplishes the objective as stated in the purpose.

Purpose.

The purpose of this requirement is to ensure that:

a) required external lighting will be effective at helping people, outside the subject airplane, to avoid collision with the subject airplane.

b) when used, any external lighting will not shine into the cockpit in such a way as to significantly degrade flight crew performance.

c) sea/float planes, when parked on the water, are equipped with external lighting to help operators of other water-born craft avoid collision with the subject airplane.

Application.

This requirement applies to all airplanes, certified under this part, when equipped with external lighting required by regulation, and to sea/floatplanes parked on the water at night.

Requirement.

(a) The lights required by operating rule shall have the intensities, colors, fields of coverage and other characteristics such that they furnish the pilot, the pilot of another aircraft, or personnel on the ground with adequate time for interpretation and for subsequent maneuver necessary to avoid a collision. In the design of such lights, due account shall be taken of the conditions under which they may reasonably be expected to perform these functions.

(b) Lights shall be installed in airplanes so as to minimize the possibility that they will adversely affect the satisfactory performance of the flight crew's duties.

(c) For seaplanes or floatplanes, riding lights are required when anchored at night.

23. 1400 Cockpit and Cabin Environment

Scope.

This requirement accomplishes the objective as stated in the purpose.

Purpose.

The purpose of this requirement is to ensure that airplanes are designed to have ventilation, pressurized cabins, oxygen equipment and supply, minimum mass flow of supplemental oxygen, oxygen distribution system, equipment standards for oxygen dispensing units, means for determining use of oxygen, chemical oxygen generators, fire protection for oxygen equipment, and protection of oxygen equipment from rupture, appropriate for safe operation.

Application.

This requirement applies to all airplanes certified under this part.

Requirement.

A safe, habitable environment for crew and passengers must be provided throughout the normal operating envelope of the airplane and during emergency events.

23.1419 Ice Protection Equipment.

Scope.

This requirement accomplishes the objective as stated in the purpose.

Purpose.

The purpose of this requirement is to ensure that airplanes are designed to be capable of operating in icing conditions of durations consistent with the approved kinds of operations and limitations established for the airplane

Application.

This requirement applies to all airplanes certified under this part.

Requirement.

(a) The airplane must be shown capable of operating in icing conditions of durations consistent with the approved kinds of operations and limitations established for the airplane.

  (1) For basic approval under this part, the aircraft must be capable of operating in accordance with paragraph (b) of this section

  (2) If approval for instrument flight rules is requested, the aircraft must be capable of operating in accordance with paragraphs (b) and (c) of this section

  (3) If approval for flight in icing conditions is requested, the aircraft must be capable of operating in accordance with paragraphs (b)(c) and (d) of this section.

(b) The airplane propulsion system must be protected against icing and be shown capable of operating through the applicable power ranges without accumulations of ice on the engine, induction system components or airframe components that would adversely affect engine operation, result in unacceptable engine damage, or provide insufficient power or thrust.

(c) Pitot and static pressure sources and any other critical external probes must be protected sufficiently to perform the intended function

(d) The windshield and windows must be protected sufficiently to provide adequate view for taxi, takeoff, approach, landing and approved maneuvers

Subpart G – Operating Limitations and Information

23.1501 Operating limitations.

Scope. This standard specifies performance standards for providing operating limitations to the pilot.

Purpose. The purpose of this standard is to ensure the flight crew is supplied and has available a complete, accurate and usable list of limitations used during airplane operation.

Application. This standard applies to all part 23 airplanes.

Requirement. The operating limitations within which compliance with this part is determined, together with any other information necessary to the safe operation of the airplane, must be established and made available to the flight crew by an acceptable means.

23.1529 Instructions for Continued Airworthiness.

Scope. This standard specifies performance standards for the continued airworthiness instructions.

Purpose. The purpose of this standard is to provide the airplane's maintainers with the appropriate instructions to repair and maintain the airplane in a safe manner relating to the airplanes conformity at type certification and/or following an approved alteration or modification.

Application. This standard applies to all part 23 airplanes.

Requirement. The applicant must prepare Instructions for Continued Airworthiness in accordance with Appendix G to this part that are acceptable to the Administrator. The instructions may be incomplete at type certification if a program exists to ensure their completion prior to delivery of the first airplane or issuance of a standard certificate of airworthiness, whichever occurs later.

23.1541 Instrument markings and placards.

Scope. This standard specifies performance standards for instrument markings and placards.

Purpose. The purpose of this standard is to provide the pilot with immediate information for critical parameters such as loading limits and V-speeds. It also provides the pilot with helpful references for safety related parameters.

Application. This standard applies to all part 23 airplanes.

Requirement.

(a) Each airplane must contain:

(1) Placards and instrument markings appropriate for the category of airplane for which certification is requested; and

(2) Any additional informational placards and instrument markings required for its safe operation if it has unusual design, operating, or handling characteristics.

(b) Each placard and instrument marking prescribed in paragraph (a) of this section:

(1) Must be displayed in a conspicuous place; and

(2) May not be easily erased, disfigured, or obscured.

(c) For airplanes which are to be certificated in more than one category:

(1) The applicant must select one category upon which the instrument markings and placards are to be based; and

(2) The instrument marking and placard information appropriate for each category in which the airplane is to be certificated and that is required for its safe operation must be furnished in the Airplane Flight Manual.

23.1581 Airplane Flight Manual.

Scope. This standard specifies performance standards for pilot information requirements relating to airplane limitations, operations, performance, and procedures.

Purpose. The purpose of this standard is to provide the pilot with all the information necessary for the safe operation of the airplane as it applies to the relevant operating rules.

Application. This standard applies to all part 23 airplanes.

Requirement. An Airplane Flight Manual appropriate to the type of airplane for which certification is requested must be furnished, stowage for it must be provided, and it must contain the following:

(a) Information that is necessary for safe operation because of design, operating, or handling characteristics.

(b) Further information necessary to comply with the relevant operating rules.

APPENDIX F – TYPE CERTIFICATION / PRODUCTION CERTIFICATION WORKING GROUP PAPERS AND PROPOSALS

Appendix F.1 - Type Certificate/Production Certificate Report Out

14 CFR Part 23 Reorganization ARC

Type Design and Production Certification (TC/PC) Working Group

Report Out

Purpose: In response to the 14 CFR Part 23 Reorganization ARC charter to reduce simple airplane certification costs and time burden, the TC/PC working group set out to identify improvements in both the type design certification process and the production certification process. These improvements would cut the cost of certifying all part 23 airplanes or changes to them and also cut the costs of production. Further, opportunities to improve safety were also considered.

Working Group Membership:

Name	Company
Randy Shields - chair	Hawker Beechcraft
Oliver Reinhardt	Flight Design
Brian Richardet	Cessna
David Stevens	Quest Aircraft
Rob Robino	Honda
Larry Van Dyke	ICX Consulting
Kerri Hinton	Kestrel
Chris Mitchell	Cirrus
Clay Barber	Garmin
Anna Dietrich	Terrafugia
Blake Cheney	TCCA (AARTC)
Dave Magruder	FAA: AIR-220 (PC)
Steve Flanagan	FAA: AIR-110 (Cert Proc)

Approach: The initial activity of the working group was to identify cost drivers in the certification process (Attachment 1). For each cost driver, comments were identified along with suggested changes or solutions. In addition, it was indicated if the suggested solution would decrease costs for industry as well as FAA. It was also identified if the change would improve safety.

Appendix F

After considerable discussion about this list of cost drivers and possible solutions, the working group decided to focus their efforts on several key areas and develop white papers. These white papers would explain the issue and then provide a suggested solution for FAA consideration. White papers were developed for the following:

- FAA Conformity
- Minor Change Approval
- Applicant Showing Only
- Use of Video Recordings in Testing
- Design Organization / Production Organization Handbook including Simplified Production Certification

The following discusses each white paper at a high level. Copies of each paper are provided in appendices F.2 through F7.

Cost Savings Summary:

FAA Conformity	Direct type certification conformity expense savings on the order of 2 to 8 full time heads depending on the complexity of the project. Travel savings of $40,000 per year during routine times to $200,000 per month during peak type certification efforts.
Minor Change Approval	One company that has a more onerous minor change approval process stated they review approximately 2000 minor changes per year. They expect to save over $100,000 per year through this proposed process.
Applicant Showing Only	For a company with a single product line, this is estimated to be on the order of $50,000 per program. For a company with multiple product lines, savings on the order of $250,000 per year are anticipated. Additional savings due to the ability to use critical designee resources for higher level safety enhancing activities were not quantified.
Use of Video Recordings in Testing	Travel expenses for applicants could easily be reduced by $40,000 or more per project depending on the quantity of tests
Design Organization / Production Organization Handbook including Simplified Production Certification	A new entrant to the aviation field could save $200,000 in their initial development of manuals and processes through the use of this document. Additional savings for routine maintenance were not quantified.

Appendix F

FAA Conformity Process:

There was unanimous agreement by the working group that the FAA conformity process was the number one cost driver in certification. The FAA conformity process is essentially a double check of the applicant process, as the applicant is required to do 100% company conformity. It is interesting to note that the FAA conformity process is unique to the FAA. For example, two of the other major certification authorities, EASA from Europe and TCCA from Canada, do not require this second check of configuration. The working group outlined the following objectives for a new process:

- Replace individual component based conformity with a systematic approach to test article configuration management that satisfies FAA conformity and safety requirements in accordance with 14 CFR 21.33 and 21.53.
- Streamline the test article inspection and conformity process to eliminate unnecessary and redundant activities.
- Maintain or improve safety for flight test pilots.
- Consolidate and integrate records for as-designed, as-built and as-tested configurations to improve assurance that the as-tested configuration is representative of the approved type design, or serves the intended purpose of the test.
- Consolidate and integrate records showing a company's progression towards production approval readiness for a new model and to facilitate expedient issuance of applicable airworthiness certificates.
- Utilize Configuration Management as an integral part of the production process.

The proposed solution was for the FAA to allow adoption of modern configuration management practices. Configuration Management (CM) can be used to track the design throughout the life of the test article and provides the same information as conformity about the as-designed, as-built and as-tested configurations, including any deviations and their disposition, at any time during the project. This approach ensures the article is properly controlled through a CM system versus the current conformity process which is only capable of managing configuration at the individual component level. This is because a CM system manages the complete lifecycle of the article through an integrated system whereas the FAA conformity process manages build configuration in discrete packages that require manual reconciliation of configuration, which is often overly burdensome to manage. Further, under FAA conformity, the business systems for managing as-designed, as-built and as-tested configurations are often separate systems (e.g. design and test configuration changes are often tracked separately following the as-built conformity inspection), which makes reporting difficult during the reconciliation process.

Benefits of this process for the applicant would be reductions in:

a. Direct expenses caused by FAA conformity,
b. Indirect expenses caused by program delay, and
c. Operating expenses for designee or FAA inspectors to travel to witness FAA conformity inspections.

Appendix F

The white paper details direct type certification conformity expense savings on the order of 2 to 8 full time heads depending on the complexity of the project as well as travel savings of $40,000 per year during routine times to $200,000 per month during peak type certification efforts.

While the FAA also benefits from reduced cost of oversight and travel, some of the more intangible benefits the FAA may see include:

- Advisory Circular (AC) guidance that will standardize the CM procedure across applicants that is created by industry participants to assure grounding in current practice (note there is significant disparity between applicants implementing the FAA conformity process today).
- More accurate revision control of test article configuration for applicants and Aircraft Certification Offices that allow use of "…or later FAA approved revision" statements on Request For Conformity because a CM process would allow the applicant or FAA to query article configuration and compare to the required configuration at any time during the test program rather than leaving an open-ended conformity request.
- Configuration management systems that enable documentation of the evaluation of mid or late program design changes on previously accomplished testing

Three sections of 14 CFR part 21 apply to the conformity process: §§ 21.33, 21.35(a) and 21.53. The white paper provides a brief discussion of each and the impact of this proposal. In summary, the proposal to use configuration management meets the requirements of part 21 without further rule change. FAA conformity is not discussed anywhere in the regulation, but instead has been used as one method to meet the intent of § 21.33(a). This proposal would enable an alternative method to meet the inspection and configuration management requirements of part 21.

The white paper proposes new guidance should be developed to provide a configuration management and inspection standard that can be referenced by applicants and FAA personnel and provide the minimum requirements by which to approve and audit the applicant's program. The following Advisory Circular should be developed to provide a complete description of the CM process:

- Draft AC 21-xx Configuration Management System for Control of Certification Test Articles, Production, and other appropriate article configuration relevant areas (this will be drafted by industry and proposed to FAA)
- This AC should consider:
    - The controlled data listed in FAA Order 8110.4C, Para 5-3.d.
    - The controlled data listed in FAA Order 8110.49, Para 4-3 and 4-4
    - Description of Compliance Verification Engineer qualifications, functions, and limitations.
    - Improving guidance for completing Request for Conformity Special Instructions that addresses the issue of generic Special Instructions that are insufficient to determine the specific issue of concern to the requesting FAA ACO Engineer or designee.

To avoid burden for applicants already using FAA approved inspection procedures for type certification, the guidance should allow for inclusion of inspection procedures in the Quality Assurance Manual (QAM), ODA manual or other FAA approved manual held by the applicant.

Minor Change Approval:

The working group compared the minor change approval process each ARC member company used and noted a lot of variation, with some companies having a very onerous process and others a more streamlined process. The working group compared the various processes and then selected best practices from each to develop a proposed method for approval of minor changes to type design by an airplane manufacturer. It should be noted the Alterations and Maintenance Working Group also addressed this issue, but from an alteration perspective. The two groups worked together to develop common definitions to the extent possible.

14 CFR 21.95 states that minor changes in a type design may be approved under a method acceptable to the FAA before submitting to the FAA any substantiating or descriptive data. Further, 14 CFR 21.93 defines a minor change as one that has no appreciable effect on the weight, balance, structural strength, reliability, operational characteristics, or other characteristics affecting the airworthiness of the product.

A significant area of concern to both working groups was the definition of "appreciable" in 14 CFR 21.93. The white paper proposes what "appreciable" means for each of the 6 characteristics identified in the rule (weight, balance…). The paper also offers guidance as to the types of changes that affect different engineering disciplines. Lastly, the paper proposes a process for approval of a minor change to type design.

The process relies on qualified personnel to determine if a change to type design is major or minor based on 14 CFR 21.93 and the guidelines in the white paper which supplement 14 CFR 21.93 (i.e. the definition of appreciable). The decision of major or minor for the change is determined for each affected discipline, including consideration for the cumulative effect of minor changes. For the change to be minor, it must be determined to be minor for all affected disciplines. The change evaluation rationale is documented and retained.

The company completes any engineering activities associated with the minor change, including:

a. Any analysis is complete and company approved
b. Any company testing required to confirm no appreciable affect at the airplane level is complete, documented, and company approved
c. The change to the type design drawing(s) are company approved

After completing these activities, the minor change is considered approved through this process. The company retains evidence of completion of this process for every minor change. This evidence may be reviewed during FAA audit activities.

One company that has a more onerous minor change approval process stated they review approximately 2000 minor changes per year. They expect to save over $100,000 per year through this proposed process.

It is the working group's expectation that the FAA will find the process defined in the white paper for approval of minor changes to type design acceptable and issue a policy memo or other statement supporting it as a "method acceptable to the FAA." Each company can then decide to either stay with their currently approved process or adopt this new one.

Applicant Showing Only :

The goals of the part 23 ARC were to reduce the cost of certification and to improve safety for the part 23 aircraft. This paper proposes a method to do both through:

a. Use of Safety Management tools the FAA is implementing, and
b. Less direct involvement of the FAA in determining compliance to the regulations as allowed by 14 CFR 21.

A number of the FAA Safety Management Processes and Orders were considered when developing the risk based process proposed in this paper for determining when an applicant can simply show compliance without the FAA, a DER, or ODA unit member finding of compliance.

A recent change to 14 CFR 21 is the addition of the Statement of Compliance requirement of 14 CFR 21.20(b) and 21.97(a)(3) that increases the accountability of the applicant's management to ensure that compliance is properly shown as described in Advisory Circular 21-51. Consequently, in addition to there being economic incentive, there is further legal incentive for applicant management to ensure compliance is properly accomplished without having to rely on the FAA, a DER, or ODA unit member to find compliance.

This paper proposes a structure for when applicant showing only is sufficient as a function of the type of applicant and the risk of improper test conduct / data analysis and the resulting potential impact on safety. This proposal evaluates applicants based on three criteria:

1. Staff Competency – What is the skill level of the individual staff members of the company working the certification activities? Are there sufficient DER's or UM's on staff to support a complete aircraft design and certification project? Does the company have ready access to specialists at suppliers or consultants as necessary to complement staff?
2. Company Competency – What internal organization and resources does the company have in place to facilitate certification programs? Does the company management fully support the staff training and access to resources necessary to keep the staff current with FAA policies, regulations, and guidance related to certification activity?
3. Procedural Effectiveness – Does the company have adequate internal processes to ensure that work product is thorough, consistent, well-documented, etc.? Are the processes in place

proven, industry best-practices? Do the internal processes include a continuous improvement process to evaluate the procedures on a regular basis and take corrective action as needed?

For each of three criteria, the paper details the characteristics for being rated low, medium, or high. An applicant would work with the FAA to determine their rating for each of the three criteria. This rating could be re-evaluated on a regular basis as the company improves or concerns are raised. Either the FAA or the applicant may request a re-evaluation of the company's rating. Based on the ratings for the three criteria, an overall classification is established for the company based on the following:

- Tier 1 would rank low in two or more of the criteria.
- Tier 2 would rank medium in at least two of the criteria and high in the other.
- Tier 3 would rank high in all three criteria.

For each of these company classifications, analysis and testing methods have been reviewed to assess the risk of improper test conduct and the resulting potentially inaccurate data or potential errors in analysis. The various analysis and tests were selected based on:

1. Analyses where:
    a. The analysis method is well defined and understood – the method has been validated and is proven; and
    b. The likelihood that the analysis method will not adequately show compliance to the requirements is very low.
2. Tests where:
    a. Testing methods are well defined by either an industry standard, Advisory Circular, or other accepted standard including company test procedures that are proven;
    b. Testing methods are well understood and have little subjectivity;
    c. Testing methods are repeatable – all variables that could affect the test are known and are controllable and repeatable;
    d. There are clear pass / fail criteria; and
    e. The likelihood that the test method will not adequately show compliance to the requirements is very low.

Table 1 provides the proposed work split between the applicant and the FAA for the three tiers of applicant discussed above.

Table 1 – Work Split Definition

Type	Category of Applicant		
	Tier 1	Tier 2	Tier 3
Analysis	Data Analysis Performed by Applicant Analysis Approval Approved by FAA (or DER)	Data Analysis Performed by Applicant Analysis Approval Approved by Applicant	Data Analysis Performed by Applicant Analysis Approval Approved by Applicant
Testing	Test Procedure Approved by FAA Conformity Conformed by applicant, may have FAA oversight (or DAR) Test Conduct Conducted by Applicant Test Witness Witnessed by FAA (or DER) Test Data Approval Approved by FAA (or DER)	Test Procedure Approved by Applicant Conformity Conformed by Applicant Test Conduct Conducted by Applicant Test Witness Witnessed by Applicant Test Data Approval Approved by FAA (or DER)	Test Procedure Approved by Applicant Conformity Conformed by Applicant Test Conduct Conducted by Applicant Test Witness Witnessed by Applicant Test Data Approval Approved by Applicant

Table 2 of the white paper in Appendix F.5 identifies 24 types of analysis covered by this proposal.
Table 3 of the white paper in Appendix F.5 identifies 87 types of testing covered by this proposal.

It is suggested the FAA issue a policy memo, Advisory Circular, or FAA Order to endorse this proposal with any adjustments as required. This would allow the use of the applicant showing only process without waiting on further development of the FAA's Risk Based Resource Targeting (RBRT) tool.

Use of Video Recording in Testing:

Objectives:

- Acknowledge validity of utilizing video recording techniques for capturing key testing information.
- Improve quality and/or integrity of captured test data.
- Improve utilization of FAA resources and designees by enabling remote witnessing.
- Define parameters necessary for the successful utilization of video recordings for data capture.

Background Information:

The current primary method of data capture during certification testing is via real-time witnessing by appropriately delegated individuals. While this method of witnessing is sometimes augmented with video recordings, the use of video is typically viewed as a "back-up" to the physical presence and real-time witnessing of a human being. (Note that there are precedent instances where video has been

utilized as the sole means of witnessing, but these have been rare and have required "special dispensation.")

The vast majority of test witnessing is performed by FAA designees, which places a burden on the applicant to either hire consulting DER/UMs or obtain delegation of company DER/UMs. Regardless of the nature of the designee, minimizing the time required of that person will have a direct corollary effect on the financial impact experienced by the applicant.

For testing that takes place at or near the applicant's place of business, direct travel expenses for the applicant already will be minimal. However, if the applicant is utilizing consulting DER/UMs it is likely that such individuals will need to travel in order to witness the test. In addition to the "base fee" for the consultant's time, the applicant will also incur travel, lodging, and meal expenses; also, many consultants will charge for their on-location time based on full-day increments, even if the actual witnessing efforts consume only a few hours. Even if company DER/UMs are utilized, some testing requires travel to lab locations for witnessing; thus, the associated travel costs remain.

These effects can also significant consume FAA resources when the option is exercised to witness tests with FAA personnel. Exercising this option normally involves traveling some distance to the test site, incurring similar expenses to those discussed above due to either the distance traveled or the length of the testing in question. This eventuality is more likely in the case of startup companies when confidence in the company processes and procedures is still being assessed.

FAA test witnessing is conducted for one primary reason: to provide confidence in the validity of the test setup, the test execution, and the ensuing results. It is possible to accomplish all of these requirements through an alternate means to personal, real-time witnessing – utilization of video recording.

The white paper details many potential uses of video recording and the advantages. The paper also details the benefits to both the applicant and the FAA.

The paper identifies three primary areas that must be considered to make the use of video witnessing a viable proposition; these are adequate coverage, video fidelity, and data integrity. The paper discusses various requirements to consider when the FAA establishes the guidelines for video witnessing.

The paper reviews the part 21 requirements and concludes that there is nothing in the use of video as described in the white paper that would violate any part 21 requirements; therefore, no modifications to the FARs are necessary to allow the use of video witnessing.

A brief search of the available guidance material was conducted to see if any language was currently being used that would preclude the use of video as described in the document; none was found. However, two lines of reasoning were discovered that lend credence to the idea that video witnessing is in line with the current philosophy underlying witnessing.

In FAA Order 8110.37E, paragraph 2-6.b, it states:

> *…DERs may be authorized to witness tests outside their area of authority provided that the DER (1) is authorized to do so by the ACO, and (2) does not make the final compliance finding.*

The implication here is that physically observing the test taking place is not necessary to find the data valid. The importance is in monitoring the activity to ensure that the test plan was followed, no critical errors were introduced, the data was appropriately collected, etc. Employing video witnessing as described in the white paper can accomplish these same goals, enabling properly authorized individuals to make final compliance findings although they were not physically present for the test.

Additionally, FAA Order 8110.37E, paragraph 4-4.a states:

> *…Before witnessing the test, the DER must verify that the necessary FAA conformity inspections have been accomplished, that the test article is in conformity, or that all unsatisfactory conditions have been dispositioned. A DER is not required to witness an entire test to approve the test data. However, the DER must coordinate with the ACO to determine which conditions are critical and must be witnessed in order to ensure that all the data are valid. When DERs approve test data, they indicate that they witnessed those portions of the test dealing with critical conditions, the test was conducted in accordance with the FAA approved test plan, and the data are official test results that satisfy the test criteria for compliance.*

The proper use of video witnessing would provide the ability to not only "witness those portions of the test dealing with critical conditions", but also the ability to review these critical events in detail. In addition, non-critical portions that may otherwise go un-witnessed would be available for review at the DER's discretion. The utilization of video witnessing would not only meet the intent of the existing guidance, but could be leveraged to actually enhance the witnessing coverage.

The white paper concludes that new guidance should be developed to provide a video witnessing standard that can be referenced by applicants and FAA personnel, and to provide the minimum requirements by which video witnessing can be successfully utilized. The following Advisory Circular should be developed to provide a complete description of the video witnessing process:

- Update policy to endorse the use of video technology in test witnessing
- Endorse an industry standard developed by ASTM F44 on Video Witnessing of Certification Tests
- This standard should consider:
    - The types of testing that could most benefit from the use of video witnessing; and
    - The minimum parameters discussed above regarding coverage, fidelity, and integrity.

<u>Production Certification Manual:</u>

Several airplane manufacturers of this working group provided a copy of their Quality Manual to show how the 14 elements of 14 CFR 21.137 are satisfied to establish and maintain a production certificate. These manuals were compared and best practices identified with an eye toward simplicity. The result is a draft quality manual that provides new aviation business entrants a detailed starting point in

developing and obtaining their own production certificate. This draft manual is part of the Design Organization/Production Organization (DO/PO) handbook described in the next section.

Design Organization / Production Organization Handbook:

In a typical aviation company of today, different applicable sets of procedural, organizational, and quality management/assurance requirements are satisfied by separate handbooks for different segments of company. Most companies maintain separate TC and PC handbooks, and when operating in different countries, sometimes slightly varying versions of these handbooks.

Current implementation of the regulations (by FAA Orders) asks for predefined handbook structures for the individual operational segment that do not allow for a unification of the process world. Significant effort is spent to establish and maintain separate handbooks resulting in high administrative burdens, especially for small companies that maintain both TC and PC handbooks for one product, for one company, under one roof. This gets more complicated when the same company acts as component supplier under AS / EN 9100 approval with a third set of requirements and a third handbook. The situation causes a direct basis for conflicting information with the connected risk of process errors in daily work.

By comparing the requirements basis for existing accepted handbook samples, a harmonized approach is identified that allows small companies to set up one single, integrated quality management process satisfying all typical requirements, as an alternative to today's interpretation indicated by the Orders.

The harmonized approach is manifested in a standard handbook template that can be utilized and adopted to the individual company conditions.

The harmonized standard handbook implements several results of other ARC part 23 work group topics with identified significant potential for optimization of today's process in time, effort, cost and safety. By including these results within a standard handbook, a level playing field is established with limited room for local interpretation that might have negative impact for an individual company.

Throughout the process of generating the standard handbook approach, it has been verified that this handbook is capable of complying with the regulations of different major Agencies. This levels the playing field even beyond the limits of FAA jurisdiction.

The subject matter was identified within the Part 23 ARC activity as it highly relates to cost occurring when certifying a new project or making changes or STC to an existing project. It is recognized that the implementation is beyond the Scope of Work of the Part 23 ARC. Therefore, this paper is used to relate the outcome of the intense discussions and subsequent work to a parallel Part 21 ARC process.

The level of completion of this task is such that the activity can be handed over to an industry standards body. It is the recommendation of the task group to initiate this as the next step.

Appendix F.2 - PC/TC Work Group Cost Drivers List

The PC/TC Work Group brainstormed issues that were causing each of their company's difficulties and non-value added costs in the certification process. The initial list below identifies 50 of these items.

Item No.	Cost Driver
	PART 21 SPECIFIC
1	Conformity – we need to adopt the Canadian and EASA approach and be configuration based. We would still perform company first article inspections, but we don't need FAA inspectors (or designees) doing a second check of what the company has already done. Also, use the fact an article has passed its functional test as a measure that the configuration is OK.
2	Remove the requirement for Function and Reliability testing. Leave it to the business to decide if the airplane is ready for the marketplace or not. Don't impose an additional 150 to 300 hours of flight test time just flying around to continue to prove everything is working.
3	Part 21 requirements are in several areas disconnected from other industry standards. Industry level QM certificates are a complete "parallel universe" with no transparency and repeated effort, double documentation, partially conflicting.
	FAA ORDER SPECIFIC
4	Current standard definition of major / minor changes suits large aviation, but is often overdone for small aviation where some items can be less critical. This results in major changes, that could be easily minor changes; but reclassification requires Agency interaction with all time constraints.
5	ODA Order appears to require setting up completely independent TC and STC ODAs that essentially have to have duplicate requirements for TC and STC ODA if a TC ODA holder desires to create STCs for changes instead of doing an amended TC.
6	Having to send the FAA project notifications by letter is time consuming and delays getting projects reviewed, responded to, and accepted by the FAA.
7	The procedures in FAA Order 8110.4 are stifling the certification process and choking both the FAA and industry on unnecessary paperwork.
8	Make it easier to get all aspects of the unit design and qualification under TSOA as possible irrespective of specific TSOA requirements. Often unless the TSOA has a mandated requirement, credit cannot be taken for effort done by the TSOA supplier.
9	Unwillingness of ACO to accept electronic approvals of 8110-3, 8100-9, and other FAA forms drives additional unnecessary costs and delays into certification process.
10	Software design assurance is also very expensive to conduct with minimal perceived safety value. We rarely find anything wrong other than the documentation could be better. It either passes the testing or it doesn't.
11	The NACIP/RFC process is hugely cumbersome with very little value added.
	DESIGN ORGANIZATION SPECIFIC
12	One of the biggest problems with the ODA process has been the ability to get an ODA manual written and approved in a timely manner.
13	ODA Order manual requirements are not written to allow easy combination of multiple types of ODAs. Some larger companies have TC, STC, PC, and MRA ODAs but manual structure requirements make it difficult to use same procedures such as conformity and approvals for TC,

Item No.	Cost Driver
	STC, PC, or MRA ODA's without duplicating procedures in separate manuals within a manual. The entire recommended manual structure is difficult and cumbersome to make work efficiently.
14	No standard manuals for PO and DO available. For small companies standard handbooks can be very beneficial, as differences between the company setups are little in this segment.
15	Eliminate the need for people with special authorizations (FAA or designees) as much as possible. Accept company or supplier testing with no need for a special witness to the maximum extent possible. Company approval of data should be sufficient.
16	Conflicting interpretations create unnecessary delays and costs in the certification process.
17	Orders and ACs are being enforced as de facto rules, and are often interpreted in direct opposition to the actual rules (FARs).
18	Sequencing and the lack of FAA resources to work project issues early (while in sequencing) if applicant is ready → The FAA encourages applicants to better amortize project workload, but sequencing pushes this workload off for 6 – 12 months or more.
19	Trend toward FAA requiring higher-fidelity PSCPs from applicants (major issue seen w/ GAMA Airframe Manufacturers Group members…i.e., the Wichita manufacturers)
20	Lack of repeatability in expectations amongst FAA staff (engineering and manufacturing/airworthiness)…despite the goal, there is not 'one FAA'
21	FAA maintains a paradigm that turbofan aircraft need to have a higher level of safety than reciprocating and even turboprop aircraft, even though they acknowledge a turbofan's much better safety record
22	Establishing a product's certification basis is probably more contentious than it needs to be in many instances
23	Long duration to obtain the certificate requires effort and support and drives cost.
24	High demand to document staff qualification.
25	Qualification requirements for staff are very high and the same regardless if a small aircraft or an airliner is produced. For small aircraft companies this increases qualification cost and salaries.
26	High demand to document supplier and design subcontractor qualification and continued surveillance.
27	Consideration of DO and PO as independent companies, resulting in the need for an independent setup and interface definition. In the world of small Part 23 manufacturers this is an uncommon setup, the requirements overload the majority of companies for extremely few companies that might have this split setup of TC holder versus PC holder.
28	Stepwise approval process, especially for the different organizations, generates repeated effort and cost in own and contracted specialist staff.
29	<Validation Issue> EASA discourages early application and coordination from U.S. manufacturers by imposing an annual fee after application. Many FAA applicants cannot shoulder the cost of nearly concurrent EASA cert/validation, yet they would greatly benefit from early coordination and issue resolution.
30	EASA world: Cost allocation for DO surveillance is defined on the basis of the staff (headcount)

Item No.	Cost Driver
	at the Design organization. This is questionable, as the number of staff is not automatically complicating the management system under surveillance. Therefore, the headcount at the company is not automatically increasing the effort the Agency has when providing oversight.
31	Standards / suitable and pragmatic AMC for standard case qualifications are missing. This affects load assumptions, test methods, system qualification.
32	Annual fee while in TC process results in a certification cost block that is time dependent and cannot be predetermined. True workload is certification project related, not time related
33	Development of certification basis does not keep pace with technological developments.
34	Composite material certification requirements tend significantly to Part 25 aircraft requirements and do not match the needs for small aircraft. Results in inefficient solutions or drives to systems the small manufacturer cannot handle, resulting even in safety risks.
35	Validation of types for other countries often delayed due to non-availability of representatives abroad.
36	Strong focus on formal correctness, instead of technical and factual correctness results in enhanced efforts with no technical result achieved or safety enhanced.
37	For organizations with an ODA, eliminate the Partnership for Safety Plan since nobody follows it anyway.
38	ODA process does not seem to be functioning as was intended. In some cases there seems to be less delegation than under the standard cert process being used prior to companies going over to ODA.
39	Auditing is becoming more and more effort. We have many redundant audits and audits of audits. It is obvious that there must be a robust means to ensure a company is doing what they need to but we need to find a way where this can be done easier and with less redundancy.
40	Showing of compliance to regulations for small and simple aircraft (e.g. Class I and II).
	PRODUCTION ORGANIZATION SPECIFIC
41	Certified Quality Standard – re-write Part 21 to allow a general quality standard, such as ISO 9001 or AS9100, in place of a PC. However, don't be prescriptive in writing this so that there is the ability to comply in several different ways. For companies that also produce Part 25 business jets, it would be nice to pull these into the Part 23 tiered system or develop a Part 24 for them so that the same efficient production system that will be developed for Part 23 airplanes can also be applied in the same factory to Part 25 business jets.
42	Undue Burden – getting out from under the FAA PC process will lessen the need for FAA audits of foreign suppliers or the "belts and suspenders" approach required when the FAA doesn't have the budget to do the inspections. Using a Certified Quality Standard as mentioned above would enable this. Let the industry control their suppliers wherever they reside.
43	Export of Parts – getting away from the FAA PC process would eliminate the re-inspection of supplier parts that are already fully inspected and the paperwork currently required. You would still meet State Department requirements for export, and also inspect for damage or shelf life before shipping. However, you would stop inflecting damage through this second inspection of parts already fully inspected and packed appropriately by the supplier.
44	FAA oversight of the physical plant floor plan layout is stifling and creates unnecessary cost. Which work bench is used for which work effort should be an internal business decision,

Item No.	Cost Driver
	provided that the work product is properly controlled and identified. A great deal of time is spent roping off areas and hanging signage to identify "non-production work areas" – this adds nothing to the safety of the final product.
45	Production ends with Form 52 (Statement of Conformity). In case of maintenance or repair needs after signing this sheet, but prior to delivery, an approved maintenance organization is required. Therefore, POs (at least in EASA world) must maintain in parallel a MO, which is again another organization under again different oversight. Also valid for repairs after delivery – who, if not the manufacturer, is best suited to do especially major repairs; why different organization certificate required?
46	EASA world: Cost allocation for PC surveillance is bound to company turnover. This is questionable, as the complexity of the organization under surveillance is not automatically turnover dependent.
	FAA SPECIFIC
47	Auditing by Authorities requires staff availability and generates travel cost, especially when DO and PO are treated separately.
48	Waiting times for authority audits (due to capacity limitations and priority definitions at the authority) cost serious money, as the staff must be held available while no privileges exist to generate income.
49	Required repeating (scheduled) supplier and subcontractor audits bind capacity and generate cost.
	EASA SPECIFIC
50	In EASA World: Responsibilities for design and production surveillance are split between EASA and national authorities. This causes significant raise in effort, justified by no safety gain at all. How is situation in FAA world – is the identical section of FAA responsible for PO and DO, or is this also split between different branches resulting in complete double work?

The work group narrowed the list down to 17 items that they felt were significant and that needed further review. From the 17 items the group determined that they would concentrate on 5 items that would provide the most benefit and could be accomplished with no regulatory changes but might require policy papers or changes to Orders or issuance of new ACs.

Final List of Cost Saving Items Proposed

The following lists only the five issues the TC/PC group felt would provide significant cost savings and could be accomplished without changes to part 21.

1. Establish acceptable major/minor criteria for changes. Minor changes shall be automatically delegated to an organization who uses the procedures defined within this document or another

procedure documented and accepted by the FAA. This led to the minor change approval white paper.

2. A standard template for a production manual to cover production. The standard manual must be detailed and complete enough and without duplications, that only minor customization is required for a start-up company to get it working and approved. The standard handbook shall be structured to be most efficiently with a small company, that holds TC and PC in one hand, and at one location. The handbook shall identify how it should be split when this is not the case, without duplicating efforts for companies who have it all in one hand. Note: Standard Handbook structured is recommended for new start-up companies with only a TC application. This led to the DO/PO Handbook template.

3. Finding of compliance in non-complex projects by company delegates; Authority will only perform spot checking. This led to the Applicant Showing Only paper.
4. Configuration control and verification of certification and test articles (e.g., conformity inspections) shall be typically done by the organization, not by the Agency. Definition of a proper standard process allows for this delegation. This led to the Configuration Management paper.
5. The final issue was on Video Test Witnessing as presented in the Video Witnessing white paper.

Appendix F.3 - Conformity White Paper

Topic: FAA Conformity

Objectives:

- Replace individual component based conformity with a systematic approach to test article configuration management that satisfies FAA conformity and safety requirements in accordance with 14 CFR 21.33 and 21.53.
- Streamline test article inspection and conformity process to eliminate unnecessary and redundant activities.
- Maintain or improve safety for flight test pilots.
- Consolidate and integrate records for as-designed, as-built and as-tested configurations to improve assurance that the as-tested configuration is representative of the approved type design, or serves the intended purpose of the test.
- Consolidate and integrate records showing the company's progression towards production approval readiness for the new model and to facilitate expedient issuance of applicable airworthiness certificates.
- Utilize Configuration Management as an integral part of the production process.

Background Information:

The current method of implementation of the FAA conformity process results in significant redundancy of conformity inspections and disposition of deviations. By regulation, the applicant must complete 100% inspection which is followed by applicant disposition of deviations. When applying the FAA conformity process, the FAA may again conduct another inspection and must disposition deviations. The FAA conformity process is:

- Frequently being applied to 100% of components due to current interpretation of FAA guidance found in 8110.4, although not required by Part 21, and
- May be applied multiple times to a single component if used on multiple unrelated tests.

Both of these scenarios are discussed in more detail in paragraph a) of the Benefits section of this paper.

FAA designees are most commonly used for FAA conformity inspections, thus the burden is significant on the applicant to either hire a DAR or employ a DMIR. Note: hiring of DMIRs is only an option available to existing FAA production approval holders so the current FAA conformity inspection practice is even more burdensome on new start-up companies because they have to hire DARs.

Significant FAA resources are also consumed by this process to manage FAA paperwork and support designee oversight, especially when full delegation is not authorized for all conformity activity which is often the case with new startup companies.

FAA conformity is conducted for three primary reasons: to ensure the test article complies with the type design approved for the test; to ensure the article is in a safe condition for flight; and to monitor an applicant's progression towards obtaining a production approval for the new model. It is possible to accomplish all of these requirements through an alternate means – configuration management.

Description of Change:

Configuration Management (CM) can be used to track the design throughout the life of the test article and provides the same information as a conformity about the as-designed, as-built and as-tested configurations, including any deviations and their disposition, at any time during the project. This approach ensures the article is properly controlled through a CM system versus the current conformity process which is only capable of managing configuration at the individual component level. This is because a CM system manages the complete lifecycle of the article through an integrated system whereas the FAA conformity process manages build configuration in discrete packages that require manual reconciliation of configuration, which is often overly burdensome to manage. Further, under FAA conformity, the business systems for managing as-designed, as-built and as-tested configurations are often separate systems (e.g. design and test configuration changes are often tracked separately following the as-built conformity inspection), which makes reporting difficult during the reconciliation process.

Most applicants do not use the idealized design-build-test-report-optional FAA spot check due to it being too costly and time consuming. Rather they use a concurrent design-build-test-certify process. With this process the test articles are constantly evolving and changing configuration during the test program. Without a compelling beneficial reason for an applicant to implement a robust CM system, early in its certification efforts, both the FAA and the company relegate themselves to relying on a labor intense and discrete FAA conformity inspection process verses an overarching conformity lifecycle process such as that afforded by a CM system.

The CM system would be approved and audited by the FAA, removing the need to inspect and document individual components and greatly increasing FAA and company efficiency. The applicant would be required to document and manage the CM system to ensure integrity in the process is maintained. This could be accomplished similar to Part 21 quality systems through an FAA approved procedure, internal audits and corrective action for process non-compliances. These audits would be "spot-checks" of the system to support continuous improvement of the processes and people involved. Metrics would be maintained for measuring process maturity over time that could include compliance percentage from process audits, turnaround time on corrective actions, personnel qualifications, or missed inspection points from product audits. Further details for measuring CM system maturity will be documented in the AC proposed later in this paper.

The applicant would increase efficiency by removing redundancy in the inspection process and combining activities into a single integrated process as opposed to the current multiple independent processes. Further, use of a systematic integrated approach to managing configuration enables greater efficiency during testing and reporting – a time when applicant schedule is most compressed and the certification costs per day are the highest.

The applicant would use a FAA approved inspection system through an existing approval such as a Production Certificate or specifically approved through FAA approval of the CM system itself. This would enable equivalent FAA MIDO oversight as used for the current conformity inspection process. This inspection system will be audited by the applicant and the FAA to ensure continued integrity. The inspection system will require some form of standard guidance for new applicants that is described below.

The applicant would also use a FAA approved configuration management system that would enable equivalent FAA ACO oversight as used for the current RFC issuance process. This would be described in a standard industry guidance document to establish the minimum requirements for configuration management that maintains at least the same level of safety as the existing conformity process.

Documentation and FAA approval of both the inspection system and configuration management system can be through a combination of a PSP (or ODA manual) and company procedural documents. New applicants that lack a PSP or ODA could also achieve FAA approval through a project specific document such as a PSCP or project conformity plan. Note: use of a CM process in lieu of FAA conformity requires an applicant to demonstrate maturity of the process sufficient that it will satisfy the conformity requirements of Part 21. Failure to demonstrate would require the applicant to default to the FAA conformity process or to make appropriate changes in the process to ensure the appropriate capability is added.

Benefits for Applicant:

Three different aspects are considered for the analysis of applicant benefits:

a) Direct expenses caused by FAA conformity,

b) Indirect expenses caused by program delay, and

c) Operating expenses for travel to witness FAA conformity inspections.

a) Use of an FAA approved CM system in place of the current FAA conformity process using individual discrete Requests for Conformity will reduce applicant workload through reduction of redundant activity already performed by the applicant during the inspection process. Due to inconsistency in applying the FAA conformity process, two different scenarios have been experienced by applicants.

The first scenario consists of requiring FAA conformity only for critical components undergoing tests. With this process, FAA conformity is applied against a specific test plan. Thus, if a single component is

considered critical for more than one test plan, it may have an RFC for each test plan. This requires redundant information on each RFC and redundant tracking and conformity of each individual RFC.

The second scenario applies FAA conformity to every component and/or drawing on the test article, but only once regardless of how many tests it will be used for. This method is applied because the applicant wants to reduce risk of failing to conduct FAA conformity on components the ACO may find to be critical just prior to test. This conservative approach removes any uncertainty in having to decide what is and is not critical for the test but adds significant unnecessary work.

The first scenario may result in fewer FAA conformity items, but the applicant is at risk of failing to identify a critical item until just prior to testing, thus causing a delay in the test preparation and test process. The second method reduces that risk at the cost of possibly applying more FAA conformity than necessary.

For each FAA conformity request, a conservative direct savings to the applicant will be as follows assuming designees have full authority of the FAA conformity process:

- 10 min – 8120-10 form processing
- 5 min – 8130-9 form processing
- 10 min – FAA inspection review
- 10 min – 8100-1 form processing
- 5 min – copying, filing and transmittal of data to FAA staff
- Total time = 40 min per conformity request

These procedural activities would not be required for managing conformity through configuration management and are considered purely redundant to existing applicant inspection procedures. With a mature inspection system, it is unlikely the DMIR/DAR inspection will find non-conformances not already identified by the applicant's inspector. Further, most companies conducting FAA conformity also use an electronic database to manage data. Thus, the data entry on the FAA forms is purely redundant relative to a configuration management process.

Note this does not include resources for applicants also using the NACIP system, which could add another 10 minutes to the data entry process. It is possible applicants using NACIP would discontinue using one of the other business processes, but not guaranteed depending on the level of business system integration of the other systems already in place.

A small aircraft company using the low-risk approach to FAA conformity by applying it to every component and drawing will require approximately 7500 conformity articles (3 flight test aircraft and equivalent of 2 aircraft in ground test articles) for a new TC airplane. Total applicant savings would be 2.4 FTE (Full Time Equivalent). Savings on a more complex small aircraft project could be as high as 25,000 conformity articles, or 8.0 FTE.

b) Another possible cost to an applicant is in program delay. Risk for program delay is increased for applicants who do not have designees with authority to conduct portions of the FAA conformity process. Program delays could be caused by applicants waiting for FAA to issue RFC forms, disposition deviations or conduct conformity inspections. While it is expected the applicant coordinate with FAA personnel, unanticipated events or non-standard work may interfere with those plans and inadvertently cause delay. An FAA approved configuration management and inspection process would mitigate this risk. Program delays of a single day can run over $100,000 and have been calculated up to nearly $1,000,000 per day for higher-end Part 23 aircraft. While it is difficult to quantify this cost or even determine the probability that FAA conformity contributes to a program delay, the risk exists, and in fact has caused significant delays on a number of programs.

c) The current FAA conformity process requires travel to the location of manufacture not only for the applicant's inspector but also for the FAA inspection designee. Under a CM process, the travel could be reduced to a single person authorized by the FAA approved process. Travel expenses for applicants can be reduced by $40,000 or more depending on quantity of suppliers.

In general, designee expenses for a TC program can be quite high to support FAA conformity as it exists today. One company noted DAR expenses up to $200,000 per month and $15M throughout the entire TC program. These expenses create a significant barrier for a new start-up company—greater than the expenses necessary to demonstrate objective evidence for adherence to a CM procedure. The approach discussed in this paper that focuses on process control rather than on individual designees should provide relief to applicants.

In conclusion, other workload activities associated with configuration management are typically already conducted by applicants through other means and would have no impact on applicant costs. However, configuration management should increase efficiency in test article control and creating final reports, which isn't taken into consideration in this proposal. Nor does this consider the efficiency gained by the ability to better schedule and manage test activities to shorten the test schedule duration. Further, the indirect costs of signature wait time associated with the FAA conformity process and loss of efficiency due to multiple redundant activities and corresponding business system are not considered. Thus, the savings shown above are assumed to be very conservative.

Benefits for FAA:

Assuming the FAA currently makes full use of designees during the FAA conformity process, the direct FAA benefits will be limited to reduced oversight requirements and paperwork processing reduction. The FAA will benefit even further for projects where the FAA takes a more active role during the conformity process (e.g. ACOs making extensive use of FAA employees for issuing RFC and conducting inspections). Thus, this estimate is conservative.

FAA will save approximately 15 minutes per conformity item in paperwork review and filing for closed conformity paperwork (both ACO and MIDO). Thus, total savings will be 0.9 – 3.0 FTE during the TC projects previously discussed. This will be balanced by inspection system oversight for applicants without an approved inspection system under a PC (or other means). This oversight should require

approximately 40 hours per year to audit the process or 160 hours (0.08 FTE) over a three-year program. To maintain conservatism in the model, this evaluation does not consider reduction in designee oversight if the final process reduces the number of designees that are involved in the process.

