Light-Sport Aircraft Manufacturers Assessment (LSAMA)

FINAL REPORT

Production and Airworthiness Division, AIR–200

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EXECUTIVE SUMMARY

This report presents the results of the Light-sport Aircraft Manufacturers Assessment (LSAMA), (herein referred to as assessment and team). This executive summary briefly discusses the assessment team's analysis, conclusions, and recommendations based on data collected during the assessment.

BACKGROUND

During the 2008 Experimental Aircraft Association (EAA)/Federal Aviation Administration (FAA) Recreational Aviation Summit, the FAA Aircraft Certification Service, Production and Airworthiness Division (AIR–200) agreed to assess the current state of the light-sport aircraft (LSA) industry. AIR–200 chartered and sponsored an assessment team, comprised of individuals from several offices within FAA Aviation Safety (AVS).

GOAL

The assessment team's goal was to review current LSA manufacturing industry systems and processes through on-site evaluation, analysis, and reporting. The team was also tasked to recommend enhancements to industry consensus standards for LSA design, manufacturing, continued airworthiness, and maintenance and FAA processes and procedures. The team's methodology was to collect data from LSA manufacturers, including their extensions and distributors, located in the United States. The team collected data on LSA industry compliance with applicable regulations, standards, and existing processes.

METHODOLOGY

The team developed survey questions and data gathering tools, performed evaluations, analyzed collected data, and developed conclusions and recommendations. The team designed the questions to evaluate the LSA industry's understanding and application of applicable regulations, standards, processes and procedures. The team developed conclusions and recommendations based on the analysis of the collected data, team observations, and comments and suggestions of individuals the team interviewed during the assessment.

The team evaluated 14 manufacturers, including their extensions and 16 distributors. This sample of 30 LSA facilities established a 93 percent confidence level that the results of this assessment represent the LSA industry as a whole. The assessment surveys began in September 2008 and were completed in March 2009. The assessment survey participants were cooperative and provided unrestricted access to their LSA facilities. They exhibited a willingness and desire to build and promote safe LSA.

CONCLUSIONS

This report identifies four areas that need minor to significant improvement. Deficiencies vary from facility to facility, by degree, quantity, and type.

1. **Compliance with FAA-accepted consensus standards**.

   The majority of LSA facilities surveyed could not fully demonstrate their ability to comply with certain consensus standards. The assessment indicates that manufacturers are making statements of compliance for aircraft that may not fully meet certain consensus standards. We have concluded that relying solely on the manufacturer's statements of compliance, for the issuance of airworthiness certificates, should be reconsidered.

2. **Implementation of manufacturing systems**.

   Some manufacturers have failed to implement widely accepted internal quality control and production procedures that are necessary to assure minimal compliance to the ASTM consensus standards. Many manufacturers also lacked corrective action systems used to address systemic deficiencies. Further compounding this scenario is the fact that current consensus standards identify only minimum requirements without a systems-based approach which only exacerbates procedural and record keeping weaknesses. We conclude that these lack of controls may result in the production and distribution of such poorly documented aircraft that it may be very difficult to verify conformity.

   Distributors have not developed and implemented manufacturing and quality system procedures for many of the tasks they perform. When distributors perform assembly, inspections, and other functions, they seldom use the manufacturers' procedures, records, or controls. The consensus standards do not require distributors to use process control procedures and as a result, distributors have only partial manufacturing and quality system procedures and associated records. We conclude that the consensus standards need revision to require documented controls and processes for assembly and other production functions that distributors perform prior to airworthiness inspections and flight.

3. **Understanding FAA regulatory requirements, policy and guidance, and industry consensus standards**.

   We conclude that industry and FAA designees have inadequate knowledge of FAA regulatory requirements and policies and ASTM/industry consensus standards. The evidentiary factors for this conclusion include: (1) inadequate application of manufacturing process procedures necessary to establish eligibility, (2) misinterpretations of the intent of FAA regulatory requirements, policy and guidance, and industry consensus standards, (3) misinterpretations of overall roles and responsibilities of the various industry entities (manufacturers, their extensions and distributors), (4) non-standardized methods and sequencing of airworthiness certification, and (5) uncertainty of appropriate contacts for needed guidance.

4. **Industry's system for managing, assessing, and maintaining the effectiveness of the consensus standards**.

   The industry does not have a means to communicate with manufacturers on how to comply with the requirements of the consensus standards. We conclude that the process for evaluating compliance with the standards and taking corrective action needs significant improvement. Additionally, the process for maintaining and updating consensus standards needs improvement.

RECOMMENDATIONS

The team developed its recommendations based on data analysis, conclusions, trending indicators, and industry responses to a questionnaire. Specific recommendations are located in section 2.1 through 2.8 of this report, and the following summarizes those recommendations:

Industry

- Take immediate steps to fully comply with FAA regulatory and consensus standard requirements.
- Standardize the continuous airworthiness notification process for all LSA types.
- Develop training to ensure industry fully understands FAA regulatory and policy requirements, and the methods and means to comply with those requirements.
- Establish periodic meetings between FAA and industry to work toward full compliance to FAA regulatory and consensus standard requirements.
- Conduct an initial conformity inspection of all first-time-manufactured LSA models.
- Continue assessments of manufacturers, extensions, and distributors.
- Review current accepted consensus standards for adequacy and revise existing standards or create new standards where necessary.

FAA

- Update existing policy (Advisory Circulars and Orders) pertaining to airworthiness certification requirements, registration marking, and designee management.
- Update Designated Airworthiness Representative(s) (DAR) and advisor training.
- Establish a process to receive safety alerts, directives, and other pertinent information.
- Continue oversight of the LSA manufacturers to assure compliance with FAA requirements and ASTM consensus standards.

INTRODUCTION

1.0 BACKGROUND

1.0.1 Light-sport Aircraft Manufacturers Assessment

On July 16, 2004, the Federal Aviation Administration (FAA) issued a new rule for the manufacture, certification, operation, and maintenance of light-sport aircraft (LSA), which became effective September 1, 2004. LSA have a maximum takeoff weight of not more than 1,320 pounds (1,430 pounds for aircraft intended for operation on water) and are heavier and faster than ultralight vehicles. LSA include airplanes, gliders, balloons, powered parachutes, and weight-shift-control aircraft. Adoption of the rule was necessary to address advances in sport and recreational aviation technology, lack of appropriate regulations for existing aircraft, several petitions for rulemaking, and petitions for exemptions from existing regulations.

The FAA adopted the rule to provide for the manufacture of safe and economical aircraft that exceeded the limits previously allowed by ultralight aircraft regulations. The rule also allows certificated pilots to operate these aircraft for sport and recreation, carry a passenger, and conduct flight training and towing in a safe manner.