Some more intangible benefits the FAA may see include:

- AC guidance that will standardize the CM procedure across applicants that is created by industry participants to assure grounding in current practice (note there is significant disparity between applicants implementing the FAA conformity process today).
- More accurate revision control of test article configuration for applicants and ACOs that allow use of "…or later FAA approved revision" statements on RFC because a CM process would allow the applicant or FAA to query article configuration and compare to the required configuration at any time during the test program rather than leaving an open-ended conformity request.
- Configuration management systems that enable documentation of the evaluation of mid or late program design changes on previously accomplished testing

Maintaining Safety:

Use of configuration management in lieu of the current conformity process will maintain or improve safety of the test articles for those conducting the tests. Real time knowledge of exact test configuration will be known, all inspections will be by the FAA approved process and deviations closed by a Compliance Verification Engineer (A DER, UM, or other qualified and authorized engineer whose qualifications, functions, and limitations will be defined in the AC). This accomplishes all major safety checks found in the current conformity process. Additionally, if a database is used it can assist the mechanics and shop in automatically identifying any open actions on the test article that now depend on the mechanics to remember, or something written on a piece of paper that may be buried in a book and overlooked.

Effects on Part 21:

Three sections of 14 CFR Part 21 apply to the conformity process: Section 21.33, 21.35(a) and 21.53. The following provides a brief discussion of each:

Section 21.33: This rule requires that "each applicant must <u>allow</u> the FAA to make any inspection and any flight and ground test necessary to determine compliance with the applicable requirements of this subchapter. (21.33(a))" This does not require 100% FAA inspection of every article for every test. This rule requires an applicant to conduct 100% inspections of the test article (21.33(b)), ensure the article is under configuration control (21.33(a)(2)), and make the product available to the FAA for inspection and testing (21.33(a)). There is no requirement for FAA inspection or testing. This FAA discretion unburdens the FAA from having to inspect and test everything submitted by the applicant. Thus, there exists latitude in the minimum requirement; enabling the FAA flexibility in how conformity is managed and to what extent it is applied. Use of an FAA approved inspection and configuration management system is one method to meet this rule.

Section 21.35(a): This rule requires an applicant to conduct 100% inspections prior to flight testing. There is no requirement in this rule that the FAA must also conduct inspections.

Section 21.53: Requires an applicant to submit a statement of conformity for each article to be tested. Use of the singular implies a single statement for the entire article undergoing test is acceptable. There is no requirement for FAA conformity nor does the rule specify how the statement of conformity is submitted.

In summary, the proposal discussed herein meets the requirements of Part 21 without further change. FAA conformity is not discussed anywhere in the regulation, but instead has been used as one method to meet the intent of Section 21.33(a). This proposal would enable an alternative method to meet the inspection and configuration management requirements of Part 21.

Effects on Existing Guidance:

The following FAA Orders were evaluated for applicability to FAA conformity: 8110.4C, 8110.41A, 8110.49, 8110.105, and 4040.26A.

<u>FAA Order 8110.4C Type Certification:</u>

The following paragraphs of this order discuss when FAA conformity is required.

Paragraph 2-5.c. states the following:

> "…FAA conformity process is a validation of the applicant's conformity. During the inspection, FAA manufacturing inspectors base the depth of their assessment on factors such as quality of the applicant's conformity paperwork, comparison of inspection results, and magnitude and complexity of the inspection."

Paragraph 2-5.c.(1) states the following:

> "The applicant is responsible for …conducting 100 percent applicant conformity…The ACO is responsible for identifying features, attributes, and components critical to the test results and for requesting FAA conformity on these test articles with special instructions as necessary. The MIDO is responsible for determining what conformity inspections will be necessary for processing production approvals."

Paragraph 2-6.b. states the following:

> "Conformity inspections verify and provide objective documentation that the test articles, parts, assemblies, installations, functions, and test setups conform to the design data…It is the responsibility of FAA engineering personnel to determine the need to conduct conformity inspections…"

All of these paragraphs together state that the ACO is required to determine when FAA conformity is necessary and the MIDO is required to determine when an FAA inspection is necessary to establish FAA

conformity. There is latitude within the guidance to accept the proposed change. With an approved configuration management process, the ACO could accept the process based approach in place of the FAA conformity process. Further, the MIDO could use its discretion to accept the approved inspection process in place of a direct inspection.

Additionally, Section 5 provides extensive detail about how to conduct the FAA conformity process when it is deemed necessary. As stated above, if determined that FAA conformity is not necessary, or an approved procedure can be used in place of FAA conformity, much of this section is not applicable to the proposed CM procedure. However, Section 5 should be revised to include reference to the CM process and how ACO and MIDO personnel should conduct oversight of the system.

> *Recommendation*: It is recommended 8110.4 be revised to provide description of the alternative process proposed herein to explicitly state to FAA personnel how to manage test articles with the approved configuration management and inspection procedures. This should be incorporated into Section 5 as an alternative to the FAA conformity process.
>
> *Recommendation*: *Paragraph* 5-3.d should be considered when developing guidance for an applicant's inspection procedure and is identified in the final section of this paper.

FAA Order 8110.41A Aircraft Certification Service FAA Flight Test Responsibilities, Procedures, and Training:

Paragraph 507 states the following:

> "When applicant flight tests are performed early in a program (prior to TIA), before an FAA conformity inspection is conducted, the resulting data may still be valid if it can be established that the testing took place on an aircraft that was essentially identical to the article that is later conformed to the type design and that no significant changes were made between the time of the test and the subsequent conformity inspection."

Through configuration management, this could easily be accomplished and would be in full compliance with the expectations of this order. The TIA request would become a formality to establish the flight test program, but would not prohibit applicant compliance testing prior to this gate review. This order also states FAA conformity is established through the 8110-1 for flight testing. This order omits discussion of component level FAA conformity requests through 8120-10. Thus, the CM process could be used to establish complete test article configuration and the 8110-1 would reference this data for establishing top-level article conformity. No change is necessary to enable the new process as proposed.

FAA Order 8110.49 Software Approval Guidelines:

Section 4 of this order discusses FAA conformity when testing software for certification credit. Paragraph 4-2 states the following:

> "A conformity inspection is required to determine that the applicant complies with 14 CFR § 21.33(b) and that the product and components conform to approved type design."

This statement is highly restrictive relative to the minimum requirement of 14 CFR Section 21.33(a) since the only regulatory requirement is for an applicant to make the article available to FAA for inspection and test. FAA conformity is discretionary and nowhere does regulation state FAA conformity is a requirement. FAA employees that should have discretion in the process are stripped of that authority when following this order. Further, this section does not give credit to applicant inspection process maturity achieved through the DO-178 process, assuming only FAA can ensure proper configuration control. However, many of the controlled data listed in Paragraphs 4-3 and 4-4 could be used to provide guidance for incorporation into the applicant's approved procedures when managing software.

> *Recommendation*: It is recommended 8110.49 be revised to remove the specific conformity requirements found in Section 4 and replace it with a reference to 8110.4 for acceptable conformity management procedures. This, combined with the recommendation for 8110.4, will provide either the existing FAA conformity process or the new FAA approved CM system as methods for controlling test article configuration.

> *Recommendation*: The controlled data listed in paragraphs 4-3 and 4-4 should be considered when developing guidance for an applicant's inspection and configuration control procedure. This would ensure the intent of these paragraphs will still be met through the applicant's FAA approved CM system.

FAA Order 8110.105 Simple and Complex Electronic Hardware Approval Guidance:

This order makes multiple references to "hardware conformity review" but does not differentiate between applicant conformity and FAA conformity. Thus, the guidance provides flexibility in the process to allow applicant conformity throughout. No change is necessary to enable the new process as proposed.

FAA Order 4040.26A Aircraft Certification Service Flight Safety Program:

Appendix 2, Paragraph 4 requires the MIDO or a designee verify aircraft conformity in writing in accordance with the TIA (FAA form 8110-1), but does not require component level FAA conformity. Similar to the discussion about 8110.41A, the TIA could reference the CM data when establishing top-level test article conformity. No change is necessary to enable the new process as proposed.

Recommendation for New Guidance:

New guidance should be developed to provide a configuration management and inspection standard that can be referenced by applicants and FAA personnel and provide the minimum requirements by which to approve and audit the applicant's program. The following Advisory Circular should be developed to provide a complete description of the CM process:

- Draft AC 21-xx Configuration Management System for Control of Certification Test Articles, Production, and other appropriate article configuration relevant areas (this will be drafted by industry and proposed to FAA)
- This AC should consider:
    - The controlled data listed in FAA Order 8110.4C, Para 5-3.d.
    - The controlled data listed in FAA Order 8110.49, Para 4-3 and 4-4
    - Description of Compliance Verification Engineer qualifications, functions, and limitations.
    - Improved instructions on RFC Special Instructions that result in generic Special Instructions that are insufficient to determine the specific issue of concern to the requesting engineer.

To avoid burden for applicants already using FAA approved inspection procedures for type certification, the guidance should allow for inclusion of inspection procedures in the Quality Assurance Manual (QAM), ODA manual or other FAA approved manual held by the applicant.

Appendix F.4 - Minor Change White Paper

The Type Design and Production Certification Working Group of the Part 23 14 CFR Reorganization ARC compared the minor change process each represented company used and noted a lot of variation, with some companies having a very onerous process and others a more streamlined process. The working group compared the various processes and then selected best practices from each to develop a proposed method for approval of minor changes to type design by an airplane manufacturer.

Applicable Rules:

Sec. 21.93 - Classification of changes in type design.

> (b) In addition to changes in type design specified in paragraph (b) of this section, changes in type design are classified as minor and major. A "minor change" is one that has no appreciable effect on the weight, balance, structural strength, reliability, operational characteristics, or other characteristics affecting the airworthiness of the product. All other changes are "major changes" (except as provided in paragraph (b) of this section).

Sec. 21.95 - Approval of minor changes in type design.

> Minor changes in a type design may be approved under a method acceptable to the [FAA] before submitting to the [FAA] any substantiating or descriptive data.

14 CFR 21.95 states that minor changes in a type design may be approved under a method acceptable to the FAA before submitting to the FAA any substantiating or descriptive data. Further, 14 CFR 21.93 defines a minor change as one that has no appreciable effect on the weight, balance, structural strength, reliability, operational characteristics, or other characteristics affecting the airworthiness of the product.

One issue is the definition of appreciable in 14 CFR 21.93. This white paper proposes what appreciable means for each of the 6 characteristics identified in the rule (weight, balance,…). This paper also offers guidance as to the types of changes that affect different engineering disciplines. Lastly, the white paper proposes a process for approval of a minor change to type design.

One company that has a more onerous minor change approval process stated they review approximately 2000 minor changes per year. They expect to save over $100,000 per year through this proposed process.

It is the working group's expectation the FAA will find the process defined in this white paper for approval of minor changes to type design acceptable and put out a policy memo or other statement supporting it as a "method acceptable to the FAA." Each company can then decide to either stay with their currently approved process or adopt this new one.

Appendix F

Proposed Method Acceptable to the FAA:

1. General - the company must have and maintain access to the knowledge and technical capability required to maintain the continued airworthiness of the product with respect to the change as required by the CFR.
2. The change is evaluated by qualified company personnel to determine if the change is major or minor and the evaluation rationale is documented and retained
3. Qualified Personnel include:
    a. DERs or UMs
    b. Other authorized personnel who have the endorsement of the head of Engineering on the basis of the following recommendations:
        i. Four years of applicable engineering experience including 2 years of regulatory experience, and
        ii. Knowledge of the minor change classification criteria and the applicable regulations through directly related work experience, and
        iii. Knowledge of the factors on how a change may affect different disciplines
    c. Suppliers who:
        i. Have a minor change determination process acceptable to the OEM, and
        ii. Is audited by the OEM's quality system on a regular basis, and
        iii. Will only approve minor change within agreed parameters with the OEM
4. The disciplines affected by the change are determined based on the guidelines in Attachment 1 in conjunction with the engineering experience of the qualified personnel.
5. The minor change classification is based on 14 CFR 21.93. Attachment 2 provides guidelines to supplement 14 CFR 21.93.
6. The decision of major or minor for the change is determined for each affected discipline, including consideration for the cumulative effect of minor changes. Note: For the change to be minor, it must be determined to be minor for all affected disciplines.
7. The company completes any engineering activities associated with the minor change, including:
    a. Any analysis is complete and company approved
    b. Any company testing required to confirm no appreciable affect at the airplane level is complete, documented, and company approved
    c. The change to the type design drawing(s) are company approved
8. The minor change is now approved through this process.
9. The company retains evidence of completion of this process for every minor change. This evidence may be reviewed during FAA audit activities.

Appendix F.4
Attachment 1

Discipline	WHEN AFFECTED
Structures	– New load paths – New installations – Box movements – Change in fasteners or fastener pattern – Cut outs – Change in materials – Antennae changes – Weight or CG limit changes
Weights	– Changes affecting the fore or aft CG limits – Change in max takeoff, landing, or zero fuel weights
Interiors	– New fabrics or materials – Placards – Seating arrangement changes – Lavatory or galley changes – In-Flight Entertainment (IFE) changes – Flight Deck changes
Powerplant	– Engine related change – Propeller related change – Fuel system changes – Bleed air changes – Noise changes – Emission changes – Electrical load changes – Air conditioning change – APU changes – Thrust reverser changes – Fire protection changes
Mechanical Systems	– Bleed air changes – Auto-pilot changes – Air conditioning changes – Changes to FDR – Changes to ice detection or protection system – Changes to wheels, tires, brakes – Changes to flight control system – Door mechanism changes
Avionics	– Changes to nav or comm – Auto-pilot changes – Software changes – Changes to CVR / FDR – Antennae changes

Discipline	WHEN AFFECTED
	– Changes to IFE – Changes to aircraft equipment (e.g. TAWS, TCAS) – Display changes
Electrical	– Electrical load changes – Wiring adds or deletions – Circuit breaker changes – Changes to SPDA / PDA's – Air conditioning changes – Changes to CVR / FDR – Changes to IFE
System Safety	– Interiors changes involving systems – Powerplant changes: powerplant, fuel system or accessory changes – Mechanical Systems changes – Avionics changes – Software Changes – AEH changes – Electrical Systems changes – Changes to installations that may violate assumptions made in zonal analyses and may otherwise impact zonal analyses – Operations and environmental changes that impact failure rates, mission duration, or criticality of failure conditions
EME (EMC, EMI, HIRF, Lightning, P-Static, ESD)	– Affects exterior materials, installation methods, configuration and coatings – Affects fuel system; including tanks – Affects HIRF, Lightning, P-static and ESD protection – Affects DO-160 Sections 15, 18 through 23 and 25 qualification – Affects electrical bonding – Affects ground jumpers, ground straps and ground terminations – Affects wire and coaxial cable design and routing – Affects system installation location and methods – Adds, changes or deletes functions

Discipline	WHEN AFFECTED
	that have major, hazardous or catastrophic failure conditions
Software	– Electrical Systems – Clock speeds – Frequencies – Adds functions – Software filtering – Loop gain – Airborne Electronic Hardware (AEH)
Aerodynamics	– Exterior changes – Performance changes (airplane or engine) – Flight control changes – Noise changes – Auto-pilot related changes – Changes to ice detection or protection system – Weight or CG limit changes – AFM changes related to performance or flight characteristics – Inertia changes affecting dynamic characteristics – Air data changes – Wheels, tires, or brake changes
Pilot	– Crew work load – Lighting / glare – Handling qualities – AFM changes
Noise	– Engine performance changes – Aerodynamic changes – Performance Changes

Appendix F.4
Attachment 2

Classification of changes in type design is discussed in 14 CFR 21.93(a), which states:

> "A minor change is one that that has no appreciable effect on weight, balance, structural strength, reliability, operational characteristics, or other characteristics affecting the airworthiness of the product. All other changes are major..."

The following provides guidance on what the word "appreciable" means as applied to the six areas identified in this rule at the airplane level. Major changes can be further assessed to determine if they are also substantial or significant using the guidance in Advisory Circular 21.101-1.

1. Weight: Appreciable changes are:
    a. Changes increasing the certified maximum or decreasing the certified minimum weight limits:
        i. Max Taxi Weight
        ii. Max Takeoff Weight
        iii. Max Zero Fuel Weight
        iv. Max Landing Weight
        v. Minimum Flying Weight
2. Balance: Appreciable changes are:
    a. Changes in the certified center of gravity (CG) limits
        i. Decreasing the forward limit (i.e. move it more forward of the certificated forward limit)
        ii. Increasing the aft limit (i.e. move it further aft of the certificated aft limit)
3. Structural Strength: Appreciable changes are:
    a. Changes to primary structure (structure that carries flight, ground, or pressure loads as defined in AC 25.571-1, Damage Tolerance and Fatigue Evaluation of Structure)
        i. Changes in loads / load paths
        ii. Changes in material
        iii. Changes to method of construction
        iv. Changes to stiffness
        v. Changes to primary structure to accommodate appliances installed on the exterior of the aircraft (i.e., Forward Looking Infrared (FLIR) equipment or system, cameras, firefighting, agricultural dispensing equipment, etc.) (See the current edition of AC 23-17, Systems and Equipment Guide for Certification of part 23 Airplanes and Airships, for guidance for the substantiation of modifications involving installation of external equipment).
    b. Changes to structural design speeds:
        i. V_A
        ii. V_{FE}
        iii. V_{NE}
        iv. V_D / M_D
        v. Stall speeds

c. Substituting an engine or propeller (such as replacing a reciprocating engine with a turbine engine).
d. Substituting or altering a reciprocating engine such that the net result is an increase of more than 10 percent greater horsepower.
e. Substituting or altering a turbine engine such that the net result is an increase of more than 10% greater thrust.
f. Internal cabin changes:
    i. Changes that increase floor loading limits
    ii. Changes to increase cargo compartment loading limits
    iii. Changes to cabin configuration resulting in relocation of major items (galleys, lavatories, etc.)
g. Other factors:
    i. Changes to control surface deflections
    ii. Changes in control system component weight, balance, stiffness, or mass distributions
    iii. Increasing the maximum differential pressure of a pressurized aircraft

4. Reliability: Appreciable changes are:
    a. Changes to flight critical systems that decrease reliability at the product (aircraft, engine, or propeller) level
5. Operational Characteristics: Appreciable changes are:
    a. Airplane, engine, and propeller changes that affect the performance data presented in the AFM (including the approval of different takeoff and landing surface conditions)
    b. Engine cooling changes
    c. Change in types of acceptable fuel
    d. Changes to the basic engine or propeller design, or controls, which affect the product operating limitations.
    e. Changes to operating limits in the AFM, including changes to the ambient envelope (altitudes and temperatures)
    f. Changes that affect the flight characteristics of the airplane in a manner that is perceptible to the pilot (e.g. change in control surface deflection and/or gearing; thrust/power changes; external configuration changes, mass distribution changes)
    g. Changes to flight-critical electrical/electronic equipment and systems such as electronic flight controls or the engine control system, full-authority digital electronic control (FADEC), electronic engine control (EEC), or fly-by-wire.
    h. Changes to operating or imbedded software:
        i. For operationally required equipment not made by the original equipment manufacturer, or
        ii. that invalidate the original aircraft level certification assumptions
    i. Changes that alter the part 36 noise data in the AFM (consult Advisory Circular 36-4C Subpart A, Section 36.1(c) for a list of type design changes that might affect the certified noise levels of the airplane)

j. Changes in the part 34 emissions level
k. Changes that require the pilot to continuously monitor the added component, or system, in order to ensure safe operation
l. Changes in the certified maximum seating capacity
m. Changes to unusable fuel supply

6. Other characteristics affecting the airworthiness of the product: Appreciable changes are:
   a. Changes as a result of a unsafe condition that may result in an Airworthiness Directive
   b. Changes to the limitations contained within the Airworthiness Limitations Manual
   c. Interior changes that reduce passenger safety
   d. Changes to systems or equipment that have a negative effect on safety or require the pilot to continuously monitor the added component, or system, in order to ensure safe operation.

Appendix F.5 - Applicant Only Showing White Paper

Background

The goals of the Part 23 ARC were to reduce the cost of certification and to improve safety for the part 23 aircraft. This paper proposes a method to do both through:

1. Use of Safety Management tools the FAA is implementing, and
2. Less direct involvement of the FAA in determining compliance to the regulations as allowed by 14 CFR 21.

There are a number of FAA references to the FAA Safety Management Processes and Orders at the end of this paper that were considered when developing the Risk Based Process proposed in this paper for determining when an applicant can simply show compliance without having to have the FAA, DER, or unit member finding of compliance.

A recent change to 14 CFR 21 is the addition of the Statement of Compliance requirement of 14 CFR 21.20(b) and 21.97(a)(3) that increases the accountability of the applicant's management to ensure that compliance is properly shown as described in Advisory Circular 21-51. So now, in addition to there being economic incentive, there is further legal incentive for applicant management to ensure compliance is properly accomplished without having to rely on the FAA, DER, or unit member to find compliance.

There are a variety of applicants for type certification projects. At one end is the applicant who is very competent, has successfully completed multiple certification programs, and holds an Organization Designation Authorization (ODA). At the other end is a company lacking proven processes and organizational competency relevant to the certification process; and everything in between. All applicants, no matter what level of experience or competency, have a responsibility under part 21 when executing a type certification project to:

1. Conduct all inspections and tests to show the compliance of the design and product (14 CFR 21.33(b))
2. Make all flight tests that the Administrator finds necessary (14 CFR 21.35(b))
3. Submit all data showing compliance (14 CFR 21.21(b))
4. Provide a statement certifying compliance (14 CFR 21.20(b))

As the applicant completes the showings of compliance detailed in steps 1 through 4 above, the FAA or its designees:

1. Find upon examination of the type design that applicable requirements have been met (14 CFR 21.21(b)1)
2. Make any inspections and tests necessary to determine compliance of applicant's design and product (12 CFR 21.33(a))

The testing and analysis activities that make up a typical certification project also vary in difficulty and risk. In 2007, the FAA proposed via Order IR 8110.102 that their level of involvement (or that of their

designees) could be minimized based on the level of risk, making use of a tool called RBRT (Risk Based Resource Targeting). The type of risk considered in this paper is that due to either improper test conduct or data analysis and the possibility of compromised data fidelity. In low-risk projects or low-risk activities within a project, it may be acceptable from a risk perspective to accept the applicant's showing only with no further findings by either the FAA or their designees.

This paper proposes a structure for when applicant showing only is sufficient as a function of both the type of applicant and also considering the risk of improper test conduct / data analysis and the resulting potential impact on safety. It is suggested the FAA issue a policy memo, Advisory Circular, or FAA Order to endorse this idea with any adjustments as required.

Proposal

This proposal evaluates applicants based on three criteria:

1. Staff Competency – What is the skill level of the individual staff members of the company working the certification activities? Are there sufficient DER's or UM's on staff to support a complete aircraft design and certification project? Does the company have ready access to specialists at suppliers or consultants as necessary to complement staff?
    a. Low –
        i. There are no, or insufficient, DERs to support a complete aircraft project.
        ii. There is no training program for DERs.
        iii. The DERs do not have a strong working relationship with the applicant ACO.
        iv. Access to FAA policy, regulations, and guidance is limited.
    b. Medium –
        i. There are sufficient DER's to complete an aircraft project but internal and ACO communications, cooperation and record-keeping is weak.
        ii. There is no training program beyond the required minimum to maintain status as a DER or UM.
        iii. Not all DERs have a strong working relationship with the applicant ACO.
        iv. Access to FAA policy, regulations and guidance is satisfactory.
    c. High –
        i. There are sufficient DERs or UMs and internal and ACO communications, cooperation, and record-keeping is strong.
        ii. The DERs and UMs are encouraged to take training in their discipline and on regulations, policy, and guidance beyond the minimum required to maintain their DER or UM status.
        iii. The preponderance of DERs/UMs have a strong working relationship with the applicant ACO.
        iv. Access to FAA policy, regulations, and guidance is excellent.
2. Company Competency – What internal organization and resources does the company have in place to facilitate certification programs? Does the company management fully support the

staff training and access to resources necessary to keep the staff current with FAA policies, regulations, and guidance related to certification activity?

a. Low –
    i. Management organization is incomplete or not structured and lacks clearly defined responsibilities.
    ii. Management does not support staff training and access to resources to keep staff current with FAA policies, regulations, and guidance.
    iii. Management does not require following written procedures.
    iv. Management does not have a process for internal audits of processes or work, corrective action, and continuous improvement of their procedures and processes.
b. Medium –
    i. Management organization is complete but structure and responsibilities are not all completely defined.
    ii. Management supports staff training and access to resources but limits participation through budgetary restrictions.
    iii. Management does not consistently support following written procedures.
    iv. Management supports audits of processes and work, but does not have a process for timely corrective action and continuous improvement.
c. High –
    i. Management organization is complete and structure and responsibilities are well defined and available to all of the organization.
    ii. Management is fully supportive of staff training, is capable of providing their own training, and includes training requirements as an objective on each person's yearly evaluation.
    iii. Management supports following procedures for consistency, thoroughness, and safety; and has a process for resolving procedures issues in a timely fashion with appropriate corrective action.
    iv. Management ensures staff has complete and open access to all FAA policy, guidance, and regulations.
    v. Management fully supports internal audits of processes and work; and ensures timely corrective action and continuous improvement.

3. Procedural Effectiveness – Does the company have adequate internal processes to ensure that work product is thorough, consistent, well-documented etc.? Are the processes in place proven, industry best-practices? Do the internal processes include a continuous improvement process to evaluate the procedures on a regular basis and take corrective action as needed?
    a. Low -
        i. Written procedures and processes don't exist or have not been proven through successful completion of an aircraft project.
        ii. Procedures that exist are not rigorous or well defined with clear guidance and expectations.

iii. Procedures are not audited, or infrequently audited, and corrective action is inconsistent or not timely.
iv. Management does not consistently insist on following set procedures.

b. Medium –
   i. Written procedures and processes exist, but have not been completely proven through use and audit.
   ii. Procedures and processes state basic requirements, but lack sufficient detail to allow the reader to completely understand the requirement without external guidance.
   iii. Procedures are audited on an infrequent basis and corrective action for continuous improvement is frequently not timely or complete.
   iv. Management generally supports procedures, but allows deviation from procedures without justification and no corrective action to resolve issue(s).

c. High –
   i. Written procedures and processes exist and have been proven through use and audits.
   ii. Procedures state requirements and provide sufficient guidance and instructions to allow the reader to completely understand each requirement and the means of satisfying each requirement.
   iii. Procedures are audited on a regular basis and corrective action is timely and complete.
   iv. Management is fully supportive of following procedures and requires justification for deviation with timely corrective action implemented to resolve the issue(s).

An applicant would work with the FAA to determine how they rate for each of the three criteria above: staff competency, company competency, and effective procedures. This rating could be re-evaluated on a regular basis as the company improves or concerns are raised. Either the FAA or the applicant may request a re-evaluation of the company's rating. Based on the ratings for these three criteria, an overall classification is established for the company based on the following:

- Tier 1 would rank low in two or more of the criteria.
- Tier 2 would rank medium in at least two of the criteria and high in the remainder.
- Tier 3 would rank high in all three criteria.

For each of these company classifications, analysis and testing methods have been reviewed to assess the risk of improper test conduct and the resulting potentially inaccurate data or potential errors in analysis. The various analysis and tests were selected based on:

A. Analyses where:
   1. The analysis method is well defined and understood – the method has been validated and is proven; and

2. The likelihood that the analysis method will not adequately show compliance to the requirements is very low.

B. Tests where:
   1. Testing methods are well defined by either an industry standard, Advisory Circular, or other accepted standard including company test procedures that are proven;
   2. Testing methods are well understood and have little subjectivity;
   3. Testing methods are repeatable – all variables that could affect the test are known and are controllable and repeatable;
   4. There are clear pass / fail criteria; and
   5. The likelihood that the test method will not adequately show compliance to the requirements is very low.

Table 1 provides the proposed work split between the applicant and the FAA for the three tiers of applicant discussed above.

Table 2 provides a list of the types of analysis covered by this proposal.

Table 3 provides a list of the type of testing covered by this proposal.

These tables contain initial lists of analysis and testing and will be added to as experience is gained with this process and as new technology becomes common place.

As illustrated in Table 1, "Tier 3" companies are given the maximum use of the applicant showing only process. In many cases, a "Tier 3" company's FAA designees will still be involved in the various elements of the projects when doing applicant showing only, though they will be acting as company personnel and not specifically as designees. Both the companies and the FAA will nonetheless benefit. This process provides the needed flexibility to use other talented people within the companies who are capable of doing the applicant's role either completely or with the oversight of the appropriate designees. When designees are involved, this process minimizes the volume of paperwork required. This frees up the designees to focus on the higher value, safety enhancing activities, to support the FAA's goal of improving safety.

In order for the FAA to maintain its discretionary function, certification plans will identify any testing or analysis or portion thereof where applicant showing only is proposed. The applicant will use tables such as in this paper (once the FAA concurs with this proposal) as a basis for their certification plan proposal. In accepting the certification plan, the FAA will have the opportunity to identify any activities where they will exercise discretionary function and their level of participation through ACO engineers, DERs, or unit members to make a finding of compliance.

As seen, this paper proposes a structure for when applicant showing only is sufficient as a function of both the type of applicant and also considering the risk of improper test conduct / data analysis and the resulting potential impact on safety. It is suggested the FAA issue a policy memo, Advisory Circular, or FAA Order to endorse this idea with any adjustments as required. This would allow the use of the

applicant showing only process without waiting on further development of the FAA's Risk Based Resource Targeting (RBRT) tool.

Table 1 – Work Split Definition

Type	Category of Applicant		
	Tier 1	**Tier 2**	**Tier 3**
Analysis	Data Analysis Performed by Applicant Analysis Approval Approved by FAA (or DER)	Data Analysis Performed by Applicant Analysis Approval Approved by Applicant	Data Analysis Performed by Applicant Analysis Approval Approved by Applicant
Testing	Test Procedure Approved by FAA Conformity Conformed by applicant, may have FAA oversight (or DAR) Test Conduct Conducted by Applicant Test Witness Witnessed by FAA (or DER) Test Data Approval Approved by FAA (or DER)	Test Procedure Approved by Applicant Conformity Conformed by Applicant Test Conduct Conducted by Applicant Test Witness Witnessed by Applicant Test Data Approval Approved by FAA (or DER)	Test Procedure Approved by Applicant Conformity Conformed by Applicant Test Conduct Conducted by Applicant Test Witness Witnessed by Applicant Test Data Approval Approved by Applicant

NOTE: *Use of an experienced and/or specialized testing lab is considered to be simply a means of conducting a particular test. The responsibilities of the applicant do not transfer to the lab, and the accountability for the activities listed in this table remains unchanged.*

Table 2 –Analyses

ELECTRICAL SYSTEMS ANALYSES			
Electrical Load Analysis			
MECHANICAL SYSTEMS ANALYSES			
Oil system heat rejection	Oil system capacity and consumption	Cabin depressurization	Ventilation rate
Tire burst analysis	Proof & burst pressure determination	Temperature evaluation of adjacent structure and equipment	Cooling of equipment bays
Bleed air extraction	Temperature correction	System pressure drop	System temperature capacity
Max pressure in return	Max pressure in closed circuits	Unusable fuel	Transient pressure
Pitot allowable leakage rate	Flight Control cable tension, deflection substantiation	Flight Control gearing and trim rates	Oxygen Duration Charts
Oxygen quantity requirements	Duct temperature determination	Fuselage temperature due to heated pitot tubes and static plates	

Table 3 – Testing

MISCELLANEOUS TESTS			
Flammability Testing			
FLIGHT ANALYST TESTS			
Air data system (altimeter and airspeed) calibration	TAT probe calibration and AOA system calibration	RVSM	Noise
MECHANICAL SYSTEMS TESTS			
DO-160 Testing	Endurance Testing	Proof & Burst Testing	Tire Burst Testing
System Functional Testing	Static Source error	Water /Waste system Leakage test	Component fatigue and endurance tests
Fire extinguishing concentration	Indication and synoptic page functioning	Bird strike tests	Full Scale Static Test (flight controls)
Drainage from Dedicated Zones Test	Complete Hyd. system functionally tested on the airplane at 1.25 times working pressure	Failure condition testing	Verification of Cabin cooling analysis / Cabin temperature survey
ECS System performance and heat load verification	Ventilation verification	Cabin distribution verification	Engine Exhaust Impingement Temperature Survey
Pitot Water Drainage	Pitot Leakage	Pass oxygen drop tests	Operation of LG controls
Fuselage & Fuselage Fairing Fluid Drainage Test	Nacelle Anti-Icing System Wind Tunnel Test		
AVIONICS SYSTEMS TESTS			
VHF Communications	HF Communications	Satellite Communications	Cabin to Ground Telephone
Data Link Transmitters / Receivers	Audio, Intercom, Passenger Address Systems	Transponder	Traffic Collision Avoidance System (TCAS)
Enhanced Ground Proximity Warning System (EGPWS)	Terrain Awareness Warning System (TAWS)	Aural Warning Tone Generating Systems	Electronic Flight Instruments including Primary Flight Display (PFD) and Multi-Function Display (MFD)
Weather Radar	Cabin Management System	VHF Nav. Systems / Marker Beacon / Localizer / Glideslope	Distance Measuring Equipment (DME)
Automatic Direction Finder (ADF)	Global Positioning System (GPS)	Inertial Reference System (IRS)	Air Data System
Radio Altimeter	Flight Data Recorder (FDR)	Cockpit Voice Recorder (CVR)	Airshow Network
Cabin Entertainment System	Secondary Flight Displays (Emergency)	Engine Indication and Crew Alerting System (EICAS)	Radio Management System
Emergency Locator Transmitter (ELT)	DO-160 Testing	Flight Management System (FMS)	Takeoff And Landing Distance (TOLD)
ELECTRICAL SYSTEMS TESTS			
External Power	Electrical Load Distribution	Auxiliary Power Generating Systems	Electrical Control Panels
Flight Deck Lighting System	Passenger Lighting System	Cabin Management and Entertainment Systems	Electrical Galley System
Electrical Lavatory Systems	Data bus Communication	Flight Deck Lighting	Cargo & Service Lighting System
Baggage Area Lights	Navigation Lights	Landing Lights	Taxi Lights

Anti-collision/Beacon Lights	Recognition Lights	Wing Inspections Lights	Tail (Logo) Floodlights
Wheel Well Lights			
HIRF / EMC / P-STATIC TESTS			
Electromagnetic Effects Component Testing	EMC Aircraft Tests	P-Static Aircraft Tests	

FAA Safety Management Related Publications

The following documents provide guidance on the Safety Management process and may be used as applicable to provide guidance on risk assessment in determining what an applicant can show compliance to without the necessity of an FAA finding.

a. FAA Order 8000.369, *Safety Management System Guidance*, September 30, 2008

b. FAA Order 8040.4A, *Safety Risk Management Policy*, April 30, 2012

c. FAA Order VS 8000.370, *Aviation Safety (AVS) Safety Policy*, September 30, 2009

d. FAA Order VS 1300.2B, *AVS Quality Management System*, June 21, 2010

e. *Joint Planning and Development Office (JPDO), Safety Management System Standard v1.4*, July 30, 2008

f. *International Civil Aviation Organization Annexes 1, 6, 8, 11, 13, and 14*

g. International Civil Aviation Organization Document 9859, *ICAO Safety Management Manual*

h. International Civil Aviation Organization Document 9734, *Safety Oversight Manual*

i. American National Standard, Quality Management Systems – *Requirements* (Document Number: ANSI/ISO/ASQ 9001-2008)

Appendix F.6 - Video Only Test Witnessing White Paper

<u>14 CFR Part 23 Reorganization ARC – TC/PC Workgroup Recommendations</u>

Topic: Use of Video Recordings in Testing

Objectives:

- Acknowledge validity of utilizing video recording techniques for capturing key testing information.
- Improve quality and/or integrity of captured test data.
- Improve utilization of FAA resources and designees by enabling remote witnessing.
- Define parameters necessary for the successful utilization of video recordings for data capture.

Background Information:

The current primary method of data capture during certification testing is via real-time witnessing by appropriately delegated individuals. While this method of witnessing is sometimes augmented with video recordings, the use of video is typically viewed as a "back-up" to the physical presence and real-time witnessing of a human being. Since the majority of witnessing is performed by FAA designees,

The vast majority of test witnessing is performed by FAA designees, which places a burden on the applicant to either hire consulting DERs or obtain delegation of company DERs. Regardless of the nature of the designee, minimizing the time required of that person will have a direct corollary effect on the financial impact experienced by the applicant.

For testing that takes place at or near the applicant's place of business, direct travel expenses for the applicant will already be minimal. However, if the applicant is utilizing consulting DERs it is likely that such individuals will need to travel in order to witness the test. In addition to the "base fee" for the consultant's time, the applicant will also incur travel, lodging, and meal expenses; also, many consultants will charge for their on-location time based on full-day increments, even if the actual witnessing efforts consume only a few hours. Even if company DERs are utilized, some testing requires travel to lab locations for witnessing; the associated travel costs remain.

Significant FAA resources can also be consumed by these effects when the option is exercised to witness tests with FAA personnel. Exercising this option normally involves traveling some distance to the test site, incurring similar expenses to those discussed above due to either the distance traveled or the length of the testing in question. This eventuality is more likely in the case of startup companies when confidence in the company processes and procedures is still being assessed.

FAA test witnessing is conducted for one primary reason: to provide confidence in the validity of the test setup, the test execution, and the ensuing results. It is possible to accomplish all of these requirements through an alternate means to personal, real-time witnessing – utilization of video recording.

Appendix F

Potential Uses of Video Recording:

There are a variety of examples where advantages can be realized through the utilization of video recording. As mentioned above, current test witnessing may sometimes employ video capture to augment the personal witnessing already taking place. For example, video recording may be utilized during a static structural test; this video can then be used later to verify that an ultimate load was in fact held for an appropriate amount of time prior to structural failure. However, there are instances where the use of video recording can be used to great advantage in lieu of personal witnessing.

One area where video graphic methods can provide significant enhancements over traditional witnessing is cases where multiple and/or high speed events are occurring. One such circumstance that already employs the use of video recording is dynamic seat testing. High speed cameras are employed from multiple vantage points, allowing subsequent review of the details of the event that take place far too rapidly to be seen by the human eye. However, this idea of supplementing the abilities of the witnessing agent can be expanded to other areas as well. For example, video recording of multiple instrument readouts could be captured for later review; in this instance, although the test setup may be such that one person could not simultaneously view and process all of the readouts real-time, the use of video capture would allow the various readouts to be synchronized and compared later – and at whatever speed was convenient for observation. (This is not meant to imply that video would be able to replace a sophisticated digital data acquisition system if one is required; nonetheless, it could be used as an adjunct to such data acquisition to support witnessing.)

Another example that places the use of video in an even more prominent role is the case of "slow speed" testing; that is, testing that takes place over an extended period of uninterrupted time. Examples are long-term pressure bleed-off testing, HIRF and IEL testing, cyclical testing, etc. In this scenario, there are two possible advantages to employing the use of video recording. Firstly, testing could be allowed to continue monitored only by the video equipment. This would free up the witnessing personnel to focus on other activities (or possibly go home for the night). Upon return, the video could be reviewed at a higher-than-normal speed to locate any time periods that would require further scrutiny; for example, a view of a pressure gauge could be recorded and the recording could be reviewed later to determine the time at which a threshold pressure was reached. A second possible advantage would be the enabling of remote monitoring. By employing web-based video equipment, the status of a test could be monitored even from remote locations; this would be very useful in the event that it was necessary to periodically confirm that an automation system was performing properly, for example.

The most compelling argument for the use of video recordings from a resource utilization standpoint is that of remote witnessing. Depending upon the nature of the test and the video equipment used, the remote witnessing may be performed real-time or may be delayed; the advantages remain the same regardless of the timing. The most obvious advantage is a reduction in travel expenses; by employing the use of video recording, the physical co-location of the test setup and the witnessing personnel becomes irrelevant. There is also a secondary effect that must not be overlooked. Enabling the utilization of truly remote witnessing mitigates the potential for scheduling conflicts due to travel

availability, test facility availability, conflicting commitments, etc. Also, it opens the pool of potential witnessing agents for a particular timeframe, allowing the applicant access to a wider base of experts. Both of these secondary effects translate to a more efficient testing process for the applicant.

Benefits for Applicant:

There are two primary aspects to consider regarding applicant benefits: direct expenses incurred through traditional real-time witnessing, and indirect expenses caused by program delay.

Direct Expenses

The current witnessing process requires travel to the location of testing for the designated witnessing DER. Using remote video witnessing, the travel could be significantly reduced or eliminated altogether. Travel expenses for applicants could easily be reduced by $40,000 or more depending on the quantity of tests, the variety of disciplines that must witness those tests, and the distance between the test sites and the witnesses' bases of operation.

In general, designee expenses for a TC program can be very high to support test witnessing as it exists today. DER fees are quite high, approaching $200 per hour for some disciplines; consultant DERs typically charge a minimum of 8 hours per day for the duration of their travel, even if their witnessing duties consume only a small fraction of a single day. These expenses create a significant barrier for a new start-up company – far greater than the expenses necessary to procure adequate video graphic equipment. The approach discussed in this paper would not only alleviate travel costs, but would allow companies to incur only those costs associated with actual technical review of the video evidence.

Even in that event that a particular test is found to qualify for an "Applicant Showing Only" approach, many tests must be performed at specialized laboratories that are often remote from the applicant's place of business. The proper use of video witnessing would allow travel expenses to be minimized if not eliminated with no decrease in the veracity or validity of the evidence supporting the applicant's showing.

Indirect Expenses

Another possible cost to an applicant is in program delay. Risk for program delay is increased for applicants who do not have company designees with authority to witness certification tests. Program delays could be caused by waiting for a consultant DER to be available for travel or by waiting for a test facility's schedule to synchronize with a DER's availability; these effects can be exacerbated in the event that FAA witnessing authorities exercise their option to be present. Even if these various influences are successfully initially mastered, unanticipated events may interfere with those plans and inadvertently cause delay. The use of video witnessing would mitigate this risk. Program delays of a single day can run over $100,000 and have been calculated up to nearly $1,000,000 per day for higher-end part 23 aircraft. While it is difficult to quantify this cost or even determine the probability that traditional witnessing contributes to a program delay, the risk exists – and in fact has caused significant delays on a number of programs.

Benefits for FAA:

Assuming the FAA currently makes full use of designees during the test witnessing process, the direct FAA benefits will be limited. Nonetheless, the FAA will certainly benefit for projects where the ACOs making extensive use of FAA employees for witnessing certification testing.

FAA will save a minimum of 3 days per witnessing agent when certification test witnessing is chosen; this is based on an assumption of one day for travel to the test site, a minimum of one day for testing, and one day for travel back to the ACO. While it is likely that multiple tests may be conducted during a single visit, it is highly unlikely that all testing necessary for a certification project could be schedule for such a timeframe. Assuming that the performance of multiple tests will increase a given visit to two testing days, and further assuming that at least three such batteries of tests would be necessary over the course of a certification project, the total savings would be a minimum of 12 work days, plus associated travel expenses.

Some more intangible benefits the FAA may see include:

- Historical archiving of the video evidence for future reference
- Comparison of tests conducted for design change substantiation with similar tests conducted for initial certification

Minimum Parameters:

There are three primary areas that must be considered to make the use of video witnessing a viable proposition; these are adequate coverage, video fidelity, and data integrity.

<u>Adequate Coverage</u>

In order for video recordings to be reliably used for witnessing purposes, the information captured in the recordings must be adequate to allow meaningful review. Guidelines must be developed to ensure a minimum set of requirements are met. For example, for structural test witnessing it may be necessary to utilize multiple cameras in a “3-view” configuration. Additional viewing angles may be required to adequately capture specific areas of interest. Video equipment should be located in such a manner that obstructions are not an issue – whether from fixed test apparatus or from the movement of test personnel into the camera’s field of view.

<u>Video Fidelity</u>

Adequate coverage will prove irrelevant if the resulting images are too blurred or of too low a resolution to be clearly seen. The use of video recording as valid witnessing must address these issues. Adequate lighting must be employed to prevent the presence of obscuring shadows. Adequate resolution must be provided; for some tests the using of standard definition recording equipment may be acceptable, but for others the use of high definition video may be required. Recording speed is also an important consideration; if playback in slow motion will be required in order to appropriately perform the

witnessing tasks, high-speed filming equipment may be required. Nonetheless, it must be recognized that the primary argument for the use of video witnessing is to minimize the expenses associated with real-time witnessing by human beings; accordingly, the minimum acceptable video fidelity must really be only that which would replicate the fidelity of the human eye.

Data Integrity

In order to gain the maximum benefits of video witnessing, the footage must be converted into a format that is easily copied and distributed without significant degradation of image quality. This will typically mean that the footage will be converted to one of the standard digital video formats; therefore, the medium for capturing the "raw" footage must be selected with this final converted state in mind. Also, the ability to time stamp the footage can improve the integrity and usefulness of the data; for example, time stamps can allow multiple video streams to be synchronized with each other for chronological comparison of events captured by different cameras.

Effects on Part 21:

Five sections of 14 CFR part 21 discuss FAA involvement with tests and/or the witnessing of tests. These sections can be divided into two groups.

The first group, dealing with Type Certificates, involves §§ 21.33 and 21.123. While these sections deal with different focuses of the Type Certificate process, they share common language with respect to testing:

> *Each applicant **must allow the FAA to make any inspection and any flight and ground test** necessary to determine compliance…*
>
> *Each manufacturer of a product being manufactured under a type certificate **must allow the FAA to make any inspection or test**, including any inspection or test at a supplier facility, necessary to determine compliance…*

In practice, the FAA deals with its right to "make any inspection or test" through the use of delegated witnessing agents, or by witnessing the tests themselves.

The second group, dealing with Production Certificates, involves §§21.140, 21.310(a) and 21.610. While these sections deal with different focuses of the FAA, they again all share common language with respect to witnessing:

> *…**must allow the FAA to** inspect its quality system, facilities, technical data, and any manufactured … articles and **witness any tests**, including any inspections or tests at a supplier facility, necessary to determine compliance…*

There is nothing in the use of video as described in this document that would violate any of these requirements; therefore, no modifications to the FARs are necessary to allow the use of video witnessing.

Appendix F

Effects on Existing Guidance:

A brief search of the available guidance material was conducted to see if any language was currently being used that would preclude the use of video as described in the document; none was found. However, two lines of reasoning were discovered that lend credence to the idea that video witnessing is in line with the current philosophy underlying witnessing.

In FAA Order 8110.37E, paragraph 2-6.b, it states:

> *…DERs may be authorized to witness tests outside their area of authority provided that the DER (1) is authorized to do so by the ACO, and (2) does not make the final compliance finding.*

The implication here is that physically observing the test taking place is not necessary to find the data valid. The importance is in monitoring the activity to ensure that the test plan was followed, no critical errors were introduced, the data was appropriately collected, etc. Employing video witnessing as described in this document can accomplish these same goals, enabling properly authorized individuals to make final compliance findings although they were not physically present for the test.

In FAA Order 8110.37E, paragraph 4-4.a, it states:

> *…Before witnessing the test, the DER must verify that the necessary FAA conformity inspections have been accomplished, that the test article is in conformity, or that all unsatisfactory conditions have been dispositioned. A DER is not required to witness an entire test to approve the test data. However, the DER must coordinate with the ACO to determine which conditions are critical and must be witnessed in order to ensure that all the data are valid. When DERs approve test data, they indicate that they witnessed those portions of the test dealing with critical conditions, the test was conducted in accordance with the FAA approved test plan, and the data are official test results that satisfy the test criteria for compliance.*

The proper use of video witnessing would provide the ability to not only "witness those portions of the test dealing with critical conditions", but also the ability to review these critical events in detail. In addition, non-critical portions that may otherwise go unwitnessed would be available for review at the DER's discretion. The utilization of video witnessing would not only meet the intent of the existing guidance, but could be leveraged to actually enhance the witnessing coverage.

Recommendation for New Guidance:

New guidance should be developed to provide a video witnessing standard that can be referenced by applicants and FAA personnel, and to provide the minimum requirements by which video witnessing can be successfully utilized. The following should be developed to provide a complete description of the video witnessing process:

- Update policy to endorse the use of video technology in test witnessing
- Endorse industry standards on Video Witnessing of Certification Tests
- A video test witnessing standard should consider:
    - The types of testing that could most benefit from the use of video witnessing; and
    - The minimum parameters discussed above regarding coverage, fidelity, and integrity.

Appendix F.7 – Production Certification Manual

ABC AIRCRAFT COMPANY
PRODUCTION CERTIFICATION MANUAL

Appendix F

PREFACE

This preface is not intended to be included in a finished manual but to provide guidance on how to go about creating a Quality Procedures manual for a new startup aircraft company. The intent is to allow this document to satisfy the requirements for a Quality Assurance Manual of a new startup company, but in such a way that it will integrate with the more comprehensive requirements of a DO/PO Design Handbook without major changes, should one be desired in the future.

This document is an attempt to provide guidance for new start-up aircraft companies in establishing their procedures for how they will conduct their aircraft production operations. It combines information that different existing companies and the FAA MIDO have provided on how to organize procedures. The guidance is intended to be organized in such a way that a new company with only a few employees could start with this and easily modify it to accommodate growth of the company and eventually separating different functions into different departments as appropriate. The following diagram is taken from the DO/PO Design Handbook Template. By using the guidance in that Handbook and this document it should be relatively easy to create a Quality Assurance manual that will be a standalone document for a new startup company but then allow the manual to become an integral part of the company's TC/PC Handbook should they evolve to the point where they need such a document.

This document provides only the basic general information and each company must determine how much to add to or modify to satisfy their needs.

Figure 1 – Requirements and Procedures Hierarchy

Figure 1 is a depiction of a way to structure a company's procedures to start with something minimal and then be able to expand it over time. Some companies may be tempted to start at the bottom and write process descriptions and work instructions or forms and templates and then try to figure out how it all satisfies requirements later. This is not a good idea. A better way is to start at the top and work down because all of the processes and work instructions should flow back and satisfy either a company or regulatory requirement. Think of it as a tree with the roots and trunk being level 1 and the branches and leaves being levels 2, 3, and 4. This does not mean that a new startup company should create all of those procedures but if you should plan for the possibility that you may want to at some time in the future it will save a significant amount of time and effort to do so when the time comes.

For this document requirements will be driven by the 14 CFT 21.137 requirements. This may seem like overkill for a new startup company and indeed you may not want to develop procedures to satisfy all of those requirements in the beginning but you should at least be aware of them and what you might have to do if you want to at some point put the aircraft into production and issue airworthiness certificates.

Appendix F

This paper will not discuss the certification aspects at this point but will focus on the production aspects. If you look closely at 14 CFR 21.137, it is the requirements for obtaining a production certificate to allow you to produce and license an aircraft. It may seem like overkill to some not familiar with all that you should consider when producing an aircraft but for the most part every paragraph in 14 CFR 21.137 is general requirements and should be something that anybody contemplating producing and selling an aircraft should be doing regardless of whether they plan on getting a production certificate or not. If the decision is made later to go for a production certificate it will be much easier to do so. Plus, regardless of whether a company decides to go for a production certificate or not, it will make it much easier for the FAA to inspect the company and ensure they are performing in an acceptable manner.

Another key consideration should be whether to break the requirements into department level procedures and requirements. Where the procedure in fact does only affect one department this may be acceptable. However, the problem with breaking procedures that affect multiple departments into department level procedures is that with time they have a tendency to drift apart and in fact may eventual be in conflict with each other. Plus it can be very confusing, time consuming, and difficult to have to jump from one department's procedures to other department's procedures to determine what the total requirements are for any one aspect. A startup company cannot afford to have a department whose sole purpose is to manage and coordinate their procedures unless they can show how it reduces cost and time. It is generally better to keep the joint procedures in a single high level procedure that establishes the requirements and then let lower level work instructions satisfy the department level requirements. This forces the departments to always make sure their activity stays aligned with the overall company requirements and that they don't create silos with tall walls for their activities that make it difficult for other departments to work with them.

Particularly for the small companies, a better solution is an integrated single set of procedures that address each requirement with the specific responsibilities distributed to the appropriate positions within the departments. It is much easier to reassign a responsibility than it is to write a procedure for a separate department and ensure it stays synchronized with the procedures for the same requirement in a different department. This will require that all of the departments have input into the procedures but it will better keep the procedures synchronized with the requirements than to have independent departments writing their own procedures for each requirement.

Another key to keeping things simple is to avoid the creation of more forms than are necessary. The more forms that are created, the more administrative burden and cost that will be placed on the company with little or no benefit. This does not mean that everything can be put on one form but look at the requirements before creating a form and see if another form can be modified slightly to serve multiple purposes. Every time a new form is created that uses data from another form there is at least a 50% chance that something will not be copied correctly from one form to the next. This simply adds unnecessary cost and confusion into the process.

This paper will use the fictional "ABC Aircraft Company" for illustration purposes only. The organization chart for the "ABC Aircraft Company" does not show the typical "boxes" for all of the sub-departments, since a small manufacturer would most likely need to cross-utilize personnel to achieve the most

economical operation. The user of this manual may arrange the sub-organization functions in departments that best suit the specific needs, with one person's name appearing in more than one of the boxes.

The intent of the organization chart showing Receiving Inspection and Production Inspection reporting to the Director of Manufacturing instead of the Director of Quality Assurance (which may be considered "traditional") is to have one company focal point instead of two, with the responsibility to establish the requirements for staffing (including inspectors), facilities, equipment, scheduling, and cross-utilization in order to most effectively meet the company budgetary and production goals. The Director of Quality Assurance still has the major responsibility of controlling the issuance of inspection stamps and inspection credentials only to persons the Director of Quality has found experienced and properly qualified, and to closely monitor the inspector's performance. The Director of Quality Assurance is also responsible for auditing all production functions and facilities to ensure compliance with established procedures and to ensure that corrective action is taken promptly when discrepancies are found.

The control and tracking systems described in the Operating Procedures Manuals (OPMs) may be purposely very fundamental (e.g., index cards) and they serve the purpose, but a manufacturer having computer capability may find it more convenient to use computer generated systems that meet the same goals. Computerized systems allow the same data to be input once and used in multiple applications without the potential for it being erroneously entered or interpreted from paper forms. The process may make use of things like EXCEL Spreadsheets or simple databases that can significantly improve efficiency and reduce time and cost to accomplish tasks.

The Engineering OPM describes a system for documenting minor changes with "Advanced Change Notices " (ACN), up to 5 before the basic drawing is updated. This ACN system would benefit a small manufacturer by keeping the cost of changing and printing complete drawings to a minimum, while still providing a means to document, identify, and control minor changes to the design.

Appendix F

FORWARD

This Quality Assurance Manual (QAM) and the Operating Procedures Manuals (OPMs) referenced herein describe the quality assurance requirements for the ABC Aircraft Company, 1350 Willow Road, Wichita, Kansas, 67215, for showing compliance with the applicable Federal Aviation Administration (FAA) regulations and industry consensus standards governing the manufacturing of aircraft. Changes to this manual and/or changes to the quality assurance system are made available for review by the appropriate airworthiness authority, upon request.

The ABC Aircraft Company Director of Quality Assurance is responsible for implementing the provisions of this manual.

APPROVED BY:

ABC Aircraft Company: _____
Director of Quality Assurance

_____
Date

Appendix F

ORGANIZATION CHART AND FUNCTIONAL RESPONSIBILITIES

PRESIDENT

DIRECTOR MANUFACTURING	DIRECTOR ENGINEERING	DIRECTOR QUALITY ASSURANCE
FUNCTIONS	FUNCTIONS	FUNCTIONS
Work Instructions	Work Instructions	Work Instructions
Purchasing	Test Procedures	Quality Manual
Production Inspection	Materials Review	Inspection Records
Measure & Test Equipment	Process Specifications	QA System Changes
Manufacturing Planning	Materials Specifications	QA Audits
Production Control	Service Difficulties	Supplier Control
Receiving Inspection	Data Change Control	Airworthiness Certification
Storage & Issuance	Production Flight Test	Materials Review
Non-conformances & Materials Review	Production Ground Test	Statistical Sampling
Production Flight Test	Supplier Qualification	Inspector Qualification
Production Ground Test	Forms	Inspection Stamp Control
Inspection Records		Production Inspection
Inspection Stations		Inspection Stations
Forms		Forms

Appendix F

REVISION CONTROL

Revision Number	Change	Approved (signature)	Date

Appendix F

QUALITY ASSURANCE MANUAL

ABC AIRCRAFT COMPANY
1350 Willow Road
Wichita, Kansas 67215

COMPANY QUALITY ASSURANCE POLICY

The ABC Aircraft Company is dedicated to maintaining a quality assurance system that will assure conformity of each aircraft at all stages of fabrication and assembly to the applicable Federal Aviation Administration (FAA) regulations and industry consensus standards governing the manufacturing of aircraft.

ORGANIZATION

The organization (less administration and accounting) consists of three departments, ENGINEERING, MANUFACTURING, and QUALITY ASSURANCE. Each department is further subdivided as necessary to achieve the most efficient use of manpower as needed to maintain the established production rate for completed aircraft. The Organizational Chart and Functional Responsibilities chart on page 7 shows the major departments and the potential functions for which each is responsible.

PROCEDURES AND FORMS

The ABC Aircraft Company operating procedures may be contained in separate Operating Procedures Manuals (OPMs) that by reference become a part of this Quality Assurance Manual or for a very small company may all be included in the Quality Assurance Manual. For a company just getting started it may be more appropriate to have the Quality Assurance Manual and the Operating Procedures in a single manual but organized and structured in such a way that they can be easily separated later. This document will show them combined. In this paper the Quality Assurance manual would be the requirement followed by a brief compliance statement. Everything after the compliance statement could be retained in the Quality Assurance Manual or pulled out to separate Operating Manuals. But again a word of caution is in order. When that information is put in separate manuals there must be a process to ensure that it stays aligned with the requirements in the Quality Assurance Manual.

Detailed step-by-step instructions to supplement an OPM procedure may be issued by individual departments as Operating Instructions (OIs). Each such OI must be identified with the OPM number and with the OPM paragraph upon which the OI is based, and must be signed by the Director of the department involved. The first OI to be issued for an OPM would be titled, for example, “OPERATING INSTRUCTION.

BASIC PROCEDURE REQUIREMENTS FOR A SMALL STARTUP COMPANY

Responsibilities

A clear definition of responsibilities must be established prior to issuing procedures as this will establish who in management is responsible for what activities and procedures. The position title that will be used in this paper for the heads of the organizations will be Vice President but that could be Director or any

other appropriate title as determined by the company. Also, in some companies Manufacturing is referred to as Operations. Either term may be used in this document to mean the same thing.

Each Vice President:

a. May delegate functions or tasks but not responsibility for compliance with regulatory or company legal requirements. Any delegation of a legal responsibility must be in writing from a person legally authorized to make such a delegation on behalf of the company.
b. Must ensure procedures that affect another Vice Presidents organization or operations are coordinated with that organization prior to implementing.
c. May also be responsible for the following or other requirements:

Vice President of Engineering

The Vice President of Engineering is responsible for ensuring:

a. That all new designs or design changes meet the provisions of the appropriate regulations and/or consensus standards, as applicable.
b. That a process is defined to ensure that all drawings and specifications defining the type design of the product are created, approved, released, and controlled in a manner that when followed, results in a product that meets the approved configuration of the specific model and serial number being built.
c. That the appropriate documents are distributed to Manufacturing and Quality Assurance,or any other applicable department within the company.
d. Selection and training of personnel to ensure that certification and approvals are conducted in accordance with the approved procedures and regulations.
e. There is close coordination with the Vice Presidents of Manufacturing and Quality assurance in ensuring that procedures remain coordinated between the departments and no conflicts are created between those procedures.
f. There is a process for coordination between the other Vice Presidents and with the appropriate regulatory authorities as required to resolve safety of flight and service difficulty issues and, as necessary, generating safety directives.

Vice President of Operations

The Vice President of Operations is responsible for ensuring:

a. The planning for, and construction of, the product to meet the type design of the model and serial being built from the purchase of raw material to the final production flight test.
b. The product is inspected and a record of that inspection is retained and provided to the Quality Assurance department for verification.
c. That processes are in place within the manufacturing operation to provide Material Review Board (MRB) feedback to engineering using the appropriate forms or mechanism on any issues that manufacturing finds that requires corrective action on the part of engineering.
d. Close coordination with the Director of Quality Assurance in performing those functions that require inspection duties. Inspection personnel may report administratively to the Director of Manufacturing when such reporting results in more efficient use of company personnel, however, the responsibility for oversight of all inspection functions remains with the Vice-President or Director of Quality Assurance, as applicable.
e. Selection and training of personnel to ensure that operations are conducted in accordance with the approved procedures.

Vice President of Quality Assurance
The Vice President of Quality Assurance is responsible for:

a. Establishing qualifications for and approving inspection personnel and issuing the appropriate stamps or other means for approving parts to approved personnel.
b. Verifying and documenting that the proper documents have been used for building and testing the model and serial being built.
c. Verifying that the model and serial meets the approved type design requirements specified by those documents.
d. Establishing a Material Review Board process in conjunction with Engineering to ensure production issues are properly identified and dispositioned, including changes to engineering where required.
e. Maintaining the Quality manual and notifying appropriate personnel of any changes in the quality assurance system that may affect the inspection, conformity, or airworthiness of ABC aircraft.

QUALITY ASSURANCE PROCEDURES
The following quality assurance requirements will be used by the ABC Aircraft Company.

DESIGN DATA CONTROL – 14 CFR 21.137(a)

Requirement

Procedures for controlling design data and subsequent changes to ensure that only current, correct, and approved data is used.

Compliance

This is a joint effort between engineering, manufacturing, and quality assurance. A defined set of procedures is required to ensure that only released and approved type design is used in the construction and inspection of a specific model and serial of a product and also so that any service difficulties can be quickly and appropriately addressed. This set of procedures must address the needs of engineering, operations, and quality assurance and will be described in the following sections.

Type Design Control

All drawings and specifications defining the (*Can substitute any product as defined by part 21 here.*) aircraft will be controlled in such a manner that the specific configuration is defined for each model and serial number. This includes all drawings and specifications for new products and changes to either new products or existing aircraft.

Change Requests

A Change Request (CR) will be required to initiate any new product or a change to an existing type design. The change request should have at least the following information:

a. Description of a new product design when used to initiate a new product. *(Although it could be argued that a change request is not needed for a new product there is also some logic to using one since the change request can be the vehicle used to initiate a new project and it keeps a consistent process in place for initiating any project. The change request for a new product will contain the management approvals for the project and other information necessary to create a project so this should be considered before arbitrarily dismissing it as additional unnecessary paperwork.)*

b. Description of what needs to be changed on existing type designs.
c. Why the new product is required or an existing product needs to be changed, i.e. affects safety, affects ability to fabricate, part no longer available, etc.
d. Who requested or needs the change.
e. The impact of not changing.

Note: Some companies use forms other than the CR to identify change requests coming from manufacturing planning or quality assurance for changes to drawings or documents that are in work and which do not have final approval. This is acceptable but a word of caution is in order. Just remember that each form that is created will add to the amount of administrative work required. A properly designed Change Request form can easily handle those types of planning or quality assurance requests as well as a different form.

Change Request Procedure

To maintain an orderly process between engineering, manufacturing, and quality assurance, a documented process to identify, control, disposition, and track all change requests and make that information available to all affected organizations within the company. The following procedures will apply to change requests:

a. A CR may be initiated on ABC Form XXXX by anyone. It is not restricted to engineers. They may come from management, manufacturing planning, manufacturing Material Review Board (MRB) action, Quality Assurance, the service organization, or any other organization within the company. They may also indirectly come from an authority through the certification office.
b. A CR form is completed by the person requesting the change.
c. The CR is routed to Engineering.
d. Engineering will enter CR into CR Tracking Tool.
e. CR will be assigned to an engineer to determine if the request is valid and if it should be accomplished.
f. A priority will be established for completing the CR. Safety issues should be highest priority. Issues that affect production or the field should normally be the second priority. Issues that are more inconvenience issues should be the lowest priority.
g. CRs that are deemed a safety issue will be approved by the head of engineering. CRs that affect production or are convenience issues will be approved by the engineering manager in charge of the aircraft.
h. If the change needs to occur on a specific serial that will be identified on the CR.
i. If request is valid it will be noted in CR Tracking Tool and assigned to the appropriate engineer to accomplish.
j. The associated Engineering Change Record (ECR) will be linked to it in the CR Tracking Tool.
k. The Change Request will be closed in the tracking tool when either it has been rejected or all of the engineering is released that resolves the issue.

Type Design

The Director of Engineering is responsible for ensuring the type design is adequate to build the aircraft and the compliance documents show compliance to the applicable regulatory requirements. The type design consists of all drawings and process and material specifications used to define the product. The compliance documents substantiate that the design meets the regulatory requirements and are also considered part of the type design.

1.6.1 Drawings

The drawings will convey the description of the parts, assemblies, and installations that make up the aircraft design and the appropriate dimensions, specifications, and notes to allow parts to be fabricated and assembled. The drawing requirements will be defined and published and will consist of at least the following items on the face of the drawing:

a. Title Block providing:
   i. Drawing number.
   ii. Drawing Title
   iii. Approval Block
   iv. Drawing Size
   v. Standard Tolerances
   vi. Standard Specifications Applicable
b. Revision Block
   i. Revision Number/Letter
   ii. Revision Description
   iii. Revision Date
   iv. Revision Approvals
c. Zones
   i. Vertical zones
   ii. Horizontal zones
d. Notes
   A designated area on the face of the drawing where notes may be written to provide additional information on fabrication, assembly, or installation.

1.6.2 Process Specifications

Process specifications required to be used in the fabrication or assembly of a part, or parts, will:

a. Be industry consensus standards where possible.
b. Be developed by engineering with input from Operations and Quality Assurance where industry standards do not exist or are inadequate.
c. Will be included in the Notes section of the drawing.
d. Will be released and made available to Operations and Quality Assurance using the same procedures as all other type design documents.

1.6.3 Material Specifications

Materials specifications will:

a. Will use industry standard specifications where applicable and appropriate.
b. Define the type of material to be used for each part.
c. Define any specific characteristics of the material such as heat treat, etc.
d. Be developed by engineering if industry standards do not exist or are inadequate.
e. Will be released and made available to Operations and Quality Assurance using the same procedures as all other type design documents.

Type Design Changes

Type design changes will be classified as major or minor in accordance with 14 CFR 21.93 or a significant change in accordance with 14 CFR 21.101 for aircraft being certified under part 21. Even for LSA aircraft the changes will be classified as major or minor using essentially the

same guidelines as found in 14 CFR 21.93 or the ASTM F37 requirements. There will be a place on the Change Request for documenting both the major/minor and the significant or not significant determination and identifying the person(s) making those determinations.

In general, type design changes that affect the flight manual, any limitations, structure, or equipment that requires re-testing to establish compliance or that may affect safe operation of the aircraft will be major changes.

Design Change Notices

Design Change Notices (DCN):

a. Are interim changes to a drawing to provide a change to type design prior to incorporating it into the drawing.
b. DCN paper size will be either 8 ½ x 11 or 11 x 17. Any change requiring more than 11 x 17 will require a drawing revision.
c. Will be identified by a sequential number that is related to the affected drawing, i.e. the first DCN released against a drawing will carry the number 1, succeeding DCNs will carry the numbers, 2, 3, 4, etc.
d. Will include the issue date.
e. Will include a description of the change.
f. Carry the same authority and approval requirements as a revision to a drawing.
g. Will have serial effectivity assigned just as a drawing revision would.
h. Can be revised themselves.
i. Are Engineering changes that are recorded on a separate form from the drawing but become attachments to that drawing until incorporated into the drawing.
j. Are related to the drawing that is being changed and must identify the affected drawing and drawing revision.
k. Are related to an ECR.
l. Are for minor changes.
m. Are expeditious ways of getting a change to the planning and quality assurance departments without having to revise and re-issue the entire drawing.
n. Will be incorporated into the drawing when more than 5 DCNs have been released against that drawing.
o. Detailed change information identifying what the current configuration is and what the new configuration is, i.e. for a dimension it should be stated “3.57 inches was 3.47 inches” and identify the part and zone of the drawing where the dimension is called out.
p. Will be approved by the applicable engineering personnel. This includes the person making the DCN, his supervision including the project engineer, and any specialists that must approve the specific type design changes.
q. Will include the date(s) approved.
r. Will be released and stored in the company document storage facility that includes a tracking system for identifying the deviations and the associated drawings, when checked in, when checked out, and by whom.

Deviations

Deviations:

a. Are for temporary changes to type design that may be to accommodate use of an alternate material for a part for a short period, a minor dimensional difference that is

acceptable on a limited number of parts, substitution of another part in an assembly due to availability, or any number of other reasons.

b. Deviation paper size will be 8 ½ x 11 or 11 x 17 only.
c. Will carry sequential numbers related to the applicable drawing in the same manner as DCNs.
d. Will carry the issue date.
e. Will be reviewed and approved the same as any other type design change.
f. Will have serial effectivity recorded if it is a major change or it is desired to be able to find the products the deviated parts were installed on for any reason at a later date. Minor changes do not require serial effectivity unless they could require finding and removal at a later date.
g. Are linked to the drawing which they affect.
h. Will not be incorporated into the drawing but will remain attachments to that drawing forever.
i. Will be approved by the engineering specialist responsible for that component and by the project engineer for the aircraft.
j. Will include the date of approvals.
k. Will be released and stored in the company document storage facility that includes a tracking system for identifying the deviations and the associated drawings, when checked in, when checked out, and by whom.

Project Number

A number that is unique to the company will be established to collect all of the activity associated with a specific new product or change. This project number can be used:

a. To collect cost, engineering data that is used for both development and certification or approval and keep it separate, project schedule, or any other appropriate project related information.
b. In place of an FAA Project number in accordance with FAA Order 8110.115.

Engineering Change Record

The Engineering Change Record (ECR) is the document that collects all of the drawings, specifications, reports, manuals, and any other documents required to document compliance to the regulations associated with a specific new product or a change to an existing product. The ECR may be used in the following ways:

a. For a new product, multiple ECRs may be issued with each ECR covering specific parts of the aircraft, such as wing structure, power plant installation, electrical installation, etc. In this case there may be a collector ECR that all of the ECRs feed into simply as a way to manage all of the individual ECRs, or they may simply be linked to the Project Number which is the primary project management tool.
b. For a significant serialized change to an existing product where all of the documents associated with the change are listed on a single ECR.
c. For a collection of minor changes that do not require identification of the serial on which they are incorporated. This may involve multiple CRs.

Engineering Change Record Content

An Engineering Change Record (ECR) will be created to record all engineering for either a new product or a change to an existing product. This ECR will contain a list of drawings,

specifications, reports, manuals, or any other documents associated with the new design or change. It will provide as a minimum:

a. Description of the new product or change
b. Reason for the change
c. Model Number(s)
d. Serial Effectivity by Model
e. Document Number
f. Document Title
g. Document Revision
h. Document Revision Date
i. Other information may also be added to the ECR if deemed necessary or appropriate. Multiple ECRs may be used for large projects to break the project down into smaller segments. These ECRs are frequently for specific functional areas, such as collecting the engineering associated to the propulsion system, or the electrical system. Some companies use the project number to collect multiple ECRs associated to a project and some companies use a top collector ECR. Using the Project Number is usually a better solution but each company needs to make the decision based on their processes.

Frequently a specific document will be revised multiple times throughout a project. Each revision associated to that ECR must be recorded on the ECR.

The ECR must be approved, released, distributed, and controlled in a manner similar to type design and reports.

Type design

Type design is all drawings, specifications, and documents supporting the certification or approval of a product. The type design will be company approved, released, distributed, and controlled.

When a new document or a change to a document is required, the document number, title, and revision will be checked out and listed on the appropriate ECR. This will provide visibility to others of any documents that are either in the process of being created or revised.

Approval

All type design and supporting documents will be company approved prior to release. Company approval documents that the company, through its authorized engineering personnel, have reviewed the documents and agree that the type design meets the applicable regulations or design standards. This company approval documents the company has satisfied the regulatory or standard requirements and legal acceptance of responsibility for the product. The persons making these approvals must have appropriate experience and integrity and be approved by the Director of Engineering.

When documents need FAA, FAA designee, ODA Unit member, or other authority approval they will be released prior to that approval. This would not apply to light sport aircraft processes but would apply to any aircraft certified under the part 21 rules. All such approvals will be retained by the certification organization within the engineering department. This approval simply provides evidence of agreement by the FAA, the FAA designees, the ODA UM,

or other regulatory authorities of the company approval. In FAA terms this is a Finding of Compliance.

Release

A release procedure will document when the document is closed to any additional changes. Once released, a document cannot be changed or modified in any way except through a new revision to the document. The document number, title, revision, and release date will be entered on the appropriate ECR.

Document Control

The engineering department is responsible for document control of all documents created within engineering. The document control process will include the following:

a. Date an original document is checked out so the originator can construct the document.
b. Document number and revision, including DCNs and Deviations.
c. What ECR the document is assigned to.
d. Name of person checking it out.
e. Document release date.
f. Document type, i.e. paper or electronic.
g. Identification of where the original document is stored:
   i. Paper documents will be stored in a vault or secured fireproof and waterproof file cabinet.
   ii. Electronic documents will be stored on two separate servers, one of which will not be within the same building as the first or is off site.
h. Identification of all DCNs or Deviations against each drawing or specification.
i. Document release information identifying who is notified of the document release unless the information is automatically available to all affected persons and organizations when the document is released.
j. Access to either paper or electronic document originals is controlled to prevent unauthorized changes being made to either except through a formal checkout process.

Distribution

Document distribution will occur only after the document is released and will be by either paper or electronic means. If documents are distributed by electronic means the downstream users may simply request notification of when new documents, or revisions, are released. It is then their responsibility to obtain copies as needed. Normally the distribution, or use of documents, will be in accordance with the following:

a. Drawings and specifications defining type design will be distributed, or made available, to:
   i. Manufacturing Planning
   ii. Shop Floor
   iii. Quality Assurance
b. Functional Test Procedures defining production test procedures will be distributed, or made available, to:
   i. Manufacturing Planning
   ii.
   Quality Assurance
c. Compliance Reports will normally not be distributed except as requested for specific reports.

Control of Document Copies

All type design drawings and specifications used in the manufacturing planning or shop areas will:

a. Be maintained in a secure area with appropriate limited access if the originals are paper documents.
b. Be maintained on a secure server with appropriate limited access if the originals are electronic.
c. Have all copies permanently marked to identify the date when it can no longer be used for planning or production purposes. This date will be 20 calendar days after it was produced.
d. Be the responsibility of the person using the drawing or specification to ensure that it is within the acceptable date range.
e. Be the responsibility of the person using the drawing or specification to ensure that all applicable DCNs and/or Deviations are included with any drawings checked out for use on the shop floor.
f. Be the responsibility of the person using the drawing to ensure that an out of date document is removed from the floor and destroyed.
g. Be the responsibility of Quality Assurance to ensure that all drawings, DCNs, Deviations, and Specifications used in the fabrication of an article were the correct number and revision for the affected model and serial.

DOCUMENT CONTROL – 14 CFR 21.137(b)

2.1 Requirement

Procedures for controlling quality system documents and data and subsequent changes to ensure that only current, correct, and approved documents and data are used.

2.2 Compliance:

The Quality Assurance procedures for controlling quality system documents and data will:

a. Approve documents for adequacy prior to issue.
b. Review and update documents as necessary and re-approve revised documents.
c. Ensure that changes and the current revision status of documents are identified.
d. Ensure that relevant versions of applicable documents are available.
e. Ensure that documents remain legible and readily identifiable.
f. Ensure that documents being used in production are not beyond the allowable date printed on the document.

SUPPLIER CONTROL – 14 CFR 21.137(c)

Requirement

Procedures that:

(1) Ensure that each supplier furnished product or article conforms to its approved design; and
(2) Require each supplier to report to the production approval holder if a product or article has been released from that supplier and subsequently found not to conform to the applicable design data.

Compliance

Supplier control involves all three organizations and it will involve an integrated process with the involvement of each organization at the appropriate time in the process.

3.2.1 Engineering

It is the responsibility of engineering to:

a. Identify on the bill of material for any product or article any parts to be obtained from a supplier.
b. Identify the part(s) by supplier name, supplier part number, and/or the OEM part number when used, as well as the specific version as described by the supplier's drawing revision.
c. Identify when parts will require part serialization, modification number, or other unique means of identifying a specific part.
d. Identify for inclusion on the Purchase Order the conformity requirements for the part or parts. (This will be done for production parts as well as parts to be used in development or certification testing.)

3.2.2 Manufacturing

It is the responsibility of manufacturing through their planning and purchase order to:

a. Identify on the Purchase Order the part number as defined by the Supplier along with the drawing number and revision level the part is to be built to.
b. Identify any serialization, modification number, or other appropriate means of identifying a specific part,
c. Identify any conformity requirements such as FAA Form 8130-3, 8130-9, etc. that is required by either manufacturing or engineering.
d. Any other instructions necessary to ensure the part received by ABC satisfy their requirements.
e. Ensure that the supplier is made aware of his responsibility to report to the purchaser, any product or article that has been released from the supplier and subsequently found not to conform to the applicable type design. This requirement should be included in any contract with a supplier and reiterated on the Purchase Order.

3.2.3 Quality Assurance

It is the responsibility of Quality Assurance to:

a. Verify that the parts received match the requirements on the Purchase Order.
b. Retain all records of supplier provided parts, including any conformity paperwork provided by the supplier, to that ensure they meet the required type design.
c. Ensure the parts are installed on the applicable model and serial product.

Supplier Qualifications

All suppliers providing parts, materials, assemblies, or services affecting the type design of all parts included in the approved type design of the product will:

a. Be evaluated and approved by Engineering and Quality Assurance to ensure that all products or articles the supplier provides will consistently conform to the approved type design and quality requirements. This will be accomplished using ABC-XXXX form that will be signed by the representatives of both engineering and quality assurance who conducted the evaluation.
b. Be included on the Approved Suppliers List maintained by Quality Assurance.
c. Be re-evaluated yearly, or at any time the Director of Quality Assurance determines a need based on quality of products received, to ensure they continue to provide satisfactory parts or materials.
d. Provide ABC with the required inspection documentation as defined on the purchase order for each product or article or lot of products or articles.

e. Maintain records of the inspection results of each product or article or lot of products or articles and make those records available to ABC upon request.
f. Implement a process to identify deviations from the required type design and a process to identify root cause and corrective action for those deviations.
g. Implement a process to identify and report products or articles to ABC that have been released to ABC and have been subsequently found to not conform to the applicable type design data.

Delegation of Authority to Suppliers.

When a supplier has demonstrated that they can comply with the requirements in 3.1 they may be delegated to perform conformity on their products and provide that information to ABC.

3.4.1 The Director of Quality Assurance is:

a. Responsible for ensuring each supplier is evaluated to determine if they are eligible for delegation and the extent and type of delegation.
b. Responsible for ensuring the results are reviewed with the Engineering and Operations Directors or their representatives to obtain agreement from them.
c. Responsible for ensuring the delegation information is added to the Approved Supplier List when approved.
d. Notifying the Supplier of the delegation authority and any specific requirements or limitations that may apply.

3.4.2 Delegations to suppliers may include:

a. Major inspections of parts or assemblies that cannot be completely inspected by ABC Receiving Inspection upon receipt.
b. Materials Review actions at the supplier facilities. When this function has been delegated, ABC Engineering and Quality Assurance are responsible for reviewing each such action after the fact to ensure that the dispositions are in accordance with ABC policy and procedures. If the function is not delegated, each MRB action by the supplier must be reviewed by ABC Engineering and Quality Assurance, and approved before the action is implemented.
c. Direct shipment of a domestic supplier's product to ABC aircraft operators. This authority is delegated ONLY when:
    i. The supplier is one of high integrity in the industry.
    ii. Has demonstrated for at least 2 years that the parts/materials furnished are consistently in conformity with the Purchase Order specifications.
    iii. The Directors of Engineering and Operations have concurred with the Director of Quality Assurance that direct shipment may be authorized.

MANUFACTURING PROCESS CONTROL – 14 CFR 21.137(d)

Requirement

Procedures for controlling manufacturing processes to ensure that each product and article conforms to its approved design.

Appendix F

Compliance

This is a joint requirement of engineering, operations, and quality assurance and compliance will be as defined in the following sections.

4.2.1 Engineering

It is the responsibility of engineering to define on the drawing any parts, , materials, and manufacturing processes that must be followed and controlled to ensure the end product complies with the type design. This includes the writing of process specifications to define to manufacturing and quality assurance any such requirements.

4.2.2 Operations

It is the responsibility of manufacturing to ensure their planning includes the appropriate work instructions and process controls to ensure the part or assemblies satisfy the type design requirements for the applicable aircraft serial.

4.2.3 Quality Assurance

It is the responsibility of quality assurance to verify that manufacturing has complied with the manufacturing process requirements defined on the engineering and the manufacturing planning and work instructions for applicable aircraft serial.

Approved Parts List

The parts list will contain all of the parts, assemblies, and installations as necessary to completely assemble the finished article. All parts lists must be approved by the appropriate engineering personnel prior to being issued to manufacturing.

Materials Evaluation

4.4.1 The ABC Engineering Department is responsible for:

a. Evaluating all materials to be procured from suppliers that require chemical or physical analysis to verify that the material meets the design specification and documenting the results on ABC-XXXX form signed by the evaluating engineer.
b. Forwarding the findings of the analysis, whether satisfactory or rejected, to Quality Assurance for further investigation of the suppliers qualifications.
c. Recommending adding the supplier to the Approved Parts List if acceptable.

4.4.2 The ABC Quality Assurance Department is responsible for:

a. Reviewing the engineering evaluation and if acceptable add the material to the Approved Materials List containing at least the following information:
    i. The specific material identification.
    ii. The material specification, including revision, identification.
    iii. The date approved.
    iv. The specific supplier name and address.
b. Implementing a review of the supplier, and/or the material, if the results are not acceptable.
c. Adding the supplier to the Approved Parts List if acceptable.

Appendix F

Supplier Parts or Assemblies Evaluation

4.5.1 The ABC Engineering Department is responsible for:

a. Evaluating all parts and assemblies procured from suppliers that require analysis or testing to verify that the parts or assemblies meet the design specification and documenting the results on ABC-XXXX form signed by the evaluating engineer.
b. Forwarding the findings of the analysis or testing, whether satisfactory or rejected, to Quality Assurance for further investigation of the suppliers qualifications.
c. Recommending the part/assembly supplier be added to the Approved Parts List if acceptable.

4.5.2 The ABC Quality Assurance Department is responsible for:

a. Reviewing the engineering evaluation and if acceptable add the parts or assemblies to the Approved Parts List containing at least the following information:
   i. The specific part or assembly identification.
   ii. The part or assembly type design drawing, including revision, identification.
   iii. The date approved.
   iv. The specific supplier name and address.
b. Implementing a review of the supplier, and/or the part or assembly, if the results are not acceptable.

Purchase Order (PO)

ABC Form PO-100, is written for all parts and materials purchased for use in:

a. Production aircraft.
b. Test articles to be used for development or certification purposes.

4.5.1 Purchase Order Issuance

The Purchasing Officer will issue Purchase Orders for materials and parts only to:

a. Suppliers listed on the Approved Suppliers List maintained by Quality Assurance for production aircraft.
b. Suppliers listed on the Approved Suppliers List or as specifically identified and approved and approved by Engineering for development or certification testing requirements.

4.5.2 Purchase Order Data Requirements

The Purchasing Officer will specify on the PO:

a. The materials or parts that are shown on the approved supplier drawings.
b. The supplier drawing number and revision applicable to the materials or parts.
c. Any applicable specifications, including the design and quality requirements applicable to the parts or material.
d. Any special conformity requirements such as FAA Form 8130-9 or 8130-3.
e. The documents required to be included with the parts or material.
f. A requirement that the supplier must notify and obtain approval from the ABC Engineering Department for any changes in the design from that defined by the drawing and revision identified on the PO.
g. Shipping Instructions.
h. The required delivery date.
i. Any special instructions.
j. Reminder to all suppliers to ABC Aircraft Company that they are subject to inspection/surveillance by ABC Aircraft Company at any time.

4.5.3 Substitute Materials on PO

The Purchasing Officer will obtain the approval of the Engineering Department before writing a Purchase Order (PO) for substitute materials.

4.5.4 Direct Ship Instructions

The Purchasing Officer and Director of Quality Assurance will provide instructions for direct shipment on the PO when a domestic supplier has been found by Quality Assurance to be qualified for making such shipments. Suppliers selected to make direct shipments will be authorized by the Director of Quality Assurance to place the following statement on invoices, as evidence to the purchaser that the materials or part(s) are approved:

> "The materials or part(s) covered by this invoice has (have) been produced under ABC Aircraft Company authorization and conform(s) to the approved design."

4.5.5 Purchase Order Distribution

The PO will be distributed as follows:

a. Original to permanent file.
b. Two for the supplier.
c. One for the "open PO" file.
d. One for Receiving Inspection.

Receiving Inspection

The Directors of Operations and Quality Assurance are responsible for receiving all products and services procured from suppliers. This responsibility includes the following:

a. All materials and parts will be delivered to the receiving area to be initially processed.
b. The PO identified on the Packing Slip will be pulled to verify the order matches the PO.
c. The Receiving Inspector will verify that any documents such as material certifications, affidavits, or conformity paperwork is included.
d. The Receiving Inspector will check the condition of the shipment to ascertain if there is any damage.
e. If there is damage or the shipment does not meet the PO requirements, the Receiving Inspector will complete a Rejection Slip, ABC Form J-100, and the shipment will be routed to the Material Review Board for disposition.
f. If the shipment is in good condition, the Receiving Inspector will inspect the items for compliance with the applicable drawings and specifications.
g. Raw materials will be visually inspected for condition, and must be accompanied by the certifications or affidavits as required by the PO.
h. The Receiving Inspector will stamp or tag raw materials before releasing to the stockroom.
i. Any included documents attached to parts to be used in production will be attached to the PO.
j. Any included conformity documents to be used for development or certification work will be forwarded with the part to the experimental department.
k. When the shipment has met the PO and inspection requirements, a Receiving Report, ABC Form RE-100 will be completed and distributed to:
    i. One copy attached to the PO copy and held by Receiving Inspections until final completion of the Receiving Report.

ii. One copy to Production Control.
iii. One copy to permanent storage.
iv. One copy to Accounting.

l. When a shipment has been rejected for any reason, the Receiving Inspector will send all copies of the Receiving Report with the shipment to the Materials Review area for disposition on the Receiving Report which will be returned to the Receiving Inspector for distribution in accordance with k.
m. If the Material Review Board rejects a shipment, the shipment will be returned to the supplier.
n. When a PO has been completely filled, the PO copy held by Receiving Inspection and all attached documents will be returned to the Purchasing Office and filed for the record with the original PO.

Production Control

4.8.1 Shop Travelers

Production control will be maintained though issuance of Shop Travelers, ABC Form ST-100, by Manufacturing Planning. The Shop Traveler will:

a. List the work items for manufacturing detail parts, and for all subsequent assembly or installation operations.
b. Be based on the latest drawings and specifications applicable to the parts, assemblies, or installations for the applicable aircraft serial. It is the responsibility of Planning to ensure they have the latest applicable drawings or specifications.
c. When revisions to Shop Travelers are necessary, the shop will be notified of a pending revision so they can plan accordingly.
d. When a revision to a Shop Traveler is issued, the superseded Shop Travelers will be removed from the production areas.
e. Shop Travelers will be released at the appropriate stages of production to ensure that no work items will result in areas on an assembly that cannot be inspected.
f. Have each work item stamped and dated in the space provided on the Traveler by production employee upon completion of that work item.
g. Be presented to Production Inspection along with the applicable drawings and specifications for conformity with the drawings and for condition and workmanship.
h. When found to be in conformity, each work item on the Traveler will be stamped and dated in the place provided by the Production Inspector.
i. When a work item on a Shop Traveler is not in conformity:
    i. The inspector will prepare a Rejection Slip, ABC Form RJ-100.
    ii. Route the rejected part back to the shop for corrective action either through engineering approved rework or Material Review action.
    iii. The part or assembly will not be released for delivery to the next operation until the rejected item has been cleared and satisfactorily inspected.
j. When a Shop Traveler has one or more open work items because of parts shortages or other valid reasons, the part or assembly may be released to the next production operation, if:
    i. The incomplete Shop Traveler is posted in a prominent place in the appropriate Inspection Station to ensure that subsequent assembly operations cannot be finally cleared until the open item(s) on the open Shop Traveler have been satisfactorily completed and stamped.

ii. Production Control has a process to continually review Shop Travelers with open work items to ensure that completion of a subsequent work operation will not render the open item "not inspectable" such as by enclosing the area in which the open item is to be completed.
iii. "Working around" an open item is kept to a minimum and used only in extenuating circumstances to preclude shutting down production.
iv. Shop Travelers with open items may follow an aircraft through final assembly and flight test if necessary but must be cleared before an aircraft is licensed and delivered.

k. When all the work items for detail parts or assemblies on the Shop Traveler have been satisfactorily completed and inspected:
   i. The Inspector will stamp each part or assembly.
   ii. The parts or assemblies will be routed to the next assembly area or to storage for later assembly or installation.
   iii. The Shop Traveler will be routed to Quality Assurance for filing.
l. When all the work items for a final assembly Shop Traveler have been completed and inspected:
   i. The Inspector will stamp and date each work item.
   ii. The Shop Traveler will be filed in a master file for each aircraft is shop complete and satisfactorily flight tested.
   iii. The completed master file will be routed to Quality Assurance for filing.

4.8.2 Work Instructions

The Director of Manufacturing is responsible for ensuring that clear and concise work instructions are provided to all personnel involved in production fabrication and assembly operations. Work Instructions may:

a. Be initiated by any ABC person involved in production operations at any level,
b. Be reviewed by that person's supervisor and submitted to the Director of Operations for approval.
c. Be added to the Operations Manual upon approval by the Director of Operations.
d. Be issued as Operating Instructions if the new work instructions concern only details to supplement specific items in the Operations Manual.

INSPECTING AND TESTING – 14 CFR 21.137(e)

Requirement

Procedures for inspections and tests used to ensure that each product and article conforms to its approved design. These procedures must include the following, as applicable:

(1) *A flight test of each aircraft produced unless that aircraft will be exported as an unassembled aircraft.*
(2) *A functional test of each aircraft engine and each propeller produced.*

Compliance

Creation of the Functional Test Procedures will be a joint responsibility of Engineering, Operations, and Quality Assurance. This will help ensure that the testing can be conducted in an efficient and expeditious manner and the proper results are obtained. A single Functional Test Procedures document will be utilized to ensure that Engineering, Operations, and Quality Assurance have all reviewed and agreed on the test procedures and requirements. This will save considerable effort and eliminate much confusion and misunderstanding of the

requirements. In some cases the test procedure may utilize a consensus standard to help ensure the testing is in agreement with accepted practice.

Functional Test Procedures Requirements

The production functional test procedures requirements will include a checklist that contains the following:

a. A place for recording:
   i. Product model.
   ii. Product serial number.
   iii. Specific test procedure document number, name, and revision.
   iv. Specific test equipment used along with make, model, and serial or other identification to allow finding the equipment later in the event of a question about the data.
   v. Dates of all tests.
   vi. Signoff by the person performing each test attesting to performing the test in accordance with the procedure and the results are as recorded on the checklist.
   vii. Signoff by the quality assurance person verifying each test was conducted in accordance with the procedure and results are as recorded on the checklist.
   viii. In the case of flight tests where a quality assurance person is not on board the aircraft during a flight test, the quality assurance signoff should be by the flight test engineer accompanying the test pilot.
   ix. A place for recording unusual difficulties, questionable results, or potential safety issues with the product or the test that can be fed back to engineering, operations, and quality assurance to determine if changes need to be made to the product, test procedures, equipment, etc.
b. A detailed and sequential checklist of the steps to be taken in each test, or phase of the test if the test is long or may be performed at different stages of production.
c. The parameters that must be measured and the acceptable values for each parameter identified and recorded. Avoid calling for specific equipment to be used in measuring parameters unless absolutely necessary as this can drive costs up. Instead specify the measuring range, accuracy, or other pertinent requirements of the equipment as much as possible to provide operations with the option to obtain equipment that is acceptable and may be used for other testing.
d. Clear pass/fail criteria must be identified for each test. In some cases this will be measured values whereas in flight testing this may be more subjective and depend on the skill and experience of the pilot to determine if the results are satisfactory.
e. When a test requires a subjective evaluation, the person performing the test must have proper training to ensure that they can determine acceptability of the test results and be approved by the head of engineering to perform such tests. In these cases it may be appropriate to identify acceptable characteristics that can be described and evaluated with criteria for when a second pilot may be called on to provi de a second opinion. The training requirements for the pilots conducting these tests must be identified in the test requirements and documented in the individuals personnel records.
f. When a test fails, or a potential safety issue with the product is identified:
   The cause must be determined and documented in the test results.
   A solution must be agreed to between engineering, operations, and quality assurance.
   Approved by engineering and quality assurance signing the document defining the issue and the resolution.

g. When a test fails, or the system being tested is disturbed in any way, there must be clear instructions for what portions of a test must be repeated.
h. All checklists, either ground or flight, containing the results will become a permanent production record for that model and serial will be routed to Qualtiy Assurance and be retained by Quality Assurance.

Test Facilities, Equipment, and Personnel

It is the responsibility of Operations to provide facilities, equipment, and personnel to conduct the required testing.

INSPECTION, MEASURING, AND TEST EQUIPMENT CONTROL – 14 CFR 21.137(f)

Requirement

Procedures to ensure calibration and control of all inspection, measuring, and test equipment used in determining conformity of each product and article to its approved design. Each calibration standard must be traceable to a standard acceptable to the FAA.

Compliance

It is the responsibility of the Directors of Operations and Quality Assurance to ensure the calibration and control of all inspection, measuring, and test equipment and production tooling used in determining conformity of each product and article to its approved design. This requirement applies to all inspection, measuring, and test equipment, whether owned by the company, its employees, or on loan or provided by the customer or a supplier.

Applicable Devices

These requirements apply to.

a. Any production tooling that, when used, establishes the conformity to the drawings or specifications of the part or assembly made with the tool.
b. Any devices that monitor temperature, pressure, time, humidity, etc. that is required either in production or for storage of materials.
c. Any devices used to measure materials by volume, weight, etc. when those parameters are critical to ensuring the fabricated parts conform to type design.