In January 2008, the FAA established the LSA Manufacturers Assessment to evaluate the health, state of systems implementation, and compliance of the LSA industry as a whole. Specifically, the goal of the assessment was to assess current LSA industry manufacturing systems and processes through on-site evaluation, analysis, and reporting under a continuous improvement process, and to provide recommendations to enhance aviation safety.

1.0.2 Assessment Team

AIR-200 chartered and sponsored an assessment team. The team comprised individuals from AIR-200, the Aircraft Engineering Division (AIR-100), the International Policy Office (AIR-40), Flight Standards Service, Aircraft Maintenance Division (AFS-300), and the Aircraft Certification Service Small Airplane Directorate (ACE-114). A listing of these participating offices is provided in appendix C to this report. The team was responsible for developing assessment questions and data gathering tools, performing evaluations, analyzing data, and developing conclusions and recommendations. All items were developed with team consensus.

The team also developed a team operating agreement, which outlined steps to take if a significant safety issue requiring immediate action was discovered during an evaluation.

1.1 SCOPE

The team collected data from LSA manufacturers, their extensions, and distributors, which are individually and collectively referred to as "LSA facilities" in this report (see appendix B, Glossary). The assessment collected relevant data on LSA industry compliance with regulations, standards, and processes. The team used the data collected to evaluate and report on the

LSA industry as a part of FAA safety oversight. The FAA did not use the assessment and evaluation of collected data for individual light-sport manufacturer compliance audits.

1.2 METHODOLOGY

1.2.1 Determination of Sample Size and Selection of LSA Facilities

A representative sample size of LSA facilities and of associated confidence levels were calculated as part of this assessment. Calculations were based on the total population of LSA facilities within the United States as of June 8, 2008 (52). This information was obtained from the EAA Web site. A graphical breakdown of facility types is presented in figures 1 and 2.

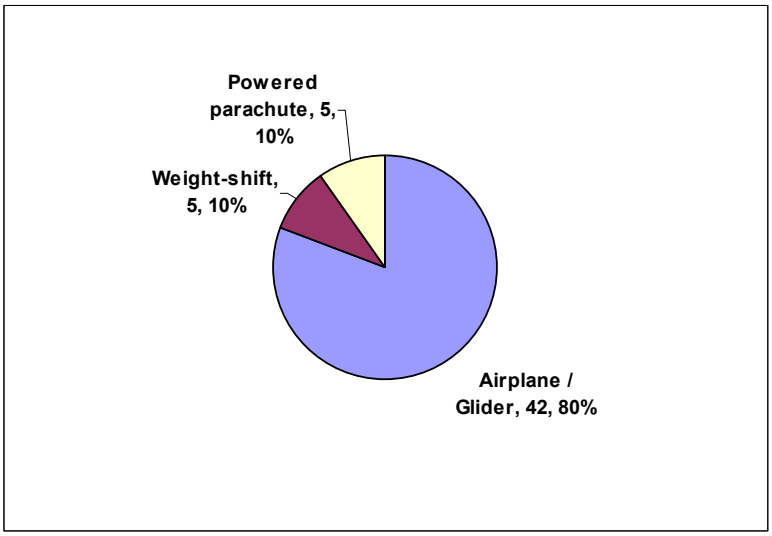

Figure 1 – Facility by Aircraft Type

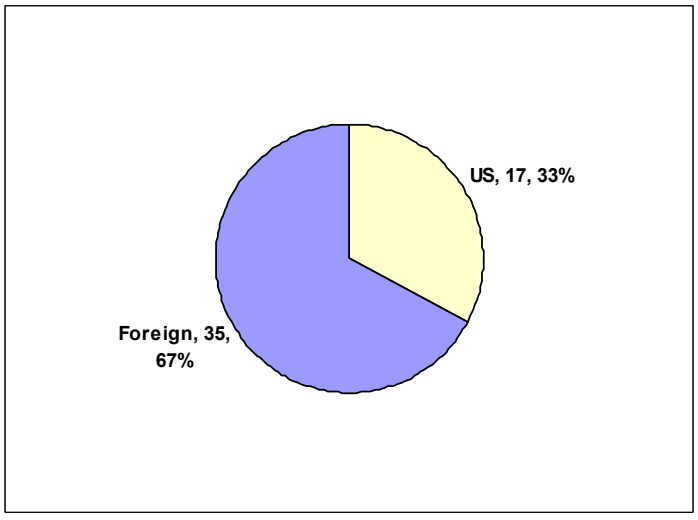

Figure 2 – U.S. vs. Foreign Facilities

The sample size was determined by performing calculations based on various confidence levels, assuming a standard distribution. No differentiation was made for facility type or aircraft type. The calculations consider confidence level, degree of variability, and sample precision. Table 1 presents the confidence levels and associated sample sizes. Calculations were based on choosing a degree of variability of 30 percent and sample precision of 10 percent.

An initial confidence level of 92 percent was chosen for the assessment; this corresponded to evaluating 29 LSA facilities. However, the team evaluated an additional facility, providing an overall confidence level of 93 percent based on the LSA facility population as of June 8, 2008. This confidence level corresponds to a 93 percent confidence that the results of this assessment represent the LSA industry as a whole.

Population = 52	
Confidence Level	Sample Size
98%	36
95%	32
93%	**30**
92%	29
90%	27
75%	18
50%	8
25%	2
10%	1

Table 1. Sample Size Determination

To minimize travel, the team chose survey locations in specific geographic areas. The team evaluated LSA facilities in Florida (nine), Georgia (three), North Carolina (four), California (three), Wisconsin (three), Michigan (four), Texas (two), Virginia (one), and Connecticut (one), including 14 manufacturers and manufacturer extensions, and 16 distributors. Each evaluation was a 1-day event. Two- to four-person teams composed of members from the team conducted the evaluations.

1.2.2 Assessment Questions

The team developed 156 questions to evaluate how the LSA industry understands and applies applicable regulations, standards, and processes. The majority of questions were based on the FAA-accepted ASTM international consensus standard requirements (formerly the American Society for Testing and Materials) (referred to in this report as ASTM consensus standards). Some questions were designed to evaluate the application of current best practices used in the aviation industry.

1.2.3 Assessment Question Grouping

The team grouped the questions into six major sections for data collection and analysis:

- Continued Airworthiness System
- Product Conformity to Regulations
- Manufacturer Extension/Distributor Assembly Procedures and Documentation System
- Compliance to ASTM Design Standards
- Manufacturer's Quality Systems

- Maintenance Procedures and Documentation System

The team further identified subtier categories of questions within each major section.

1.2.4 Data Collection and Analysis Process

The team used both formal and informal data collection methods during this assessment. The methods included auditing techniques, interviewing, and soliciting comments and suggestions.

Most answers to questions were scored on a 0 to 5 scale. Scores were totaled and averaged. Because the team derived questions for specific LSA subjects, each question did not necessarily apply to every facility. Questions the team determined were not applicable (N/A) to a facility or not evaluated were not scored with a numerical value and were not included for determining averages. An example question worksheet is provided below (figure 3).

Light Sport Evaluation and Assessment Project Job Aid – Quality System Functions

Facility Name:
Facility Location – Country:
Facility Location – State:
Manufacturer, Extension, or Distributor:
Full Assembly or Partial:
Aircraft Type:
Number of Employees:
Number of Aircraft Produced Per Year:

	QUES.	RESPONSE							PROCESS QUESTION
Reference:		0	1	2	3	4	5	Not Evaluated for Time: NET N/A for Facility Type: NAFT N/A no A/C available: NAAC N/A no Records Available: NARA	*Note: Use the following scores:* *Manufacturing processes not documented = 0* *Personnel using out of date documentation = 1* *Personnel not using documentation = 2* *Personnel do not verify currency of documentation = 3* *All processes not documented (systemic) = 3* *All processes not documented (isolated) = 4* *All processes documented and available = 5*
ASTM Consensus Standard F2279 6.1, 6.2, and 6.3 **Engineering and Manufacture**	**2C**	Are all manufacturing processes and procedures documented and readily available to personnel? (If the facility does this function or has information for this function, score this question. Do not use N/A.)							
		Instructions: Check to see that personnel are verifying they use current documentation and that they are using documentation during the manufacturing process.							
		Comments:							
6.3 *Production Documentation*—The manufacturer shall maintain a record of all production documentation, including revisions. Production documentation may include, but is not limited to, the following: 6.3.1 Parts lists, 6.3.2 Process routings, 6.3.3 Component and assembly drawings, 6.3.4 Manufacturing instructions and specifications, 6.3.5 Tooling and gauge drawings, 6.3.6 The AOI, 6.3.7 The maintenance manual, and 6.3.8 The QAM.									

Figure 3. Sample Question Worksheet

1.2.5 Manufacturer's Facility Questionnaire

In addition to gathering data based on specific questions, the team gave the assessed LSA facilities an opportunity to contribute information they considered important. During each assessment, the team gave a representative of the facility a Manufacturer's Facility Questionnaire and return envelope addressed to AIR-200. Before the start and during the out brief of each assessment, the team requested that the representative of the LSA facility complete the questionnaire and return it to the FAA as soon as possible. The team also asked the LSA facility representative to comment on the questionnaire regarding any aspect of the assessment and about LSA in general. The results of the questionnaire are discussed in section 2.7.

1.2.6 Data Limitations

This report presents data collected during the assessment and selected discussion. The following must be considered when reviewing the data:

The team was tasked with assessing LSA manufacturers. However, in conducting the assessment, the team discovered that over half of the participants were distributors.

The assessments were limited to LSA facilities located in the United States, but many LSA aircraft involved in the assessment were designed and/or built in foreign countries for sale in the United States (that is, over half of the participants were distributors of foreign designed/built aircraft).

The assessment included 156 total questions; however, the number of questions answered by individual participants ranged from a low of 10 to a high of 130 (the average number of responses was a fraction over 87). Examples of the reasons for this follow:

- Distributors frequently could not respond to design or manufacturing-specific questions, especially if the design or manufacturing activities took place in a foreign country,
- Some questions were tailored to very specific activities (for example, assembly by distributors) which were not common to all participants, and
- Some questions asked about specific types of aircraft (for example, airplanes) that could not be answered by manufacturers/distributors of other aircraft types (for example, powered parachutes).

Assessment results related to types of aircraft must be viewed relative to the number of respective participants. For example, the assessment included 22 airplane manufacturers/ distributors and two glider manufacturer/distributors.

1.3 Organization of the Data Analysis/Discussion Section

Each of the paragraphs in the Data Analysis/Discussion section is presented using the same format: data presentation, data analysis, conclusion(s) based on the analysis, and recommendation(s) based on the conclusion(s).

The Data Analysis/Discussion section is organized using a tiered approach. An outline is provided below:

Analysis — General Overall, *Section 2.0*

- Continued Airworthiness System (CA), *Section 2.1*
  - General Discussion – CA
- Product Conformity to Regulations (PCR), *Section 2.2*
  - General Discussion – PCR
- Manufacturer Extension/Distributor Assembly Procedures and Documentation System (MEDAPD), *Section 2.3*
  - General Discussion – MEDAPD
- Compliance to ASTM Design Standards (CDS), *Section 2.4*
  - General Discussion – CDS
- Manufacturer's Quality Systems (QS), *Section 2.5*
  - General Discussion – QS
- Maintenance Procedures and Documentation System (MPD), *Section 2.6*
  - General Discussion – MPD
- Manufacturer's Facility Questionnaire, *Section 2.7*
  - General Discussion – Manufacturer's Facility Questionnaire
  - Manufacturer's Facility Questionnaire Results – Analysis Summary
- Other Data, *Section 2.8*
  - General Discussion – Other Data
  - Specific Analysis – Other Data

The Data Analysis/Discussion section first presents a general overview. The narrative presents analysis, conclusions, and recommendations that apply to all of the major groups together.

The next level of discussion applies to each major group. It begins with a general narrative that summarizes a major group, followed by overall conclusions and recommendations that apply to the major group.

2.0 ANALYSIS— GENERAL OVERVIEW

The FAA conducted this assessment at 30 manufacturers, extensions, and distributors. All provided unrestricted access to their LSA facilities. During the interviews the participants were cooperative and willing to answer questions to the best of their ability. The LSA facilities involved significantly contributed to the successful completion of this assessment.

This report recommends correcting and improving several different areas of the LSA manufacturing industry and FAA policy and guidance. Many of the companies surveyed during this assessment exhibited exuberance and confidence in their contribution to the LSA industry. There is a willingness and desire, regardless of experience level, to build and promote safe LSA.

The recommendations below reflect a summary of the individual and section recommendations presented later in this report. Furthermore, the conclusions come from a consideration of how the individual sections support each other.

Graphical data is presented in Appendix D of this report.

NOTE: There was not a significant difference in the overall average scores between distributors, manufacturers and extensions, and all LSA facilities.

2.0.1 Compliance

A review of the overall results indicates that a majority of LSA manufacturers could not fully demonstrate their ability to comply with FAA regulatory and policy requirements. The section summaries indicate that the manufacturer's ability to demonstrate compliance varied a great deal.

Conclusion: LSA manufacturers could not fully demonstrate compliance to FAA regulatory and policy requirements.