Equipment Management

To satisfy these requirements the following procedures will be followed:

a. A measuring equipment and production tooling tracking tool will be created to:
    i. Identify each piece of equipment or production tool with a permanent identification number.
    ii. Link the identification number to the specific piece of equipment by make, model, serial number, date procured, and source.
    iii. Identify storage location.
    iv. Identify calibration dates.
    v. Identify maximum time period between required calibrations.
    vi. Identify who performed the calibration.
    vii. Identify when next calibration is due and when recall is issued to ensure equipment is returned in time to satisfy calibration schedule.
    viii. Identify issue dates and who issued to.
    ix. Identify check-in dates and by whom.

x. Any other information pertinent to the maintenance of the measuring equipment.

b. All gages and other measuring and testing equipment are the responsibility of the Operations department to:
   i. Procure
   ii. Maintain.
   iii. Store.

c. All gages and measuring equipment that is sensitive to environmental conditions must be stored in areas or containers that protect the equipment from those environmental conditions that could cause the equipment to provide unacceptable measuring capability to ensure the products or articles inspected with the equipment meet the approved type design.

d. All calibration of measuring equipment must be performed by agencies or laboratories that use certified measurement standards traceable to the National Institute of Standards and Technology.

e. The tracking tool will be reviewed weekly to determine which devices need to be recalled that week.

f. Upon recalibration a sticker will be attached identifying the date it was calibrated and the next due date.

INSPECTION AND TEST STATUS – 14 CFR 21.137(g)

Requirement

Procedures for documenting the inspection and test status of products and articles supplied or manufactured to the approved design.

Compliance

Compliance with this requirement will consist of the following:

a. Production Orders will contain sufficient definition of the product to be manufactured that all parts, assemblies, installations, and tests will be included on Shop Travelers.

b. The Shop Travelers used to fabricate all parts and assemblies and perform installations document conformity results.

c. Functional test procedures provide documents to record the results of all functional testing to ensure that tests satisfy the type design requirements.

d. All inspection or test operations will be at points in production where accurate determinations can be made and documented.

e. This information will be contained in the Quality Assurance files and documented in the Production Inspection Record (PIR) for each aircraft manufactured

NONCONFORMING PRODUCT AND ARTICLE CONTROL – 14 CFR 21.137(h)

Requirement

(1) *Procedures to ensure that only products or articles that conform to their approved design are installed on a type-certificated product. These procedures must provide for the identification, documentation, evaluation, segregation, and disposition of nonconforming products and articles. Only authorized individuals may make disposition determinations.*

(2) *Procedures to ensure that discarded articles are rendered unusable.*

Compliance:

ABC maintains procedures to assure that articles which do not conform to specified requirements are prevented from inadvertent use or installation. When articles are initially found to be nonconforming, it shall be examined, promptly recorded, and conspicuously identified. In accordance with XXX – Control of Nonconforming Material, identified nonconforming articles shall be controlled until dispositioned, to prevent unauthorized use. This control includes, but is not limited to, the identification, documentation, evaluation, segregation, and disposition of articles. Nonconforming articles shall be subjected to review by designated persons to determine an appropriate final disposition. Persons carrying out the review shall consist of qualified members of Quality Assurance, Liaison Engineering (when referred to MRB), and a customer representative when applicable in accordance with criteria established in XXX and XXX – XXX Material Review Board Membership List.
Nonconforming articles dispositioned as scrap shall be processed as necessary to preclude production use in accordance with XXX – Mutilation of Scrap Material.

MATERIAL REVIEW

The Materials Review Board (MRB) will consist of the Directors of Engineering, Quality Assurance, and Operations, or their qualified appointees. A qualified appointee will have:

a. An engineering degree and 4 years' experience in the area for which he/she will be making dispositions, or
b. Eight years of experience in the area for which he/she will be making dispositions.

8.3.1 Facility and Equipment Responsibilities

The Director of Operations is responsible for providing:

a. An enclosed area(s) with a lockable entry to be used for storing nonconforming items awaiting MRB disposition.
b. Bins or containers marked in red with the word REJECTIONS, located in the fabrication and subassembly areas where items awaiting material review action or damaged detail parts will be placed until transported to the Materials Review area.
c. Facilities and/or tools as may be required for physical mutilation or destruction of items that are rejected by the Material Review Board.

8.3.2 MRB Responsibilities

The MRB will:

a. Review rejected parts and materials.
b. Make decisions as to their disposition. Final decisions of the MRB will be for one aircraft only and will not be used as repetitive decisions and be applied to other parts or materials for review.
c. Ensure that the causes of non-conformances are determined promptly, and that appropriate corrective or remedial action is taken by the responsible Director.
d. Maintain records of causes, trends, and individual causes it acted upon and prepare individual records for summaries of action taken.
e. Establish a follow-up system to ensure the timeliness and effectiveness of all corrective or remedial action.

MRB Process

The MRB process will:

a. Receive the Rejection Slips and parts or assemblies from receiving inspection or production.
b. Review the rejection and determine which of the following actions to be taken:
   i. "Use As Is" for parts with minor discrepancies that have no effect on the physical strength or the function of the part or assembly that would create any safety issues.
   ii. "Rework/Repair" with detailed instructions of how to rework the part to make it acceptable.
   iii. "Replace" when the discrepancy cannot be satisfactorily resolved for the particular installation but it may be able to be reworked to satisfy other requirements.
   iv. "Reject" when the part is beyond the capability of being able to be reworked to a satisfactory condition for use.
c. Record the recommended action on the Rejection Slip.
d. Have the Rejection Slip signed and dated by the MRB members.
e. Return the Rejection Slip and the part(s) or assembly(ies) to the issuing department.
f. Have non-conforming parts or materials that cannot be reworked, repaired, or otherwise salvaged by approved modifications scrapped and destroyed, or in the case of supplier furnished parts will be returned to the supplier.
g. Have the MRB recommend to engineering that the design data be changed when:
   i. A rejection becomes chronic.
   ii. Is of a major magnitude that could affect other related parts or materials,
   iii. Is of a nature where the corrective action would result in a product improvement.
h. Mark an item with the word REJECTED, in lieu of mutilation of the rejected part, ONLY when the item might still be usable as part of a prototype mockup by the Engineering Department.
i. Items that are determined to be SCRAP will be placed in a locked container, preferably colored red, until they can be mutilated by cutting with tools or torch, or smashing with a hammer in such a way that the item cannot possibly be repaired or otherwise refurbished and used on an aircraft.
j. Require the Director of Operations to be responsible for ensuring that no rejected item will be sold as scrap by the ABC Company until mutilation has been carried out.
k. Ensure a copy of each Rejection Slip processed by the MRB is attached to the affected Shop Traveler for use by shop personnel when rework or repair is required and for the permanent aircraft record.
l. Ensure all Rejection Slips:
   i. Are in a file maintained by the engineering department.
   ii. Will be made available to auditors upon request.

CORRECTIVE AND PREVENTIVE ACTIONS – 14 CFR 21.137(i)

Requirement

Procedures for implementing corrective and preventive actions to eliminate the causes of an actual or potential nonconformity to the approved design or noncompliance with the approved quality system.

Compliance

Corrective Action Response and Review Requirements addresses the requirements for answering and reviewing Corrective Action (CA) requests generated by Quality Assurance.

Actions shall be taken as outlined in XX – Preventive Action to prevent occurrence of nonconformance's relating to articles, processes, or the Quality Management System.

HANDLING AND STORAGE – 14 CFR 21.137(j)

Requirement

Procedures to prevent damage and deterioration of each product and article during handling, storage, preservation, and packaging.

Compliance

The Director of Manufacturing will establish standards and procedures for stocking and handling production parts. This will include but not be limited to the following:

a. Ensuring Purchase Orders have a quality clause to specify marking, handling, documentation, transportation, and delivery requirements for all parts and materials.
b. Receipt of materials and parts from suppliers to ensure they meet requirements of Purchase Order.
c. Ensuring documents received with materials or parts are properly filed for record retention requirements.
d. Ensuring materials and parts are properly labeled or marked to avoid any confusion in use.
e. Ensuring materials and parts have appropriate protection from damage while in storage or in transit between operations.
f. Ensuring materials are stored in facilities meeting any environmental requirements for the materials or parts.

STORAGE AND ISSUANCE

The Director of Manufacturing is responsible for ensuring the storage, issuance of materials and supplies, and maintenance of records for all materials is in accordance with the following:

a. Storage area(s) must be provided that will provide for protection against deterioration or damage to products in storage, and that handling devices, environmental control methods, and transportation vehicles are suitable for the products involved and are loaded as required to prevent damage.
b. Raw materials are checked for proper identification and stored in an area appropriate for their condition and packaging,
c. When special packaging requirements or storage environments (refrigerators, freezers, etc.) must be maintained, packages are labeled to indicate this condition, with the labeling requirements shown on the Purchase Order, ABC Form PO-100.
d. Upon receipt of a shipment from Receiving Inspection, the shipment is accompanied with a copy of the Receiving Report, ABC Form RE-100 that indicates satisfactory acceptance and the report is filed in the appropriate storage area.
e. Items that are labeled with expiration dates (O-rings, seals, composite materials, etc.) will be stored in properly identified bins. A file will be maintained to ensure that the oldest items are issued first, and that items that have expired are routed to the Materials Review segregated area for disposition.
f. Items that require environmentally controlled storage, ("icebox" rivets, sealants, composite materials, etc.) will be:
    i. Stored in refrigerators or freezers with appropriate temperature controls and recording thermometers installed to ensure that the temperature requirements are

maintained and recorded daily to ensure that the temperature has remained within limits,

ii. If a discrepancy is found, such as due to a power failure or a faulty refrigerator or freezer a Rejection Slip, ABC Form RJ-100 covering all of the material involved is created,

iii. The Rejection Slip is routed to the Materials Review area for action by the Materials Review Board, and

iv. The contents of the refrigerator or freezer will not be used in production until corrective action or rejection has been determined by the Board.

g. All completed or semi-completed detail parts and/or subassemblies are routed to storage pending eventual use in further stages of production and ensuring that:

i. A shop traveler, ABC Form ST-100 accompanies the item to indicate its inspection status at the time of routing to storage.

ii. The Shop Traveler remains with the item in storage to be issued with the item when it is eventually requisitioned by production, and

iii. Notification to production inspection if a Shop Traveler is not with the semi-completed detail parts and/or subassemblies.

h. Maintaining all storage areas in a clean and orderly condition.

i. Conducting monthly checks to ensure appropriate disposition of all out-of-date items are properly dispositioned.

j. Ensuring that large or unwieldy items are secured and properly protected from damage when placed in transport vehicles and during delivery to work areas.

k. Maintaining storage booths and/or storage bins, for small parts that are located in the production shop areas and ensuring that such booths or bins are adequately stocked to meet production needs by ordering replenishments before the supply is exhausted.

l. Ensuring proper handling of composite materials, and separation of composite storage areas from the rest of the manufactured items.

CONTROL OF QUALITY RECORDS - 14 CFR 21.137(k)

Requirement

Procedures for identifying, storing, protecting, retrieving, and retaining quality records. A production approval holder must retain these records for at least 5 years for the products and articles manufactured under the approval and at least 10 years for critical components identified under § 45.15(c) of this chapter.

Compliance:

The Director of Quality will ensure the Appropriate records are maintained to demonstrate achievement of quality requirements and to verify the effective operation of the Quality System. General requirements for control of records are provided in the Records Management Instructions Manual, maintained electronically on the XXX home intranet page. In all cases, the following requirements shall be assured:

a. Quality records shall be legible and identifiable to the article or service involved as outlined in XXX – Forms and Their Use and other QA documentation requirements.

b. Quality records shall be stored and maintained so they are readily retrievable in facilities that provide a suitable environment to minimize deterioration or damage and to prevent loss.

c. Retention times of quality records shall be established, documented, and observed. Where agreed contractually, quality records shall be made available for evaluation by the

customer for an agreed period.

INTERNAL AUDITS – 14 CFR 21.137(l)

Requirement

Procedures for planning, conducting, and documenting internal audits to ensure compliance with the approved quality system. The procedures must include reporting results of internal audits to the manager responsible for implementing corrective and preventive actions.

Compliance

ABC will establish and conduct internal audits meeting the requirements described in the following sections.

Responsibilities

a. The Director of Quality Assurance is responsible for ensuring a master audit plan for conducting audits of all production and quality areas and activities on a regular basis will be established.
b. The Director of Engineering is responsible for ensuring a master audit plan for conducting audits of all engineering areas and activities on a regular basis is established.

Audit Master Plan Requirements

The master plan will contain:

a. A general schedule with the ability to conduct spot audits at any time.
b. Identification of how the audits will be coordinated.
c. Identification of what the audits will cover.
d. The frequency of audits or how to establish the frequency.
e. How the results will be documented.
f. A process for identification of any safety issues and the required action.
g. A process of notification of the Director of Engineering and the FAA of any safety issues.
h. A process for identification and resolution of isolated versus systemic issues.
i. Who and when the results will be reported to.
j. A process for determining root cause of any discrepancy.
k. A process for determining corrective action, who is responsible for the corrective action, and when it will be completed.
l. A process for closure of any findings.

Instructions:

A major function of the Quality Assurance Department is to maintain a system and schedule of annual audits of all ABC Aircraft Company facilities and activities, including selected suppliers, to ensure that the Quality Assurance data and procedures approved for the manufacturing of aircraft are being adhered to. These audits will cover the following, in addition to any special audits deemed necessary by Quality Assurance in individual cases:

a. Fabrication and assembly areas
b. Receiving and storage.
c. Processes and controls.
d. Materials Review Board Areas.
e. Measure and Test Equipment Control.
f. Selected suppliers, generally of critical items.

Audit Follow-Up Action

The audit findings will be recorded on Correction Sheets, ABC Form QA-100, and routed to the appropriate department for corrective action, which must be accomplished within 5 working days by the department receiving the form. The Correction Sheet will then be stamped by production and returned to Quality Assurance, who will verify that the item has been resolved. In the case of suppliers, the audit findings will be transmitted by letter to the supplier.

The Quality Assurance Department is responsible for ensuring that prompt corrective action is taken by the applicable department on any discrepancies found by the auditor(s).

Third Party Audits

The Quality Assurance Department is the focal point for the ABC Company in all matters related to scheduled third party audits. Quality Assurance will provide a room, desks, and copies of all ABC technical data, including the Quality Assurance Manual, the Operating Procedures Manuals, Process Specifications, and Operating Inspections that have been issued by ABC departments, as well as any other material or data requested by the auditor(s).

IN-SERVICE FEEDBACK – 14 CFR 21.137(m)

Requirement

Procedures for receiving and processing feedback on in-service failures, malfunctions, and defects. These procedures must include a process for assisting the design approval holder to:

(1) *Address any in-service problem involving design changes; and*

(2) *Determine if any changes to the Instructions for Continued Airworthiness are necessary.*

Compliance

ABC will establish procedures to receive feedback from customers and the FAA to address service difficulties.

Responsibilities

13.3.1 The Director of Engineering is responsible for establishing and maintaining the ABC Customer Support Department, which is the focal point for all communication involving customer services with operators of ABC aircraft. ABC Company does not prohibit direct communication with operators by either Engineering or Quality Assurance, however, such direct communication is held to a minimum, and copies are routed to Customer Support for information.

13.3.2 The Customer Support Business Unit has final authority in all matters relating to customer relations, warranty policy administration, customer satisfaction, and technical support (in coordination with the Product Development and Engineering Business Unit) concerning commercial articles as outlined in Customer Service procedure XXX. These customer communications may include article information, enquiries, contract or order handling, and customer feedback, including customer complaints.

Production Aircraft List

The Customer Service Department will maintain a current listing of ABC aircraft in service by model and serial number and FAA registration number, together with the name and address

of the owner/operator, or have access to the information through the FAA aircraft registration records.

Service Issues

Product Support coordinates corrective actions and response to the customer including service information documents in accordance with XXX – Issuance of Service Information Documents for Delivered Products.

Specific technical issues raised by the operators, a regulatory authority, or any other person are reported to the Model Specific Technical Group as Field Condition Reports, call logs, direct reports, etc. These issues are assigned to the appropriate engineering technical group for evaluation and resolution. The related information may be entered into a Field Corrective Action System where the issue is reviewed, prioritized, and staged for completion. Engineering will develop the appropriate response to the issue.

Service Publications

The Director of Engineering is responsible for the development of publications that advise ABC aircraft operators of service problems that have been reported and that may affect other aircraft in the fleet, and of the corrective action for such problems. The Engineering Department will promptly investigate all reported failures, malfunctions, and defects and develop the appropriate corrective action. As determined by the magnitude of the service problem, the publication subsequently distributed to the operators will be:

a. SAFETY DIRECTIVE. Issued when an unsafe condition exists that may also exist in other aircraft in the fleet. All Safety Directives issued by ABC Engineering will be distributed to all operators and made available to the appropriate airworthiness authority. Safety Directives are considered mandatory and must be performed and documented in the aircraft permanent records.
b. SERVICE BULLETIN. When no unsafe condition exists, but a service problem has become repetitive, ABC Engineering will develop a design change that will contribute to the safety of ABC airplanes and issue a Service Bulletin containing information on the design change for distribution to all operators of ABC aircraft. Service Bulletins may also be issued for minor changes considered product improvements. Service Bulletins are not considered mandatory.
c. SERVICE LETTERS. ABC Engineering will also issue Service Letters on any subject that is considered helpful to operators. Such letters are intended to maintain a good rapport with the operators, to encourage feedback on service or other problems, or to circulate items of interest that an operator may feel would be of value to all operators. Service Letters are not considered mandatory.

<u>NOTE:</u> AIRWORTHINESS DIRECTIVE (AD). An AD will be used when an unsafe condition is found to exist in a type-certificated product or component installed in the aircraft. The FAA processes and issues ADs, however, ABC Engineering is responsible for full cooperation with the FAA in providing design data for rework that may be required, in conducting static or flight tests to verify the adequacy of corrective action, and any other assistance that may be requested by the FAA, such as making available ABC engineering or quality assurance personnel to participate in accident scene investigation.

Appendix F

Distribution of Service Documents

Customer Support will distribute Safety Directives, Service Bulletins and Service Letters issued by ABC Engineering. Customer Support may also issue Service Letters with information that does not require engineering evaluation or action.

QUALITY ESCAPES – 14 CFR 21.137(n)

Requirement

Procedures for identifying, analyzing, and initiating appropriate corrective action for products or articles that have been released from the quality system and that do not conform to the applicable design data or quality system requirements.

Compliance

Quality escapes released from the ABC quality system will:

a. Be identified.
b. Be evaluated.
c. Have root cause determined.
d. Have corrective action initiated.
e. Require notification of the FAA within 24 hours.

Appendix F

Appendix A
FACILITY DIAGRAM

A facility diagram should be provided that identifies where major functions are located such as Engineering, Production, and Quality Assurance. Do not make it so detailed that every move of equipment or activities results in having to revise the diagram. It should be sufficient to get a person to the main location of a function where people can then provide directions to specific areas.

Appendix F

Appendix B FORMS

This section shows examples of forms used by the ABC Aircraft Company in the production process. These should be modified as required to suit the needs of the company.

Appendix F

EXAMPLE

ABC Form PO-100
Page ___ of ____

PURCHASE ORDER

ABC AIRCRAFT COMPANY
1350 Willow Road
Wichita, Kansas 67215

TO:

Purchase Order No.: _____
Date: _____
Terms: _____
Ship Via: _____

SHIP TO:

PLEASE ACKNOWLEDGE PROMPTLY AND INVOICE IN DUPLICATE

ITEM	QTY	CODE NO.	PART NO.	DESCRIPTION	UNIT PRICE	UNIT	AMOUNT

SUBJECT TO CONDITIONS ON REVERSE SIDE

PACKING SLIPS MUST ACCOMPANY ALL SHIPMENTS

SHIPPING SCHEDULE DESIRED:

_____
_____
_____

_____
PURCHASING AGENT

Appendix F

(PURCHASE ORDER REVERSE SIDE)

AGREEMENTS AND CONDITIONS

Acknowledgment - This order shall not be effective nor shall Buyer be obligated to pay any monies called for hereunder unless and until Seller shall have signed and returned written acknowledgment and acceptance.

Seller's Conditions - No conditions laid down by Seller in accepting or acknowledging this order shall be binding upon Buyer if in conflict with any instructions, agreement and/or condition herein stated, unless expressly accepted by Buyer in writing.

Invoices - Seller must mail invoices for each shipment to Buyer on date of shipment.

Shipping Instructions - Seller shall make no charges for boxing, crating, or carting unless previously agreed to in writing by Buyer. Seller shall comply with the shipping instructions specified on the reverse side hereof. All articles shall be suitably packed or otherwise prepared for shipment to prevent damage in transit and to meet carrier's requirements. All articles shall also be suitably packed and classified to assure lowest transportation and insurance rates consistent with full protection against loss or damage.

Cash Discount - The cash discount period will date from the receipt in Buyer's main office of Seller's invoice accompanied by waybill, and not from date of Seller's invoice. Buyer may pay Seller's invoice before delivery and complete inspection or test of the article and thereby avail itself of the cash discount. By such payments, Buyer does not waive its right to reject the articles and may charge the account of Seller for any loss, shortage, defect or failure in performance, delay, or other default.

Cancellation - If the Seller refuses or fails to make deliveries of the articles within the time specified in this order or any extension thereof, Buyer may terminate the right of Seller to deliver the articles, except when delay of Seller in delivering articles is due to unforeseeable causes beyond the control and without the fault or negligence of Seller, including but not restricted to, acts of God or of the Public Enemy, acts of Government, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, but not including delays caused by subcontractors or suppliers; provided that Seller shall, within ten (10) day from the beginning of such delay, notify Buyer in writing of the cause of delay; and provided further that if delay due to such unforeseeable causes exceeds a total period of sixty (60) days, Buyer may terminate the right of Seller to deliver the articles.

In the event of any suspension of payment, or the institution of proceedings by or against either party, voluntary or involuntary, in bankruptcy, or insolvency, or under provisions of the United States Bankruptcy Act, or for the appointment of a receiver or trustee or an assignee for the benefit of creditors, of the property of either party, the other shall be entitled to cancel this contract forthwith by written notice.

If any of the articles ordered herein purports to be protected by one or more patents, and a decree of judgment be entered in a court of competent jurisdiction holding invalid any such patents or any of the protection which it purports to give, this contract may forthwith be canceled by the Buyer.

Specifications - Except as otherwise stated, all material or equipment for aircraft construction listed herein, to which Government or Buyer's specifications are applicable, must comply with such

specifications current as of date of this order. Should such specifications be revised prior to shipment, Seller, by first obtaining consent of Buyer, may furnish such material or equipment in accordance with revised specifications.

Where a specification number is noted for supplies ordered, Seller must supply in triplicate a notarized report confirming manufacture of materials to the specification. This report must bear Buyer's purchase order number and description of materials shipped. This report must be mailed at time of shipment direct to Buyer, one copy of same to accompany shipment.

Patent Protection - By accepting this order, the Seller agrees to indemnify and hold harmless and protect the Buyer, its successors, assigns, customers, and the users of its products from and against all loss, liability, claims, demands, and suits of law or equity for actual or alleged infringement of any patent or patents by the normal use or sale of such material or goods. No patent application is to be made by Seller in connection with design development during the manufacture of items of Buyer's original design unless prior written approval is given to Seller by Buyer.

Warranties - The Seller warrants that the articles to be supplied under this contract are fit and sufficient for the purpose intended; that they are merchantable, of good quality and free from defects, whether patent or latent, in material and workmanship; and that material or equipment for aircraft construction conforms to required specifications as outlined in paragraph 7.

The Seller warrants that is has good title to the articles supplied and that they are free and clear from all liens and encumbrances. These warranties, together with their service warranties and guarantees shall run to Buyer, its successor, assigns and/or to persons to whom the materials or articles may be resold.

Inspection - All materials or articles ordered will be subject to final inspection and approval at the plant of Buyer. Any articles which do not comply with this order or which contain defective material or workmanship may be rejected by Buyer irrespective of payment therefor. The Buyer may hold any articles rejected for cause for the Seller's instructions, or he may return them to the Seller at Seller's expense.

Confidential - The Seller shall not disclose any information concerning the order to any third party except as herein specified without first obtaining the written consent of the Buyer.

Seller as Independent Contractor - In filling this Purchase Order, the Seller shall be considered as an Independent Contractor, and in no sense or case an agent of the Buyer.

Assignment - Neither party may assign this contract without first obtaining written consent of the other party; provided that consent is hereby given to such assignment to any corporation with which either party may merge or consolidate or which may succeed to its business.

Interpretation - This Purchase Order is to be governed by the laws of the state in which it is issued.

All warranties herein shall be construed as conditions as well as warranties

EXAMPLE ABC Form RE-100

RECEIVING REPORT

Shipper _____ P.O. No.: _____
_____ Date: _____
_____

ITEM	QTY	CODE NO.	PART NO.	DESCRIPTION

By _____
RECEIVING INSPECTOR

EXAMPLE

ABC Form ST-100
Page ___ of ____

SHOP TRAVELER

Fill in blanks that apply:

Part/Assy Dwg. No. _____ Next Assy Dwg. No. _____
Part/Assy Serial No. _____ Affixed: (Insp stamp) _____

Qty in Batch _____ No. Inspected _____ Insp. stamp _____
Sampling Plan Used: _____

Final Assembly Operation _____
Aircraft Serial Number: _____

Assembly Operation Complete Y ____ N ____ Insp stamp _____
If No, Open Items: _____
OK for next operation with open items? Y ____ N ____
If yes, Quality Assurance Signature: _____ Date: _____
Next Assembly Operation: _____

		Stamps	
Item No.	Work Operation	Shop	Insp

(continue as needed)

EXAMPLE ABC Form RJ-100

REJECTION SLIP

Date: _____ Time: _____ Part No.: _____

Aircraft Serial No.: _____ Assembly Serial No.: _____

Description of Defect:

Found by (Name & Department): _____

Evaluated by (Engineer): _____

date

Materials Review Required? (Yes or No) _____

Final Disposition:

Use as is ____ Rework/Repair _____ Replace _____ Reject _____

Approved by (Name & Department): _____

Description of Corrective Action: (Include detailed/dimensioned sketch if necessary)

Drawn By: _____ Date: _____

Approved By: _____ Date: _____

Recommended for drawing change? (Yes or No) _____

Recommended for system corrective action to preclude recurrence? (Yes or No) _____

EXAMPLE ABC Form FT-100

FLIGHT TEST CHECK-OFF LIST

Procedure & Check List

Reg. No. _____ Serial No. _____ Model No. _____ Date _____

BEFORE TAKE-OFF	**CHECKS OK**
1. Check engine controls	
2. Check idle speed carb heat cold	
3. Oil pressure	
4. Oil temperature	
5. Fuel pressure	
6. Ammeter	
7. Static max. RPM with mixture position at best power setting _____	
8. Mag. Drop _____ Left _____ Right _____ @ 1700 RPM	
9. Carb. heat RPM drop from 1700 RPM setting with mixture rich _____	
10. Check control travel & direction	
11. Brake check	
12. Radio check	

DURING FLIGHT	
1. Full throttle RPM at best rate of climb IAS 75 mph RPM _____	
2. Cruising RPM 2350 altitude _____ OAT _____ IAS _____ balance oil temp _____ oil pressure _____ fuel pressure (engine _____ electric) _____	
3. Top level flight IAS _____ RPM _____ Altitude _____	
4. Stall power on _____ IAS Power off _____ IAS Altitude _____	
5. Dive VG (135) RPM _____	

6. Power off glide - nose up trim _____ IAS @ _____ RPM	
7. Check stall warning _____ IAS	
8. Check flap operation in flight	
9. Ammeter (after 1-1/2 hrs. flight)	
10. Cabin heater operation	
11. CO test	

EXAMPLE

ABC Form QA-100
Page____ of ____

CORRECTION SHEET

Kind of Audit: _____ Date(s): _____

Conducted By: _____ Department: _____

Shop/Department Audited: _____

Shop/Department Notified (Date & Stamp): _____

FINDINGS
(First stamp blocks indicate findings. Second stamp blocks indicate that corrective action has been completed.)

Item No.	Discrepancy	Stamps Insp.	Stamps Date

(continue as needed)

Appendix F.8 - Standard DO/PO Handbook

14 CFR Part 23 Reorganization ARC

Type Design & Production Certification - Working Group

Whitepaper:

Standard DO/PO Handbook

Applying Streamlined and Standardized Company Procedures

Issue date: 08 Jan 2013

Table of Contents

Table of Contents 212
1. General 213
1.1. Requirements Basis 214
1.2. Desired Effects 214
2. Standard Process Environment 217
3. Handbook Analysis 220
3.1. Data Basis 220
3.2. Analysis Results 220
3.3. Analysis Conclusion 222
3.4. Standard Handbook Structure 222
4. Proposed Steps for Implementation 227
5. Cost / Benefit Analysis 228
5.1. Safety Effects 228
5.2. Cost Effects 229
6. APPENDIX 1 - Handbook Analysis 232
6.1. ODA Handbook Structure 232
6.2. PC Structure 233
6.3. AS / EN 9100 Structure 235
6.4. EASA Design Organization Structure 237
Appendix 2 – Standard TC/PC Handbook 239

Appendix F

1. General

In a typical aviation company of today, different applicable sets of procedural, organizational and quality management / assurance requirements for different segments of company activity are satisfied by separate handbooks. Companies maintain separate TC and PC handbooks, when operating in different countries sometimes in slightly varying, parallel versions.

Current implementation of the regulations (by FAA Orders) asks for predefined handbook structures for the individual operational segment that do not allow for a unification of the process world. Significant effort is spent to establish and maintain separate handbooks resulting in high administrative burdens, especially for small companies that maintain both, TC and PC of one product, for one company, under one roof. This gets more complicated when the same company acts as component supplier under AS / EN 9100 approval with a third set of requirements and a third handbook. The situation causes a direct basis for conflicting information with the connected risk of process errors in daily work.

By comparison of the requirements basis with existing accepted handbook samples a harmonized approach is identified, that allows for small companies to set up one single integrated quality management process satisfying all typical requirements, as an alternative to today's interpretation indicated by the Orders.

The harmonized approach is manifested in a standard handbook template, which can be utilized and adopted to the individual company conditions.

The harmonized standard handbook implements several results of other ARC Part 23 work group topics with identified significant potential for optimization of today's process in time, effort, cost and safety. By including these results in the standard handbook a level playing field is established with limited room for local interpretation that might have negative impact for an individual company.

Throughout the process of generating the standard handbook approach it has been verified, that this handbook is capable to comply with the regulations of different major Agencies. This levels the playing field even beyond the limits of FAA jurisdiction.

The subject matter was identified within the Part 23 ARC activity, as it highly relates to cost occurring when certifying a new project or making changes or STC to an existing project. It is recognized that the implementation is beyond the Scope of Work of the Part 23 ARC. Therefore, this paper is used to relate the outcome of the intense discussions and subsequent work to a parallel Part 21 ARC process that would reduce the cost of certification with no negative impact on safety and potentially some positive impact through more consistent procedures across a company.

The level of completion of this task is such that the activity can be handed over to an industry standards body. It is the recommendation of the task group to initiate this as the next step.

Appendix F

1.1. Requirements Basis

The following requirements sets must be considered for ODA / PC activity:

14 CFR part 21 (general TC, STC, repair requirements)
14 CFR part 21, Subpart G (PC)
14 CFR part 183 (ODA)

The equivalent requirements on EASA basis are:

COMMISSION REGULATION (EC) No 748/2012, Part 21 (general TC, STC, repair requirements)
COMMISSION REGULATION (EC) No 748/2012, Part 21, Subpart G (PC)
COMMISSION REGULATION (EC) No 748/2012, Part 21, Subpart J (DOA)

The equivalent Transport Canada requirements are:

Canadian Aviation Regulation (CAR) 521 (TC, STC, PDA, repair design approval requirements)
Canadian Aviation Regulation 561 Manufacturer Approvals
Airworthiness Manual (AWM) Chapter 505 Delegation of Authority, Subchapter E (DAO)

Other Agencies have comparable requirements that typically match one of the above systems.

Applicable Industry Standards are:

AS 9100
EN 9100:2009

1.2. Desired Effects

During the discussion it has been recognized, that the current costs in time and money spent do mostly not originate from the wording of part 21 as such. This is true for the FAA system, as well as for the other systems investigated. Those aspects that result in increasing time consumed and cost spending originates from the interpretative material, such as ACs, Orders, AMC or GM.

Identification of the key cost and time killers in the current process identify the following working areas where the approach must provide more efficient guidance. All serve as success criteria to check the resulting proposal:

6. Establish acceptable major/minor criteria for changes including a usable definition of the term “appreciable effect” when used within changes classification. Finding of Compliance for Minor Changes shall be delegated to an organization who uses the procedures, once the company is approved by the FAA.

The Minor / Major process has been developed within a separate ARC part 23 task and is identified by a separate whitepaper. Once completed, this process shall be implemented to the standard handbook.

7. One set of processes, established in one company, must be capable of satisfying all types of design and production efforts that can occur (TC, STC, changes, MRA, and production under PC). By implementing the unified handbook this is ensured.

8. Rules for the usage of electronic approvals shall be defined. The possibility shall be considered within the handbook. Transport Canada and EASA currently run prototype procedures with companies that seem to work well. The handbook can pick up this experience and implement.

9. The Standard manual must be detailed and complete enough and without duplications, so that only minor customization is required for a start-up company to get it working and approved. This requires proper boilerplate language, that in some cases can offer different case-dependent variants. The applicant will then select the relevant version.

10. The level of qualification for nominated staff shall be defined, so that staff can be trained and verified by the company or by third party consultants for as many cases as possible, and not necessarily through FAA training. The company shall be entitled to nominate staff on the basis of such training, not necessarily through the Agency. The requirements for qualification documentation shall be unified and kept reasonable, simple and straightforward.

11. Finding of compliance in non-complex projects by company delegates, once the company is FAA approved. FAA shall only perform spot checking. This directly links to the separate ARC part 23 effort defining an Applicant Showing Only process. Once completed the process will be implemented to the standard handbook.

12. Configuration control and verification of certification and test articles shall be typically done by the organization, not by the Agency. Definition of a proper standard Configuration Management Process allows for this delegation. This directly links to the separate ARC part 23 effort defining a Conformity Management process. Once completed the process will be implemented to the standard handbook.

13. Provide structure and contents for certification programs that are adequate for small / simple projects and allow the required scaling for complex projects. This item requires further work. Parallel EASA efforts shall be analyzed for usability in this effort.

14. Provide standard compliance checklists for simple products in template form to directly support simple projects, and to serve as example cases for more complex projects. This task requires further work.

15. Provide standard approach on supplier documentation and evaluation. Generate the ability to share supplier information across users to minimize burden on suppliers. Auditing activity should only be required when reasonable doubts exist. Having a standard process shall create the ability to take credit for another OEM's audit findings of the supplier. From the supplier's perspective, he currently must host numerous audits by different customers, which becomes a burden to repeat the same exercise for each customer. The supplier might chose an independent, third party auditor that will share results with each customer who has implemented the process defined in the standard handbook, instead of hosting repeated individual audits by OEMs. It is understood that a separate industry – Agency working group has been started to deal with this aspect. The task group generating this whitepaper will coordinate with the other working group.

16. Standard handbook shall be structured to be most efficiently with a small company that grows into TC and PC, holding it in one hand and at one location. The handbook shall identify how it should be split when this is not the case, without duplicating efforts for companies who have it all in one hand. This desired effect is linked to item 4, above.

17. Provide standard forms (e.g. conformity and quality functions, supplier audits, major/minor change classification, etc.) that strongly support / focus on factual correctness, not formal efforts. The forms shall be such that they automatically guide step by step through the process, so that a potential process implementation failure is minimized. In the end, an employee shall be able to satisfy the related process automatically by following the template, without need to re-iterate the actual process language. This item requires further work.

18. Allow for joint auditing of PC and TC to reduce auditing efforts. Having one unified handbook ensures a consistent process landscape. On this basis, FAA could jointly schedule their ODA audits with the ACSEP assessment to reduce company costs/burden. This is also the entry point for later possible third party audits by qualified / accredited Auditors like AS9100 auditors.

19. Use industry QM standard philosophy wherever reasonable. Only exceed where absolutely unavoidable to meet the basic requirements of the regulations (not the Orders).

(Discussion during Nov KC ARC meeting: Some sort of initiative where FAA expresses buy-in to industry efforts. Linkages between part 21 and AS9100. FAA: What credit do you get for ISO? Answer: None, or basically none. However, now FAA is an ISO organization, position could be reviewed. More use of ISO in the certification procedure requirements would encourage procedures standardization that can better control schedule and costs. Companies growing from other business segments can get benefit of having ISO qualifications already in place. Start-up companies would be encouraged to obtain ISO qualification as first and affordable step for a new installed quality system rather than jumping in one leap to the full part 21 compliant system which helps control risk associated cost for the company. Companies that use AS9100 might in future use third party audits rather than exclusively FAA audits. Current audit practices set by internal policy within the FAA so could be reviewed without a rulemaking exercise.)

20. Keep company infrastructure definition in the standard handbook pragmatic and reduced to what really has effect on the compliance and quality of the product. Avoid overly detailed floor plans. FAA could advise those auditing the systems of the minimum acceptable level of detail. It starts with the first approval of the quality manual.

21. Allow for maintenance / repair on products that have shown compliance, but are still under control of the production organization. Used to be called a manufacturer's maintenance facility. Today the product moves through production until a certificate of conformity/standard certificate of airworthiness/certificate of airworthiness for export is issued. Once that occurs, the product falls under maintenance rules of alteration and repair. The process needs to be more flexible. While the product is still in production control, a company should be able to do maintenance, alterations and repairs under the existing production organization processes. This would allow coverage for damage on the production line, during storage or in shipping. The process would allow the production organization to take back the part, repair and maintain conformity under the PO without having to have a part 145 approval. Take the part back to the

line, process it as any other part going through production, still resulting in a new part and not in a reworked part. Today, once the conformity tag is issued, the part crosses the line from production to service. A production organization can't touch a part today once it is issued its conformity tag. If damage happened in final inspection, PO could issue an MRB to repair damage. With the changed process in effect the company would remove the conformity tag (in a documented way), do what the MRB would normally do to repair the damage, then issue a new conformity tag.

2. Standard Process Environment

A typical industry standard process environment has a three level structure. Typical AS 9100 implementations use a 4 level approach:

- Level 1: AS 9100 Quality Manual,
- Level 2: AS 9100 Procedures,
- Level 3: AS 9100 Instructions and
- Level 4: AS 9100 Records.

When unifying the handbooks to a joint industry standard handbook, this 4 level model shall be used as basis. The graphical representation of this model is as follows.

Appendix F

In this model:

- The first level unifies general QMM, Design Handbook and Production Handbook. All three logical sections have wide overlapping, joint sections, and each one has limited amount of individual sections.
    - The three handbooks are merged to one consistent handbook.
    - The relation to the three logical sections is given through compliance checklists for the three individual requirements sets AS9100, part 21 PC and part 21 TC, STC, Changes / part 183 ODA.
    - It is possible to leave out one of the two segments Design Handbook and Production Handbook when a company only covers one aspect.
    - Design Handbook and Production Handbook form part of the top level Quality Management Handbook that may reach beyond (certificated) aviation activities. Design

and Production specific items are clearly identifiable. Cross-cutting items need only be defined once, and potential for conflicting definitions is eliminated.

- Design and Production handbook are prescriptive to a certain extent.
    - The generic manual shall hold sufficient minimum prescriptive information to unmistakably identify an efficient process flow that satisfies the applicable requirements, without overly complicating it.
    - For a simple company with non-complex undertaking the wording within the handbooks, together with process flow oriented templates, must be sufficient to ensure compliance with the requirements, without need for separate Process Descriptions in Level 3.
    - For a company with a more complex undertaking, the handbook sections remain in place but are enhanced by separate Process Descriptions in Level 3.
- Level 4 contains all applicable Forms and Templates.
    - Forms and templates are provided as separate documents with identifier. This way the handbook remains generic and international, and specifies what kind of information must be provided, not how the form looks and how to fill the form.

The discussion above differentiates between simple and complex “undertaking”. Discussion of the handbook subject did show that the deciding factor for the required process complexity is not related just to either product complexity or company size, but to the complexity of the undertaking a company has, explicitly with respect to the activities covered by the handbook. The importance of this consideration is visible when looking at the following examples:

- A very small company conducts all its activities in one location. The product is by product definition complex. The company relies in many areas upon suppliers holding their own approvals. The company produces very few aircraft per year, with very few workers. Even having a complex product, such a company can clearly operate within a very pragmatic and slim process environment. The undertaking of the company is simple.
- A small company operates in different locations. Engineering, component production and final assembly are separated, maybe out of cost reasons even in different countries. The company produces very simple and basic products with no system complexity. The company runs several variants in parallel, maybe even different types and delivers to many countries, the overall annual production number is high. Even having a small company and non-complex products, such a company will require a detailed process structure that considers the challenges from its spread-out setup and the parallel products on production. The undertaking of the company is complex.

3. Handbook Analysis

3.1. Data Basis

To analyze the current situation and identify the need for improvement, the task group has analyzed and compared a variety of handbooks from industry operating on an international basis, in different segments of part 23 and with different levels of privileges. The Following handbook structures were made available for analysis, several in different company versions:

Type	***Requirements Basis***
ODA TC handbook	FAA part 21 and 183, subpart D
ODA PC Handbook	FAA part 21 and 183, subpart D
FAA PC QMS	FAA part 21
FAA PC generic structure; no handbook but required contents listing	FAA part 21
Engineering Process Handbook non- ODA	FAA part 21
EASA DO Handbook	EASA part 21
Quality Management Manual	EN 9100
Generic structure QMM	AS 9100
Generic structure QMM LSA	ASTM F2279

3.2. Analysis Results

With the detailed summary of the comparison provided in Appendix 1, the following observations are done for Design Handbooks:

1. The same is covered in each variant of design handbook. But:

    a. AS/EN 9100 handbook consolidates design processes very much. Therefore, using a pure 9100 handbook might not be sufficient to satisfy expectations of the Authorities.

        ➔ Does this “more” add value?
        Not always, but there is a clear risk for “too little”

    b. ODA handbook is extremely detail oriented and breaks the requirement into very fine steps that are predefined. This includes very fine detailed ODA staff functions and involved “committees” / meetings. This shows more of a procedure guide (work instructions), than a process guide.

        ➔ Does the much finer procedural guidance / oversight result in higher reliability / quality of the development results?
        No, it does not.

    c. ODA handbook groups all design related procedures in one block with no real substructure. This section includes again partially generic procedures.

d. AS/EN 9100 handbook has economics related overhead that is not requested by part 21 (company commitment, management review, customer focus, planning, …)

➔ Does this "more" add value?
This "more" builds sound company culture, and therefore can be considered added value that generates an improved basis for lasting quality, being the basis for lasting safety.

2. As soon as one looks at handbooks of approved companies, the handbooks follow a somewhat similar structure in logical blocks. However, some handbook samples are efficient in this (AS9100), some not (ODA). The typical blocks you can find are:

   a. Generic / normative issues and introductions

   b. Organizational aspects, org charts, staff and roles, training, HR

   c. Approval related information, privileges, delegations, validities, requirements for update and communication to maintain validity

   d. QM generic functionalities, document handling, auditing, changing the QM; improvement

   e. Development process incl. showing of compliance either

      i. integrated for the tasks design, changes, STC

      ii. in separate blocks for the tasks design, changes, STC

   f. Instructions for Continued Airworthiness

   g. Occurrence Management (COSM)

   h. Production Interface

   i. Appendices with detailing information for the individual company, that may change while the process remains the same (staff assignments, facilities, locations, detail org charts, subcontractors, …)

   j. Appendices with forms, or references to form documents

With the detailed summary of the comparison provided in Appendix 1, the following observations are done for Production Handbooks

1. PC structure and AS9100 structure have a high overlap.

   a. AS/EN 9100 handbook consolidates production processes very much. Therefore, using a pure 9100 handbook might not be sufficient to satisfy expectations of the Authorities.

i. Does this add "more" value?
Not always, but there is a clear risk for "too little"

b. AS/EN 9100 handbook has economics related overhead that is not requested by part 21 (company commitment, management review, customer focus, planning, …)

i. Does this add "more" value?
This "more" builds sound company culture, and therefore can be considered added value that generates an improved basis for lasting quality, being the basis for lasting safety.

3.3. Analysis Conclusion

Analysis shows that:

- The topics dealt with in all process worlds are comparable enough to allow unification.
- The level of detail is different. The proper balance must be found that provides sufficient guidance to ensure compliance, but does not overburden the "small" or new applicant.
- The generic structure of DO and PO handbooks are comparable enough that a unification in one handbook is possible, with a generic block, a DO related block, a PO related block. Several procedures affect both business segments in the same way. This approach allows split-up when only one function shall be covered.

3.4. Standard Handbook Structure

The standard handbook structure resulting from this discussion shall be as follows. Only one chapter structure is used, to keep consistency between AS 9100, part 21 TC and part 21 PC worlds. To generate this structure, the typical AS 9100 structure was used as starting point, matched with part 21 requirements, carefully enhanced and refined, as required.

The markings in the table below show which sections of the handbook are intended to provide compliance for which company "functionality". As can be seen, incorporation of AS/EN 9100 to what is used today in order to comply with part 21 or 183 even carefully enhances the scope of the handbook and adds general accepted practices for quality management and assurance, in addition to plainly satisfying the product oriented results. Implementing this into the standard handbook adds significant value, as it actively ensures a quality management culture within the organization. Such a QM culture in itself ensures detection and correction of potential, future quality problems before they get visible on the product, and better implements customer satisfaction.