Recommendation: LSA industry should take immediate steps to fully comply with FAA regulatory and policy requirements.

Recommendation: Industry should establish periodic meetings to work towards full compliance with FAA regulatory and policy requirements.

2.0.2 Initial Conformity Check

Most of the aircraft reviewed during the assessment exhibited deficiencies in the ability to fully meet basic requirements in certain ASTM consensus standards. Therefore, an initial standardized evaluation should be conducted for all first-time LSA models. The initial acceptance evaluation should include document review, manufacturing record review, audit of compliance to standards, and special light-sport aircraft (SLSA) conformity inspection. The evaluation should inspect aircraft and verify whether they meet applicable FAA-accepted

consensus standards, 14 CFR part 21 rules, and any LSA-related policy and guidance. The evaluation should encompass all requirements of the applicable standards.

Conclusion: LSA evaluated as a part of this assessment did not fully conform to certain FAA-accepted ASTM consensus standards.

Recommendation: LSA manufacturers should conduct an initial conformity inspection of all first-time-manufactured LSA models, including standards, any regulatory required documentation and records review, along with an SLSA conformity inspection. Airworthiness certificates should not be issued until all issues are resolved.

2.0.3 Oversight

A review of the data identified that many assessed LSA facilities did not fully comply with ASTM consensus standards in the area of continuous oversight. Manufacturers, their extensions and distributors could not show that they adhere to all consensus standard requirements. Additionally, many LSA facilities had no process in place to conduct external or internal audits. For those LSA facilities that did have audit programs in place, there was no corrective action process to address audit findings.

To assure compliance, a light-sport manufacturer oversight program with periodic evaluations of LSA manufacturers, their extensions and distributors should be considered. The evaluation should sample design elements, quality system elements, continued airworthiness system procedures, marking requirements, production control systems, and maintenance publications applicable to LSA. An oversight program should evaluate those items against the appropriate FAA-accepted consensus standards, applicable 14 CFR part 21 rules, and other policy and guidance relevant to LSA. Manufacturers should be required to implement corrective action plans for findings discovered during the recommended oversight activities.

Conclusion: The LSA industry is not adequately conducting oversight of its manufacturing operations.

Recommendation: Industry should continue assessments of LSA manufacturers, extensions, and distributors.

2.0.4 Advisory Material

Many LSA facilities showed weaknesses in written procedures, knowledge, or experience (see section 2.7, Manufacturer's Facility Questionnaire) related to the design, manufacture and continued airworthiness of LSA. LSA manufacturers need advisory material describing basic elements of manufacturing, design, quality, and continued airworthiness systems to include:

- Continued airworthiness processes.
- Handling of airworthiness directives (ADs) on products with type certificates (TC).
- Processes for design elements, including testing methods to substantiate design.
- Explanation of the sequencing and importance of special flight permits for testing.

- Explanation of the proper sequencing and importance for completing the aircraft before issuing an LSA certificate.
- Major repair and alteration processes.
- Maintenance instructions and their distribution.

Conclusion: The LSA manufacturing industry lacks sufficient guidance to ensure compliance to FAA rules and FAA-accepted consensus standards.

Recommendation: FAA should update existing policy (Advisory Circulars and Orders) pertaining to airworthiness certification requirements, registration marking, and designee management.

2.0.5 Consensus Standards

The content and development of the FAA-accepted consensus standards is currently the responsibility of the standard setting bodies. The FAA reviews consensus standards to provide a minimum acceptable level of safety when LSA are designed, manufactured, and continuously supported by LSA facilities.

The data indicates that some areas of current FAA-accepted consensus standards are ambiguous or lack basic requirements. Many of the consensus standards lack processes and requirements for creating records or traceability.

Conclusion: Consensus standards need clarification and expansion, plus incorporation of additional requirements. Also, there are insufficient resources for continuous maintenance of consensus standards.

Recommendation: Current ASTM and FAA accepted consensus standards should be reviewed for adequacy and revised as necessary. Dedicated resources should be provided for continuous maintenance.

2.0.6 Designated Airworthiness Representatives (DAR)

There is evidence that DARs have not adequately followed FAA directives. Data recorded at manufacturers, extensions, and distributors indicates multiple errors in DAR review of application packages and supporting documentation, to include FAA Form 8130-15, Light Sport Aircraft Statement of Compliance.

Conclusion: In specific areas, some FAA DARs are not following FAA directives.

Recommendation: The FAA should update DAR and FAA advisor training.

2.0.7 Availability of Safety Critical Information

The LSA industry currently uses safety directives and safety alerts to disseminate safety critical information. ASTM requirements to disseminate that information to appropriate airworthiness authorities and owner/operators differ by type of aircraft (powered parachute, airplane, etc). The assessment results show that LSA manufacturers lack adequate systems to develop and distribute safety critical information.

Conclusion: The current system for distributing safety alerts and safety directives for LSA aircraft is inadequate.

Recommendation: Industry should standardize the continuous airworthiness notification process for all types of LSA.

Recommendation: The FAA should establish a process to receive safety alerts, directives, and other pertinent information.

2.0.8 Industry Training

The LSA industry has been in existence for approximately 5 years. The data indicates a segment of the LSA industry needs more experience and knowledge in developing and maintaining an LSA manufacturing infrastructure. In addition, a significant portion of LSA manufacturers were unaware of standard manufacturing practices and processes used throughout the aviation industry.

Conclusion: Increasing the knowledge base of the LSA industry will improve manufacturer competence, resulting in safer and more reliable products.

Recommendation: Industry should develop initial and continuous training to ensure the manufacturers fully understand FAA regulatory and policy requirements, and the methods and means to comply with those requirements. FAA designees will be trained by the FAA.

2.1 CONTINUED AIRWORTHINESS SYSTEM

2.1.1 General Discussion—Continued Airworthiness System

Specific data for this section has been analyzed and is combined below to provide a general discussion of concerns relating to LSA Continued Airworthiness. Data results are discussed to exemplify areas for improvement and recommendations are provided for those resultant areas.

Data shows that some manufacturers provide insufficient and or inadequate instructions for their customers to comply with manufacturer safety directives. Related data supports a need for clear instructions and procedures to increase manufacturer's understanding of compliance to standards in general, regarding flight and service difficulty issue requirements, and concerning operations safety risk assessment procedures. In response, the assessment team recommends that the consensus standards clarify where instruction requirements for safety directives are located.

And, that those instructions address all related processes and procedures for their implementation to achieve comprehensive continued airworthiness support.