Chapter	***Chapter Title***	***LSA***	***AS/EN 9100***	***Part 21 PC***	***Part 183 ODA***
0	**General**				
0.1	List of Revisions	X	X	X	X
0.2	Distribution List		X	X	X
0.3	Table of Contents		X	X	X

Appendix F

Chapter	*Chapter Title*	*LSA*	*AS/EN 9100*	*Part 21 PC*	*Part 183 ODA*
0.4	Scope		X	X	X
0.4.1	Documenting Compliance			X	X
0.4.2	Determining Compliance			X	X
0.4.3	Production to Approved Design	X		X	
0.4.4	Maintenance of Type Design and Compliance Documentation	X		X	X
0.4.5	Identification and Correction of Deviations	X		X	X
0.4.6	Customer Support	X		X	X
0.5	Normative Reference	X	X	X	X
0.6	List of Abbreviations	X	X	X	X
0.7	Definitions and Terms	X	X	X	X
0.8	List of Referenced Documents	X	X	X	X
0.8.1	Regulations	X	X	X	X
0.8.2	Procedures	X	X	X	X
0.8.3	Instructions	X	X	X	X
0.8.4	Forms	X	X	X	X
1	**QUALITY MANAGEMENT SYSTEM**				
1.1	General Requirements		X		
1.2	Documentation Requirements		X		
1.2.1	General		X		
1.2.2	Document Control	X	X	X	X
1.2.2.1	Document Identification	X	X	X	X
1.2.2.2	Document Control	X	X	X	X
1.2.2.3	Document Notification and Availability			X	X
1.2.2.4	Document Storage	X	X	X	X
1.2.2.5	Documentation Interface between Design and Production Entity	X		X	X
1.2.2.6	Documenting of Approvals	X	X	X	X
1.3	Guidance Material				X
1.4	Records	X	X	X	X
1.4.1	DO Related Records	X	X	X	X
1.4.2	PO Related Records	X	X	X	X
2	**MANAGEMENT COMMITMENT**				
2.1	Management Commitment	X	X	X	X
2.2	Customer Focus		X		
2.3	Quality Policy		X		
2.4	Planning		X		
2.5	Scope of Work	X		X	X
2.6	Responsibility, Authority, and Communication		X		
2.6.1	Responsibility		X		X

Chapter	*Chapter Title*	*LSA*	*AS/EN 9100*	*Part 21 PC*	*Part 183 ODA*
2.6.2	Authority		X		X
2.6.3	Authorized Functions and Limitations			X	X
2.6.3.1	Scope of Work			X	X
2.6.3.2	Delegations/Privileges			X	X
2.6.3.3	Authority to Sign	X		X	X
2.6.4	Internal Communication		X		
2.6.5	Communication with Authority			X	X
2.6.6	Application for (changes) to Design and Production Certificates			X	X
2.7	Management Review		X		
3	**RESOURCE MANAGEMENT**				
3.1	Provision of Resources		X	X	X
3.2	Human Resources		X	X	X
3.2.1	General		X	X	X
3.2.2	Competence, Training, and Awareness		X	X	X
3.2.2.1	Competence		X	X	X
3.2.2.2	Training	X	X	X	X
3.2.2.3	Awareness		X	X	X
3.2.3	Nomination of Staff			X	X
3.3	Infrastructure		X	X	X
3.4	Work Environment		X	X	X
4	**PRODUCT REALIZATION**				
4.1	Planning of Product Realization		X		
4.1.1	Project Management		X		
4.1.2	Risk Management		X		
4.1.3	Control of Work Transfers			X	
4.2	Configuration Management	X	X	X	X
4.3	Customer Related Processes		X		
4.3.1	Determination of Requirements Related to Product		X		
4.3.2	Review of Requirements Related to Product		X		
4.3.3	Customer Communication		X		
4.4	Design and Development				
4.4.1	Design and Development Planning		X		
4.4.2	Design and Development Inputs		X		X
4.4.3	Identification of the Certification Basis	X			X
4.4.4	Design and Development Outputs	X	X		X

Chapter	*Chapter Title*	*LSA*	*AS/EN 9100*	*Part 21 PC*	*Part 183 ODA*
4.4.5	Design and Development Review	X	X		X
4.4.6	Design and Development Verification and Validation		X		X
4.4.6.1	Testing	X	X		X
4.4.6.2	Flight Testing	X			X
4.4.6.3	Verification and Validation Documentation		X	X	X
4.4.7	Control of Design and Development Changes		X	X	X
4.4.7.1	Changes Classification				X
4.4.8	Showing and Finding of Compliance	X			X
4.4.8.1	Applicant Showing Only				X
4.4.8.2	Applicant Statement of Compliance				X
4.5	Supplier Management	X	X	X	
4.5.1	Purchasing Process		X	X	
4.5.2	Purchasing Information		X	X	
4.5.3	Verification of Purchased Product	X	X	X	
4.5.4	Reporting of Non-Conforming Purchased Products	X	X	X	
4.6	Production and Service Provision		X		
4.6.1	Control of Production and Service Provision		X		
4.6.1.1	Production Process Verification	X	X	X	X
4.6.1.2	Control of Production Process Changes		X	X	X
4.6.1.3	Control of Production Equipment, Tools, and Software Programs	X	X	X	X
4.6.1.4	Control of Work Transferred, on a Temporary Basis, Outside the Organization's Facilities			X	
4.6.1.5	Control of Service Operations		X		
4.6.2	Post-Delivery Support	X	X	X	X
4.6.2.1	Repair	X	X	X	X
4.6.2.2	Alteration	X	X	X	X
4.6.2.3	Maintenance	X	X	X	X
4.6.3	Validation of Processes for Production and Service Provision		X	X	X

Chapter	*Chapter Title*	*LSA*	*AS/EN 9100*	*Part 21 PC*	*Part 183 ODA*
4.6.4	Identification and Traceability	X	X	X	
4.6.5	Customer Property		X		
4.6.6	Preservation of Product		X		
4.6.7	Product Conformity			X	X
4.6.7.1	Determination of Conformity	X		X	X
4.6.7.2	Issuance of Airworthiness Approvals/Certificates	X		X	X
4.6.7.3	Issuance of Flight Permits			X	X
4.8	Control of Monitoring and Measuring Devices	X	X	X	X
5	**MEASUREMENT, ANALYSIS, AND IMPROVEMENT**				
5.1	General		X		
5.2	Monitoring and Measurement		X		
5.2.1	Customer Satisfaction		X		
5.2.2	Audits	X	X	X	X
5.2.3	Monitoring and Measurement of Processes	X	X	X	X
5.2.4	Monitoring and Measurement of the Product	X	X	X	X
5.2.4.1	Inspection Documentation	X	X	X	X
5.2.4.2	First Article Inspection	X	X	X	X
5.2.4.3	Tests on Manufactured Products	X	X	X	
5.2.4.2	Flight Test on Manufactured Products	X	X	X	
5.3	Control of Nonconforming Product	X	X	X	
5.3.1	Quality Escapes			X	
5.3.2	Manufacturer Maintenance or Repair			X	
5.4	Analysis of Data	X	X	X	X
5.5	Improvement	X	X	X	X
5.5.1	Continual Improvement		X		
5.5.2	Corrective Action	X	X	X	X
5.5.3	Preventive Action		X		
5.5.4	Continued Airworthiness (CA)	X		X	X
5.5.4.1	Instructions for Continued Airworthiness (ICA)	X		X	X
5.5.4.2	Continued Operational Safety Monitoring (COSM)	X		X	X
Appendix 1	**Procedures (only for complex undertakings)**	X	X	X	X
Appendix 2	**Instructions**	X	X	X	X

Chapter	*Chapter Title*	*LSA*	*AS/EN 9100*	*Part 21 PC*	*Part 183 ODA*
Appendix 3	**Forms and Templates**	X	X	X	X

Starting from here, a compliance checklist can be created, defining the minimum content per chapter. This is the basis to define the general philosophy that is envisaged per chapter.

4. Proposed Steps for Implementation

The achieved result reaches beyond the Scope of Work of the Part 23 ARC. Nevertheless the results were consolidated, as the opportunity was unique to have the broad level of industry experience from implementing current systems in one spot. With the level of achieved detail the work result shall be submitted to a parallel Part 21 ARC activity for further consideration.

It is the proposal of the task group formed under the Part 23 ARC, that significant cost and time benefit can be obtained while maintaining or even enhancing safety, by initiating AC, Order, AMC and GM changes to implement this approach. Needs to be finally verified, but from today's point of view the most significant achievements can be obtained without regulation change, as the language in part 21 and part 183 (and others) allows for sufficient leeway.

The current proposal comprises the method and the outline of the future standard handbook, represented by the chapter structure, allocation of chapters to requirements and key items to be considered in each chapter. It is proposed, at this level of detail, to hand off the generation of the actual standard handbook template to an Industry Standards body. Using an industry standard as vehicle will ensure that the boilerplate text sections and the associated templates are truly acceptable in a most efficient way for the every-day development and production work of the companies. Through the participation of the major Authorities in the industry standard processes, conformity to regulations can be easily ensured in this process, without the need to invest massive resources from the Agency side.

As a further reaching outlook, such a standardized approach opens up possibilities for potential future acceptance of third party auditing for design- and/or production organizations with products in the low performance / complexity aircraft segment. This would further allow for a smooth and harmonic connection to the segments ranging "below" part 23 scope, such as the Light-Sport Category where the current experience already leads to a similar system. Utilization of third party audit also supports joint Design and Production audit in one step, which was identified as one of the cost drivers.

Remaining open items yet to be addressed are:

1. Rules for the usage of electronic approvals shall be verified on the basis of Transport Canada and EASA.

2. Provide structure and contents for certification programs that are adequate for small / simple projects and allow the required scaling for complex projects.

3. Provide standard compliance checklists for simple products. Serves as usable template for simple projects, and serves as example cases for more complex projects.

4. Provide standard templates that strongly support / focus on factual correctness, not formal efforts.

All those items can be well addressed by the standards body.

5. Cost / Benefit Analysis

5.1. Safety Effects

1. Having multiple case-relevant procedures in one enterprise is known to create an environment where procedures are considered “paper-tigers” that are applied only in Audit situations, and not in daily life. Therefore, daily life shows repeated omissions in vital processes. Having a unified handbook for Design and Production activities, where the common procedures are not defined repeatedly but only once and applicable for all areas of the enterprise, eliminates the risk for conflicting procedures, and therefore the risk for procedural omissions. The single procedure is more likely to be truly applied throughout the company operation. This immediately increases the safety level of the designed and produced aircraft, part or component.

2. Handbook structure that satisfies AS/EN 9100 and part 21 requirements allows for company growth, starting from components / PMA up to full aircraft development and manufacturing. This removes the need for process change within the company as consequence of an actual growth step. This increases the acceptance of the involved personnel from the start, resulting in increased professionalism, directly reducing the possibility for mistakes and thus increasing safety.

3. Consideration of AS/EN 9100 requirements enhances the company process landscape towards a quality management culture and orientation towards customer satisfaction. Enhanced quality management automatically drives product safety to a higher level. Instead of just detecting mistakes and correcting them, these aspects are commonly accepted principles to help avoid mistakes before they happen. Typically this is not covered by handbooks purely satisfying part 21 or part 183 requirements. By adding this layer to the process landscape of a company, a direct increase of product quality and with this safety is achieved.

4. Enhancing the possibility for delegation / privileges on company side, on the basis of qualification and agreed processes, allows a company to move faster in a project. As consequence, design updates or production improvements can reach the product on a faster timeline, thus also making safety improvements available to the market earlier. Having more flexibility to move will also encourage companies to actually make and implement safety improvements timely, instead of delaying them in order to avoid the associated authority interaction effort.

5. Enhancing the use of true delegation to the company, including finding of compliance and verification of conformity in selected or wide areas significantly increases the responsibility of

the Applicant. Having no third-party corrective step following the company's task completion will drive the companies to even more thorough working and verification principles.

6. The proposed streamlined processes that get implemented to this unified handbook significantly reduce the timeline and therefore cost associated with new developments or product changes. This significantly improves the ability for small companies to conduct such changes, and therefore bring safety enhancing technology to the market earlier, allowing for faster associated safety enhancements.

5.2. Cost Effects

Cost reduction is achieved for Agency and Applicant in different aspects:

1. Having a standardized Agency agreed process environment to start from reduces effort on applicant and Agency side during the manual/handbook acceptance process.

2. Especially small cost sensitive companies with lower staffing are required to hire consultant labor force for the generation of an acceptable handbook. Typically support is required for 2 – 4 years for an initial approval. With the proposed standard handbook template, the applicant is able to set up his process environment with very low risk of need for iterations. Having the mature standard handbook, efforts for the individual company reduced by as much as half.

3. On the FAA side, efforts for re-negotiating questionable company proposals is expected to reduce by half.

4. Reduced duration to achieve first approvals for a new company effectively shortens the project duration for a first product.

5. Reduction of the project duration has direct effect to the expenditure to get the product up to certification, which directly results in more efficient product cost. Especially production certification efforts are due towards the end of the certification project, where monthly costs are highest.

6. Handbook structure that satisfies AS9100 and part 21 requirements allows for company growth.

7. Companies may start as component supplier following AS 9100 setup, and grow into making own complete products without change of the applied quality system. As consequence, repeated efforts for establishing and implementing quality systems do not occur, new training and losses due to temporary inefficiency is not required.

8. Companies that have to satisfy different systems need to maintain only one manual.

9. This efficiency gain starts with daily work to one procedure set only, continues through internal auditing and need for repeated and parallel qualification.

10. Making use of delegations for the finding of compliance through company nominated staff instead of FAA staff.

11. This approach allows optimization of the timeline for the certification program of the company. This has direct and increasing cost effect on the company side. To a certain extent this is compensated by raised effort for the company to make the required qualified nominated staff available, but remains to be a significant savings potential.

12. This aspect has significant cost savings potential to the FAA, as the required staff for time critical finding of compliance is reduced. One part of this staff will be used in the surveillance of company procedures instead, but independent from project schedules and therefore with significantly reduced intensity, ensuring a lasting saving for the Agency.

13. Optimized Supplier Management and Auditing process allows for streamlining the associated effort.

14. The amount of possible cost savings is highly dependent from the complexity of the supplier environment of the company, but is based on the reduced frequency of supplier auditing, resulting in reduced labor and travel expenses for both, company and supplier.

15. Unified definition for Staff Qualification Requirements, enhancing the possibility for company-internal training and qualification instead of mandatory FAA qualification.

16. Cost reduction is obtained for the company by being able to react faster to upcoming needs and better tailoring the required training schedules to the actual company needs.

17. Cost reduction on Agency side is achieved by reducing the need for qualification and training.

18. Minor / Major process with privilege for minor changes

19. Cost reduction is obtained for the company by being able to move faster with changes. Savings potential has been evaluated under a separate work item. The Standard handbook is the vehicle to make this process transparent and available to the companies.

20. Implementation of a Configuration Management System instead of repeated and disjointed conformity inspections

21. This step will result in significant cost saving, as has been identified in the separate Configuration Management white paper. The Standard handbook is the vehicle to make this process transparent and available to the companies.

22. Applicant showing only

23. Savings potential has been evaluated under a separate work item and appears for company and for FAA. The Standard handbook is the vehicle to make this process transparent and available to the companies.

24. Qualification through a qualified body (Accredited entity, AS/EN 9100 qualified auditing entity or similar) is considered acceptable also for Agency approval.

25. Cost effect on company side is in two directions. Implementation of a commercial third-party (accredited) Auditor generates direct cost to be taken by the applicant. In return, the available

market for these auditors offers significantly improved availability compared to FAA staff alone, allowing for the applicant to significantly save project time. As approvals are needed especially towards the end of a development project, the added cost for the third party auditor are easily compensated by the project duration related cost savings.

26. This aspect also brings significant cost saving for the Agency, when the amount of staff required to audit companies where this alternative may be offered can be reduced.

27. Joint Auditing of Design and Production Quality System

28. By allowing and supporting single audits that cover both, Design and Production aspects installed under one company roof, the effort for Audit preparation and support by the company is significantly reduced. Especially for smaller companies where the processes are highly connected this is a significant cost effect that can be easily leveraged. Usage of third party auditing will automatically lead to this option, as auditing bodies, that for example typically do AS 9100 audits, are fully set up to audit both aspects in one audit.

6. APPENDIX 1 - Handbook Analysis

6.1. ODA Handbook Structure

ODA handbook structure is repeatable between the companies in its general outline. Order 8100.15A, Appendix B, defines this structure.

There is one headline for all the procedures. Within this single headline the majority of the contents is included that defines the real implemented processes, and varies significantly between the companies. The typical structure is:

6.2 PC Structure

PC handbook structure is derived from § 21.137, where the required content is identified. This is used as handbook structure. Procedures are grouped in separate blocks. Some topics repeat at different positions.

Appendix F

SECTION	DESCRIPTION
1	Introduction
2	Manual Control
3	Organization/Organizational Chart
4	Responsibility and Authority
5	Design Data Control Procedures Design Changes
6	Document Control Procedures Document and Data Changes Electronic Storage
7	Supplier Control Procedures Responsibilities
8	Manufacturing Process Control Manufacturing Processes Work Instructions and Revisions Changed Processes Traceability Software Use Software Quality Assurance
9	Inspection and Testing Inspection Procedures Testing Procedures Statistical Processes Nondestructive Testing
10	Inspection, Measuring and Test Equipment Control Approval, Inspection and Calibration Procedures Tool Control Procedures
11	Inspection and Test Status Procedures Inspection
12	Nonconforming Product and Article Control Procedures Disposition Determinations Data Analysis Disposition of Scrap and Salvageable Articles
13	Corrective and Preventative Actions Corrective Action Preventative Action Monitoring of Actions
14	Handling and Storage Procedures Storage, Handling, Manufacturing and Assembly
15	Control of Quality Records Procedures Record Retention Schedule Record Disposition
16	Internal Audits Procedures Reporting
17	In-Service Feedback Procedures Corrective Actions Service Bulletins and Maintenance Manuals Recalls
18	Quality Escapes Procedures Analytical Tools
Appendix A	Configuration Management Process
Appendix B	Suppliers QA Requirements

6.3 AS / EN 9100 Structure

AS/EN 9100 does not mandate a handbook structure, but it is common practice to re-build the requirements structure as handbook structure. The handbook provides clearly structured blocks that allow for the representation of the procedures to conform to the actual process-flow.

Appendix F

1.0 QUALITY MANAGEMENT SYSTEM
- 1.1 General Requirements
- 1.2 Documentation Requirements
- 1.3 General
- 1.4 Quality Manual
- 1.5 Control of Documents
- 1.6 Control of Records
- 1.7 Configuration Management

2.0 MANAGEMENT RESPONSIBILITY
- 2.1 Management Commitment
- 2.2 Customer Focus
- 2.3 Quality Policy
- 2.4 Planning
  - 2.4.1 Quality Objectives
  - 2.4.2 Quality Management System Planning
- 2.5 Responsibility, Authority and Communication
  - 2.5.1 Responsibility and Authority
  - 2.5.2 Management Representative
  - 2.5.3 Internal Communication
- 2.6 Management Review
  - 2.6.1 General
  - 2.6.2 Review Input
  - 2.6.3 Review Output

3.0 RESOURCE MANAGEMENT
- 3.1 Provision of Resources
- 3.2 Human Resources
  - 3.2.1 General
  - 3.2.2 Competence, Awareness and Training
- 3.3 Infrastructure
- 3.4 Work Environment

4.0 PRODUCT REALIZATION
- 4.1 Planning of Product Realization
- 4.2 Customer-Related Processes
  - 4.2.1 Determination of Requirements Related to the Product
  - 4.2.2 Review of Requirements Related to the Product
  - 4.2.3 Customer Communication
- 4.3 Design and Development
  - 4.3.1 Design and Development Planning
  - 4.3.2 Design and Development Inputs
  - 4.3.3 Design and Development Outputs
  - 4.3.4 Design and Development Review
  - 4.3.5 Design and Development Verification
  - 4.3.6 Design and Development Validation
    - 4.3.6.1 Documentation of Design and/or Development Verification and Validation
    - 4.3.6.2 Design and/or Development Verification and Validation Testing
  - 4.3.7 Control of Design and Development Changes
- 4.4 Purchasing
  - 4.4.1 Purchasing Process
  - 4.4.2 Purchasing Information
  - 4.4.3 Verification of Purchased Product
- 4.5 Production and Service Provision
  - 4.5.1 Control of Production and Service Provision
    - 4.5.1.1 Production Documentation
    - 4.5.1.2 Control of Production Process Changes
    - 4.5.1.3 Control of Production Equipment, Tools and Numerical Control (NC) Machine Programs
    - 4.5.1.4 Control of Work Transferred, on a Temporary Basis, Outside the Organization's Facilities
    - 4.5.1.5 Control of Service Operations
  - 4.5.2 Validation of Processes for Production and Service Provision
  - 4.5.3 Identification and Traceability
  - 4.5.4 Customer Property
  - 4.5.5 Preservation of Product
- 4.6 Control of Monitoring and Measuring Devices

5.0 MEASUREMENT, ANALYSIS AND IMPROVEMENT
- 5.1 General
- 5.2 Monitoring and Measurement
  - 5.2.1 Customer Satisfaction
  - 5.2.2 Internal Audit
  - 5.2.3 Monitoring and Measurement of Processes
  - 5.2.4 Monitoring and Measurement of Product
    - 5.2.4.1 Inspection Documentation
    - 5.2.4.2 First Article Inspection
- 5.3 Control of Nonconforming Product
- 5.4 Analysis of Data
- 5.5 Improvement
  - 5.5.1 Continual Improvement
  - 5.5.2 Corrective Action
  - 5.5.3 Preventive Action

General Processes

Responsibilities, Authorization, Control of the QM System

Human Resources, Organization

Product Specification

Design and Development

Procurement

Production

Analysis of QM System, Design, Product, Internal Auditing, Non-Conforming Products

Improvement

6.4 EASA Design Organization Structure

EASA Part 21 does not mandate a handbook structure. The sample handbook provides structured blocks with very little repeating information. The process flow follows the real sequence of events. Administrative information is mostly at the beginning.

Appendix F

I List of Revisions
II List of Effective Pages
III Distribution List
IV Table of Contents
1. General Requirements
1.1. Introduction
1.2. Normative References
1.3. Abbreviations
1.4. Definitions and Terms
1.5. Corporate Commitment
1.6. Referenced Documents
2. The Design Organization
2.1. Office Locations
2.2. Management Structure
2.3. Nominated Staff
2.3.1. Authority to Sign
2.3.2. Responsibilities
2.3.3. Qualifications of Nominated Staff
2.3.4. Usage of External Resources as Nominated Staff
2.4. Human Resource Management
2.4.1. Training / Instructions
3. Terms of Approval
3.1. DOA certificate
3.2. Scope of Work
3.2.1. Type Certification
3.2.2. Changes
3.2.3. Current Projects
3.2.4. Applied Technologies and Methods
3.3. Privileges
3.4. Changes in the Scope of Work
3.5. Findings
3.6. Surrender or Revocation of the DOA
4. Design Assurance System Evaluation
4.1. Auditing of Design Assurance System
4.1.1. Auditing by the Agency
4.2. Changes to Design Assurance System
5. Type Investigation Process
5.1. General, Applicability
5.2. Type Investigation / Development for New TC or RTC
5.2.1. Design Process Initiation
5.2.2. Definition of the Type Certification Basis
5.2.3. Certification Program and Supporting Documents
5.2.4. Project Application
5.2.5. Definition of Product Specifications
5.2.6. Generation of Type Design
5.2.7. Investigation and Test
5.2.8. Showing and Verification of Compliance
5.2.9. Declaration of Compliance
5.2.10. Agency Approval
5.2.11. Interaction with Subcontractors
5.2.12. Coordination with Production
5.2.13. Communication with the Agency
5.2.14. Surrender or Revocation of TC/RTC
6. Changes to the Type Design
6.1. Design Change Process
6.1.1. Design Process Initiation
6.1.2. Classification Major / Minor
6.1.3. Definition of Applicable Certification Basis for the Design Change
6.1.4. Certification Program
6.1.5. Definition of Product Specifications
6.1.6. Generation of Type Design
6.1.7. Investigation and Tests
6.1.8. Showing and Verification of Compliance
6.1.9. Declaration of Compliance
6.1.10. Agency Approval
6.1.11. Interaction with Subcontractors
6.1.12. Coordination with Production
6.1.13. Communication with the Agency
7. Continued Airworthiness
7.1. Instruction for Continued Airworthiness (ICA)
7.1.1. General
7.1.2. Document Generation
7.1.3. Compliance Verification
7.1.4. Approval Statement
7.1.5. Issuance of ICA
7.1.6. Amendment Procedure for Issued Documents
7.2. Occurrence Management
7.2.1. Monitoring of Significant Events
7.2.2. Evaluation of Significant Events
7.2.3. Reporting to the Agency
7.3. Pilot's Operating Handbook
7.3.1. New Pilot's Operating Handbook, Document Generation
7.3.2. Changes to the POH
8. Documentation Handling
8.1. Document and Record Control
9. Production Interface
9.1. Production Organization, Production Facilities
9.2. Formal Production Interface Point, Responsibilities
9.3. Interface Responsibilities and Commitments
9.4. Issue of Design Data to Production
9.4.1. Types of Drawings
9.5. Production Deviations
9.6. Access to Production
10. Design Partners, Subcontractors, Vendors
10.1. General Selection Criteria for Subcontractors
10.2. Subcontracting to Approved Subcontractors
10.2.1. Subcontractor Assessment
10.2.2. Deliverables Acceptance
10.3. Subcontracting to Non-Approved Subcontractors
10.3.1. Subcontractor Assessment
10.3.2. Deliverables Acceptance
10.3.3. Tests performed by Non-Approved Subcontractors
11. Maintenance of the Design Organization Handbook
Appendix 1 List of Nominated Staff
Appendix 2 Subcontractors
Appendix 2.1 List of Approved Subcontractors
Appendix 2.1 List of Non-Approved Subcontractors

7. Appendix 2 – Standard TC/PC Handbook

FAA ARC Part 23

Type Design & Production Certification - Working Group

Appendix 2 to Whitepaper:
Standard DO/PO Handbook
Applying Streamlined and Standardized Company Procedures

Issue date: 20 Dec 2012

Note 1:

The contents of this document provides the starting point for a unified quality management manual that covers design and production aspects for an aviation company. This version is intended as starting point for a Standardization Activity that will develop the actual handbook. The level of detail in this current draft is intended that it defines what the final handbook will support / provide, how the efficiency will be increased by this and how cost will be reduced while increasing safety.

Having one unified manual will allow a new company to start with a setup that allows for growth without re-structuring of the quality system, and without having parallel systems in place for different products.

This manual is structured following the guidance in AS / EN 9100, carefully modified and enhanced to meet the requirements of Part 21 and 183. In some few cases this leads to deviations in the sequence / structure compared to AS 9100, but in no case removes contents needed to meet AS 9100. It is the purpose of this standard manual to provide a usable template that satisfies all, ISO 9001, AS/EN 9100, ASTM standards for quality assurance on LSA aircraft, Part 21 and Part 183 requirements.

The manual must satisfy the requirements of Parts 21 and 183, as appropriate, but will not necessarily satisfy the guidance in the FAA Orders.

Note 2:

General Note on Level of Detail of this draft // intended Next Steps:

1) *This is not yet a finished standard manual.*
2) *What is presented here:*
   a) *Provides the structure of the intended standard manual,*
   b) *Provides the majority of references to the normative sources that shall be covered under each headline*
   c) *Provides the keywords that shall be enhanced to fill the individual sections.*
   d) *Provides more detailed guidance at those points where today's practice shows that:*

   i) *There is ambiguity in the understanding which leads to conflicting interpretations / implementations in different companies*
   ii) *There has been established an interpretation that overshoots the truly needed compliance*
   iii) *There has been established an interpretation that undershoots the truly needed compliance*
   iv) *There is conflict potential between the different normative references and guidance shall be given how to bring this to a common denominator*

3) *Background for the efficiency gain is to allow for a unified handbook to satisfy several related normative bases in one step, allowing for easy growth and also stepwise implementation without need to change the system or to maintain parallel systems.*
4) *Background of the safety gain is to allow for implementation of one single system within a company that satisfies all needs at the appropriate level, which makes it much more possible for the company to follow this system and to gain the desired effect, than when having a company that has multiple systems that can be conflicting in different areas. This often leads to the result that the systems are defined on paper but are not lived.*
5) *Background of the cost saving is to allow for a modular system with growth potential that is properly guided and can be implemented with little local effort by simple customization to the individual case. Surveillance of one unified system reduces parallel efforts for multiple systems. Consistent system allows for proper delegation of authorities again reducing effective cost.*

Note 3:

This manual template is designed to allow usage as a whole, or by applicable segments, when the company does not cover all aspects (scope) the handbook offers.

Normal font will be used to identify possible text for the manual. Italicized wording is general explanatory notes and guidance and should be removed from the finished manual.

Standard Aircraft Certification and Production Handbook

0 General

This manual will define the requirements by which (Company Name) will comply with the regulatory requirements found in the applicable Part 21, Subparts A, B, C, D, E, F, G, and H and in Part 183 in performing certification activities, manufacturing products and articles, and supporting the product and articles after delivery.

0.1 List of Revisions

a) Each revision will be assigned a sequential number starting with "0" the for the original issue of the manual.

(Note: Revisions can be either letters or numbers. If letters are used revise this template accordingly for your specific process.)

b) Revisions will be listed in tabular form by section of the manual
c) Record the name of the author of the manual and revision.
d) Record the name(s) of the persons to check / approve the manual or revisions.

Generation and checking of the manual shall be done by two different persons. Approval does not need a new person. Identify which company function (person role) is needed to generate, check and approve.

e) Record the date when each revision was approved

0.2 Distribution List

a) All individuals or organizations, including addresses as needed, required to receive a paper copy of the manual and all revisions are listed below.
b) An electronic copy of the manual will be posted on the company website at the location shown here *(Insert link to website here)* along with instructions on how to access it. The website will be available for all users to access the manual 24/7.

This way of distribution may not be needed in all cases.

0.3 Table of Contents

(Note: If a particular section in this standard does not apply it does not need to be included. In some instances it may be desirable to leave a place holder using "Reserved" to indicate a potential future use for that section.

0 General 241

Appendix F

0.1 List of Revisions 241
0.2 Distribution List 241
0.3 Table of Contents 241
0.4 Scope 246
0.4.1 Documenting Compliance 246
0.4.2 Determining Compliance 246
0.4.3 Production to Approved Design 246
0.4.4 Maintenance of Type Design and Compliance Documentation 247
0.4.5 Identification and Correction of Process Deviations 247
0.4.6 Customer Support 247
0.5 Normative Reference 247
0.6 List of Abbreviations 247
0.7 Definitions and Terms 248
0.8 List of Referenced Documents 248
0.8.1 Regulations 248
0.8.2 Procedures 248
0.8.3 Instructions 248
0.8.4 Forms and Templates 249
1 QUALITY MANAGEMENT SYSTEM 249
1.1 General Requirements 249
1.2 Documentation Requirements 249
1.2.1 General 249
1.2.2 Document Management 249
1.2.2.1 Document Identification 250
1.2.2.2 Document Control 250
1.2.2.3 Document Notification and Availability 251
1.2.2.4 Document Storage 251
1.2.2.5 Documentation Interface between Design and Production Entity 252
1.2.2.6 Documenting of Approvals 252
1.2.3 Changes to this Handbook 253
1.3 Guidance Material 253
1.4 Records 254
1.4.1 Design Related Records 254

1.4.2 Production Related Records 255
2 MANAGEMENT COMMITMENT 255
2.1 Management Commitment 255
2.2 Customer Focus 255
2.3 Quality Policy 256
2.4 Planning 256
2.5 Scope of Work 256
2.6 Responsibility, Authority, and Communication 256
2.6.1 Responsibility 256
2.6.2 Authority 256
2.6.3 Authorized Functions and Limitations 257
2.6.3.1 Scope of Work 257
2.6.3.2 Delegations/Privileges 257
2.6.3.3 Authority to Sign 258
2.6.4 Internal Communication 258
2.6.5 Communication with the Authority 258
2.6.6 Application for (changes) to Design and Production Certificates 259
2.7 Management Review 259
3 RESOURCE MANAGEMENT 259
3.1 Provision of Resources 259
3.2 Human Resources 259
3.2.1 General 259
3.2.2 Competence, Training, and Awareness 259
3.2.2.1 Competence 259
3.2.2.2 Training 260
3.2.2.3 Awareness 260
3.2.3 Nomination of Staff 260
3.3 Infrastructure 260
3.4 Work Environment 261
4 PRODUCT REALIZATION 261
4.1 Planning of Product Realization 261
4.1.1 Project Management 261
4.1.2 Risk Management 261

4.1.3 Control of Work Transfers 261
4.2 Configuration Management. 262
4.3 Customer Related Processes 263
4.3.1 Determination of Requirements Related to Product 263
4.3.2 Review of Requirements Related to Product 263
4.3.3 Customer Communication 263
4.4 Design and Development 263
4.4.1 Design and Development Planning 263
4.4.2 Design and Development Inputs 263
4.4.3 Identification of the Certification Basis 264
4.4.4 Design and Development Outputs 264
4.4.5 Design and Development Review 264
4.4.6 Design and Development Verification and Validation 264
4.4.6.1 Testing 264
4.4.6.2 Flight Testing 264
4.4.6.3 Verification and Validation Documentation 265
4.4.7 Control of Design and Development Changes 265
4.4.7.1 Changes Classification 265
4.4.8 Showing and Finding of Compliance 265
4.4.8.1 Applicant Showing Only 265
4.4.8.2 Applicant Statement of Compliance 265
4.5 Supplier Management 265
4.5.1 Purchasing Process 266
4.5.2 Purchasing Information 266
4.5.3 Verification of Purchased Product 266
4.5.4 Reporting of Non-Conforming Purchased Products 266
4.6 Production and Service Provision 266
4.6.1 Control of Production and Service Provision 267
4.6.1.1 Production Process Verification 267
4.6.1.2 Control of Production Process Changes 267
4.6.1.3 Control of Production Equipment, Tools, and Software Programs 267
4.6.1.4 Control of Work Transferred, on a Temporary Basis, Outside the Organization's Facilities 267

4.6.1.5 Control of Service Operations 267
4.6.2 Post-Delivery Support 267
4.6.2.1 Repairs 268
4.6.2.2 Alteration 268
4.6.2.3 Maintenance 268
4.6.3 Validation of Processes for Production and Service Provision 268
4.6.4 Identification and Traceability 268
4.6.5 Customer Property 268
4.6.6 Preservation of Product 269
4.6.7 Product Conformity 269
4.6.7.1 Determination of Conformity 269
4.6.7.2 Issuance of Airworthiness Approvals/Certificates 269
4.6.7.3 Issuance of Flight Permits 269
4.7 Control of Monitoring and Measuring Devices 269
5 MEASUREMENT, ANALYSIS, AND IMPROVEMENT 269
5.1 General 269
5.2 Monitoring and Measurement 269
5.2.1 Customer Satisfaction 269
5.2.2 Audits 270
5.2.3 Monitoring and Measurement of Processes 270
5.2.4 Monitoring and Measurement of the Product 270
5.2.4.1 Inspection Documentation 271
5.2.4.2 First Article Inspection 271
5.2.4.3 Tests on Manufactured Products 271
5.2.4.4 Flight Test on Manufactured Products 271
5.3 Control of Nonconforming Product 271
5.3.1 Quality Escapes 272
5.3.2 Manufacturer Maintenance or Repair 272
5.4 Analysis of Data 272
5.5 Improvement 272
5.5.1 Continual Improvement 272
5.5.2 Corrective Action 273
5.5.3 Preventive Action 273

5.5.4 Continued Airworthiness (CA) 273
5.5.4.1 Instructions for Continued Airworthiness (ICA)..... 273
5.5.4.2 Continued Operational Safety Monitoring (COSM)..... 273
Appendix 1 - Procedures..... 273
Appendix 2 – Instructions 274
Appendix 3 – Forms & Templates..... 274

0.4 Scope

This handbook is established and maintained by <company name> and includes:

a) The scope of the quality management system, including details of and justification for any exclusions,
b) The documented procedures established for the quality management system, or reference to them, and
c) A description of the interaction between the processes of the quality management system.

By doing this:

d) The handbook describes, directly or by cross-reference, the organization, the relevant procedures and the products or changes to products to be designed. (EASA.21.A.243(a)),
e) The handbook describes the quality system that ensures that each product and article conforms to its approved design and is in a condition for safe operation. (21.137),
f) The manual will define the process by which compliance with the minimum requirements called out in 14 CFR 21, Subpart B and Subpart G, 14 CFR 183, Subpart D, and AS/EN9100 is shown,(Ref 183.53(c)(2)), and
g) The handbook will be amended as necessary to remain an up-to-date description of the organization, and copies of amendments shall be supplied to the Agency. (EASA.21.A.243(c))

0.4.1 Documenting Compliance

The manual defines the process by which compliance with the appropriate airworthiness regulations applicable to the products listed in the Scope of Work is documented. (183.53(c)(2))

0.4.2 Determining Compliance

The manual will define the process by which compliance with the appropriate airworthiness regulations applicable to the products listed in the Scope of Work is assured. (183.53(c)(2))

0.4.3 Production to Approved Design

The manual will define the process by which production aircraft will be produced and shown to conform to the approved type design and issued a standard airworthiness certificate in accordance with the requirements of 14 CFR 21, Subpart F or G, and 14 CFR 183 Subpart D, as appropriate. (183.53(c)(2))

0.4.4 Maintenance of Type Design and Compliance Documentation

Within this manual processes are defined by which all of the documentation required for determination of compliance is maintained, submitted, and stored in accordance with the requirements of 14 CFR 21.123 and/or 14 CFR 21.137, and 14 CFR 183, Subpart D, as appropriate. (21.123, 21.137, 183.61

0.4.5 Identification and Correction of Process Deviations

Within this manual processes are defined by which all deviations from any of the processes are identified and corrected. (21.137, 183.53(c)(2))

0.4.6 Customer Support

Within this manual processes are defined for obtaining feedback from the customers and resolving service issues. (183.53(c)(2))

0.4.7 Normative Reference

Part 21 Subparts B, D, E, F, G, and H, Part 183, Subpart D, and AS/EN 9100.

> *Note: enhance with revision numbers / issue references. When the revision number differs from paragraph to paragraph, list the highest applicable revision number / issue reference. With this the revision level is intrinsically identified for all paragraphs.*

0.5 List of Abbreviations

All abbreviations used in this manual will be listed and defined in the following table along with the source from which they were obtained.

Item	Definition	Reference

0.6 Definitions and Terms

21.1(b)

All items used in this manual that are not a part of ordinary everyday use will be listed and defined in the following table along with the source from which they were obtained.

Item	Description	Reference
Design Data	The drawings and specifications defining the product and the fabrication requirements.	

(Note: The items shown above are typical items and may or may not be applicable to your requirements. The applicant making use of the standard manual should add or remove items to fit your needs.)

0.7 List of Referenced Documents

All documents referenced in this manual will be listed below in one of the appropriate sections. The documents will be in alphabetical order in each section.

Regulations

a) 14 CFR 21, Certification Procedures for Products and Parts
14 CFR 183, Subpart D, Organization Designation Authorization TBD

Procedures

(Reference is either to a separate document, or to the applicably entry in the applicable Appendix.)

a) TBD
b) TBD

Instructions

(Reference is either to a separate document, or to the applicably entry in the applicable Appendix.)

a) TBD

b) TBD

Forms and Templates

(Reference is either to a separate document, or to the applicably entry in the applicable Appendix.)

a) TBD
b) TBD

1. QUALITY MANAGEMENT SYSTEM

(21.137(a)(b)(k), 183.53(c)(10), 183.61(a)(d)(e))

1.1. General Requirements

This section defines the Quality Management System requirements and functions. In this manual The Quality Management System is the overarching guidance and requirements for both the Engineering and Manufacturing functions. The procedures in this section set the standard for the activities to be accomplished and the expectations of the company management in satisfying company and regulatory agency requirements for both functional areas. The Quality Management System requirements and functions are thus not limited to the Inspection and Production functions but also includes the activities performed by Engineering in support of the compliance determination and documentation.

1.2. Documentation Requirements

(21 Subpart B: 21.31, 21.39, 21.49, 21.50, 21.53, 21.55,21 Subpart C: 21.93, 21.95, 21.97, 21.99, 21.101; 21 Subpart E: 27.113, 21.115, 21.117, 21.119, 21.120; 21 Subpart F 21.122, 21.123, 21.127, 21.128, 21.129, ; 21 Subpart G: 21.133, 21.135, 21.137(a)(b)(k), 21.138, 21.139, 21.140, 21.141, 21.142, 21.145, 21.146, 21.147, 21.150; Subpart H: 21.173, 21.177, 21.182, 21.183,

1.2.1. General

(21.137(a)(b)(k), 183.53(b) and 183.53(c)(10).)

The (Company Name) requirements for managing all documents and records required for the functions for which it has been approved are defined in this section.

1.2.2. Document Management

Document Control process is applicable in the same way to:

a) Design Data Documents 21.137(a)
b) Quality Documents
c) Quality Records
d) Company (organizational) records.

1.2.2.1. Document Identification

All documents must:

a) Be identified with a unique name, number or alpha/numeric combination
b) Have a revision number or letter to identify the specific version, and
c) Have a means to identify the affectivity with each revision. In some cases this may be by serial affectivity but in most cases it will be by means of an Engineering Change Record (ECR) or other means that allows the serial to be changed without having to revise the drawing or document. That process must be identified here.
d) Identify the persons who authored and checked the document either on the front page or in a prominent and consistent place within the document. The names must be identified along with their role in the organization. Author and Checker must be two different persons. Further Approval identifications may be added as reasonable or required by company policy.

1.2.2.2. Document Control

All documents and other data supporting the type design or produced products, including revisions to such data, will be controlled to ensure only current, correct, and approved data is used when conducting the processes specified in this handbook. (Ref. 14 CFR 21.137(a), 14 CFR 21.137(b), 14 CFR 21.137(k), 183.53(b)).

This will require that:

a) The original document(s) will be stored in a controlled file with access limited to only those persons authorized to have access to it or check it out for the purpose of revising it. ,
   Therefore, all documents will:
   a. Require the person desiring to create or make a change to an original to record their name and the *project identification or ECR* to which it is associated prior to being given authority to create an original document or access to the original for the purpose of changing it,
   b. Be approved by the Engineer(s) responsible for the type design and the Project Engineer prior to release,
   c. Be formally released with the release date linked to the document revision and the document locked from further changes after the release without creating the next revision,
   d. Have access to the original document or electronic file controlled to prevent unauthorized changes or damage to the document or electronic file
b) Copies are made available to those organizations responsible for producing test articles, or production parts or articles,

c) Copies are made available to those organizations responsible for inspecting the test articles or production parts or articles, and copies are made available to engineering for approving as part of a production document approval or a test article document approval.

1.2.2.3. Document Notification and Availability

All new or revised documents will be:

a) Identified on a list made available to the appropriate organizations as needed through publication of the document release information. This information will be published daily and will identify the type of document, the document identification, the revision, and the affectivity.

(Note: Each company must insert the means by which the release information is published and/or distributed. It may be published electronically with notification being automatically pushed out as soon as it is released or it may be left up to each organization to query the release file to determine if any new documents have been released that may affect them. Or the release information may be published on paper or other means but the means and frequency must be identified.)

b) Made available to the appropriate organizations.

(Note: Each company must identify how the documents are made available. Electronic documents may be "pulled" as needed by the using organization or they may be "pushed" to persons or organizations. For paper documents there may be a distribution list created that identifies which organizations need to be provided the different types of documents and the quantity.)

1.2.2.4. Document Storage

All documents will:

a) For paper or other documents in a physical form stored in a manner that will protect the documents from environmental effects such a fire, water, sun, or other degradation that might render them unusable,
b) For electronic documents they shall be stored on at least two independent servers that are not located at the same facility or location such that destruction of one facility due to acts of nature, fire, or access by unauthorized users cannot result in the loss or corruption of the data. It must also identify the frequency of the backup.
c) Be retained for the time shown in the table below:
(Add additional documents and their retention period as required.)

Document	Retention Period
Products and articles manufactured under the approval	5 years
Critical components identified under 14 CFR 45.15(c)	10 years
Type design (drawings and specifications)	Permanent
Compliance showing documentation (Reports, etc.)	Permanent
record of each periodic audit and any corrective actions resulting from them	5 years
record of any reported service difficulties associated with approvals or certificates issued	5 years
application and data required to be submitted to obtain the certificate or approval	2 years
data and records documenting the approval or determination of compliance	2 years

1.2.2.5. Documentation Interface between Design and Production Entity

Design data that are technically approved by the Design Entity must be production released and brought to Production Entity through a formal channel.

All in all we have three layers that must be covered:

1) *All documents, regardless what type, must be identifiable, must have revision numbers or letters as required by company directive and must have information on model and serial effectivity.*
2) *All types of documents at the relevant revision must be made available in a controlled way for actual use. This includes distribution as per distribution lists, retrieval of not actual data, marking of wild data as "uncontrolled".*
3) *Controlled handover between design and production, so that production has no chance to build to not actual and approved design data. This includes production initiation with proper reference to the Type Design revision level for traceability.*

This we must spread correctly to the headlines in this section 1.2, having no gap and no overlap. Requires more detail wording to provide guidance.

1.2.2.6. Documenting of Approvals

This process applies to all cases where Approvals have to be given, following the definitions as provided through Authority to Sign. Any approval must be identified by reference to the approval date, name of the approving person and reference to the role as per this Handbook in which the person grants the approval.

Approval may be granted providing a hand written signature on the original printout of a document or an electronic approval as agreed to by the regulator. Abbreviated signatures /

short signs may be used when they are uniquely identifiable. Any approval may only be given along with noting the date of approval. For the generation of small data volume pdf documentation it is acceptable to use typed short signs along with the approval date, given the original paper exists and is archived following the procedures of this handbook.

Approval may be granted remotely by unmistakably expressing the approval in a documented way, provided the means allows to clearly reference the approval back to be provided by the originator and the time of approval. In this sense, submission of email approvals to the person responsible for document control, with unmistakable reference to the document identifier and version, and stored along with the document is acceptable. In a similar way, database supported approvals are acceptable. When granting remote approvals, the person responsible for document control completes the formal signature table, with reference to this electronic approval.

> *This way of accepting remote approvals represents the way EASA is handling this in first test cases. The basis for this process is that the procedure must clearly identify how the remote approval may be given, and how the evidence has to be stored. There is a significant difference in the required level of originator authentication compared to banking applications, for example. The system does not need to try to prevent criminal activity in falsification of approvals. The system must be only such that mistakes by simple error or simple negligence are avoided.*

1.2.3. Changes to this Handbook

Changes to this handbook are initiated and generated, checked and approved like any other compliance or quality document.

Changes to this handbook are classified as editorial or non-editorial.

Editorial changes are all those changes that do not affect the Quality Management System as such, the availability or qualification of required staff, or the scope of work. These changes do not need to be coordinated with the Agency.

All other changes are considered non-editorial. Non-editorial changes require communication and approval through the Agency. Application for approval shall be requested in a form and manner acceptable to the Agency.

1.3. Guidance Material

183.53(c)(8)

Procedures will be established to:

a) Identify the appropriate guidance material necessary to support the certification and production activities,
b) Describe the procedure to obtain the correct, applicable, and current requirements from the official sources,
c) Ensure a change to any of the guidance material is not overlooked, and
d) Ensure the material will be readily available in a timely manner to all who have need of the information when it is needed.

1.4. Records

1.4.1. Design Related Records

The Design Organization maintains the following records:

(1) Any records generated and maintained while holding a previous Authority delegation under subpart J or M of part 21, or SFAR 36 of this Subpart D of Part 183.

(2) For any approval or certificate issued (except those airworthiness certificates and approvals not issued in support of type design approval projects):

(i) The application and data required to be submitted to obtain the certificate or approval; and

(ii) The data and records documenting the approval or determination of compliance.

(3) A list of the products, components, parts, or appliances for which a certificate or approval has been issued.

(4) The names, responsibilities, qualifications and example signature of each nominated staff.

(5) A copy of each manual approved or accepted, including all historical changes.

(6) Training records for nominated staff.

(7) Any other records specified in this Handbook.

(8) This handbook including all changes.

(9) A record of each periodic audit and any corrective actions resulting from them; and

(10) A record of any reported service difficulties associated with approvals or certificates issued.

For airworthiness certificates and approvals not issued in support of a type design approval project:

(11) The application and data required to be submitted to obtain the certificate or approval; and

(12) The data and records documenting the approval or determination of compliance.

For all above records:

(1) Records and data are made available to the Administrator for inspection at any time;

(2) Records and data are submitted to the Administrator upon surrender or termination of the authorization.

(3) Any report required by the Administrator to exercise his supervision of the organization is compiled and submitted.