Additional data indicates that some manufactures lack procedures to ensure that, as equipped, LSA will comply with applicable ADs. Although a majority of the LSA facilities assessed do not integrate type-certificated products into their design, some use type-certificated products and technical standard order (TSO) components. The LSA manufacturer is responsible for ensuring the continued airworthiness of all equipment installed on any of its aircraft certified as SLSA. The team therefore recommends the LSA industry standards body, in conjunction with FAA requirements and policy, develop guidance to clarify and expand a Continued Operational Safety Monitoring/Notification system for LSA manufacturers.

Only one manufacturer had procedures in place to provide service bulletins to the FAA. One other manufacturer provided service bulletins to the FAA but had no procedure in place. Although there is a requirement in the consensus standards to provide safety directives to the appropriate civil aviation authorities, it only applies to powered parachutes and weight-shift-control aircraft. The FAA does not have a formal system in place to receive or maintain safety critical information such as safety directives, safety alerts, and service bulletins.

There are two recommendations for this conclusion. The first is that the consensus standards be revised to require safety directives be provided to civil aviation authorities for all types of LSA. The second is that the FAA should consider developing and implementing a system to receive and maintain service bulletins. The FAA should also provide guidance to manufacturers addressing where and how to provide safety critical information to the FAA. Objective data supporting these recommendations are located in Manufacturer's Facility Questionnaire, section 2.7.

Sixty three percent of the LSA facilities indicated a lack of adequate procedures to ensure that LSA manufacturers maintain owner information for the aircraft they manufacture. This is of concern because LSA manufacturers are the sole source of critical safety information for LSA owners. Without adequate procedures to maintain owner information, LSA manufacturers may be unable to ensure that all their LSA owners receive critical safety information in a timely manner.

The assessment team recommends that a standardized procedure for ownership change notification be included as part of the consensus standard. This should be considered a top priority. The team also recommends reviewing and verifying the LSA facility's continued airworthiness process for notification during initial and periodic assessment of LSA facilities.

Another area that requires improvement is compliance to standards for records, adherence to procedures, and verification that the continued airworthiness system is functioning to consensus standards. Some LSA manufacturers inadequately comply with consensus standards when performing risk assessments of customer identified service difficulties. Inadequately performed risk assessments increase the possibility of misjudging the severity of safety of flight issues. The low assessment scoring indicated a number of LSA facilities lacked procedures for safety of flight assessments. Furthermore, those LSA facilities that had procedures lacked appropriate

records showing the performance of those risk assessments. The lack of performance and records can inhibit the ability of manufacturers to perform adequate safety investigations.

The assessment team recommends that manufacturers conduct an immediate review of safety directives they have issued. The review must include an application of risk assessment, with appropriate actions taken. In addition, a review of an LSA facility's risk analysis procedure and compliance to the appropriate consensus standard should be completed during initial and periodic assessments of all LSA facilities.

Seventy percent of LSA facilities provide a system that complies with the consensus standard in its present form. Many LSA facilities lacked processes and procedures to properly verify operation of their continued airworthiness systems. Low scores for the supporting questions indicate that the LSA manufacturers are not sufficiently verifying that their continued airworthiness system is functioning properly.

One recommendation is that manufacturers review LSA facilities' continued airworthiness processes for notification and verification. This is to include records of corrective actions taken for consensus standards compliance. Another recommendation is that during initial and periodic assessments of all LSA facilities a review of the LSA facilities' continued airworthiness process for notification and verification including corrective actions taken,

Very few manufacturers have procedures or a system in place to ensure their design data and continued airworthiness notification systems remain accessible and viable should the company cease to exist.

The team recommends that continued airworthiness processes be reviewed for adequate provisions that allow LSA operators access to the design data should the LSA company cease to exist. In addition, the review should be verified during initial and periodic assessments of LSA facilities.

2.2 Product Conformity to Regulations

2.2.1 General Discussion—Product Conformity to Regulations

An analysis of the data gathered in the Product Conformity to Regulations section shows both positive and negative conclusions.

Some of the positive outcomes are noteworthy. Specifically FAA Form 8130-6 and FAA Form 8130-7 have been properly completed by applicants and DARs. The aircraft reviewed during the assessment were found to be largely in compliance with the regulatory definition in 14 CFR § 1.1. In addition, LSA manufacturers are generally providing the minimum required aircraft documentation.

However, some manufacturer's lack documented design control systems. For example, the data shows a lack of consistency in ensuring that every consensus standard is the latest FAA "accepted" consensus standard. ASTM consensus standards should include requirements to develop and follow written procedures for design control systems.

In addition, some manufacturers are inconsistent in properly placarding aircraft systems and instruments. Fuel system placards were missing or incorrect in showing fuel grade or fuel tank capacity. Instruments were not marked in accordance with 14 CFR § 91.9, Civil aircraft flight manual, marking, and placard requirements, and the applicable consensus standards. There were also cases when the presence of emergency parachutes on the aircraft were not externally marked. Emergency parachutes incorporate ballistic deployment devices and can be inadvertently discharged if mishandled. Some LSA manufacturers are not complying with marking and placarding requirements of FAA regulations and FAA-accepted consensus standards. Therefore, an LSA oversight program should be established to include initial compliance audits and periodic evaluations of LSA facilities Manufacturers.

A third of aircraft surveyed did not fully comply with the proper display of the words "Light-Sport" per 14 CFR § 45.23, Display of marks; general. During the surveys it became apparent that this rule is being interpreted in many ways regarding how and where to locate the placard. Manufacturers, inspectors, and DARs are confused about how to properly mark the aircraft. Also, there is an overall lack of understanding about the intent in the original rule for "light-sport" marking.

Some FAA DARs lack an understanding that manufacturers must obtain a special flight permit to conduct production flight tests. Furthermore, some DARs lack an understanding regarding application and eligibility requirements for issuing certificates to LSA. These are basic certification requirements that should have been reviewed by the DAR and corrected by the manufacturer before issuance of an LSA certificate. Survey results show some FAA DARs do not have a clear understanding of the requirements for issuing an SLSA certificate.

Some LSA manufacturers lack experience and knowledge in manufacturing design systems for the production of aircraft. It is recognized that LSA are simple aircraft and should require the least burdensome procedures to ensure conformance to regulations. The team recommends that the consensus standards be reviewed and clarified. And, that advisory material be published to assist LSA facilities in developing procedures that include information regarding where to obtain and how to use the latest FAA-accepted consensus standards.

2.3 Manufacturer Extension/Distributor Assembly Procedures and Documentation System

2.3.1 General Discussion—Manufacturer Extension/Distributor Assembly Procedures and Documentation System

This section addresses LSA that are manufactured outside the United States. The results are representative of a portion of the distributors and dealers surveyed. The assessment results demonstrated that some manufacturers lack controls and successive (flow-down) processes for quality system requirements, procedures, records, and practices. Although most of those surveyed have written authorization to perform assembly operations, many do not have the documented processes, procedures, and quality practices that are common for an aircraft manufacturing quality system.