(4) Records shall be maintained for unlimited time, unless defined different in Section 1.2.2.4c of this manual.

1.4.2. Production Related Records

Section yet to be completed.

2. MANAGEMENT COMMITMENT

2.1. Management Commitment

(21.2, 21.3, 183.55, 183.57)

The requirements of this manual are binding on all employees and (Company Name) management is committed to supporting those requirements. Management will follow the requirements of this manual when giving directions and the employees must object when they receive a conflicting order.

2.2. Customer Focus

(183.63, 183.65)

(Company Name) management is committed to supporting the needs and welfare of the customer with respect to the products and articles offered to the customer.

Note: refer to ICAO Safety Management Manual *– would it make sense to carefully implement a Safety Management Focus here? ICAO SMM Section 7 describes nicely the difference between QMS and SMS and how they complement. This is an addition in scope,*

but adding this scope proactively allows control of the extent it gets included, such that we gain benefit and do not create undue burden.

2.3. Quality Policy

It is the policy of (Company Name) to design, build, sell, and service products and articles to the highest quality standards in the industry.

2.4. Planning

Planning is a key factor in being able to meet the quality standards (Company Name) is committed to. Procedures will be established to ensure that projects are planned and executed in an orderly and controlled manner to produce quality products and articles. Planning is required by management for product realization, details see Section 4.1, but also for Quality Objectives and for the Quality Management System as such.

2.5. Scope of Work

The company is in the process of developing, certifying and producing products for the Aviation industry and the scope of work will include all aspects of these activities.

2.6. Responsibility, Authority, and Communication

2.6.1. Responsibility

An Accountable Executive of (Company Name) will be responsible for ensuring compliance with the requirements in this manual and making the required certifying statements to the Agency on behalf of the company.

Here we must clearly define the minimum of „roles“ that must be allocated. This is more than the Accountable Executive, at least includes the independent Quality Management Representative and may be enhanced in complex companies, but the bare minimum and their responsibility and authority must be made clear, as this is one section where the complexity can be easily overdone. Reference AC 21-51, Applicant's Showing of Compliance and Certifying Statement of Compliance for guidance on what needs to be addressed in this section.

2.6.2. Authority

The names of those to whom an authority is granted will be defined in Appendix ?? of this manual.

Here we must clearly define the minimum of „roles“ that must be allocated. This may be enhanced in complex companies, but the bare minimum and their responsibility and authority must be made clear. Attention must be paid to what is included in this section as this is one section where the complexity can be overdone. A proper means to clarify

Authorities is to have a signature matrix that identifies, which role is approved to sign off which documents / work results on what level and that may be sufficient. .

2.6.3. Authorized Functions and Limitations

(21.???, 183.49(a), 183.53(c), 183.55)

2.6.3.1. Scope of Work

Pointer to a separate document, listing the projects where the Delegations as identified in the next section, apply.

The (Company name) holds Type Certificate(s) _____ (or Supplemental Type Certificate(s) _____) (or Rights to the benefits of TC ____ (or STC _____) under the following licensing agreement in accordance with the requirements of 14 CFR 21.132.

Same with ongoing developments to be listed.

2.6.3.2. Delegations/Privileges

(183.53(c)(1))

Note: This is US specific wording. Either find internationally applicable wording that is also OK for US use when the way of delegation is comparable, or provide selectable contents per CAA.

This is a very important part to be predefined now and here for this draft. This has major trigger on effort / time / cost of designing, certifying, building aircraft and keeping them airworthy

The Administrator may delegate any function determined appropriate under 49 U.S.C. 44702(d). The functions delegated to (Company Name) will be based on the organization's qualifications and will be identified in the procedures. (Company Name) will perform only those functions so delegated.

The limitations will consist of those items that are inherently retained by the Agency and any other limitations that the Agency deems appropriate based on the qualifications of (Company Name) personnel and the ability of the procedures to ensure compliance with the requirements.

Following are the functions granted to (Company Name):

a) ??????
b) ?????
c) ?????

2.6.3.3. Authority to Sign

Responsibilities of the nominated staff are defined by the individual procedures, linked with the authority to sign for an individual design step. Signatures are required as by the following Matrix:

Match to the finally required functions, documents and signature needs within the company

Document to be signed	F1	F2	F3	F4	F5
fill					

X This document can be signed by one person alone for generation and correctness

1 This document can be signed by this function for generation

2 This document can be signed by this function for verification, provided the person holds the appropriate nomination for the relevant field of competence. Verification can be given when the correctness of the technical content has been confirmed, and when the compliance statements provided by the document are factually correct and suitably answers to the related certification basis requirements. This person must not be identical with the person signing as "1"

3 This document can be signed by this function for approval, confirming it is verified that the generation was following the rules of this handbook and compliance is shown correct and complete in accordance with the applicable Certification Program (in cases where a Certification Program is required as per this DOH).

A This document has been signed by "1" and "2" or "C" and is subsequently explicitly approved

B The Binding Statement is signed by both functions in conjunction.

C This document can be signed by this function for checking of factual correctness. This person must not be identical with the person signing as "1". The difference to the verification of a person signing as "2" is, that the signature as "C" does not belong to the institutional role of a CVE, and therefore does not provide formal "compliance verification".

2.6.4. Internal Communication

A procedure will be defined to identify internal communications including what must be communicated, when, and by whom. The internal communication must include regular meetings where minutes are taken and tasks tracked.

2.6.5. Communication with the Authority

(183.57)

Make sure to cover development, production and CA contacts. Make clear who is the focal point for any information flow and specify time constraints when needed.

Predefined milestones where communication with the Agency is mandatory should be summarized here in a kind of overview, providing transparency. This is another critical item where effort and cost can be affected by avoiding unnecessary communication, hence waiting times for Agency responses. Strongly linked to Delegations / Privileges.

2.6.6. Application for (changes) to Design and Production Certificates

Application for issuing or changes to Design Certificates and Production Certificate or a revision to a Production Certificate will be made in a form and manner acceptable to the (Agency).

2.7. Management Review

Management will be responsible for periodically reviewing the operation of the organization and ensuring that procedures are current and applicable and the defined goals are met.

3. RESOURCE MANAGEMENT

(183.51, 183.53(c))

3.1. Provision of Resources

(183.53(c)(11) & (12))

The management of (Company Name) will provide adequate staff to ensure that the capability authorized by the (Authority) is properly supported. (Company Name) will notify the (Authority) when the staffing in numbers and / or qualification goes below the minimum agreed staffing and understands that when that occurs it may result in the loss of those privileges affected by that staffing reduction.

(Note: wording to allow international use and AS9100 use)

3.2. Human Resources

3.2.1. General

(Company Name) understands its responsibility to have and maintain sufficient resources and staff to perform the functions for which it is authorized and will establish procedures to ensure satisfying that requirement. (183.47(a), 183.51)

3.2.2. Competence, Training, and Awareness

(183.51)

3.2.2.1. Competence

Procedures will be established to ensure the persons nominated to positions have the necessary competence to perform the activities required of the position.

Here we must define adequate qualifications for the minimum roles defined in 2.5.1. It was one of the cost drivers identified in the beginning of the ARC that the hurdles to fill a function is often set too high or inadequate. So this is a trigger that must be defined now.

Either spec out the key procedures here, or have a separate procedure and reference from here. Recommended to spec out the principles here, and if an applicant has a more complex system, he can replace with his specific and more detailed separate procedure.

3.2.2.2. Training

Training appropriate for the job will be made available to the persons performing authorized functions. This training will include any (Authority) required training plus training available from the company or third parties necessary to ensure the persons are kept current with the regulations, guidance, and policies of the (Authority).

Here we must define adequate training for the minimum roles defined in 2.5. It was one of the cost drivers identified in the beginning of the ARC that the hurdles to fill a function is often set too high or inadequate. So this is a trigger that must be defined now.

Either spec out the key procedures here, or have a separate procedure and reference from here. Recommended to spec out the principles here, and if an applicant has a more complex system, he can replace with his specific and more detailed separate procedure.

3.2.2.3. Awareness

Procedures will be established to ensure the employees are aware of the consequences of their actions and the importance of reporting any incidents to the appropriate management without fear of reprisal.

3.2.3. Nomination of Staff

(Company Names) will establish procedures to ensure that the persons nominated to positions requiring the ability to determine compliance with the regulations are competent to do so.

Define who may nominate to what role, and how the nomination is documented.

This must cover Development staff as well as Certifying Staff in production.

Nomination is possible for internal and for external staff. In the case of external staff, additional contract work between company and external staff is required (work share agreement or similar), spec out, how this shall be done.

Either spec out the key procedures here, or have a separate procedure and reference from here. Recommended to spec out the principles here, and if an applicant has a more complex system, he can replace with his specific and more detailed separate procedure.

3.3. Infrastructure

(183.51, 183.53(c))

(Company Name) will provide adequate facilities and infrastructure to ensure that the activities authorized by the (Authority) can be performed. The infrastructure description will be included in this manual and will provide the company the flexibility to arrange work in an efficient and productive manner.

This was also one of the cost drivers. It must be given more guidance here to what detail level it must be defined at all, otherwise we do not gain the desired effect here.

3.4. Work Environment

Management of (Company Name) will ensure that the persons responsible for performing the certification and production functions authorized by the (Authority) as defined in this manual will be allotted adequate time and resources to perform their duties without undue pressure.

This is broader than what is shown and also affects the true environment, so health, safety at work, cleanliness and waste, working methods, working climate (environmental), resources etc. Without this we fall short of AS/EN9100.This section might be broken into appropriate sub-sections to address the other items mentioned in this note.

4. PRODUCT REALIZATION

(21.137(e)(f), 183.53(c). 8100.15(8-6))

4.1. Planning of Product Realization

(183.53(c))

(Company Name) will develop planning procedures to ensure that certification and other related activities can be conducted in an efficient and timely manner by both the company and the (Authority).

4.1.1. Project Management

(Company Name) will assign a project manager (or project engineer) to each project for the purpose of coordinating the certification relevant activities both within the company and with the (Authority).

4.1.2. Risk Management

A procedure will be established to determine the risk for each project and a plan developed for mitigation of that risk.

There are two aspects of risk management that should be addressed. There is the risk to successfully completing the overall project and the individual safety related risks of any tests, not just flight tests. Each needs to be addressed early and a mitigation plan developed. Normally the project risks and mitigation should be addressed in the certification plan and the safety risks and mitigation should be addressed in the test plans.

4.1.3. Control of Work Transfers

A procedure will be created to define how any certification activity may be performed by a supplier on behalf of the certificate holder. The supplier must acknowledge and abide by those procedures to satisfy the requirements of 14 CFR 21.137(c) and 183.53(c).

This has also cost effect, especially when it comes to supplier auditing. In several cases this does not work and is not possible / supportable by suppliers, therefore a proper guideline is required, here, to keep cost affordable. Includes, what the company may audit on their own, and when Agency involvement is required.

Either spec out the key procedures here, or have a separate procedure and reference from here. Recommended to spec out the principles here, and if an applicant has a more complex system, he can replace with his specific and more detailed separate procedure or reference it here.

4.2. Configuration Management.

This is to be enhanced using the result of the separate Configuration Management activity. This is an area with significant effect.

(21.137(e)(f)(h))

Configuration Management System is installed to ensure that the configuration of each produced product is identifiable and traceable. The Configuration Management Process affects design and design change by making the configuration of the product always properly identifiable, leads to production by ensuring that the configuration of every produced product is managed, documented and controlled throughout the production process, and leads to Continued Operational Safety Management by holding all essential configuration information available for delivered aircraft or products.

Note: When implemented to the full extent, this is considered as Product Lifecycle Management.

The configuration of the approved design must always be identified with proper correlation to the date of validity.

When an individual aircraft or product production is formally initiated, the specific order must be linked to the design data configuration revision.

Two methods are possible: 1. PO section does always have current data on file, means a "document control" entity must ensure to issue and retrieve production data from the production floor, along with exactly controlling the S/N effectivity of a change. Sometimes tricky but normal in bigger companies. 2. PO section does not have drawings continuously on the shop floor and the complete set of valid production drawings is issued in a big folder to production together with the relevant AC specification. This set is to be returned with the production documentation when AC finished. Returned drawings get sent out with next order as long as they are not changed. This allows very efficient control of S/N effectivity of changes but requires more paper handling.

Configuration management will track all changes, both intended and unintended, that occur to a part or article to ensure:

a) All unintended changes (non-conformities) have been properly dispositioned using the non-conformity disposition process defined in (ref),
b) The article or part is in a configuration acceptable for intended certification testing,
c) The article or part configuration is known at any point in time and may be used for future substantiation that might not be known at the time the configuration was established, and
d) The article or part is representative of the configuration approved for production.

Make sure this links properly to the non-conformity and concession process, covering intended and unintended changes.

With the full configuration management installed and active, product conformity may also be verified and declared on the basis of the documentation in the configuration management system, as alternative to a specific conformity inspection that can add significant time to conformity process.

4.3. Customer Related Processes

(183.63 & 183.65)

Continued Airworthiness, including the related communication with the customer, is defined in Section 5.5.4.

4.3.1. Determination of Requirements Related to Product

A procedure will be established to ensure all customer requirements are identified in the preliminary design of the product.

4.3.2. Review of Requirements Related to Product

A procedure will be established to identify and review all regulatory requirements prior to initiating the project to ensure that the proposed product or change will be properly certified.

4.3.3. Customer Communication

A procedure will be developed to provide a clear description of the product to the customer and a response process to ensure the customer understands what the final product will be.

4.4. Design and Development

(183.53(c))

4.4.1. Design and Development Planning

Procedures will be established to define the objectives and requirements of the project and the anticipated schedule and sharing the information with the (Agency) as appropriate.

This is where a Certification Program must be set up and communicated with the Agency. As this is a wide open topic that highly triggers efforts, this should be specified closely here, along with meaningful templates.

Sharing the information is not the scope of this section; here the scope is only how to plan the activity, and in what form to have the information available.

4.4.2. Design and Development Inputs

Procedures will be established to identify the required input for each project along with the persons from whom input is required.

4.4.3. Identification of the Certification Basis

Define how the certification basis is found for new product and changed product. This includes the interaction with the Agency on that issue, how the definition is finally agreed and documented.

4.4.4. Design and Development Outputs

Procedures will be established to define the project output that is expected, how the Type Design is defined, and how this output is structured and managed. Design outputs include but are not limited to drawings and master drawing list, specifications, Bill of Materials, (production) process descriptions, compliance documentation, compliance checklist, master document list.

> *Scope of this section is to define the outcomes, what must it contain, how documented, what is part of Type Design, how is it structured and come all together, ….has a strong link to Configuration Management and to Production Release of new (changed) design data. Sharing the information is not the scope of this section; this is covered in 1.2.2 Document Control.*

4.4.5. Design and Development Review

Procedures will be established to review the design against the objectives at appropriate intervals and to ensure that the design is meeting the desired objectives or actions taken to implement the necessary objectives or change the objectives as required if necessary.

4.4.6. Design and Development Verification and Validation

(21.137(e)(f)(g), 183.59)

Procedures will be established to perform validation and verification of the design through analysis, review of the design, or testing as required.

> *This includes independent review to be applied during generation and verification on any design documentation. At least this bit must be predefined.*

4.4.6.1. Testing

Procedures will be developed to define the process to be used when conducting verification and validation tests.

> *This section must include risk assessment and mitigation for all tests, how the test setup and conduct must be specified, verified (independent checking, and by which qualification), conducted and documented. Very close link to configuration management. Includes not only configuration of the part but also of the setup, things like scales calibration, weight items calibration etc. Should be predefined here and now as this is the basis to be able to make tests without Authority participation.*

4.4.6.2. Flight Testing

> *Procedures will be developed to define the process to be used when conducting flight tests. This must include risk assessment and risk mitigation strategy definition. Flight test has a lot of distinct differences to structural / system ground testing, therefore extra section.*

4.4.6.3. Verification and Validation Documentation

Procedures will be established to define how the verification and validation will be documented.

In case of tests, documentation must include all proof of calibration and configuration.

In case of analysis, the method applied, and the program used, including revision information. Input, output and program configuration parameters, as applicable, must be documented.

4.4.7. Control of Design and Development Changes

(21.137(a))

Procedures will be developed to ensure that changes that occur as a result of analysis, review, or testing are incorporated into the approved production design.

4.4.7.1. Changes Classification

Definition how to classify changes as minor / major etc. Link to the decision matrix / Form that guides the process.

4.4.8. Showing and Finding of Compliance

(21.20(a))

Procedures will be defined for how compliance will be demonstrated and found, and the responsibility for each.

Link to the proper templates and definition who is allowed to do which finding.

4.4.8.1. Applicant Showing Only

Add the separate process on applicant-showing.

4.4.8.2. Applicant Statement of Compliance

(21.20(b))

Complete

4.5. Supplier Management

The company will establish a supplier management process that ensures:

a) A process is in place to identify suitable suppliers. This may include supplier auditing or proof by qualification (AS/EN9100 or similar) of the supplier,
b) A list of acceptable suppliers selected on the basis of a risk management assessment, including definition for surveillance (Audit need / trigger for Audit / Audit schedule) per each supplier.
c) For all active suppliers, supply agreements must be in place that specify the way of interaction between supplier and company name), as far as it affects the fulfillment of duties of (company name) as per this Handbook. In accordance with 14 CFR 21.137(c)(2), each supplier will report to the production approval holder if a product or article has been released from the supplier and subsequently found not to conform to its approved design.

d) A process is in place to conduct a regular review of suppliers to determine their continued acceptability, and
e) A process is defined for action that must be taken when a supplier is not meeting its requirements.

Supplier Audit as such is dealt with in Section 5

4.5.1. Purchasing Process

In accordance with 14 CFR 21.137(c), all products or articles being purchased for production or certification activities will be of design configuration that is in conformity with released (type) design definitions.

Define purchasing process

4.5.2. Purchasing Information

To satisfy the requirements of 14 CFR 21.137(c) the Purchase Order will specify the product or article being purchased by the part number, drawing number, drawing revision, mod level, or any other appropriate drawing or specification information necessary to clearly identify the specific configuration being purchased. Use of drawing number and dash number alone is inadequate.

4.5.3. Verification of Purchased Product

(21.137(g), 183.59)

The (Company Name) Quality Assurance department will ensure that all products or articles received from a supplier comply with the approved design data of the product or article as specified on the Purchase Order in accordance with the requirements of 14 CFR 21.137(c)(1). The results of the inspection will be documented on the appropriate Quality Assurance Forms.

This must be specified in much more detail:

- *There can be a huge difference between a yard supplier and an AS9100 approved supplier in level of effort you must put into this.*
- *Provide definitions for a classification of components by criticality. Dependent from criticality, verification effort is scaled.*

4.5.4. Reporting of Non-Conforming Purchased Products

Process for reporting of / communication about non-conforming products originating from a supplier, either detected by supplier or company. Arranging of approval for supplier non-conforming products.

4.6. Production and Service Provision

(183.53(c))

This manual will satisfy the requirements of 14 CFR 21, Subpart G, for Production Certificate holders and the applicability requirements listed in 14 CFR 21.131.

4.6.1. Control of Production and Service Provision

(Company Name) plans and carries out production and service provision under controlled conditions.

Refer to AS/EN9100 for a complete list of details. This section will structure into further subsections that cover the different production aspects and processes.

4.6.1.1. Production Process Verification

A representative item from the first production run of a new part or product is used to verify that the production processes, production documentation and tooling are capable of producing parts and assemblies that meet requirements. This process shall be repeated when changes occur that invalidate the original results (e.g., engineering changes, manufacturing process changes, tooling changes).

4.6.1.2. Control of Production Process Changes

Any changes to the manufacturing processes and procedures will be verified (*how and by whom?)* to ensure that each manufactured product or article using the revised procedures will meet its approved design to satisfy the requirements of 14 CFR 21.137(d).

4.6.1.3. Control of Production Equipment, Tools, and Software Programs

Procedures will be defined to ensure the calibration and control of all inspection, measuring, and test equipment used in determining conformity of each product and article to its approved design in accordance with the requirements of 14 CFR 21.137(f). Each calibration standard will be traceable to a standard acceptable to the (Agency).

4.6.1.4. Control of Work Transferred, on a Temporary Basis, Outside the Organization's Facilities

Procedures will be established in accordance with the requirements of 14 CFR 21.137(d) to ensure that all products and articles fabricated by any person other than the approved organization meet the same requirements as those fabricated by the approved organization.

4.6.1.5. Control of Service Operations

(183.63 & 183.65)

Procedures will be established to define how service operations will be controlled.

4.6.2. Post-Delivery Support

(183.63 & 183,65)

Procedures will be established to define how post-delivery support will be provided.

Section requires completion. Give special focus towards differentiation between repair and alteration. Often, when doing a repair on an older aircraft, improvements that have been implemented to later production serial on can be implemented to the older aircraft as part of the repair. Reasonable procedures must be defined that allow for this consideration, avoiding the need for a separate treatment of the same work step (in the customer workshop() as repair and change, in parallel.

4.6.2.1. Repairs

Section to include provision of instructions for Repair. Includes classification of repairs, link to design process, submission to customer.

4.6.2.2. Alteration

Section to include provision of instructions for Alteration. Includes classification of alterations, link to design process, delivery to customer.

4.6.2.3. Maintenance

Section to include provision of instructions for Maintenance.

Allow for maintenance / repair on products that have shown compliance, but are still under control of the production organization, as within the former manufacturer's maintenance facility. While the product is still in production control, the company shall be able to do maintenance, alterations and repairs under the existing production organization processes. This allows to cover for damage on the production line, during storage or in shipping. The part is taken back to the production line by invalidating the conformity tag, then repaired and conformity maintained under the PO like with any other part that has not yet achieved a conformity tag in normal production, without having to have a Part 145 approval.

4.6.3. Validation of Processes for Production and Service Provision

Procedures will be created to validate the process used in production and in the service activities.

4.6.4. Identification and Traceability

Components used on an aircraft have different levels of criticality.

A procedure will be defined by which all parts will be identified and traced as appropriate for their criticality to satisfy the requirements of 14 CFR 21.137(n).

On the basis of the identified criticality, requirements for product marking are applicable. 14 CFR 45,Subpart B.

Spell this out more what this exactly means. The basis for the component classification must be given here. Identifying the significance of a component and applying relaxation to traceability requirements for non-critical parts is an uncommon approach to some and is a means to significantly reduce administrative burden, hence cost.

This section must also include how the requirements for product and component markings shall be satisfied. This affects the need for marking of manufacturer, product, part number and serial or lot number. Make clear that marking of the part revision number may be omitted when the numbering system is defined in a way that requires a new part number as soon as either form, fit or function of the part are affected.

4.6.5. Customer Property

Procedures will be developed to ensure customer property is properly marked and protected.

This normally a requirement in a repair or alteration operation but for small manufacturers, a customer may provide a specific piece of equipment that he wants installed and there needs to be a process to manage this.

4.6.6. Preservation of Product

Procedures will be implemented to prevent damage and deterioration of each product and article during handling, storage, and packaging in accordance with the requirements of 14 CFR 21.137(j).

4.6.7. Product Conformity

4.6.7.1. Determination of Conformity

Procedures will be developed to define the conformity procedures for all products and articles used for both certification and production. Certifying Staff is used to determine conformity on component and product level, on the basis of qualification and nomination, applying inspections and tests defined as part of the Type Design and /or production process definitions.

4.6.7.2. Issuance of Airworthiness Approvals/Certificates

Procedures will be developed to ensure the issuance of Airworthiness Certificates is performed in accordance with the requirements of 14 CFR 21, Subpart H.

4.6.7.3. Issuance of Flight Permits

Procedures will be defined for the issuance of Flight Permits in accordance with the requirements of 14 CFR 21.197 or 199 as applicable.

4.7. Control of Monitoring and Measuring Devices

Procedures will be defined to control all monitoring and measuring devices.

Define here what is reasonable for the standard cases, to avoid over and undershoot.

5. MEASUREMENT, ANALYSIS, AND IMPROVEMENT

(21.137(f))

5.1. General

5.2. Monitoring and Measurement

(21.137(l)(m))

5.2.1. Customer Satisfaction

(21.137(m))

Procedures will be defined to measure customer satisfaction and to address and/or provide responses to each issue identified in accordance with the requirements of 14 CFR 21.137(m). The procedures will:

a) Address any in-service problem involving design changes, and;

b) Determine if any changes to the instructions for Continued Airworthiness are necessary.

5.2.2. Audits

(21.137(l), 183.53(c))

(Company Name) will conduct internal and supplier audits to ensure compliance with the requirements of 14 CFR 21.137(l) and 183.53(c)(5) & (6) for the production process and for the certification process(s) as defined in this manual. The audit procedures :

a) Will ensure the audit is completely independent and free from influence by management,
b) Will ensure that no person will audit their own work,
c) Require the organization being audited to cooperate with the auditor to ensure freedom of access to any and all documents necessary to support the audit,
d) Requires identification of any non- compliance with the requirements of this manual,
e) Requires determination of root cause and corrective action and preventive actions for each non-compliance,
f) Requires reporting of all non-compliances to the manager responsible for implementing the appropriate action,
g) Requires establishing a closure date for all audit findings, and
h) Requires reporting of any aircraft safety issues to the Agency
i) Requires review of audit results and identification of any trends or issues that identify changes that can be made to improve the processes by which the products are designed, certified, or built.

Make sure this also covers Design Subcontractors.

5.2.3. Monitoring and Measurement of Processes

(21.137(d), 21.137(l), 183.59)

To satisfy the requirements of 14 CFR 21.137(d) and 183.59, manufacturing processes and procedures will be defined and controlled to ensure that each product and article manufactured using the defined process conforms to its approved design.

Enhance with same sense to be applicable for Design processes.

5.2.4. Monitoring and Measurement of the Product

(21.137(e), 21.137(g), 21.137(l))

Inspections and tests will be conducted to ensure that each product and article conforms to its approved design. These procedures will include a flight test of each aircraft produced unless that aircraft will be exported as an unassembled aircraft.

(For engines or propellers replace the last sentence with “These procedures will include a functional test of each aircraft engine (or propeller) produced.“)

Procedures will be established for the documenting and test status of products and articles supplied or manufactured to the approved design in accordance with the requirements of 14 CFR 21.137(g).

The measurement requirements for product acceptance are documented by checklists and protocols. The checklists and protocols provide:

a) criteria for acceptance and/or rejection;
b) the sequence of measurement and testing operations that have to be performed;
c) the required records of the measurement results;
d) information on specific measurement instruments required and any specific instructions associated with their use.

5.2.4.1. Inspection Documentation

Procedures will be established to define what documentation is required for all inspection activities.

5.2.4.2. First Article Inspection

Procedures will be established to define when a first article inspection is required and what must be contained in the first article inspection records.

5.2.4.3. Tests on Manufactured Products

Procedures will be established that deal with the quality assurance / acceptance tests to be conducted on products other than prototypes. This may link to prototype testing procedures. Effects due to different company staff involved than during design must be considered.

5.2.4.4. Flight Test on Manufactured Products

Procedures will be established that deal with the production acceptance flight tests to be conducted on products other than prototypes. This may link to prototype flight testing procedures or flight test handbook when the same resources are used. Effects due to different company staff involved than during design must be considered.

5.3. Control of Nonconforming Product

(21.137(h)(n))

Procedures will be established in accordance with 14 CFR 21.137(h) to:

a) Ensure that only products or articles that conform to their approved design are installed on a type-certificated product. These procedures will provide the identification, documentation, evaluation, segregation, and disposition of nonconforming products and articles. Cases are defined where it may be acceptable to use a initially non-conforming component, by doing a design evaluation / qualification / verification, providing design approval for that specific case and granting a concession. In this case the initially nonconforming product or article must be found conforming with the definitions provided with the concession.
b) Ensure that only authorized individuals may make disposition determinations.
c) Ensure that discarded articles are rendered unusable.

5.3.1. Quality Escapes

Procedures will be established for identifying, analyzing, and initiating appropriate corrective action for products or articles that have been released from the quality system and that do not conform to the applicable design data or quality system requirements to satisfy the requirements of 14 CFR 21. 37(n).

5.3.2. Manufacturer Maintenance or Repair

The need for Manufacturer Maintenance or Repair may occur during the production process or following the initial production process, as long as the product stays under continuous control of the manufacturer (Transfer of Perils did not take place).

Maintenance or repair during production must follow approved methods. Approved methods have to be established in coordination with the design entity responsible for the affected product. Generation and approval must follow the same procedures as the generation of the design, including approval steps. Standard maintenance and repair procedures that have clear definitions for their applicability, may be applied directly by the manufacturer without consultation of the design entity. Those standard procedures must be approved once and form part of the Type Design.

Maintenance or repair following the completion of the production, while the product stays under continuous control of the manufacturer and has not yet been issued a Certificate of Airworthiness, may be conducted by the manufacturer in conformance with the established procedures for maintenance and repair during production. To do this, the issued Conformity Declaration must be revoked from the product , and the product gets inserted to the production sequence at the same step as would be when the need for the same maintenance or repair would appear during the production process. Subsequently the product has to undergo all required steps to obtain a new Conformity Declaration.

Maintenance on products that have left completely or temporarily the continuous control of the manufacturer may only be conducted by an adequately authorized maintenance or repair facility (14 CFR Part 145).

5.4. Analysis of Data

(21.137(l)(m))

Procedures will be established for analyzing the data obtained from production and the customers to identify issues that may require action and distributing the results to the appropriate department for action.

5.5. Improvement

(21.137(l))(m), 183.63(a)-(d))

5.5.1. Continual Improvement

(21.137(l)(m))

Procedures will be established to identify issues that may require changes to the product through design or manufacturing or the operation in order to continually improve the product.

5.5.2. Corrective Action

(21.137(i), 183.53(c))

Procedures will be implemented to identify when corrective actions are required to eliminate the causes of an actual or potential nonconformity to the approved design or noncompliance with the approved quality system to satisfy the requirements of 14.CFR 21.137(i).

5.5.3. Preventive Action

(21.137(i))

Procedures will be defined to identify when preventative actions should be taken to eliminate the occurrence, or re-occurrence, of a potential production, service, or operation issue.

5.5.4. Continued Airworthiness (CA)

5.5.4.1. Instructions for Continued Airworthiness (ICA)

Identify:

- *which types of ICA are to be provided,*
- *how they are named,*
- *what they shall cover,*
- *how these documents have to be structured. Link to meaningful ICA templates that unify the appearance of this documentation, for simplified infield understanding and therefore enhanced safety.*
- *How they are distributed, distinguish between new delivery, updates, Notifications, … Critical item: How are Notifications distributed.*

5.5.4.2. Continued Operational Safety Monitoring (COSM)

Identify the COSM process:

- *How in-service feedback is to be obtained*
- *What the sources for in-field feedback are*
- *How to analyze incoming information, risk assessment*
- *Definition, what is a „unsafe condition“*
- *Duties to report to Agency*
- *Way of reaction to (Agency issued) ADs*

Appendix 1 - Procedures

Important: The contents of the handbook itself shall provide sufficient process definition for companies with non-complex undertakings. For these companies no separate procedures shall be required and this Appendix is not required. Only for companies with more complex undertakings addition of separate procedure documents shall be necessary. In this case, the separate procedures apply the system that is defined by the handbook itself, and extend it to match the individual

company undertaking complexity. Therefore, separate procedures are not intended to be part of the standard handbook boilerplates. In any case, focus shall be to require as little separate procedures as possible.

When applicable, detail procedures may be added here to the handbook, as part of the handbook. Alternatively they may be treated as separate documents, linked at the beginning of the handbook.

Appendix 2 – Instructions

Detail instructions may be added here to the handbook, as part of the handbook. Alternatively they may be treated as separate documents, linked at the beginning of the handbook.

Focus shall be to require as little separate instructions as possible. The sections provided in this standard handbook shall provide enough detail for a small and low complexity entity to have all required instructions. Only for growing companies with increasing complexity of the undertaking, enhancing the general instructions from this handbook in separate instructions is considered an option and may be helpful. Therefore, separate instructions are not intended to be part of the standard handbook boilerplates.

Appendix 3 – Forms & Templates

Forms and templates may be added here to the handbook, as part of the handbook. Alternatively they may be treated as separate documents, linked at the beginning of the handbook. The forms shall be generated to be self-explaining and requiring input in line with the related process.

Forms required for DO functions:

- FAA Form 8100-13, ODA Statement of Qualifications
- FAA Form 8100-9 Used For ODA Data Approval
- FAA Form 8100-11, Statement of Completion
- Conformity Inspection Plan
- Minor / Major Classification Matrix

… to be completed

Templates required for DO functions:

- Change Request
- Certification Program
- Compliance Checklist
- Engineering, Test and Compliance Report
- Service Bulletin
- Audit Report
- Non-Conformity Report

… to be completed

Appendix F

Forms required for PO functions:

… to be completed

Templates required for PO functions:

… to be completed

APPENDIX G – ALTERATIONS / MODIFICATIONS WORKING GROUP PAPERS AND PROPOSALS

Appendix G.1 – Preventive Maintenance

Preventive Maintenance

Alterations & Maintenance Working Group

This is a report on the subject of Preventive Maintenance from the Alterations & Maintenance Working Group to the full 14 CFR Part 23 Aviation Rulemaking Committee. It includes a statement of the issue considered by the Working Group, discussion of the issue and specific recommendations to the FAA proposed for ratification by the ARC.

Issue

The part 43 provisions on preventive maintenance are outdated, inflexible and confusing, resulting in a reduction of pilot performance of preventive maintenance below optimal levels.

Discussion

Background

Section 43.3(g) permits certificated pilots (with the exception of sport pilots) to perform specific preventive maintenance (PM) operations on aircraft that they own or operate under part 91. These PM operations are limited to those listed in part 43 Appendix A Section (c). Other sections of part 43 permit the pilot to return the airplane to service following performance of PM and establish record keeping requirements. In addition to the rules, there are also two Advisory Circulars with content on PM: AC 43-9C *Maintenance Records* and AC 43-12A *Preventive Maintenance*.

Preventive maintenance is defined by § 1.1 as follows: "*Preventive maintenance* means simple or minor preservation operations and the replacement of small standard parts not involving complex assembly operations." Section 1.1 further defines maintenance as follows: "*Maintenance* means inspection, overhaul, repair, preservation, and the replacement of parts, but excludes preventive maintenance." Thus, it is clear that preventive maintenance is entirely distinct from “ordinary” maintenance for the purposes of the regulations.

At present, part 43 does not include “other operations acceptable to the Administrator” in its definition of preventive maintenance. This language is often included in the regulations in order to grant the FAA flexibility in dealing with rapidly changing or extraordinary circumstances. Because it is not included

here and because the list of authorized preventive maintenance operations is contained within the regulations, it is difficult and time consuming for the FAA to adapt to technological (and other) changes.

With the introduction of sweeping new content in a revised part 23, the FAA will face such a situation of change. Moreover, the incorporation of new technology on airplanes has already led to difficulties in this area. Additional advances in technology may be inhibited if the regulatory criteria governing preventive maintenance are not modernized. The stated objective of the part 23 rewrite is to improve the safety of small airplanes. A supporting objective is the reduction of the cost of airplane acquisition and ownership, allowing owners to more easily afford the purchase of safety-related components and systems. Thus, changes to part 43 that increase the safe availability of pilot-performed preventive maintenance are supportive of the ARC's goals.[1]

General Rulemaking Concerns

Any change to rules, guidance or policy holds the potential to have unexpected and undesirable results. For example, even where the intent is only to clarify compliance requirements, it may be the case that practices that have historically been judged compliant may be found to be non-compliant. Conversely, changes or clarifications that, in the eyes of some, appear to liberalize the rules or the conventional interpretations of existing rules may meet with strenuous opposition. Accordingly, an extremely conservative view of revisions is sometimes recommended.

The Alterations & Maintenance Working Group has attempted to strike an appropriate balance between the risks inherent in change and the potential benefits of the specific changes we considered. Nevertheless, others may see this balance differently. It is our hope that the discussion that follows will allow others to consider alternate, and perhaps more valuable, approaches than we have recommended toward the resolution of these issues.

Regardless of the level of change adopted, the success of these proposals depends also on the cultural application of those changes. The intent of PM authorization and of the changes must be understood, respected and exploited in order for the hoped-for economic benefits to be realized, facilitating operator investment in safety-related improvements to the affected airplanes.

Content and Location of the Basic List of Authorized PM Operations

As mentioned above, the current list of authorized preventive maintenance items is in part 43 Appendix A. The fact that this list is in the regulations contributes to the difficulty in revising it – the full rulemaking procedure must be followed.

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[1] It is reasonable to question whether or not Part 43 rules and guidance fall within the purview of the Part 23 ARC. The rulemaking process includes the concept of "coordinated rule changes", wherein changes to one Part require or suggest changes to another Part. To ensure consistency, these changes are made in a single rulemaking activity. Thus, from a procedural standpoint, recommendations that fall outside of Part 23 would seem to be in order. Indeed, it seems likely that recommendations for changes to Parts 1 and 21, and perhaps others, are likely to arise out of the deliberations of the ARC.

In order to grant the FAA additional flexibility in maintaining this list, the Working Group considered recommending that the list be moved from part 43 into a guidance document (likely a new revision of AC 43-12). Doing so would not only simplify and speed up the change process but would also make it possible to maintain the list items and robust descriptions of their intent in a single document.

Concerns were raised that removal of the list from the regulations would inevitably weaken the "promise" of availability of these items to the pilot. It is the nature of guidance documents that their content is not absolute, where regulations are.

After considering both sides of the issue, the Working Group decided that the guaranteed availability of these operations outweighed the advantages of flexibility offered by moving the list into guidance. Additional operations can potentially be introduced in guidance and, as warranted, moved into the regulations after a trial period.

The majority of the items in the list appear at first reading to be simple and easily understood. Upon close examination, however, there are many issues of interpretation that might arise in the application of the rules. Most of these issues arise as a result of the use of seemingly simple terms that, being undefined in the regulations, might reasonably be interpreted differently by different readers. A selection of these issues include:

- Part 43 Appendix A identifies preventive maintenance as being the listed items "provided it does not involve complex assembly operations." There is no definition of what constitutes complex assembly operations, however, nor does it prohibit performance of items where complexities other than in assembly may be present. Indeed, AC 43-12A CHG 1 specifically assigns responsibility for determining whether an operation is complex to owners and pilots, indicating that they "must use good judgment when determining if a specific function should be classified as preventive maintenance." It provides no examples to illuminate this guidance.
- Many of the list items permit removal and replacement of aircraft components (such as wheels and tires, engine cowls, windows, safety belts, etc.). It seems from context that some of these anticipate replacement of the removed component with a substitute component (windows, for example) rather than reinstallation of the removed component itself, but in other cases (engine cowls) it is unclear. Moreover, when replacement with a substitute component is permitted, it is unclear whether it must be identical to the original component or whether use of a different, but compatible, component is authorized. Some might think it reasonable, for example, to allow replacement of a common tungsten-filament landing or taxi lamp with a compatible LED lamp, while others would consider such an operation to be an unauthorized and unacceptable expansion of PM into the realm of alterations.
- Some of the items are identified as "servicing" (such as oleo strut air and oil) and "replenishing" (such as hydraulic fluid) but there are other similar items (such as engine oil) that are not addressed in this list or elsewhere in the regulations.

It is the opinion of the Working Group that AC 43-12() should be revised to include clarification of these and similar items. We recognize that there is a danger that clarification might result in a narrowing of

the items as viewed by some, but believe that greater clarity will generally benefit pilots by giving them a clearer, more reliable understanding of the PM items that they are authorized to perform.

Authorization of Additional PM Operations

At present, the only means by which the list of authorized preventive maintenance operations can be modified is through rulemaking. There is no allowance for additional authorizations in guidance or by policy, nor is there any allowance for authorization of type- or installation-specific preventive maintenance. This poses a substantial impediment to the safe and effective conduct of an increased variety of PM operations in the field.

We recommend the addition of language to the regulations to permit authorization of operations beyond those listed in part 43 Appendix A. This language could be added to § 43.3 or to the list itself.[2]

Once appropriate language is added to part 43, additional PM items can be authorized for general use in guidance or policy documents. Furthermore, type- or installation-specific items can be accepted based on manufacturers' procedures, perhaps in an ICA. We see numerous attractive opportunities for safe and economical additions to existing PM authorizations by this route, including installation of databases other than those authorized in part 43 itself and installation of software, where procedural simplicity and aircraft configuration allow.

We are concerned that some manufacturers might try to limit or eliminate pilot-performed preventive maintenance on their products once coverage of PM issues in ICAs becomes common. This is not the intent of these proposals, obviously enough, and we recommend that the FAA be sensitive to this issue in developing an acceptance process for relevant ICA content.

Competence to Perform PM

There is not now any requirement for training before a pilot is authorized to perform the operations listed in part 43 Appendix A and subsequently return an aircraft to service. By way of contrast, certified mechanics must perform these same items under supervision before they are permitted to return the aircraft to service. This seems odd, in that it is reasonable to assume that even the least qualified professional mechanic is more skilled than the average pilot.

Nevertheless, it is the opinion of the Working Group that a regulatory requirement that pilots be trained in some fashion prior to conducting PM operations should *not* be added. The Working Group members are collectively unaware of any data that would suggest that safety issues due to improper conduct of

[2] The list of preventive maintenance operations in part 43 Appendix A Section (c) is shared by two separate regulations: § 43.3(g), which authorizes PM by pilots of aircraft in non-commercial service, and § 43.3(h), which authorizes certain rotorcraft commercial operators to perform those PM operations contained in the list while in the field. Thus, the addition of "other operations acceptable to the administrator" to the list in Appendix A would affect both non-commercial aircraft operators and some commercial rotorcraft operators, while adding it to § 43.3(g) would affect only the former.

PM are present in significant numbers under the current rules, so we see no compelling need for additional regulation.[3]

We would recommend that the FAA consider the complexity of any operations proposed for authorization as well as the adequacy of the manufacturer's instructions and any supplementary training material prior to acceptance of the proposal. We would note that some such operations might be deemed acceptable only with a prior demonstration of competence. It is our belief that these recommendations are fully supported by a regulatory framework authorizing "other operations acceptable to the Administrator."

PM Guidance

The FAA has issued two pilot-directed guidance documents with content pertaining to preventive maintenance: AC 43-12() *Preventive Maintenance* (last modified in 2007) and AC 43-9() *Maintenance Records* (last modified in 1998). While these documents are reasonably good at describing the basic regulations that authorize the performance of PM operations by pilots and the approval for return to service, along with the attendant documentation requirements, they do little to address the lack of clarity in the regulations (and specifically the basic list of authorized PM operations in part 43 Appendix A). For example, as noted earlier, AC 43-12A CHG 1 specifically avoids addressing the issue of what constitutes "complex assembly operations", stating that "Owners and pilots must use good judgment when determining if a specific function should be classified as preventive maintenance."

The Working Group believes that this lack of clarity and the delegation of responsibility to the pilot is likely to intimidate and to inhibit the performance of PM operations by pilots as intended. We believe that the AC, rather than merely quoting the regulations and stating all of the conditions that apply to their use (which we acknowledge to be an important contribution in itself) should strive to *clarify* both the basic regulations and (most importantly) the list of authorized PM operations.

As was noted earlier, the provision of clarifications of these operations may serve to expand some readers' understanding of the regulations and narrow the understanding of others. Both may prove problematical in terms of acceptance in the field. Nevertheless, we feel that the advantages that accrue from increased numbers of pilots taking advantage of these regulations as a result of improved understanding outweighs any potential disadvantage.

In addition, if our other recommendations are followed, we believe that the AC is an appropriate place to introduce new universally authorized PM operations without the overhead of rulemaking (perhaps to be introduced to the rule after a trial period) and to establish that aircraft and equipment manufacturers may propose PM operations for FAA acceptance as part of their service documents.

[3] The Working Group recognizes that this statement is not especially compelling without additional evidence and is attempting to obtain additional objective data.

Recommendations

1. Part 43 should be changed to include “other operations acceptable to the Administrator” as preventive maintenance under § 43.3(g).
2. The basic list of preventive maintenance operations contained in part 43 Appendix A should remain in the regulations so as to guarantee availability of a well-defined minimum set of authorized operations.
3. AC 43-12() should be revised to:
   a. Emphasize the availability of preventive maintenance operations to pilots,
   b. Clarify the basic list of authorized PM operations,
   c. Establish conditions under which aircraft and equipment manufacturers may propose additional PM operations and procedures for their safe performance for FAA acceptance, and
   d. Encourage manufacturers to propose such operations and procedures.

Appendix G.2 – STCs and Alterations

STCs and Alterations

Alterations & Maintenance Working Group

This is a report on the subject of STCs and Alterations from the Alterations & Maintenance Working Group to the full 14 CFR Part 23 Aviation Rulemaking Committee. It includes a statement of the issue considered by the Working Group, discussion of the issue and specific recommendations to the FAA proposed for ratification by the ARC.

Issue

After manufacture, airplanes may be altered by means of Supplemental Type Certificates (STCs) developed under part 21 and by means of major and minor alterations under part 43. With the introduction of the new part 23, it is essential that these means be maintained for both new and legacy airplanes in order to insure continuing access to safety improvements as airplanes remain in service.

Discussion

Background

Existing regulations and guidance include substantial descriptions of the processes necessary to gain approval for alterations made to type certified products after their initial delivery.

Part 21 states that "A 'minor change' [to type design] is one that has no appreciable effect on the weight, balance, structural strength, reliability, operational characteristics, or other characteristics affecting the airworthiness of the product. All other changes are 'major changes'... If a person does not hold the TC for a product and alters that product by introducing a major change in type design that does not require an application for a new TC under § 21.19, that person must apply to the appropriate aircraft certification office for an STC."

In addition to alterations based on STCs, part 43 allows airplanes to be returned to service following either major or minor alterations. Part 1 defines a major alteration to be "an alteration not listed in the aircraft, aircraft engine, or propeller specification (1) that might appreciably affect weight, balance, structural strength, performance, powerplant operation, flight characteristics, or other qualities affecting airworthiness; or (2) that is not done according to accepted practices or cannot be done by elementary operations." Part 43 Appendix A further contains an enumerated list of major alterations. Alterations that fall outside these two definitions are, by definition, minor.

Irrespective of the path by which an alteration is defined and approved, the airplane must continue to comply with the applicable rules under which it was certified or, in some cases, newer or added rules applicable to the specific alteration.

These provisions are potentially complicated by the adoption of the new part 23, both as they are applied to newly manufactured airplanes and to legacy airplanes, and the removal of elements of the current part 23 to one or more Airworthiness Design Standards (ADS) maintained by industry. In particular, determining whether an alteration developed under the new regulations meets the compliance requirements applicable to an airplane produced under older regulations (whether legacy regulations or an earlier amendment of the new part 23), while conceptually simple, is potentially problematical in practice. The revised regulations, supporting guidance, and resulting changes in behavior of all involved parties could result in the emergence of unanticipated safety issues or (and, we believe, more likely) unacceptable impediments to the use of these rules.

Due to the lengthy service life of airplanes (decades, in most cases) and the rapid pace of safety-related technological development combined with anticipated changes in equipment needed to meet the needs of the evolving operational environment, it is imperative that upgrades to in-service airplanes be facilitated. At present, a robust industry of STC developers and maintenance facilities services this need. Competition among vendors ensures both diversity of offerings and, within the usual norms of our industry, a measure of economy.