The ASTM consensus standards lack specific requirements and are inconsistent when addressing quality systems for different types of LSAs. For example, the ASTM consensus standard for airplanes and gliders (ASTM Consensus Standard F2279-06, sections 2.1.9 and 9) provides that manufacturers "may assign" quality system requirements for distributors. However, weight-shift-control aircraft (ASTM Consensus Standard F2448-04) do not have the requirement and powered parachute (ASTM Consensus Standard F2240-05, section 2.2) allows assignments to distributors if "the [quality assurance] QA procedures provide for training, reporting, and tracking consistent with the overall QA system."

A major contributing factor to the lack of quality system controls is that LSA manufacturers are not required to establish an audit of performance and capabilities of their extensions, distributors, and dealers. There is a greater risk to safety when manufacturer's extensions, distributors, and dealers have no quality systems or quality manuals of their own.

The consensus standards for quality assurance should be revised to include requirements for LSA manufacturers to control and flow-down their quality system requirements to their affiliates (i.e., distributors). This flow-down of information should be accomplished through documented procedures, processes, practices and recordkeeping for regulatory compliance, flight and delivery preparation, flight testing, and assembly tasks. This consensus standards revision should apply consistently to all types of LSA.

One recommendation is that the consensus standards for quality assurance require manufacturers to conduct initial and periodic compliance audits of their extensions, distributors, and dealers (reference ASTM Consensus Standard F2279-06, "satellites" language). In addition, manufacturers should be required to maintain records of these audits that demonstrate performance and compliance to manufacturing requirements and consensus standards.

Another recommendation is that the consensus standards for quality assurance should require a documented process and records for identifying specific individual qualifications in the performance of quality tasks, including in-process and final inspections. And, that the standards require a documented process and record of all inspections and checks performed on each aircraft that identifies the individual(s) performing the quality tasks.

A third recommendation is the establishment of specific requirements for a calibration system. Consensus standards should require manufacturers to use recognized calibration system standards. This calibration system should encompass all instruments, measuring devices, and tools necessary for the manufacturing and assembly of LSA. These new requirements should be applied consistently to all types of LSA.

Some FAA DARs inconsistently applied eligibility regulations for the issuance of SLSA certificates of airworthiness. FAA DARs issuing airworthiness certificates inconsistent with FAA directives is of particular concern. The team encountered three common problems during the evaluations concerning inconsistent application of FAA regulations and policy: (1) DARs issued SLSA airworthiness certificates before completion of production or required flight testing; (2) DARs issued SLSA airworthiness certificates before the aircraft has been completed, and; (3) issuance of an SLSA airworthiness certificate by DARs who are also the principal or owner

of the distributorship or of a manufacturing facility performing assembly, quality and testing functions of the aircraft.

The team noted an instance where a DAR who issued the SLSA airworthiness certificates was also the sole owner of the LSA distributorship. In this case, the DAR/owner performed assembly and inspection of the LSA as well as applied for the airworthiness certificates. Therefore, the same person inspected the aircraft, issued the SLSA certificate, and performed a flight test or "tuning" of the aircraft. FAA Order 8130.2F, paragraph 121(e)(1) states clearly, "*IN NO INSTANCE WILL THE FAA PERFORM ANY OF THE FABRICATION, CONSTRUCTION, ASSEMBLY, OR CLOSING WORK ON OR TO THE AIRCRAFT.*"

Consensus standards should require flight testing after shipping reassembly for all LSA types. Flight testing should be performed according to national FAA policy within a controlled process and area, with the appropriate flight permit, and before a DAR issues an SLSA airworthiness certificate.

The LSA team recommends the issuance of advisory material for the LSA manufacturing industry that explains proper sequencing including the importance of a permit for flight testing, and completion of the aircraft before issuance of an SLSA certificate.

The FAA should enhance guidance in FAA Order 8130.2 to clarify that all LSA flight testing or check flight(s) must be conducted in a controlled process and area (operating limitations) with the appropriate flight permit. FAA Order 8100.8 paragraph 704 (f.) includes the requirement that no DAR may issue an airworthiness certificate for an aircraft on which that DAR performs maintenance, mechanical functions, or inspections. The Order should contain a further conflict of interest clarification when LSA DAR are owners, principle partners, managers or employees of the company that has applied for the airworthiness certificate. In addition, the FAA should expand the mandatory training in pertinent airworthiness certification procedures for LSA DARs and for ASIs that advise and perform certification functions at LSA facilities.

Data analysis shows that a small portion of participants did not have sufficient assembly instructions in either separate form or within the maintenance manual. Personnel are sometimes not provided with written instructions or diagrams to accomplish the task. This condition is inconsistent with industry practices for producing airworthy aircraft that conform to design criteria. It is recommended that at the time of the issuance of the first SLSA airworthiness certificate at an LSA facility, a full appraisal survey for conformity of the assembly and inspection operations should be conducted. In addition, the team recommends a periodical audit of manufacturer extensions, distributors, and dealers for conformity of operation.

2.4 COMPLIANCE TO ASTM DESIGN STANDARDS

2.4.1 General Discussion—Compliance to ASTM Design Standards

Based on an analysis of the responses to the questions in this section, the assessment team concluded that many LSA manufacturers lack the experience and knowledge necessary for proper development of design control systems.

The team recommends that the industry publish guidance to assist LSA manufacturers in developing design control systems and procedures. The guidance should include a documented system to ensure the LSA industry uses the most recent FAA-accepted consensus standards. The guidance should also include information about conducting spin tests, determining airplane freedom from flutter, and acceptable methods of testing for useable fuel quantity.

The team was not able to gather a sufficient quantity of data to make confident statistical determinations of the status of compliance to design standards for foreign LSA manufacturers. Most LSA are manufactured in whole or in part in a foreign country. Of the 30 LSA facilities assessed, seven currently produce domestically designed aircraft. In almost all cases of LSA, where most or all of the aircraft is manufactured outside the United States, there was no engineering analysis or test data available at the facility. The team did gather anecdotal information from discussions with the distributors and manufacturer's extensions that indicate foreign manufacturers use their own national standards as well as FAA-accepted ASTM consensus standards. Rarely could the team find evidence showing comparability of the foreign national standard in the FAA-accepted ASTM consensus standard.

The lack of conclusive data can be remedied by expanding this assessment to LSA manufacturers in other countries. However, consideration must be given to the higher cost and resource requirements of conducting assessments outside the United States. Comparing the response to questions from foreign and domestic manufacturers reveals very similar results. Therefore, when implementing changes, if any, based on the recommendations in this report, FAA should consider how the change can be applied to foreign manufactured LSA. Dialogue and cooperation with other CAAs is needed to implement some of the recommendations in this report regardless of the results of additional assessments.

There is evidence that some foreign manufacturers are not in compliance to the ASTM consensus standards. Examples include failure to properly placard the instrument panel or fuel tank inlet area and failure to provide documentation for the signoff of the proper ASTM consensus standards on FAA Form 8130-15. As with domestic manufacturers, foreign manufactured LSA aircraft generally meet the 14 CFR § 1.1 definition of LSA aircraft.

There are areas of concern common to all LSA facilities. Forty six percent of the manufacturers complied with the ASTM consensus standard requirement that all flight speeds be presented in calibrated airspeed. Some manufacturers performed inadequate tests or no tests for spin characteristics. And, there was a 62 percent compliance rate for documenting alternate methods of compliance. Additionally, some manufactures could not demonstrate compliance to usable fuel testing requirements. The analysis for these responses demonstrates a lack of compliance to the design standards.

As stated in the first paragraph in this section, analysis indicates few LSA manufacturers have a system to check for the latest FAA-accepted design standard revision. The lack of an adequate system in this area indicates manufacturers are using design standards that are out dated or not yet accepted by the FAA. These are basic LSA requirements that the DAR should question, review, and require the manufacturer to correct before issuing an SLSA certificate. Some FAA DARs do not have a clear understanding of the requirements for issuing an SLSA certificate. Also, some FAA DARs do not have a clear awareness of their ability to require the manufacturer

to provide evidence supporting the statement of compliance, particularly with respect to required documents. The FAA should improve FAA inspector and LSA DAR training programs, and enhance oversight of LSA DAR performance.

For foreign manufacturers, simply conforming to domestic CAA requirements may not ensure compliance to the LSA rule. The team recommends that the ASTM consensus standards include language directing the LSA manufacturer to use only those design standards currently accepted by the FAA.

Data analysis further shows many LSA facilities do not maintain access to copies of the prior consensus standard. This is a critical requirement to maintain continued airworthiness of aircraft designed and built to prior standards in effect at that time.

Finally, some manufacturers did not perform a peer review of design calculations. In a technical profession, the concept of peer review is a significant factor in assuring the quality of work when that work will not be proven by a demonstration test. The ASTM committee should mandate second party review of design calculations that are not proven by demonstration test.

2.5 MANUFACTURER'S QUALITY SYSTEMS

2.5.1 General Discussion—Manufacturer's Quality Systems

There were some positive conclusions regarding quality systems. Most manufacturers maintained control of nonconforming or scrap parts.

Many conclusions for this section reflect a lack of understanding, for some manufacturers, that the development and use of a good quality system to control production of LSA provides both safety and economic value.

Data analysis shows that many LSA facilities do not maintain a quality manual that meets the minimal requirements of the ASTM consensus standards. Robust quality assurance programs are essential to ensure that manufactured aircraft conform to the stated design and are in a condition for safe operation. The assessment noted that there was a specific lack of procedures and objective evidence at many LSA facilities for a proper tool and gage system to control calibrated tools. Another specific area the team found lacking is receiving inspection. There was little evidence of "supplier control", an integral part of adequate receiving inspection systems. The quality systems also lacked definition of roles and responsibilities as well as a process for delegation authorization. In some cases the manufacturer's quality assurance program did not provide adequate controls of special processes, such as welding. The team also was made aware of manufacturers using informal, or undocumented, interim inspections and tests. Informal quality systems provide for inconsistent results and may compromise conformity of the items produced.

The LSA manufacturing industry requires more guidance for the development and use of strong quality systems. The FAA has published advisory material and policy material to assist and oversee manufacturing quality systems for production approval holders. The FAA could adapt much of the existing published guidance for development of an LSA-specific AC. The guidance

also should address the quality weaknesses identified during this assessment, such as development of a quality manual, control of special processes, receiving inspection procedures, supplier control procedures, tool and gage control procedures, and incorporation of in process inspections and control systems. The guidance should also address the importance of establishing a complete recordkeeping system.

Many LSA manufacturers do not perform or maintain records of internal quality system audits. In the last few decades, FAA manufacturing has focused on internal audits by production approval holders as a key ingredient in any quality system. The practice of self checking is recognized as a good system to correct deficiencies in quality programs. The consensus standards require LSA facilities to perform internal audits of their quality system on a 12- or 24-month basis.

Some LSA facilities do not maintain a configuration control system as required by the applicable consensus standards. A well-defined and followed configuration control system is essential to manufacturing duplicate products and in providing adequate continued operational safety for the existing fleet.

The team recommends that the FAA evaluate LSA facilities for the completeness of their quality system and their compliance to procedures. An LSA evaluation checklist based on FAA rules, policy, and accepted consensus standards should be developed as a guide to conducting evaluations. New LSA facilities' quality systems should be evaluated before presentation of the initial production aircraft for certification. An evaluation of existing manufacturers should be conducted as soon as practical after development of an evaluation checklist. Finally, conduct periodic evaluations for all LSA facilities to ensure continued compliance to FAA rules and FAA-accepted consensus standards.

2.6 Maintenance Procedures and Documentation System

2.6.1 General Discussion—Maintenance Procedures and Documentation System

An analysis of the Maintenance Procedures and Documentation System data resulted in positive and negative conclusions. The conclusions and examples listed in this section have four resultant and related recommendations which appear throughout this report. They are the need for advisory materials, an oversight program, improved consensus standards, and enhanced training for the LSA industry.

Survey results and observations show that LSA manufacturers understand the requirements for formatting a maintenance manual; however, they are inconsistent in the degree of detail and documentation. This inconsistency demonstrates that some manufacturers do not completely understand how to apply and accomplish the requirements of ASTM Consensus Standard F2483-05. This indicates that the consensus standards are not prescriptive enough. More prescriptive consensus standards would enable manufacturers to write maintenance manuals that better meet the intent of the standards. Better written manuals would help eliminate confusion for owners, mechanics, airports, regulatory officials, and aircraft and component manufacturers who use those manuals.

Some LSA manufacturers have a low understanding of how to comply with numerous sections of the consensus standard. While most maintenance manuals addressed the required subjects/headings the manuals failed to do so in enough detail to satisfy the intent of the requirement. Many of the manufacturers surveyed could not provide documentation to demonstrate they were in compliance with the consensus standard requirements for major repairs and alterations, level of certification, manual revisions, and equipment list.

Analysis of data for questions addressing major repairs and alterations shows manufacturers, and possibly the LSA industry, have a low understanding of how to comply with this area of the consensus standard. Less than half of the manufacturers surveyed followed the ASTM consensus standard and provided written instructions on how to perform major repairs or alterations. Some manufacturers lacked any documented system and, throughout the assessment surveys, sought clarification from team members on how to comply with specific required items by ASTM Consensus Standard F2483-05, section 9.2. Overall the low rating for this series of questions indicates there is a general lack of understanding for the concept of major repairs and alterations for LSA. Further, the survey results show that currently there is a lack of control of major repair and alteration processes which could pose a serious safety concern.