As the new part 23 and supporting guidance (both FAA and industry) are developed, sensitivity to the needs of the aftermarket must be shown to maintain and advance owners' ability to make safety related improvements to their airplanes after delivery. These needs include workable establishment of the boundary between compliance requirements (the regulations) and means of compliance (industry standards and others), clear and appropriate establishment of the certification basis for the airplane as manufactured, provision of essential information facilitating alterations in the TCDS and aircraft service records, and publication of guidance for applicants and FAA personnel on the proper interpretation and application of it all.

Certification Basis and TCDS for Newly Manufactured Airplanes

The certification basis of an airplane describes the airworthiness regulations and other provisions – exemptions, equivalent level of safety (ELOS) findings and special conditions – that apply based on the airplane's configuration, powerplant, equipment, intended use and other characteristics [Order 8110.4c 2-3d(4)]. The certification basis is proposed by the TC applicant and finalized in consultation with the FAA. The applicant also proposes means by which compliance with each of the items in the certification basis will be shown prior to certification of the airplane. These means of compliance may include reports, analyses, tests and other procedures. They may be proposed by the applicant directly in response to the regulations or they may take advantage of specific methods recognized by the FAA, generally by means of Advisory Circulars (ACs) and sometimes including recognition of industry standards (e.g., RTCA/DO-160, DO-178 and DO-254).

Because the certification basis is strictly regulatory and is agnostic with regard to the means of compliance, it follows that it must contain only rules, exemptions, ELOS findings and special conditions. Thus, under the new part 23, the certification basis cannot (and should not) identify either the industry

standard(s) employed or particular provisions of the industry standard(s) that are found to be applicable – any more than we would do so for Advisory Circulars or existing industry standards today.

The type certification data sheet (TCDS) is a publicly available document written by the FAA based on information provided by the aircraft manufacturer and is identified by § 21.41 as part of the type certificate. It contains specific information about an aircraft (or multiple aircraft produced under a common type certificate) including the certification basis and an enumeration of many of the factors described above as influencing the certification basis. This information is a key input to the determination of the certification basis for subsequent alterations.

The specific contents and format of the TCDS are listed in FAA Order 8110.4(). The Order states that "The TCDS is the part of the TC documenting the conditions and limitations necessary to meet the certification airworthiness requirements of the regulations (14 CFR)" and requires the inclusion of the following items for each domestic airplane model included on the TC:

1. Engine
2. Fuel
3. Engine limits
4. Propeller and propeller limits
5. Airspeed limits
6. Center of gravity (CG) range
7. Empty weight C.G. range
8. Datum
9. Leveling means
10. Maximum weights
11. Minimum crew
12. Number of seats
13. Maximum compartments weights
14. Fuel capacity
15. Oil capacity
16. Maximum operating altitude
17. Control surface movements
18. Manufacturer's serial numbers
19. Certification basis
20. Production basis
21. Equipment
22. Notes

As the certification requirements contained in part 23 are simplified and as aspects are moved into industry standards, it is important that sufficient information remain in the TCDS to permit STC applicants and the FAA to clearly and accurately identify the certification basis for the alteration; the list above may not suffice and the Order may require revision to incorporate additional items. As argued above, incorporation of specific information on means of compliance (i.e., identification of any industry standards used in whole or in detail) is not appropriate. Rather, the characteristics of the airplane that lead to determination of both the certification basis and choices of compliance path within the industry standards should be required TCDS contents. This is particularly important with regard to airplane characteristics for which tiered means of compliance are identified in the ADS or other supporting documents. For example, specification of the airplane's maximum gross weight and G-loading limits (already required elements of the TCDS) lead directly to a variety of structural compliance issues. The means by which those compliance issues are addressed in the original certification need not be known; appropriate means within either the original (unknown) standard or some other acceptable standard can be identified based solely on knowledge of the essential characteristics.

Certification Basis and TCDS Information for Alterations

When airplanes are altered after initial delivery, whether under an STC or not, the same range of airworthiness concerns may arise as in original certification. Consequently, compliance with the relevant provisions of the airworthiness regulations must be assured on the altered airplane.

Responsibility for identification and resolution of compliance issues falls largely on the installer, who, depending on the nature and classification of the alteration, may rely on approved or accepted data provided by a manufacturer or on standard methods.

Identification of airworthiness compliance issues can become complicated as an airplane ages. It's rare for an airplane of any substantial age to maintain its configuration. Components, systems and equipment are added or replaced in order to deal with failures or obsolescence, adapt to changing operational requirements and increase the utility of the airplane. As these alterations are made, it is often the case that there is no single reliable data source regarding the airplane's configuration and aggregate certification basis.

As described above, the information provided in the TCDS is an important contributor to the installer's ability to identify airworthiness compliance issues that apply to the airplane as originally manufactured. Comparable information on airplanes that have been altered, however, can be difficult to find.

One potential solution would be the maintenance of an "In-Service Aircraft Data Sheet" (ISADS) as part of the airplane's permanent records. At the time of manufacture, this would be nothing more than a transcription of the relevant information for the particular model from the TCDS. As the airplane was subsequently altered, the ISADS would be updated as part of return to service. If this practice was followed, it could be assured that the information listed above would be consistently available in a convenient format. (This information, of course, isn't everything needed to identify potential airworthiness issues with regard to a proposed alteration, but it's a start.)

The regulations (most notably part 43) require that certain specific records be kept of maintenance, alterations, inspections and other actions affecting the airworthiness of the airplane. Similar records are required for engines and propellers. Neither the regulations nor any existing FAA guidance mandates the form or format of these records. Most commonly, these records are maintained in the form of a logbook, in chronological order. The logbook is sometimes divided into separate sections for maintenance activities and inspections. In addition, it is sometimes supplemented by additional records, such as an Airworthiness Directive compliance log, for easier access to information that must be periodically reviewed.

As proposed above, the ISADS may contain information that is, today, normally kept in the airplane's logbooks. This proposal is not intended to create substantial new recordkeeping requirements. Rather, it is intended to suggest a reorganization of existing information (not all of which is normally kept in the logs) to allow owners and service facilities to more easily determine the altered configuration of the airplane. The ISADS can be used as the sole detailed record in this regard, directly in support of regulatory recordkeeping requirements, with references to its contents from the primary airplane logs as needed for clarity.

We believe that a regulation mandating the use of such an ISADS would not be supported by either the FAA or industry due to sensitivity over increases in the paperwork burden associated with return to service and the absence of persuasive evidence that the current system is inadequate. We do, however, believe that voluntary use of an ISADS might be achievable given some level of FAA support. This might take the form of an Advisory Circular, perhaps supported by an industry document, giving the recommended content and organization of the ISADS and indicating which existing regulations would be supported by its use as a part of the airplane's permanent records. A well maintained ISADS would simplify both preparation for new alterations and the records check portion of the annual condition inspection.

New Regulations, Industry Standards and Their Application to STCs and Alterations

As the new part 23 is developed, it is anticipated that portions of it will be restructured and that some of the more detailed requirements will be moved into one or more industry-maintained standards that effectively form the top level means of compliance with the regulations. As these regulations, industry standards and accompanying guidance documents are developed, it is important that their structure and content continue to effectively support the development of STCs and the alteration of individual airplanes.

The current part 23 is divided into seven subparts that deal with different subject matter (General; Flight; Structure; Design and Construction; Powerplant; Equipment; and Operating Limitations and Information). Each subpart is, in turn, divided into sections that address divisions of the subject matter of the subpart. For example, Subpart E, Powerplant, is divided into sections titled General, Fuel System, Fuel System Components, Oil System, Cooling, Liquid Cooling, Induction System, Exhaust System, Powerplant Controls and Accessories, and Powerplant Fire Protection. The regulations, then, are organized under these sections.

The individual regulations tend to have well defined topics, to have well defined scope and stay within it, and to be free of interdependencies and cross references. As the new regulations are developed, it is important that these properties are preserved. The exact organization of the regulations need not necessarily be preserved, but it is essential that the individual regulations be focused and self-contained.

Moreover, the industry standards and other guidance documents (both FAA and industry) underlying the regulations should also have these properties plus one more: The individual provisions of each document must be traceable to the regulations they support. Poorly constructed documents could easily result in an inability on the part of both applicants and the FAA to determine what minimum combination of activities constitute an acceptable means of compliance for a specific regulation. This situation must be avoided at all costs.

Applicants must be allowed to exercise freedom in choosing from among recognized ADS. In addition, if multiple ADS are recognized as means of compliance with particular regulations, the applicant must be permitted to choose from among them without regard to the ADS chosen for other regulations. Use of one ADS in a project must not obligate the applicant to use that ADS in any other aspect of the project.

Of course, the applicant's proposed certification basis and means of compliance are subject to FAA review and concurrence as part of the certification planning process. These recommendations are not intended to interfere with that process of joint agreement, but are intended to identify guidelines applicable to such an agreement.

AML STCs

The use of Approved Model List (AML) STCs as described in AC 23-22 is crucial to the efficiency of alterations in the aftermarket. This is especially true for avionics systems, where support of many airplane types by a single system is normal and the potential for safety improvement is high.

Because the airplanes listed in an AML will inevitably have differing certification bases, the common practice is to develop the STC to the latest amendment of the regulations (or, depending on the classification of the change under § 21.101, to the latest amendment appearing in the certification bases of the listed airplanes) and to the most stringent requirements applicable to the listed airplanes.

This practice must still be applicable under the new part 23. Any choice of certification basis currently allowed under § 21.101 must continue to be supported, from retention of the original certification basis of the airplane to adoption of a later amendment to the regulations, depending on the specific nature of the proposed alteration and the applicant's preferences.

In particular, compliance with the new part 23 (if elected by the applicant), irrespective of the chosen means of compliance, must be regarded as sufficient with regard to airplanes originally certified under

(1) an earlier amendment of the new part 23, (2) the old part 23, (3) CAR 3 or (4) any predecessor regulation or standard applicable to airplanes that would currently fall under part 23. If a regulation included in a previous amendment of part 23 or any predecessor regulation has been eliminated from part 23 (presumably because it has been moved into an ADS), compliance with that regulation cannot be required in subsequent projects.

In addition, tiering should be accomplished wherever possible in both the regulations and the underlying industry standards in such a way as to allow compliance in a higher tier to also fulfill compliance requirements in all lower tiers with respect to the same regulation.

Tiers may be defined in several ways: by means of quantitative parameters (for example, maximum gross weight or stall speed in the landing configuration), by means of qualitative parameters (such as VFR/IFR/day/night operation or primary structure material) and by surrogate parameters (such as number or type of engines as a surrogate for complexity or mission capability). In the case of quantitative parameters, "cumulative compliance" is relatively automatic. In the case of some qualitative parameters, it may be easily achieved (for example, IFR equipment requirements include and augment VFR equipment requirements) but in the case of others it may be nearly impossible (for example, specific hazards relating to potential delamination of composite materials may have no analog in metal construction, while fatigue considerations may apply only to metal and not to composites). In the case of surrogate parameters, cumulative compliance should be possible when measured against the parameter for which the surrogate is standing in.

Beyond accommodations of the new part 23, modest changes to existing AML practices would add flexibility and reduce cost. At present, AC 23-22 states that "The AML STC process should not be applied to those systems whose installation configuration varies significantly among various serial number aircraft of the same model, or those systems that can directly control the aircraft. For example, an AML STC would not be suitable for autopilot installations [where] there may be serial number specific airplane-rigging problems... Another example would be a Reduced Vertical Separation Minimum (RVSM) STC approval." Inasmuch as there is already plenty of content in the AC directed at the identification and resolution of variability in installation considerations, these exceptions do not seem to be justified. Their removal (and the elimination of the attendant uncertainty associated with the general caution beyond the specific examples) would result in greater efficiency in these programs without substantial additional risk.

Field Approvals

At present, there are many cases where concerns about the categorization of proposed alterations result in minor alterations being treated as major and major alterations being made under STCs. As the new part 23 is introduced, the conservatism currently found in the system could very well increase, negating the hoped-for increases in efficiency. If efficiency is to be improved, a combination of updated guidance and targeted training for both FAA and industry personnel will be required. In addition, close coordination between Flight Standards, the ACOs and SAD will be required to facilitate minimum-cost resolution paths for common introduction problems.

Appendix G

Alternate Means of Compliance

As previously noted, the industry-developed Airworthiness Design Standards (ADS) are expected to constitute top-level means of compliance with the new part 23. As with any recognized means of compliance, the use of alternates, including direct compliance with the rules, has to be permitted. As is now the case, alternate means of compliance must be permitted at lower levels, as well.

In the current culture, the use of alternate means of compliance tends to be mostly impossible. Even though it's permitted in principle (and supported, typically, by the ubiquitous "one means but not the only means" clause in the Advisory Circulars recognizing the means), the FAA often has difficulty accepting concrete proposals.

A prominent example is the use of DO-178B in connection with systems development. DO-178B is recognized as a means of compliance with the software-related aspects of § 23.1309. Alternate means of compliance are offered by AC 20-115B and AC 23.1309-1E, both of which give recognition to DO-178B, and by DO-178B itself. Nevertheless, concrete proposals of alternate means tend to be either impossible or expensive to pursue, leaving no true alternative to full compliance.

In general, the FAA's inability to approve alternate means stems from the fact that DO-178B is not based on analysis, it's based entirely on a consensus of expert opinion. The expected results of compliance with DO-178B cannot be analytically related to the § 23.1309 requirements; the link between the two is AC 23.1309-1E, which relates safety objectives to compliance items based on a second layer of expert opinions. It is understandably challenging to determine what judgments form an acceptable substitute for the original decisions. Nevertheless, in order to make the promise of "one means but not the only means" be real, that's exactly what must happen.

As we transition toward greater and greater reliance on industry standards, this situation will certainly repeat. Just as we need a genuine and effective openness to the efficient use of alternate means to presently accepted means (DO-160G, DO-178B, DO-254, ARP 4754, various ACs, etc.), we will need the same for the new ADS and future supporting documents.

Role of the Aircraft Manufacturer

Certain aspects of the development of the new part 23 are loosely modeled on the experience gained in the development of the Light Sport Aircraft (LSA) approval process. In particular, the establishment and maintenance of industry Airworthiness Design Standards has a direct analog in LSA. There are, however, significant differences as well.

LSA are not type certificated under part 21. All airworthiness standards are maintained by industry and recognized by the FAA. Many LSA manufacturers are relatively inexperienced and the majority are foreign. Since there is no type certification, there is no STC process for LSA.

As a consequence of these and other factors, it is a requirement that all alterations to LSA be approved by the aircraft manufacturer.

It might be tempting to impose this same requirement for airplanes certificated under the new part 23 based on the fact that a portion of the detailed airworthiness requirements are expected to move into ADS. It is our belief that such a move is unnecessary based on the fact that the essential airworthiness requirements will continue to reside in part 23. Moreover, an extensive infrastructure of STC developers and shops is already in place to support part 23 airplanes.

Imposition of a manufacturer approval process for alterations to part 23 airplanes would substantially inhibit development and use of safety related improvements to airplanes in the fleet and should be avoided.

Recommendations

1. Recognized industry-maintained Airworthiness Design Standards (ADS) must be strictly regarded as acceptable means of compliance. All compliance showings are made only with respect to the regulations.
2. ADS and other means of compliance are not included in the certification basis and need not be listed in the TCDS.
3. Airplane specifications, performance, operating limitations, etc., that lead to compliance decisions within the ADS (and supporting documents), including tiering, must be listed in the TCDS. Conversely, ADS and other documents must wherever possible base alternative compliance paths on data that are listed in the TCDS.
4. Comparable information with regard to alterations (particularly alterations made under STCs) should be available as part of the airplane's permanent records.
5. An STC or alteration must be shown to comply with the regulations by means of any acceptable means of compliance. Use of the specific ADS (and/or other documents) of the unaltered airplane is not required.
6. If an existing design approval (TC, STC) is amended, use of the ADS previously used to establish compliance with the regulations may be preferred (to the extent that it is applicable to the change) but is not required. Upgrade to the latest revision of an ADS may be required only under the conditions that would require a cert basis upgrade under § 21.101.
7. ADS should be regarded as separable. If multiple standards are recognized in overlapping areas, compliance with the regulations may be shown using them in any combination as long as all of the compliance requirements applicable to any particular regulation within the chosen standard are fully met.
8. ADS must be written in such a way as to make it clear what portions address which part 23 requirements. Portions of an ADS that address different part 23 requirements must be kept separate as much as possible.
9. The approval of an aircraft's manufacturer must not be required in order that an STC or alteration can be approved.
10. Guidance must clearly indicate that the new part 23 is acceptable for all changes to any airplane certified under part 23 or any predecessor regulations. (21.101(a) indicates that the most recent amendment can always be used if the applicant so elects.) In particular, if a rule in the cert basis of

an airplane has been dropped from the new part 23, continued compliance cannot be required, though compliance with its replacement or equivalent can.

11. A process must be available by which an AMOC to a recognized standard can be used.

G.3 – Certification of Systems and Equipment

Certification of Systems and Equipment

Alterations & Maintenance Working Group

This is a report on the subject of Certification of Systems and Equipment from the Alterations & Maintenance Working Group to the full part 23 Aviation Rulemaking Committee. It includes a statement of the issue considered by the Working Group, discussion of the issue and specific recommendations to the FAA proposed for ratification by the ARC.

Issue

Installed systems and equipment have the potential to contribute greatly to the safety of flight, both as installed at the time of manufacture of the airplane and as installed throughout the airplane's service life. The articles themselves, however, and their installation tend to be costly, inhibiting their installation on airplanes at all levels. If these cost barriers can be lowered without compromising safety, increased adoption rates can result in safety improvements within the fleet.

Discussion

Background

The stated objective of the part 23 rewrite is to achieve a 50% improvement in the overall safety of part 23 airplanes while (or possibly by) reducing the overall cost of certification by 50%, making airplanes and equipment more affordable. A part of the underlying premise of this objective is that incorporation of new technology (primarily in electronic systems, but also in structures, propulsion, cabin furnishings, etc.) has the potential to improve safety, but that it has to be cost-reduced from traditional levels in order to achieve an effective level of market penetration.

While it might be expected that changes made in the new part 23 would primarily benefit new production airplanes, attainment of the safety improvement goal within any reasonable period of time will require that the existing fleet be considered as well. Based on readily available industry figures reflecting the service life of small airplanes, current fleet size and makeup, and production rates, it is likely to be at least forty years before airplanes certified under the new part 23 comprise a majority of the fleet. This being the case, it is essential that those factors that most directly influence safety and certification cost be directly considered, and that the availability of new certification approaches be made available to the existing fleet and not only new production airplanes. In many cases, the costs associated with design, manufacture and installation of these items are largely determined by the applicable certification requirements. If these certification requirements can be reduced without posing a direct threat to safety, the resulting cost reduction may actually result in an overall safety improvement as a result of increased adoption.

With regard to systems, many of these cost drivers result from the following items, some of which are regulatory in nature and some of which result from FAA accepted, conventional means of compliance:

- System Safety Assessment and supporting compliance items, including DO-160(), DO-178() and DO-254.
- Prescriptive safety requirements, such as defined failure classifications and development assurance levels in TSOs and guidance documents.
- HIRF and lightning compliance

Many of these requirements have their origin in the air transport world. Some have been modified for use with small airplanes, while others have not. In some cases, concerted efforts have been made to rationalize certification requirements for small airplanes, but it is our feeling that additional steps can, and should, be taken.

Equipment categories

Equipment on airplanes can be categorized in certain ways that are potentially useful in determining appropriate safety standards. Specifically, the following overlapping categories may be considered:

1. Required vs. non-required

   Required equipment is identified as such in either the aircraft certification regulations (in the present case, part 23) or the operating rules (most often part 91, but possibly part 135) applicable to the airplane. Any equipment not so identified is non-required equipment.

   Equipment that is required is generally essential to the safe operation of the airplane in an identified environment. For example, part 23 requires that all airplanes be equipped with an airspeed indicator, an altimeter and a magnetic direction indicator. These requirements (and others) are repeated in part 91, which also requires that airplanes to be operated at night be equipped with position and anti-collision lights, and that airplanes to be operated in instrument conditions be equipped with suitable flight instruments, navigation and communication equipment.

   While intuition suggests that required equipment should follow more stringent safety standards than non-required equipment (and, indeed, this is sometimes the case), the consequence of failure of a given article is actually more important than the existence of a requirement for its installation. For example, the in-flight failure of a required position light is essentially inconsequential – the airplane is perfectly capable of flying to its original destination without difficulty, though additional vigilance in traffic spotting and position reporting might be advised.

   One noteworthy example of non-required equipment is the handheld GPS. These have become ubiquitous over the last fifteen years or so, incorporating numerous functions (moving map display, satellite weather overlay, flight planning and navigation, terrain avoidance) that have obvious utility and potential for safety improvement. In fact, there is considerable circumstantial evidence that the use of handheld GPS units has caused a significant decline in

the number of CFIT accidents in small airplanes. These units, being non-installed, are of commercial quality and have no certification pedigree whatsoever. That owners who choose to install similar panel mount equipment should suffer an economic penalty that often runs to over $10,000 seems ridiculous.

2. Safety-related vs. non-safety-related

   Safety-related equipment is equipment that has the potential to improve the safety of an operation or has the potential, by means of its failure, to degrade safety. Non-safety-related equipment is equipment whose potential contribution to operational safety, either positive or negative, is negligible.

   In any realistically usable safety-related article, the potential for safety improvement must exceed the likelihood of safety degradation (which is related to the potential consequences of a failure, considering the operational environment, and the likelihood of that failure).

   One good example of non-required safety-related equipment is an installed carbon monoxide detector. The potential for safety improvement is obvious, and the hazard associated with any reasonable failure rate is completely negligible.

3. Original vs. replacement

   In order to achieve the top-level safety improvement goals of the ARC within a reasonable timeframe, consideration must be given not only to the safety of new production airplanes but to installation of potential safety-enhancing equipment on existing airplanes. Many of these existing airplanes have old, “low technology” systems that have failure rates well in excess of those required on new airplanes.

   Current guidance requires that new systems installed on older airplanes meet the same requirements as on newer airplanes. In many cases, the residual value of the older airplanes is such that the investment required to upgrade to current-standard equipment is untenable. As a matter of basic logic, it seems appropriate that the standard applicable for installation of replacement equipment on any airplane, regardless of age, should be “at least as good as that which is being replaced.” This is, in fact, the basic logic behind the changed product rule, but it is not consistently carried forward into other related guidance or used in practice.

4. Emergency use only

   Addition of redundant or supplementary equipment can contribute significantly to safety and may be permissible at significantly reduced cost if the equipment is provided for use only in case of emergency.

   An example might be an emergency auto-land system. Such a system might be engineered so as to guide the airplane to a survivable landing in cases of pilot incapacitation or other emergencies, not under normal conditions.

Appendix G

Sections 23.1306, 23.1308 and 23.1309 compliance

Much of the cost of airborne systems results from the requirements of §§ 23.1306 (lightning), 23.1308 (HIRF) and 23.1309 (system safety). The costs include extensive and intrusive development process assurance activities, expensive and sometimes difficult compliance testing, specific design features, aircraft-level configuration and protective measures in the installation.

By any normal measure, these three regulations and accompanying guidance have been created or updated in the very recent past, the oldest being § 23.1308 in 2007 (its introduction). This is largely the result of the rapid incorporation of "glass cockpit" systems and electronic engine controls into part 23 airplanes in the last twelve years or so. As higher criticality systems were introduced, concerns arose that they were not fully addressed by the existing regulations. As a result, issue papers were routinely used to establish certification criteria responsive to potential failures under exposure to HIRF and lightning, as well as other perceived risks. Coincidentally, even as §§ 23.1306 and 23.1308 were in development, § 23.1309 was simplified (both in the rule itself and in the form of guidance changes facilitating compliance) and more effectively directed at these newly emerging systems.

Compliance with each of these regulations has, as its starting point, elements of a system safety assessment (SSA). The SSA starts with a functional hazard assessment (FHA) in which each function of the equipment is categorized as to the severity associated with its failure. Two top-level failure modes are generally considered for each function: loss of the function and unannunciated failure (or misbehavior) of the function. Of the two, unannunciated failure is generally the more severe failure mode. A five point scale is used for this exercise, each failure mode being classified as "catastrophic", "hazardous", "major", "minor" or "no safety effect."

This classification of failure modes determines which of the detailed requirements of these three regulations apply to the equipment. Generally, the greater the hazard associated with the failure of the equipment, the more stringent the requirement.

Because of the scope and importance of these regulations, a host of guidance documents provide interpretation (generally in the form of FAA advisory circulars) and offer acceptable means of compliance (generally in the form of industry standards recognized by the ACs).

FAA guidance is provided in AC 23.1309-1E, which identifies acceptable means of compliance for § 23.1309; AC 20-136B and AC 20-155, which identify acceptable means of compliance for § 23.1306; and AC 20-158, which identifies acceptable means of compliance for § 23.1308. Industry standards that provide detailed means of compliance and are accepted by these ACs (and others) include SAE ARP 4754A, ARP 4761, ARP 5412A and ARP 5414A; and RTCA DO-160(), DO-178B and DO-254.

As previously noted, compliance with all three rules depends on the classification of hazards by severity. Since this classification is made in the FHA and since related guidance is presented in the context of § 23.1309, it is sensible to consider that rule first. AC 23.1309-1E interprets the rule, associating the provisions of the rule with the five failure categories identified above and defining each in terms of the effects of a failure in that category on the airplane, its function and safety margins, the crew and the

other occupants. It then identifies compliance requirements of two types for each failure category: numerical allowable failure probability requirements and development assurance levels (DALs). The allowable failure probability applies to overall system performance but in practice is generally met by estimating the reliability of the conventional electromechanical and analog electronic hardware and the gross reliability of the digital electronic components, ignoring the contribution of all programmable digital electronics. The latter is met by development assurance methods.

Prior to the issuance of AC 23.1309-1C, the association of allowable failure probabilities and DALs with particular hazard levels was uniform across all part 23 airplanes (and, in fact, matched the requirements for part 25 airplanes). AC 23.1309-1C introduced four "classes" of airplane under part 23 with increasing complexity and capability. The most complex and capable airplanes, Class IV, are the Commuter Class airplanes and continue the traditional relationship between failure categories, allowable failure probabilities and DALs. As airplanes become less complex and capable, a "sliding scale" of numerical allowable failure probabilities and DALs was introduced with the objective of rationalizing the safety requirements for smaller airplanes in order to make safety-enhancing systems more affordable. (If that goal sounds familiar, it should. The success of this AC was the model for the broader activities of the current ARC.) This sliding scale has been retained without major modification in more recent versions of the AC.

AC 23.1309-1E recognizes ARP 4754A as providing useful guidance on the determination of DALs but cautions that its approach is directed more at part 25 and may, in some areas, be inconsistent with the most appropriate practice under part 23, especially in the lower airplane Classes. It recognizes DO-178B (through AC 20-115B) and DO-254 (through AC 20-152 and Order 8110.105) as providing acceptable means of compliance for software and hardware development assurance activities, respectively. It also references DO-160() without comment.

In the case of lightning, there is some question as to whether the requirements are unrealistically stringent given the exposure seen by the GA fleet. A study published as part of NASA's Advanced General Aviation Transport Experiments (AGATE) program (*Evaluation of Harmony Between the Threat of Lightning and FAR 23 Requirements*; James Griswold, August 1999) suggests exactly that. This study analyzes a considerable base of accident data and concludes, to be succinct, that the GA lightning-related accident history does not justify the level of expense required to comply with the then-current rules. Since that time, several things have happened: the rules have changed, there has been a tremendous increase in the installation of safety related electronic systems on small airplanes and the portion of the fleet made up of composite construction airplanes has vastly increased. It would seem that at least a reconsideration of the subject would be appropriate.

Protection of safety related systems generally requires considerations at the system level, the installation level and the aircraft level. Considerable specialized knowledge and experience is required even to comprehensively determine the compliance requirements. While the current guidance material is complete and well structured, the subject is still beyond all but the most experienced engineers. As a consequence, most small companies and new applicants use one of a small number of consulting DERs

to assist in the process. Lightning compliance testing is expensive and time consuming and can be done at only a small number of test labs nationwide. It is often destructive, too.

If conservative guidance were available offering standard, acceptable solutions to identifiable situations, it could greatly cut down on the cost of compliance, both in money and in time. For example, if reference circuit designs or installation designs were available (much as standard alteration techniques are identified in AC 43.13-2B), an applicant could make the choice between a standard approach that might be more expensive, larger, or adverse in some other way but was low in certification cost and risk, or could choose to do the additional work necessary to engineer and qualify a custom design. As always, there is a risk that a standard solution presented in guidance could become seen as "the" solution; this situation would have to be avoided at all cost.

With the harmonization of US and European requirements and the incorporation of responsive test levels in DO-160(), HIRF compliance for small airplanes has become fairly routine for experienced applicants. (Helicopters are a different matter.) The design features and practices needed to produce compliant equipment and installations are not exceedingly costly or time consuming. Nevertheless, the same questions of exposure apply here as in the case of lightning, especially in the US. A reexamination of the issue is probably warranted.

Comparative risk

The existing guidance describes safety-related certification requirements in relation to the risk associated with deployment of a given system into the fleet. That risk is estimated based on a functional hazard assessment and mitigated based on the results of a design and installation appraisal or system safety assessment, depending on the level of risk.

The existing guidance, however, fails to address the risk associated with a *failure* to deploy. Specifically, safety related functions may have the potential to reduce the accident rate associated with the specific flight hazards that they address. Any risk associated with the deployment of systems that assist the pilot in avoiding specific hazards may be offset by the avoided risk to operators and their passengers associated with those hazards in the absence of the systems.

Thus, an appropriate way to judge the net safety impact of a given system would be by assessing the comparative risk associated with its deployment and non-deployment. Systems that have the potential to address hazards that are especially significant in GA (such as loss of control) would merit consideration at lesser estimated reliability (i.e., higher risk) than might be considered for less significant hazards.

Note that the analysis should consider the risk associated with the hazard in the absence of any advanced technological mitigation. Failure to do so would mean that the first introduced system could be given an unfair competitive advantage, in the form of relaxed certification requirements, over subsequently introduced systems of equal or greater capability.

As an example, a number of years ago the FAA looked at the issue of installation of shoulder harnesses on airplanes not so equipped at the time of manufacture. Their conclusion was that the use of shoulder harnesses dramatically reduced the likelihood of head injury in accidents and that their installation was inhibited by unrealistically costly and unnecessary (based on examination of the comparative risk of non-installation versus installation) compliance requirements. With no rule change, but with the introduction of new policy and guidance, these requirements were simplified, affording the pilots and passengers of many legacy airplanes safety benefits that they previously couldn't afford.

DO-178() and DO-254

Both DO-178B (soon to be C) and DO-254 use the concept of "development assurance" as a response to safety requirements. It is axiomatic under both that beyond a certain level of complexity, designs cannot be rigorously verified and, therefore, are likely to contain defects. (Conversely, below a certain level of complexity it should be accepted that designs can be rigorously verified. This concept is currently supported by the guidance recognizing DO-254. So called "simple" programmable devices may be verified by conventional means, employing comprehensive tests at the pins and comparatively simple documentation. No corresponding guidance exists, however, for DO-178(). This is a deficiency worthy of correction.) Development assurance methods prescribe process requirements in an attempt to reduce the number of design defects in released products. Both standards describe a number of "development assurance levels" (DALs) with increasing process requirements in order to reduce the likely number of design defects as safety requirements increase.

It is also axiomatic, though, that the design defects in a given product, being unknown, can have an unknown safety effect, up to the most severe hazard category associated with the product. The relationship between development assurance levels and safety is extremely indirect – the prescribed methods in the standards strive only to reduce the design defect count as the development assurance level rises, not to ensure in any way that the remaining design defects have an acceptable consequence. The presumption is that reducing the number of design errors also reduces the likelihood that any really important ones remain.

Because of the unknown relationship between the exact number and nature of design defects remaining, system safety analysts and software development theorists rigidly refuse to use DAL as predictive of reliability. While this is appropriate in theory, it leads to tremendous difficulties in practice. Most importantly, the fact that the true significance of compliance with a given DAL is largely unknown and isn't related to reliability in a commonly accepted way makes it very difficult to make reasoned judgments about DALs. Much of the literature on system safety assessment and many of its methods are forced to take a "dual track" approach, following a logical and rigorous approach to determination and combination of numerical reliability and a more ad hoc, less reasoned approach to development assurance levels.

The relationship between the DALs defined by DO-178B and DO-254 and the hazard classifications identified for part 23 airplanes in AC 23.1309-1E is somewhat arbitrary. It has its origin in the traditional relationship between the five commonly defined hazard classifications (catastrophic, hazardous, major,

minor and no safety effect) and the five DALs (Level A, B, C, D and E), established for use under both part 23 and part 25 at the time of introduction of DO-178B. This relationship between hazard classifications and DALs is based solely on the collective judgment of software development and verification experts with the knowledge that the tie to the safety objectives was very indirect; no analytical basis for the relationship was attempted, and development of such an analytical basis is regarded as impossible.

When AC 23.1309-1C introduced the "sliding scale" of numerical reliabilities and DALs assigned by airplane class, an analysis was presented giving some justification for the chosen numerical reliabilities, but *no justification whatsoever* was offered for the revised DALs. New judgments were substituted for the original, again without any direct relationship between the hazard classifications and the process requirements assigned to address them. (This is not to denigrate those judgments or demean the subject matter experts who made them, but rather to point out that alternate judgments made in the light of historical data, additional insights into the overall certification process and installation-specific considerations might well lead to other judgments. Indeed, while seldom applied, this concept is supported by the guidance.)

Since that time (and, in fact, since the introduction of DO-178B), the number of accidents in which software implementation error was identified as a factor has been negligible. The prevailing theory is that systems engineering errors (which are not governed by DO-178B or DO-254) are larger overall contributors to significant systems failures.

This suggests that a further relaxation of the existing requirements for DO-178B and DO-254 compliance could be made without significant safety impact. It does *not*, however, suggest that DO-178B and DO-254 (or some other appropriate process) should be abandoned, since the positive accident history has been accumulated in an era in which DO-178B compliance is essentially universal.

Despite the fundamental differences between numerical reliability and development assurance levels, we believe that the history accumulated in the twenty years that DO-178B has been in use offers a simplified treatment. Specifically, we believe that the FAA could, based on engineering judgment, accept that each DO-178B development assurance level satisfies a particular numerical reliability requirement. This, in turn, would eliminate the necessity of following dual tracks in the system safety assessment process, adding clarity and flexibility. It would also allow a single line of reasoning to be used in establishing a revised sliding scale for use with part 23 airplanes.

The significance of this change should not be underestimated. At present, judgment must be applied repeatedly in determining appropriate DALs, at different times and at different levels, both in determining the appropriate association of DALs with hazard classifications (primarily for guidance purposes) and in determining the DALs that should apply under existing guidance. This requirement for repeated judgments is problematical due to the fact that the original judgments were essentially arbitrary and provide no basis for follow-on judgments. Both industry practitioners and certification authorities are reluctant in practice to make judgments in this space that are not firmly grounded in accepted practice; process innovation is nearly impossible. By way of contrast, if a specific relationship between DALs and numerical reliability is accepted, *every other aspect* can be handled analytically; a

single judgment made by the FAA eliminates the need for judgments at numerous other levels. It also simplifies existing practices in the system safety process. As previously noted, in current practice, fault tree analysis examines dual paths, one for "conventional" system components subject to numerical reliability requirements and another for "complex" system components subject to development assurance methodologies. If the proposed change is implemented, the need for dual path analysis will disappear and the relationship between potential failure contributions of "conventional" hardware systems, software systems and "complex" hardware systems will be clarified. (Note that it is not intended that FTA be used below the level of the software or hardware component. That is, unless a partitioned architecture is used, FTA is not the appropriate means by which the internal structure of a software or complex hardware component would be validated. In a partitioned architecture, FTA or the analogous Functional Fault Path Analysis can be used to establish appropriate numerical reliability requirements for internal structural elements.)

While DO-254 has a shorter history, having been introduced only twelve years ago, we nevertheless believe that its similarity to DO-178B warrants similar treatment.

Exposure

The present guidance grants no credit for hazard exposure in the assignment of development assurance levels.

Exposure describes the fraction of overall flight time during which a given failure would result in a hazard. The failure of an attitude indicator, for example, is hazardous only in instrument meteorological conditions (IMC), when the pilot cannot maintain attitude by reference to the actual horizon. Exposure is used in the estimation of failure rates for comparison with the numerical reliability requirements (using guidelines that are, some would argue, excessively conservative, such as the guideline that an airplane certified for IFR use should be assumed to be in IMC at all times) but is not made a factor in determining the appropriate DALs. We would attribute this fact to the previously mentioned difficulty in interpreting the indirect relationship between DALs and predicted reliability.

One very significant influence on exposure which isn't accounted for in the guidance is level of equipage. The calculations proposed in the guidance essentially assume that the system under consideration is installed on all airplanes in the fleet and that all airplanes in the fleet are exposed to potential failure of the system. In GA, especially, this is a faulty assumption. Because of the diversity of airplane types and ages in GA, a given product is very unlikely to be installed in even 10% of the fleet, reducing the overall exposure to its failures. As the level of equipage increases, the cumulative service history obtained would enhance (and, in many ways, be of greater value than) the understanding of the system's overall reliability and failure modes based on development assurance methods alone. We believe that credit should be given for the reduction in exposure associated with reasonably anticipated initial level of equipage for a given system subject to certain considerations. First, for systems with a potential contribution to higher level failures (catastrophic failures, to be sure, and possibly hazardous failures as well), some prescriptive minimum numerical reliability requirement would be appropriate irrespective of the anticipated level of equipage. This will serve to prevent degenerate cases in which inordinate

credit is given to very low levels of estimated initial equipage with a resulting high level of exposure to potential catastrophic events on the small number of airplanes so equipped. Second, the manufacturer must have a means whereby failures detected in the field are recorded, classified and dispositioned in a manner appropriate to their classification (by means of documentation or system update). Third, a means must be identified by which owners of early systems can be informed of failure modes discovered in service so that they have the opportunity to upgrade their systems to conform more closely to the higher levels of numerical reliability required as the level equipage increases. Lastly, the adequacy of the Airworthiness Directive and SAIB processes to deal with potential safety and serviceability issues must be considered in light of the (theoretically) greater potential for latent errors to be released to the field. We further believe that service history alone should be regarded as sufficient to allow continued installation beyond the initial estimated quantity, so long as the feedback and failure report dispositioning requirements described above are met.

Alternate means of compliance (AMOC)

The FAA provides assistance to applicants by a number of means, including publishing Advisory Circulars that both clarify the often abstract rules, providing specific compliance criteria, and offer means of compliance by which the applicant can show that those criteria have been met. As noted previously, these acceptable means of compliance are often supported by industry standards, such as RTCA DO-160(), DO-178() and DO-254(). Indeed, some ACs serve no purpose other than to identify an industry standard as acceptable means by which compliance with some rule, or some aspect of a rule, may be shown.

In order to avoid "regulating by guidance" (which is illegal under the statutes that govern the FAA's operation as a Federal agency) these ACs invariably include language indicating that they constitute "one means but not the only means" by which compliance with the regulation can be shown. Thus, applicants are free to propose other paths, generally known as alternate (or alternative) means of compliance (AMOC)[4]. AMOC may partially follow the methods given in the FAA guidance or industry documents, but differ enough as to prevent the applicant from making an unconditional statement of compliance based on the AC.

In actuality, however, the means given in an AC are often the only practically acceptable means. Every applicant can cite a time when he has proposed something else and an FAA engineer has responded that "That's not the usual way it's done" or "I've only seen it done one way" or even "My preference is to see you do it like this", followed closely by "Of course, you can do it another way if you like, *but it will be a lot more work.*"

This almost invariably indicates a closed minded attitude toward the use of AMOC in general. This attitude is understandable, in that the use of the AC without deviation can often be acceptable based on

[4] Note that "AMOC" is also used in the context of Airworthiness Directives, where some party proposes means of compliance with the AD other than those contained within, or referenced by, the AD itself. Because ADs have their own regulatory structure apart from Part 23, this is a somewhat different, though related, case. It is not the intent of this paper to fully address the AD case.

a single compliance statement without further consideration, at least with an experienced applicant. By way of contrast, the use of an AMOC requires that the engineer have a detailed understanding of the intent of the regulation, clearly identify the compliance issue, determine that the proposed means of compliance are sufficient and review the compliance data to ensure that the planned means were truly followed. As a result, the workload on the FAA engineer is increased – possibly greatly so – by the applicant's use of an AMOC. Moreover, resources outside the ACO may be required in support of the approval.

To some extent, it is to be expected that an applicant proposing an AMOC will have to do some extra work. After all, the work that was invested in the development of the AC and any underlying industry standards is at least partly lost when an AMOC is employed. In particular, a given acceptable means of compliance may identify specific risks underlying the rule. While an applicant's proposed AMOC should not be judged for point-by-point equivalence to the FAA's identified acceptable means, but the specific risks may need to be addressed.

Notwithstanding the potential difficulty, an applicant proposing an AMOC ordinarily does so because he believes it to be more appropriate to his situation than the usual means, and this normally implies that he believes it will be more efficient overall, whether within the course of the project in which its first used or including successive projects. For efficiencies to be realized, the FAA must be a willing -- or even enthusiastic – partner in the endeavor; reason must prevail on both sides. Even though a given applicant's AMOC is proprietary, the experience gained in evaluating it and approving it has significant value to the FAA.

Use of service history for certification credit

Service history should not only be creditable for new systems but should also be creditable for previously developed systems, primarily as a means of allowing systems shown to be reliable on less complex airplanes to be used on more complex airplanes as well. Historically, the FAA has had very limited ability to evaluate and accept service history arguments for DAL upgrades, blocking this path. For many systems, this has the effect of denying access to highly reliable and functional equipment due to the economic barriers associated with DAL upgrades.

In all cases where the use of service history for certification credit is proposed, certain problems arise. These include:

- Determination of the relevance of the service history to the newly proposed application. Changes in aircraft configuration, equipment interfaces, pilot usage or environment can, in principle, expose new execution paths and latent errors in the software or hardware.

- Acceptance of a reliability-based argument for acceptance. As previously noted, there is not a generally accepted relationship between design assurance levels and reliability. If such a relationship is accepted as proposed above, however, it should be reversible. That is, a certain demonstrated level of reliability in an appropriate environment should be creditable against DAL requirements. (This is not intended to suggest that accumulation of the required "10^{-X}" number

of hours of trouble-free operation would be used as fully equivalent to a particular DAL. Rather, some number of hours of operation with a known, acceptable problem history would be given partial credit for development assurance methods. Combined with actual performance of other elements of a development assurance methodology, this might be judged sufficient to allow a DAL upgrade, facilitating installation on more complex airplanes.)

- Determination of the manner and amount of credit to be given. There is no obvious way in which to relate service history (quantitatively or qualitatively) to specific development assurance activities. It seems logical that service history might represent an acceptable substitute for some or all of the verification activities required by DO-178B and DO-254 in a given circumstance, but there is no analytical way to determine which or how much.

Historically, service history hasn't gotten much traction as a substitute for development assurance activities, despite the existence of well written, FAA-sponsored research papers on the subject. Its use has been sufficiently controversial that applicants and FAA personnel have been reluctant to propose it, even where it seems appropriate from a risk perspective, out of fear that projects that otherwise have merit will meet with obstruction. As a matter of policy and common sense, it would seem that we should gain some experience on which to base future practice.

In one such example, an equipment vendor proposed to upgrade the software in a system from DO-178B Level D to Level C through the application of service history. The system incorporated a "black box" commercial operating system that could not be made Level C compliant by ordinary means. The systems had been in commerce (albeit with different software versions) for many years on a wide variety of part 23 airplanes with only minor problems, none of them safety related. With input from a research paper commissioned by the FAA and written by two well-known, widely respected consulting DERs, the applicant proposed to use this service history for credit against Level C objectives that could not be met conventionally due to the closed operating system. The FAA assigned personnel from several offices, including Headquarters, SAD, TAD and others to evaluate the proposal. After lengthy discussions and several rounds of PSAC rework by the applicant, the project collapsed in stalemate. This was primarily due to one FAA member's inability to understand how "if you don't have the required number of hours of service history [corresponding to the numerical reliability requirement] you can propose to use your service history to show Level C equivalence." The applicant had been clear in establishing that service history was proposed as a supplement for other fully-compliant processes, but this stumbling block (which was essentially rooted in excessive conservatism and an inability to think in innovative terms) proved to be insurmountable.

Use of functional standards for DAL credit

At Level D, both DO-178B and DO-254 essentially require only functional verification (with some additional documentation, configuration management and quality assurance requirements). Mike DeWalt has observed that compliance with third party functional standards (such as, for example, TSO MOPS) could be regarded as equivalent to compliance with Level D. Since the step function of cost from "no compliance required" to Level D is very large (especially for companies not yet selling certified

products), there are correspondingly large advantages to be gained by formally recognizing such compliance as sufficient.

For example, because collision avoidance in the National Aerospace System (NAS) is predicated on a "see and avoid" philosophy, failure of a TCAS I or TAS system is generally recognized as representing only a Minor hazard, for which DO-178B Level D is sufficient. As such, compliance with the MPS requirements of TSO-C118 (TCAS I) or TSO-C147 (TAS) might be regarded as sufficient without a separate showing of compliance with DO-178B.

Cultural issues

In the end, the single most important factor in determining the success or failure of a regulatory structure is the culture in which it is applied. If the regulations are thoroughly understood, if the supporting guidance is clear and if those in the culture embrace the regulations, abiding by the requirements and using permissions granted to them to their advantage, great successes are possible. If, however, the regulations are largely ignored, if the supporting guidance is unclear or unsubstantiated in terms of the regulations, and if those in the culture operate on the basis of tradition and uninformed intuition rather than on the basis of the true regulatory intent, the results are sure to be negative, frustrating and costly to all involved.

As noted several times in this paper, many of the decisions made in the course of the development and certification of systems and equipment are based less on analysis and more on judgment. One of the goals of this paper is to make it possible to reduce the scope and number of judgments that must be made and to allow greater use of analysis instead. The need for judgment cannot, however, be completely eliminated.

Due to rightful concerns over the safety ramifications that might result from faulty judgments, there is a tendency toward extreme conservatism when judgments must be made. For the most part, we try to mitigate these concerns through the development of guidance material that can reduce the problem to one of making focused decisions along a prescribed path rather than making broader judgments based on a more general examination of the situation at hand. This guidance material is often extremely conservative, geared toward worst-case situations. It tends to be highly prescriptive rather than instructive, providing formulaic responses to situations that may not be a good fit for the project at hand, while failing to explain the reasoning behind those responses. This leaves those who would use the guidance powerless to understand its applicability to the situation at hand and to make related judgments that may not exactly match those reflected in the guidance material.

For the proposals in this paper to succeed, it is imperative that they be fully and clearly supported in guidance and policy. Moreover, they must be publicized and training must be available to FAA personnel, designees and applicants in order to ensure their proper use. In certain cases (the use of service history, for example), it may prove desirable to identify specific pilot projects in which the concepts can be tested for both efficacy and efficiency.

In addition, the current culture – at all levels – is one of extreme conservatism. This is best illustrated by examining the relationship between owners, their shops and Flight Standards. Shops are reluctant to make most any changes as minor alterations for fear of recourse. Their inspectors are reluctant to field approve anything. (This is a slight exaggeration, but only slight.) STCs have become a de facto requirement for everything. Much of this is not based on the regulations, any existing guidance (more on this in a moment) or policy. In fact, some of it is directly contrary to existing policy that states that STCs will not be granted for minor alterations. Owners are understandably confused as to what they can and cannot do with what level of difficulty and expense.

The extreme conservatism even makes its way into guidance from time to time. FAA Order 8900.1 Chapter 9 contains instructions to Flight Standards personnel on "determining the category of a repair or alteration and ensuring that the aircraft, engine, or accessory can be returned to service in accordance with the field approval process". Following 25 pages of discussion, the Order presents tables that "indicate which method(s) may be used for approving major alterations" to part 23 airplanes, rotorcraft and part 25 airplanes, each in its own table. In fact, the tables serve mainly to indicate that certain alterations are *not* automatically eligible for field approval; in the part 23 table, every entry lists an alteration that must be approved by STC, with ACO assistance or with unusual evaluation by Flight Standards. None of the individual entries include a rationale, so the reader is often left to guess at the reasoning employed in making the judgment, yet the reader is cautioned that "These lists are not all-inclusive, and each alteration should be evaluated on a case-by-case basis"; one can neither reliably extend the logic of the table to other situations nor assume that those situations can be treated as being "automatically eligible" for field approval by their absence from the list. In those cases where an applicant (a shop, presumably) disagrees with the classification of an alteration as requiring an STC, a lengthy passage dictates that the applicant make an appeal to the FSDO which, in all likelihood, will involve the ACO, AIR-100 and the applicable Directorate in determining whether reclassification is appropriate!

This conservatism is attributable, in our opinion, to a number of factors. Among these are fear of adverse consequences in oversight; inexperience with decision making due to high levels of technical specialization and cultural influences; and an excessive focus on process rather than on results.

Here's an unsolicited, un-redacted observation made recently by a highly experienced A&P mechanic on an aviation related mailing list that reflects the problem:

> I believe the culture in many FSDOs is not conducive to modifications of any sort without a great deal of supporting paperwork. The persons making the approvals must be able to cover their butt and the more paper the better. Nothing new really but the culture has been inbred to the point it is now policy.
>
> This mentality is contagious. Many IA's are infected also. They no longer are willing to perform or exercise their privileges and abrogate them by passing the buck up to the dead end FSDO.
>
> The interpretation offered by a previous poster is a perfect example of how the system should work. As my first PMI told me, "Do not come to us to do your job. We will make things difficult if

you insist on us doing your job." That being said, there is always going to be exceptions to the above.

It's not an exaggeration to suggest that the current culture has a stranglehold on the industry. It promotes burdensome misapplication of the regulations at all levels. It results in bottlenecks at the FAA, such as project sequencing, that could easily be avoided if fewer unproductive hours were devoted to compliance activities. It stifles innovation and the installation of safety related improvements in small airplanes. It is the single most important roadblock standing in the way of the realization of the vision of the Part 23 ARC.

Recommendations

1. Existing guidance should be revised or new guidance written to simplify certification requirements for non-required, replacement and emergency-use-only systems and equipment. The emphasis should be on improvement in overall fleet safety from the prevailing level, not attainment of any arbitrary level of reliability or system function.

2. Certification requirements as expressed in guidance should expressly consider the adverse effects that accrue from failure to install to offset risk exposure from potential systems and equipment failure.

3. Guidance should recognize "simple" software and provide simplified compliance criteria not based on DO-178().

3. Consideration should be given to amendment of AC 23.1309-1() to generally relax the DO-178() and DO-254() development assurance level requirements applicable to part 23 airplanes.

4. Guidance should recognize an accepted relationship between probability requirements and development assurance levels and permit their use interchangeably in the system safety assessment process.

5. Realistic credit should be given for all factors related to hazard exposure in showing compliance with probability and DAL requirements.

6. The existing lightning and HIRF requirements should be re-evaluated in light of current historical data and projected installation trends and re-justified in terms of the environmental exposure of GA airplanes.

7. Consideration should be given to the provision of standard protective circuits for lightning protection as acceptable means of compliance.

8. Guidance should be introduced providing a framework for the use of both aviation and non-aviation service history for certification credit.

9. A suitable showing of compliance with an established functional standard should be regarded as equivalent to compliance with DO-178() or DO-254 Level D.

10. Alternate means of compliance must be allowed in practice, not just in theory. The FAA must foster a culture and a process whereby AMOC can be encouraged and realistically evaluated with regard to the basic regulations, not just in comparison to existing acceptable means.

11. The FAA must ensure that regulations, guidance, training and management combine to create a culture that is focused on safety, not process, as the goal. Application of judgment must be encouraged

and supported at all levels. Owners, operators, maintainers, manufacturers, designees and FAA personnel must all be able to determine from clear guidance what's permitted with what level of compliance effort.

Appendix G.4 – Primary Non-Commercial Category Proposal

Primary Non-Commercial Category Proposal

Alterations & Maintenance Working Group

Creation and Implementation of a new Primary Non-Commercial Category under 14 CFR Part 21

A Recommendation by the GAMA /FAA Small Aircraft Aviation Rulemaking Committee

Background

The joint GAMA / FAA Small Aircraft Aviation Rulemaking Making Committee (ARC) has been tasked with doubling aircraft safety while at the same time reducing certification costs by half.

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Currently, there are over 190,000 General Aviation aircraft registered in the United States - however corresponding production of new replacement aircraft is only approximately 1000 units a year when averaged over the last several decades. (*General Aviation Manufacturers Association Statistical Databook & Industry Outlook pages 30 and 24 respectively- see Attachment D)* **Unfortunately, at this pace, it will take almost 200 years to replace the existing General Aviation fleet.**

Consequently, even with the most optimistic rates of production, it may be decades before the improvements pioneered by the ARC for new aircraft design will yield any measurable safety improvements or cost reductions for the General Aviation Fleet as a whole. Therefore, any effective Safety / Cost solution must address both New and Existing Aircraft, The only way of realizing the safety and cost goals is by leveraging the concepts developed by the ARC for use in new aircraft certification in a way that would have an immediately felt positive safety effect on the existing General Aviation fleet. The Primary Non-Commercial recommendation resulted from this necessity.

Recommendation: Create a Primary Non-Commercial Category under 14 CFR Part 21

The Primary Non-Commercial Category is intended for the private owner to operate his or her aircraft in a substantially less burdensome and costly manner by reducing the level of compliance to FAA maintenance and alteration requirements to a level more appropriate for a privately owned vehicle.

Owners of standard category aircraft that are more than twenty years old could elect to redesignate their aircraft as "Non Commercial" use. This would enable owners to maintain their aircraft in a manner similar to a Light Sport or amateur built aircraft. This would include owner maintenance privileges (once a FAA accepted class is passed) and use of non PMA / TSO parts. Aircraft would be subject to a yearly "condition inspection" by an A&P mechanic which certifies the aircraft is in a condition for safe operation, identical to the requirements for Amateur Built Experimental Aircraft.

While some may argue anecdotally that the creation of a Non Commercial category with its associated privileges will detrimentally affect safety, factual data indicates otherwise. First, this class follows International Precedent by leveraging the concepts of the Canadian Owner Maintenance Category, which has a proven safety record over the last decade (see attachment C). Secondly, this concept uses the maintenance training principles of the highly successful LSA program which has a proven safety record. Incorporation of this new category will offer the FAA a rare opportunity for implementation of sound Safety Continuum principles paired with international harmonization.

In addition, by allowing a practical and workable path to return Non Commercial aircraft to Standard Category through dual airworthiness certificates, owners will have a Large Financial Incentive to keep their aircraft near to type design to avoid devaluing their aircraft. This is a significant Safety Advantage over the Canadian System where it is nearly impossible to return to Standard Category – therefore affording no incentive for owners to keep aircraft compliant to safety proven type design.

Finally, the principles set forth in the GAMA/ FAA "Primary Non Commercial Category" Recommendation exclusively leverage existing US regulations with proven safety records. The recommendation simply takes successful existing regulatory practices and combines them into the new Primary Non Commercial Category. For example, Maintenance Training and Certification comes from LSA, Airworthiness Certification comes from dual certificated Standard / Restricted Category aircraft and Non Commercial use from Experimental Aircraft. There is nothing new or novel proposed… except for the unlimited potential for safety and cost improvements that would be available for users of the Primary Non Commercial class.

Primary Non-Commercial Category Recommendations

Applicability

- The owner of a fixed wing, non turbine powered Part 23 aircraft or Part 23 glider, 20 years or older, may elect to redesignate his or her aircraft as a Primary Non-Commercial. (see draft regulations 21.24 and 21.184)

Privileges

- Aircraft in this category can be maintained by the owner with a repairmans certificate, similar to currently established procedures for LSA aircraft repairmen. (see draft regulation 65.108)
- Replacement or Alteration Parts should be appropriate for aircraft use, however need not be PMA / TSO authorized. (see draft regulation 21.24)
- Owners can alter their own aircraft without the requirement for FAA Approved data. (however, some alterations may require "phase 1" flight testing similar to Experimental AB requirements) (see draft regulation 91.328)

Limitations

- Primary Non Commercial Category Aircraft are required to observe the FAA Approved Aircraft Flight Manual Operational Limitations and or required placard limitations established for the Standard Category (see draft regulations 91.328)
- Aircraft can not be used to carry persons for hire, this includes aircraft rental, but allows an owner to receive flight instruction in their own aircraft. (see draft regulation 91.328)
- Airworthiness Directives are applicable as currently allowed for Experimental Amateur Built aircraft
- Aircraft owners must maintain a list in the aircraft logbook of ALL applicable ADs and their compliance status. This list would be used to highlight the owners awareness of the ADs existence and document their choice of compliance. This list would be used to facilitate the conversion of the aircraft back to normal category. (draft regulation 21.24)
- Aircraft owners must maintain a list in the aircraft logbook of ALL alterations performed that are not FAA approved and ALL non PMAed / TSO parts installed. This list would be used to facilitate the conversion of the aircraft back to normal category. (see draft regulation 21.24)
- Incomplete or Fraudulent Maintenance log book entries result in the revocation of the aircraft's standard airworthiness certificate. (see draft Order 8130.2)

Requirements

- Before original conversion, the aircraft must have a current annual inspection – all applicable ADs must be complied with current annual inspection (see draft regulation 21.24)
- Airplane owners must either add the prefix of "NC" to the aircraft registration number or affix a "Non-Commercial" placard readily visible to all passengers (see draft regulation 45.22)
- The aircraft must have a yearly condition inspection by an A&P Mechanic certifying that the aircraft is "in condition for safe operation." (see draft regulation 91.328)
- Upon transfer of aircraft ownership, the Non-Commercial Airworthiness Certificate must be reissued in the new owner's name. (see draft regulation 21.184)

Conversion Back to Normal Category

- Aircraft operated under a Primary Non Commercial Airworthiness Certificate would be dual certificated in both the Normal and Non Commercial categories, as is common place for Restricted Category aircraft. (see draft regulation 21.184)
- Aircraft in the Primary Non-Commercial category can be operated in the Standard category, provided the aircraft meets it type design data including compliance with all ADs, removal of all Non PMA / TSO parts and replacement with certified units and the removal of all non-certified alterations (see draft 21.24, draft Order 8130.2)
- The conversion can be accomplished by an IA mechanic with a complete and thorough annual inspection and log book audit. Upon successful completion the aircraft could be operated under it's Standard Airworthiness Certificate. The Procedure is very common with Restricted Category aircraft and has proven both safe and successful. (see draft Order 8130.2)

Attachment A

Proposed Draft of Regulatory structure required to implement the Primary Non-Commercial Category

1. New Regulation 21.24 Establishing the Primary Non-Commercial Category
2. Revised Regulation 21.184 Issue of airworthiness certificates for primary category aircraft and primary (non-commercial) aircraft
3. New Regulation 91.328 Operating Limitations for Primary Non-Commercial Aircraft
4. Revised Regulation 45.22 for Markings on Primary Non-Commercial Aircraft
5. New Regulation 65.108 Establishing Primary Non-Commercial Repairmen Certificates

Code of Federal Regulations

Part 21 CERTIFICATION PROCEDURES FOR PRODUCTS, ARTICLES, AND PARTS

Subpart B--Type Certificates Revised Regulation

Sec. 21.24

Issuance of type certificate: Primary category aircraft and Primary Non-Commercial Category

(a) The applicant is entitled to a type certificate for an aircraft in the primary category if--
(1) The aircraft--
(i) Is unpowered; is an airplane powered by a single, naturally aspirated engine with a 61-knot or less V_{so} stall speed as defined in Sec. 23.49; or is a rotorcraft with a 6-pound per square foot main rotor disc loading limitation, under sea level standard day conditions;
[(ii) Weighs not more than 2,700 pounds; or, for seaplanes, not more than 3, 375 pounds;]
(iii) Has a maximum seating capacity of not more than four persons, including the pilot; and
(iv) Has an unpressurized cabin.
(2) The applicant has submitted--
(i) Except as provided by paragraph (c), a statement, in a form and manner acceptable to the [FAA], certifying that: the applicant has completed the engineering analysis necessary to demonstrate compliance with the applicable airworthiness requirements; the applicant has conducted appropriate flight, structural, propulsion, and systems tests necessary to show that the aircraft, its components, and its equipment are reliable and function properly; the type design complies with the airworthiness standards and noise requirements established for the aircraft under Sec. 21.17(f); and no feature or characteristic makes it unsafe for its intended use;
(ii) The flight manual required by Sec. 21.5(b), including any information required to be furnished by the applicable airworthiness standards;
(iii) Instructions for continued airworthiness in accordance with Sec. 21.50(b); and
(iv) A report that: summarizes how compliance with each provision of the type certification basis was determined; lists the specific documents in which the type certification data information is provided; lists all necessary drawings and documents used to define the type design; and lists all the engineering reports on tests and computations that the applicant must retain and make available under Sec. 21.49 to substantiate compliance with the applicable airworthiness standards.
(3) The [FAA] finds that--
(i) The aircraft complies with those applicable airworthiness requirements approved under Sec. 21.17(f) of this part; and
(ii) The aircraft has no feature or characteristic that makes it unsafe for its intended use.
(b) An applicant may include a special inspection and preventive maintenance program as part of the aircraft's type design or supplemental type design.
(c) For aircraft manufactured outside of the United States in a country with which the United States has a bilateral airworthiness agreement for the acceptance of these aircraft, and from which the aircraft is to be imported into the United States--

(1) The statement required by paragraph (a)(2)(i) of this section must be made by the civil airworthiness authority of the exporting country; and

(2) The required manuals, placards, listings, instrument markings, and documents required by paragraphs (a) and (b) of this section must be submitted in English.

(c) Primary Non-Commercial Category

(a) The Primary Non-Commercial Category consists of aircraft which hold a Type Certificate in another Category defined by 14 CFR 23.3. Aircraft owners may elect to make application for a Primary Non-Commercial category airworthiness certificate subject to the privileges and limitations outlined by this part. Primary Non-Commercial forms a separate group, therefore Sections (a) and (b) of this subpart do not apply to section (c) aircraft.

(b) The Primary Non-Commercial Category does not constitute type design or a certification basis.

a. The type design of aircraft in the Primary Non-Commercial Category remains as annotated in the aircrafts' original type certificated data sheet.
b. Aircraft operated under a Primary Category Non-Commercial Airworthiness Certificate may deviate from type design provided that the aircraft remains in condition for safe operation.
c. While operating under a Primary Category Non-Commercial Airworthiness Certificate aircraft are not considered type certificated aircraft.
d. As the Primary Non-Commercial Category is not considered a certification basis –

(i) A Supplemental Type Certificate is not required for a Primary Non-Commercial Category Airworthiness Certificate
(ii) Primary Non-Commercial Category Airworthiness Certificates are issued per section 21.185(e) of this part.

(c) Aircraft certificated in the Primary Non-Commercial category are dual certificated in both the original Type Certificated Category and the Primary Non Commercial category. However, the privileges of the Standard Category Airworthiness Certificate may not be utilized unless the aircraft meets the type design and maintenance requirements required for that certificate.

(d) Maintenance Requirements

(1) Aircraft operated under a Primary Non-Commercial Category Airworthiness Certificate require a condition inspection, performed at intervals not to exceed 12 calendar months, by a certified Airframe and Powerplant Mechanic, which incorporates the scope and detail of 14 CFR 43 Appendix D.

(2) Aircraft operated under a Primary Non-Commercial Category Airworthiness Certificate require the following logbook entries in the format specified in 14 CFR 43.9. Entries made under this subsection must be permanently retained as part of the aircraft maintenance records:

a) The completion of the condition inspection required by (d) (1)
Condition inspections must be recorded in the aircraft logbook and maintenance records showing the following, or a similarly worded, statement: **"I certify that this aircraft has been inspected on [insert date] in accordance with the scope**

and detail of 14 CFR part 43, appendix D, and was found to be in a condition for safe operation."

b) The completion of the ATC Transponder inspection required by 14 CFR 91.215 and the ELT inspection required by 14 CFR 91.207.

c) Aircraft operated under a Primary Non-Commercial Category Airworthiness Certificate require the compliance status of all Airworthiness Directives applicable to the aircraft when operated under it's standard category Airworthiness Certificate be logged within the time frame for compliance with the Airworthiness Directive. The aircraft owner must sign the logbook entry indicating their awareness of the compliance status.

d) Aircraft operated under a Primary Non-Commercial Category Airworthiness Certificate require a logbook entry at the time of installation of all parts and alterations which would not eligible for installation on a Standard Category Aircraft.

e) Part produced and installed on an Aircraft operated under a Primary Non-Commercial Category Airworthiness Certificate need not meet the requirements of 14 CFR 21.9 as Non Commercial category aircraft are not considered to be FAA certified.

(3) Not withstanding the above, all aircraft maintenance must be performed by an individual properly certificated for the activity under 14 CFR 43 or by the aircraft owner if he/ she has completed an FAA Accepted Training for an Primary Non-Commercial Category repairman's certificate.

Code of Federal Regulations

Part 21 CERTIFICATION PROCEDURES FOR PRODUCTS, ARTICLES, AND PARTS	
Subpart H--Airworthiness Certificates	Revised Regulation

Sec. 21.184

Issue of special airworthiness certificates for primary category aircraft and primary non-commercial category aircraft

(a) *New primary category aircraft manufactured under a production certificate.* An applicant for an original, special airworthiness certificate-primary category for a new aircraft that meets the criteria of Sec. 21.24(a)(1), manufactured under a production certificate, including aircraft assembled by another person from a kit provided by the holder of the production certificate and under the supervision and quality control of that holder, is entitled to a special airworthiness certificate without further showing, except that the [FAA] may inspect the aircraft to determine conformity to the type design and condition for safe operation.
(b) *Imported aircraft.* An applicant for a special airworthiness certificate-primary category for an imported aircraft type certificated under Sec. 21.29 is entitled to a special airworthiness certificate if the civil airworthiness authority of the country in which the aircraft was manufactured certifies, and the [FAA] finds after inspection, that the aircraft conforms to an approved type design that meets the criteria of Sec. 21.24(a)(1) and is in a condition for safe operation.
(c) *Aircraft having a current standard airworthiness certificate.* An applicant for a special airworthiness certificate-primary category, for an aircraft having a current standard airworthiness certificate that meets the criteria of Sec. 21.24(a)(1), may obtain the primary category certificate in exchange for its standard airworthiness certificate through the supplemental type certification process. For the purposes of this paragraph, a current standard airworthiness certificate means that the aircraft conforms to its approved normal, utility, or acrobatic type design, complies with all applicable airworthiness directives, has been inspected and found airworthy within the last 12 calendar months in accordance with Sec. 91.409(a)(1) of this chapter, and is found to be in a condition for safe operation by the [FAA].
(d) *Other aircraft.* An applicant for a special airworthiness certificate-primary category for an aircraft that meets the criteria of Sec. 21.24(a)(1), and is not covered by paragraph (a), (b), or (c) of this section, is entitled to a special airworthiness certificate if--
(1) The applicant presents evidence to the [FAA] that the aircraft conforms to an approved primary, normal, utility, or acrobatic type design, including compliance with all applicable airworthiness directives;
(2) The aircraft has been inspected and found airworthy within the past 12 calendar months in accordance with Sec. 91.409(a)(1) of this chapter and;
(3) The aircraft is found by the [FAA] to conform to an approved type design and to be in a condition for safe operation.
(e) *Multiple-category airworthiness certificates* in the primary category and any other category will not be issued; a primary category aircraft may hold only one airworthiness certificate.]

(f) Issuance of an airworthiness certificate for a Primary Non-Commercial category aircraft.

(1) Purpose. The FAA issues a Primary Non-Commercial airworthiness certificate to operate a Primary Non-Commercial aircraft

(2) An owner of an aircraft registered within the United States may apply and is entitled

1. More than twenty years have elapsed since the aircraft's date of manufacture.

2. The aircraft is fixed wing and either unpowered or powered by reciprocating engine(s).

3. The aircraft has a current annual inspection (14 CFR 91.409) at the time of application for original issuance.

4. The aircraft must be in condition for safe operation (14 CFR 91.328) for reissuance.

5. Aircraft which holds or has held an Airworthiness Certificate in another Category defined by 14 CFR 23.3

(3) Duration

1. Airworthiness Certificates issued to Primary Non-Commercial Aircraft are valid as long as applicant maintains ownership of the aircraft.

2. Airworthiness Certificates issued to Primary Non-Commercial Aircraft are not transferable. Upon transfer of ownership the current owner may apply for reissuance of the Primary Non-Commercial Airworthiness Certificate.

(4) Multiple Airworthiness Certifications

1. Issuance of a Primary Non-Commercial Airworthiness Certificate does not invalidate or require the surrender of the aircraft's original category airworthiness certificate. Aircraft so certificated hold multiple airworthiness certificates.

2. The aircraft may be operated under it's original standard category airworthiness certificate provided it meets it type design and has a current inspection as required under 14 CFR 91.409(a), (b) or (d).

3. If the aircraft does not meet it's type design requirements, but is in condition for safe operation, it may be operated under its' Primary Non-Commercial Airworthiness Certificate provided the aircraft has a current inspection as required under subsection (d)(1) of this part.

Code of Federal Regulations

Part 91 GENERAL OPERATING AND FLIGHT RULES	
Subpart D—Special Flight Operations	New Regulation

Sec. 91.328

Aircraft having a special airworthiness certificate in the Primary Non Commercial category: Operating limitations.

(1) Primary Non Commercial Category Aircraft are required to observe the FAA Approved Aircraft Flight Manual basic flight operating limitations and or required placard limitations established for the Standard Category aircraft unless otherwise FAA Approved via a Supplemental Type Certificate, Field Approval or other means acceptable to the administrator.

(2) No person may operate Non Commercial aircraft for carrying persons for compensation or hire.

(3) The pilot in command of a Primary Non Commercial aircraft must advise each passenger of the Primary Non Commercial nature of the aircraft, and explain that it does not meet the certification requirements of a standard certificated aircraft.

(4) This aircraft must contain the placards or markings, as required by 14 CFR § 91.9.

(5) The aircraft must display, near each entrance to the cabin, cockpit, or pilot station, in letters not less than 2 inches nor more than 6 inches high, the words "Primary Non Commercial" or display markings as required in 14 CFR 45.22(b).

(6) The pilot in command of a Primary Non Commercial aircraft must hold a pilot certificate or an authorized instructor's logbook endorsement. The pilot in command also must meet the requirements of 14 CFR § 61.31(e), (f), (g), (h), (i), and (j), as appropriate. If required, the pilot in command also must hold a type rating in accordance with 14 CFR part 61, or an LOA issued by an FAA Flight Standards Operations Inspector.

(6) When filing Instrument Flight Rules (IFR), the Primary Non Commercial category of this aircraft must be listed in the remarks section of the flight plan.

(7) Non Commercial (AB) Aircraft require a Phase I flight test program as detailed in 14 CFR 91.319 (b) and 14 CFR 91.305.

(8) Non Commercial (TC) Aircraft that have been altered an extent that would be considered a Major Change to Type Design as defined by 14 CFR 21.93 require a Phase I flight test program as detailed in 14 CFR 91.319 (b) and 14 CFR 91.305.

Code of Federal Regulations

Part 45 IDENTIFICATION AND REGISTRATION MARKING	
Subpart C--Nationality and Registration Marks	Revised Regulation

Sec. 45.22

Exhibition, antique, and other aircraft: Special rules.

(a) When display of aircraft nationality and registration marks in accordance with Secs. 45.21 and 45.23 through 45.33 would be inconsistent with exhibition of that aircraft, a U.S.-registered aircraft may be operated without displaying those marks anywhere on the aircraft if:
(1) It is operated for the purpose of exhibition, including a motion picture or television production, or an airshow;
(2) Except for practice and test fights necessary for exhibition purposes, it is operated only at the location of the exhibition, between the exhibition locations, and between those locations and the base of operations of the aircraft; and
(3) For each flight in the United States:
(i) It is operated with the prior approval of the Flight Standards District Office, in the case of a flight within the lateral boundaries of the surface areas of Class B, Class C, Class D, or Class E airspace designated for the takeoff airport, or within 4.4 nautical miles of that airport if it is within Class G airspace; or
(ii) It is operated under a flight plan filed under either Sec. 91.153 or Sec. 91.169 of this chapter describing the marks it displays, in the case of any other flight.
(b) A small U.S.-registered aircraft built at least 30 years ago or a U.S.-registered aircraft for which an experimental certificate has been issued under Sec. 21.191(d) or 21.191(g) for operation as an exhibition aircraft, as an amateur-built aircraft and which has the same external configuration as an aircraft built at least 20 years ago or a Primary Non-Commercial Category aircraft may be operated without displaying marks in accordance with Secs. 45.21 and 45.23 through 45.33 if:
(1) It displays in accordance with Sec. 45.21(c) marks at least 2 inches high on each side of the fuselage or vertical tail surface consisting of the Roman capital letter "N" followed by:
(i) The U.S. registration number of the aircraft; or
(ii) The symbol appropriate to the airworthiness certificate of the aircraft ("C", standard; "R", Primary; "L", limited; or "X", experimental or "C" for Primary Non-Commercial followed by the U.S. registration number of the aircraft; and
(2) It displays no other mark that begins with the letter "N" anywhere on the aircraft, unless it is the same mark that is displayed under paragraph (b)(1) of this section.
(c) No person may operate an aircraft under paragraph (a) or (b) of this section--
(1) In an ADIZ or DEWIZ described in Part 99 of this chapter unless it temporarily bears marks in accordance with Secs. 45.21 and 45.23 through 45.33;
(2) In a foreign country unless that country consents to that operation; or

Code of Federal Regulations

Part 65 CERTIFICATION: AIRMEN OTHER THAN FLIGHT CREWMEMBERS	
Subpart E – Repairmen	New Regulation

Sec. 65.108

Repairman certificate (Primary Non-Commercial): Eligibility, privileges, and limits.

(a) To be eligible for a Antique Non-Commercial Vintage repairman certificate you must meet the following;

a. Be at least 18 years old

b. Be able to read, speak, write and understand the English language.

c. Demonstrate the requisite skill to determine whether a Antique Non-Commercial Vintage aircraft is in condition for safe operation

d. Be a Citizen of the United States or be a citizen of a foreign country that has been lawfully admitted for permanent residence to the United States

e. Complete a 16 hour training course acceptable to the FAA on inspecting Antique Non-Commercial Vintage

(b) The holder of a repairman certificate (Primary Non-Commercial) may exercise it's privileges on any Antique Non-Commercial Vintage aircraft that is owned by the holder.

(c) Privileges:

(1) Approve and return to service an aircraft that has been issued a special airworthiness certificate in the Primary Non-Commercial category under §21.196 of this chapter, or any part thereof, after performing or inspecting maintenance.

(d) Limitations

(1) Holders of a repairman certificate (Primary Non-Commercial) <u>are not</u> permitted to perform the annual condition inspection on an Primary Non-Commercial aircraft required by 14 CFR 21.196(e)

Attachment B

Proposed Draft Orders required to implement the Primary Non-Commercial Category

1. Revised FAA Order 8130.2 Airworthiness Inspector's Handbook
2. New Order 800-ANC-ARC Defining Required training for Primary Non Commercial Repairman Courses and Evaluation

CHANGE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

ORDER
8130.ARC
CHG ARC

National Policy

Section 2. Primary Non-Commercial Airworthiness Certification

4005. General. The procedures in this section provide guidance for the issuance of FAA Form 8130-7 for aircraft type certificated in the primary non-commercial category in accordance with 14 CFR §21.24 and 21.184.

a. An aircraft must be currently or have previously been type certificated under 14 CFR § 23.3 before a Primary non commercial category airworthiness certificate can be issued.

b. Under the provisions of 14 CFR § 21.24, an applicant for an airworthiness certificate in the Primary non-commercial category is entitled to the certificate if compliance is shown with the requirements of 14 CFR 21.24 and 21.184.

4006. Certification Procedures. The FAA representative should follow the appropriate procedures outlined in paragraph 4002 of this order.

4007. Eligibility.

a. The following aircraft are eligible for a special airworthiness certificate, in the Primary category, are as follows:

6. Aircraft where more than twenty years have elapsed since the aircraft's date of manufacture.

7. Aircraft that are fixed wing

8. Aircraft that are either unpowered (glider) or powered by reciprocating engine(s).

9. The aircraft must be airworthy at the time of application for original issuance or in condition for safe operation for reissuance.

10. The aircraft must hold or has held an Airworthiness Certificate in another Category defined by 14 CFR 23.3

4009. Statement of Conformity. As the Primary Non-Commercial Category does not define a type design, no statement of conformity to this category is required. For initial issuance, the last properly completed annual inspection per 14 CFR 91.409 is considered sufficient evidence of conformity to type design. For reissuance, the last properly completed annual condition inspection per 14 CFR 21.24 is consider sufficient.

4010. Operating Limitations. All aircraft type certificated in the Primary non-commercial category must be operated in compliance with the limitations prescribed in 14 CFR § 91.328.

4012. Airworthiness Certificate. When an application is made for a Primary non-commercial category airworthiness certificate "Primary Non-Commercial" will be entered in block A of FAA Form 8130-7. Carriage of people for compensation or hire is prohibited by 14 CFR § 91.328 for any Primary non-commercial category operation. FAA Form 8130-7 must have the following words entered in block A Primary Non-Commercial ; SEE ATTACHED LIMITATIONS."

4013. Display of Marks (Primary). The FAA must determine that the aircraft displays nationality and registration marks in accordance with 14 CFR § 45.21, 45.22 and 91.328.

4014. Duration of Primary Non-Commercial Airworthiness Certificates

a. Airworthiness Certificates issued to Primary Non-Commercial Aircraft are valid as long as applicant maintains ownership of the aircraft.

b. Airworthiness Certificates issued to Primary Non-Commercial Aircraft are not transferable. Upon transfer of ownership the current owner may apply for reissuance of the Primary Non-Commercial Airworthiness Certificate.

4015. Multiple Airworthiness Certificates

4016. General. Under the provisions of 14 CFR § 21.24, an applicant for an airworthiness certificate in the Primary non-commercial category is entitled to the certificate if compliance is shown with the requirements of 14 CFR 21.24 and 21.184. This issuance of a Primary Non-Commercial Airworthiness Certificate does not invalidate or require the surrender of the aircrafts' original category airworthiness certificate, thus most Primary Non-Commercial category aircraft will be hold dual airworthiness certificates in both its' original category and the Primary non-commercial category.

a. If the aircraft does not currently hold a Airworthiness Certificate for a category listed in 14 CFR 23.3, but has previously held such a certificate, the aircraft is eligible to operate under a Primary Non-Commercial Airworthiness Certificate provided that it is in condition for safe operation as described in paragraph 4009.

b. The aircraft may be operated under it's original standard category airworthiness certificate provided it meets it type design and has a current inspection as required under 14 CFR 91.409(a), (b) or (d). Properly documented and completed inspections as previously noted are the only evidence required for conformance to type design and constitute the authorization for the aircraft to operate it's original standard airworthiness certificate.

c. If the aircraft does not meet it's type design requirements, but is in condition for safe operation, it may be operated under its' Primary Non-Commercial Airworthiness Certificate provided the aircraft has a current inspection as required under subsection (d)(1) of this part.

4017. Inadequate or Fraudulent Maintenance Logbook Entries while Operated in the Non-Commercial Category. Proper Maintenance record keeping as defined in 14 CFR 21.24(d) and 14 CFR 43.9 is essential for the safe reconversion of a Primary Non-Commercial to standard category. In cases where there has been either Inadequate or Fraudulent Maintenance Logbook Entries the aircrafts standard category airworthiness certificate should be revoked.

ORDER DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

8000.ANV.ARC

SUBJ: PROCEDURES TO ACCEPT INDUSTRY-DEVELOPED TRAINING FOR PRIMARY NON-COMMERCIAL CATEGORY REPAIRMEN

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1. PURPOSE. This order assigns the Small Aircraft Directorate (SAD) and Aircraft Maintenance Division, AFS-300, jointly as the responsible offices to accept, maintain, and monitor the industry-developed training for Primary Non Commercial Category repairmen. It also provides guidance to SAD / AFS-300 for accepting industry-developed training for Antique Non Commercial Vintage repairmen maintenance rating.

2. DISTRIBUTION. This order is distributed to the director level in Washington headquarters and the centers; to all regional administrators; to branch level in the Flight Standards Service and the Aircraft Certification Service; to branch level in the regional Flight Standards Divisions; and to all Flight Standards field offices.

3. BACKGROUND. The Flight Standards Service director, AFS-1, has assigned the Small Aircraft Directorate (SAD) and Aircraft Maintenance Division, AFS-300, jointly the responsibility for Primary Non Commercial Category repairman programs. This includes accepting and monitoring required industry-provided training for Primary Non Commercial Category repairman.

a. 14 CFR 21.26 establishes certificates for operating Primary Non Commercial Category aircraft. For the purpose of this order, the following definitions will apply:

(1) Primary Non Commercial Category aircraft. These types of aircraft will be identified as ANV for the purpose of this order.

b. 14 CFR 65.108 establishes a new Primary Non Commercial Category certificate. The specific training requirements for these ratings are as follows:

(1) An ANV repairman certificate is issued to an individual upon successfully completing an FAA-accepted training course of at least 16 hours in length. This rating will allow the repairman to perform all required maintenance on an ANV aircraft owned by him or her - It however DOES NOT allow the holder to conduct the required annual condition inspection specified by 14 CFR 91.409.

4. DISCUSSION. This order contains the policy to be used jointly by the Small Aircraft Directorate (SAD) and Aircraft Maintenance Division, AFS-300 for the acceptance and monitoring of industry-developed training for the Antique Non-Commercial Vintage repairman. Circumstances not covered by this order should be referred to AFS-300 for policy determinations.

5. PRIMARY NON COMMERCIAL OVERVIEW FOR REPAIRMAN RATING TRAINING COURSE. For an applicant to obtain an Antique Non-Commercial Vintage repairman certificate requires a minimum of 16 hours of training. The goal of the 16-hour course is to take an individual with zero knowledge and train that individual to maintain an ANV aircraft to a level of proficiency comparable to a level 3 in 14 CFR part 147 appendix A. Level 3 requirement means that the repairman can make a decision that an aircraft is in a condition for safe operation without additional technical assistance. To ensure a level 3 standard of training, the 16-hour course will be limited to 16 students per instructor for lecture and 8 students per practical project.

a. The Repairman (ANV Aircraft) Course. This course will contain at least six elements:

(1) Regulations and other guidance applicable to ANV aircraft, review of operating limitations, annual condition inspection record entry, a review of FAA Airworthiness Directives (AD) and manufacturer's safety directives.

(2) Inspection procedures in Advisory Circular (AC) 43.13-1B, Acceptable Methods, Techniques, and Practices Aircraft Inspection and Repair, and use of manufacturer's manuals, technical data, and personal safety in the work environment.

(3) Aircraft theory of flight and discussion of aircraft systems, to include proper operation and critical areas that are prone to failure or fatigue for at least the following systems:

(a) Airframe, including instrumentation, landing gear, brakes, etc.;

(b) Engine, including fuel and oil systems;

(c) Propeller and gear reduction unit;

(d) Accessories, including ballistic parachute; and

(e) Flight control operation and rigging.

(4) Use of an inspection checklist provided by the manufacturer or found in FAA AC 90-89A, Amateur-Built Aircraft and Ultralight Flight Testing Handbook, appendix A.

(5) Student course evaluation (critique).

(6) A required final test that will contain no less than 50 questions with multiple-choice answers.

NOTE: Applicant must achieve an 80 percent score or higher on the final test to pass the course. If the applicant fails, the course must be retaken in its entirety.

b. Requirements for FAA Acceptance of a 16-Hour Inspection Rating Course. An applicant submitting a 16-hour ANV aircraft repairman rating course must submit the following information to AFS-300/SAD.

(1) A letter of request, identification of the person or company, location, telephone number, contact person, and the class of Antique Non Commercial Vintage the applicant wishes to teach. If instructors are added or removed from the course, the course provider must submit a letter to AFS-300/SAD, explaining the change at least 2 weeks before presenting the next course. Included in the applicant's letter of request is a statement that the applicant will allow FAA access to any location where the training is being held.

(2) A disk with Microsoft-compatible files containing the following:

(a) Course outline covering the subjects taught and the length of time each subject is taught. The course should be 75 percent lecture and 25 percent practical training.

(b) Description of the training aids used, copy of the PowerPoint (or similar program) presentations, and a list of the videotapes, parts, tools, etc., used in the course.

(c) Handbooks and hand-out material.

(d) Description on how the training will be provided, and how names of students and each test score result will be maintained for a 2-year period.

(e) A sample certificate of completion, course critique, and course test.

(f) Instructor's qualifications. The instructor must be an individual with at least a mechanic certificate with an airframe and powerplant rating with 3 years experience working on General Aviation (GA) aircraft of 6,000 pounds or less.

(g) A schedule of where and when the training will be provided over the next 12 months.

(i) If the course will be presented at multiple locations nationwide, the applicant must provide AFS-300/SAD with:

(A) A schedule of classes and locations for the first 12 months.

(B) A schedule of classes and locations for the second 12 months, at least 30 days before the 1 year anniversary date of the letter of acceptance.

(C) A general description of how training is provided at each location.

(ii) If the course will be presented at a fixed location, the applicant must provide AFS-300/SAD with:

(A) A schedule of classes for the first 12 months.

(B) A schedule of classes for the second 12 months, at least 30 days before the 1 year anniversary date of the letter of acceptance.

(C) A description of the facility.

NOTE: The applicant must notify AFS-300/SAD within 7 working days of any change to the schedule (e.g., a course is added or canceled).

(h) A list of the make and models of Antique Non-Commercial Vintage that will be used for the practical portion of the training.

(i) Explanation of how the course provider will assign a proctor to collect the student course critiques, and send them in a self-addressed and postage-paid envelope to AFS-300/SAD. A proctor is a student who agrees to perform the task identified above. (See Appendix 1 for a sample student course critique.)

(j) A description of how the course provider will track student attendance and how make-up time will be addressed. All make-up time must be completed within 7 days after the scheduled end of the course.

c. AFS-300/SAD's Responsibilities for the 16-Hour Inspection Rating Course.

(1) AFS-300/SAD will send a letter to the applicant stating that the course is FAA-accepted for a period not to exceed 24 calendar-months from the date on the letter. Sixty days prior to the end of the 24-month acceptance period, the applicant must reapply to AFS-300 for continuing authority to provide FAA-accepted training. If the training provider fails to reapply, a notification letter will be sent to the provider stating that the course is no longer FAA-accepted, and the provider must stop further training.

(2) AFS-300 / SAD will assign an identification (ID) number to each course. The course ID will contain four elements: the prefix "ANVR" for the ANV aircraft repairman.

NOTE: The course provider is required to display the FAA's letter of acceptance at each location where the course is given. The original letter of acceptance can be displayed on the wall, or a photocopy can be displayed in the student's workbook.

(3) AFS-300 / SAD will maintain a computer database record on all accepted training providers, including training course ID numbers for each course.

(4) If an applicant does not meet the minimum training course requirements, AFS-300 will mail a letter of denial to the applicant within 30 working days after receipt of the application. If a letter of acceptance has been issued but FAA field surveillance finds the training provider course is substandard, AFS-300 may suspend or revoke the letter of acceptance by notifying the training provider, in writing, within 5 working days and include the date when the suspension or revocation becomes effective. AFS-300 will immediately notify and revoke the Antique Non Commercial Vintage repairman certificate of any individual who attended any training provider's course during the period of substandard instruction. No credit will be given to individuals who fail to complete a training course.

7. DIRECTIVE INFORMATION AND FEEDBACK. For additional information, clarification, or to suggest improvements to this order, contact the Aircraft Maintenance Division, AFS-300, at (202) 267-3546.

/s/ John M. Allen for
James J. Ballough
Director, Flight Standards Service

APPENDIX 1.
ANTIQUE NON COMMERCIAL VINTAGE REPAIRMAN TRAINING COURSE EVALUATION

Course Name: _____ **Course Number:** _____
Instructor: _____ **Instructor:** _____
Instructor: _____ **Instructor:** _____
Date: _____ **Name (Optional):** _____

Rate the quality of the items below based on the following rating scale. 1	2	3	4	NA
POOR (Provide comment on the next page)	**FAIR** (Provide comment on the next page)	**GOOD**	**EXCELLENT**	**NOT APPLICABLE**

Attachment C

Canadian Owner Maintenance Class Safety Data and Accident Rates

Overview

The Owner-Maintained Aircraft Certification category was created by Transport Canada on April 17, 2000 as a means to allow owners of certain private aircraft to continue to operate their aircraft safely in an environment where replacement parts are difficult, if not impossible to obtain.

1. This category allows an aircraft to be converted from type-certificated airworthiness certification to a special certification category where owners become responsible for maintaining their own aircraft, in a manner very similar to our experimental amateur-built and light-sport aircraft categories.
2. Once converted to the Owner-Maintained certification category the owner is prohibited from converting it back to a type-certification.
3. Owner-Maintained Aircraft are limited to a gliders (Canadian Aviation Regulation (CAR) standard 522) and small airplanes (CAR standard 523) that meet these specific criteria:
    a. Type certificate does not authorize more than four occupants;
    b. Maximum certificated take-off weight does not exceed 1,814 kg (4,000 pounds);
    c. Aircraft is of a type and model that has not been manufactured during the preceding 60 months;
    d. Fewer than 10% of Canadian aircraft of the type and model concerned are operating in Canadian commercial air service at the time of application;
    e. Powered by a single, normally aspirated, piston engine and is unpressurized; and
    f. Except for gliders, powered gliders or aircraft with airframes of wooden construction, the aircraft type and model has a fixed landing gear and a fixed pitch propeller (ground adjustable propellers are considered fixed pitch propellers)

Accident Rates

The overall accident trends and rates indicate that the Owner-Maintained aircraft category is a safe fleet with accident rates comparable to Standard category. The following is an overview of Canadian O-M accident rates and includes a comparison to accidents rates for the Canadian Civil Fleet as a whole. Data Source EAA unless otherwise noted.

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of Accidents Involving Canadian Owner-maintained Aircraft since January 1, 2002	3	2	3	8	5	4	1	3	
Number of Owner-Maintained Aircraft Registered	239	268	302	335	369	404	446	483	502
Accident Rate per 1,000 aircraft registered	12.55	7.46	9.93	23.88	13.55	9.90	2.24	6.21	
Comparison – Accident Rate of all Civil Aircraft registered in Canada									
Accident Rate per 1,000 aircraft registered	11.86* (264 total)	12.53* (284 total)	10.5* (240 total)	10.55* (251 total)	11.47* (280 total)	9.8	8.7	8.4	
Number of Canadian Civil Aircraft Registered	22,258*	22,650*	23,123*	23,771*	24,397*	26,141	26,948	27,349	

* *indicates data from Transport Canada or derived from Transport Canada Statistics*

Specific Causes of O-M Accidents

In most years the O-M accident rate appears to below the rate for standard category aircraft in general. While the number of O-M aircraft is statistically significant, normal random fluctuations could account for this number. As the number of O-M accidents is small, it is possible to evaluate them on individual basis to see the owner maintenance privileges contributed to the accidents.

Specifically, the causes of all the O-M maintenance category accidents breaks down as follows:

- 11 of the O-M accidents were seaplane landing or takeoff incidents.
- 5 of the O-M accidents were gusty winds landing or takeoff incidents.
- 4 of the O-M accidents were snow or ice landing or takeoff incidents.
- 2 of the O-M accidents were caused by not securing the aircraft on the ground.
- 1 of the O-M accidents occurred when the pilot flew into powerlines.
- 6 of the O-M accidents were either undetermined or wreckage not located.

Source EAA and Transport Canada.

It is illustrative to note that in no case has the fact that the Aircraft is Owner Maintained or the use of non-certified parts been a major or contributing factor to any of the accidents listed.

Conclusion

The accident rate data from the Canadian Owner Maintenance Category covers over a decade of experience with a statistically significant fleet size. It indicates that both in terms of accident rate and cause, owner maintenance category aircraft are as safe or safer than standard category aircraft. Neither the Owner Maintenance Program nor the use of non certified components has contributed to an accident in the Canadian O-M fleet in the last decade.

It is significant that in many of the years looked at the O-M aircraft actually had a better (safer) accident rate then the Standard Category aircraft. Likely this is not due directly to the O-M program, but as an indirect effect. It is likely that because of the lower costs and greater involvement of the aircraft owners, usage rates improved which contributed towards pilot currency. In addition, owners may have replaced components more frequently due to the lower cost thus improving the overall maintenance of the aircraft. Further, it is also likely that many of the aircraft are equipped with improved avionics systems, allowing safer flight, than comparable standard category aircraft because of the less burdensome approval process and lower cost.

Therefore it is safe to conclude that the Canadian O-M system has not detrimentally impacted safety and it is likely that it actually in directly improved safety.

Appendix G

Attachment D

General Aviation Manufacturers Association Statistical Databook & Industry Outlook data cited in Background information

Active U.S. General Aviation and On-Demand FAR Part 135 Aircraft by Type (2010)

Piston Engine Airplanes	155,419
Turboprop Airplanes	9,369
Turbojet Airplanes	11,484
Rotorcraft	10,102
Gliders	1,899
Lighter-Than-Air	3,785
Experimental	24,784
Light Sport Aircraft	6,528

FIGURE 1.2 U.S. Manufactured General Aviation Airplane Units and Billings (1974-2011)

U.S. Department
of Transportation
**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, DC 20591

JUN 10 2013

Mr. Greg Bowles
Director, Engineering & Manufacturing
General Aviation Manufacturers Association (GAMA)
1400 K Street NW, Suite 801
Washington, DC 20005-2485

Dear Mr. Bowles:

This letter is in response to your submittal of the 14 CFR Part 23 Reorganization Aviation Rulemaking Committee (ARC) recommendation report on June 5, 2013 to the Federal Aviation Administration (FAA).

We wish to thank the 14 CFR Part 23 Reorganization ARC members who provided resources to develop, review, and approve the recommendation. The industry-wide cooperation and engagement achieved through your leadership was a necessary enabler to produce the innovative set of recommendations presented in your report.

The FAA accepts the 14 CFR Part 23 Reorganization ARC recommendation report and considers the original tasking issued on August 15, 2011 completed. The recommendation report and the related documents will be placed on the FAA Committee Database website at:
http://www.faa.gov/regulations_policies/rulemaking/committees/documents/, when appropriate.

Sincerely,

Earl Lawrence

Earl Lawrence
Manager, Small Airplane Directorate
Aircraft Certification Service