Data also revealed a lack of objective evidence that manufacturers provided task specific training as required by the consensus standards.

The series of questions that address maintenance manual revisions and change distribution scored high and low. The ASTM Consensus Standard F2483-05, section 5.1.12, Revisions, requires maintenance manuals to contain a "section, such as a change history table, for the listing of any revisions to the maintenance manual by the manufacturer." Most of those assessed knew about this requirement. This reinforces the previous conclusion that manufacturers have a positive understanding of the FAA-accepted consensus standard requirements concerning maintenance manual format. However, because the consensus standards do not include a requirement or process for controlling or distributing maintenance manual revisions and changes, the survey analysis results reveal another potential safety concern. Only half of the manufacturers had a documented process to revise and distribute changes to their LSA maintenance instructions. Of those who had a process, less than half had a method to inform LSA owners of the changes and revisions. And, only four LSA facilities had a system to verify that owners received maintenance manual changes.

Of those surveyed, about half were in compliance with ASTM Consensus Standard F2483-05, section 5.1.1.1, which requires an equipment listing in their maintenance manual. In some cases, their equipment lists were found in locations other than their maintenance manual. Many did not include adequate maintenance instructions for their installed equipment or track their equipment to inform LSA owners of changes or equipment maintenance instructions. This reinforces the conclusion that manufacturers are accomplishing the requirements of ASTM Consensus Standard F2483-05, section 5.1, with an inconsistent degree of detail and documentation, and that the ASTM consensus standards need to be more prescriptive.

The questions which addressed ASTM Consensus Standard F2483-05, section 8, Overhaul, were removed from the survey because of team misinterpretation. Nevertheless, the team noted that LSA survey participants also did not have a clear understanding of the consensus standard for

overhaul manual requirements. This supports the team's first conclusion that the ASTM consensus standards are not prescriptive enough.

2.7 MANUFACTURER'S FACILITY QUESTIONNAIRE

2.7.1 General Discussion—Manufacturer's Facility Questionnaire

The team gave a Manufacturer's Facility Questionnaire to the 30 LSA facility participants in the assessment surveys. The questionnaire was an opportunity to obtain candid, anonymous information in areas of interest associated with LSA manufacturing and certification. The questionnaire contained comment areas without limitations to the response length or topic.

The questions solicited suggestions for improvement from the LSA facility's point of view, and were designed to identify best practices to benchmark.

The FAA received five responses (approximately 17 percent) which were analyzed.

2.7.2 Manufacturer's Facility Questionnaire Results—Analysis Summary

The responders seem satisfied with FAA regulations on LSA, and believe that the status quo is appropriate and not burdensome. However, the responders expressed concerns about FAA standardization of policy and guidance, and receiving timely information about the LSA rule's intent.

Given the variety of sources the LSA industry uses to obtain information, there appears to be a lack of knowledge regarding where to obtain accurate information concerning LSA regulations and standards. In addition, the responses indicate that there is a general lack of knowledge of how LSAs are addressed within the FAA. Collectively, these remarks, conclusions, and report data indicate that more extensive training for DARs, ASIs, and FAA advisors and managers is warranted. Furthermore, the FAA should provide additional guidance, such as a series of ACs for LSA manufacturers and the industry.

Respondents were divided on adequacy of the consensus standards. Three respondents stated that the standards meet their needs, and two respondents indicated that improvements are necessary, citing gaps in the standards, but acknowledged that the industry is working toward resolution of this problem.

One responder recommended changing the process for deciding what new ASTM consensus standards to write and provided detailed steps for this process. The team has made no specific recommendation in response to this comment.

Another respondent suggested changing the FAA aircraft registration process and stated that the current process for LSAs manufactured overseas requires a separate document stating that the aircraft was never registered in the country of manufacture. The respondent felt that this requirement is redundant, unnecessary, and time consuming. The team recommends that justification for the requirement be researched. If it is determined that the requirement is justified, the rationale should be included in advisory material for LSA manufacturers.

Another respondent made three specific suggestions for process change. The first suggestion is to continue the assessment (and surveys) for LSA manufacturer's located outside the United States. The team recommends that the FAA develop a process to perform initial conformity checks and continuous oversight evaluations that includes foreign LSA manufacturers. This recommendation is addressed throughout the report.

The second suggestion is for a central collection point for OEM equipment service bulletins and other LSA regulatory information. This concept could improve safety for the LSA community, particularly with regard to continued airworthiness notification and maintenance. The team recommends developing a system for a central data collection point. As previously noted, the team recommends the establishment of a public Web site to post LSA safety alerts and safety directives.

The third suggestion is that the FAA should reduce the response time for petitions for exemption. This report does not include a recommendation for improvement in this area because it is outside the scope of this assessment. The team will forward this suggestion to the appropriate FAA office.

2.8 OTHER DATA

2.8.1 General Discussion—Other Data

This assessment gathered company biographical information. The team asked questions about the nature of each facility's business and the extent of its experience.

2.8.2 Specific Analysis—Other Data

The information collected indicates that many LSA facilities have limited experience in both LSA and aviation manufacturing. The biographical information revealed that 7 of 18 manufacturers/distributors have less than 2 years of LSA manufacturing experience. In addition to recorded data, the team gathered anecdotal information from interviewees that indicated very few of them have aircraft design and manufacturing backgrounds.

APPENDIX A. ACRONYM LIST

14 CFR	Title 14, Code of Federal Regulations
ACE-114	FAA, Aircraft Certification Service, Small Airplane Directorate, Light-Sport Office
AC	advisory circular
AD	airworthiness directive
AFS-300	FAA, Flight Standards Service
AIR-40	FAA, Aircraft Certification Service, International Policy Office
AIR-100	FAA, Aircraft Certification Service, Engineering Branch
AIR-200	FAA, Aircraft Certification Service, Production and Airworthiness Branch
ASI	aviation safety inspector
CA	continued airworthiness
CAA	civil aviation authority
CAS	calibrated airspeed
DAR	designated airworthiness representative
EAA	Experimental Aircraft Association
ELSA	experimental light-sport aircraft
ELT	emergency locator transmitter
FAA	Federal Aviation Administration
IAS	indicated airspeed
LSA	light-sport aircraft
LSAMA	Light-Sport Aircraft Manufacturer Assessment
POH	Pilot Operating Handbook
QA	quality assurance
SLSA	special light-sport aircraft
TSO	technical standard order
WSC	weight-shift-control

APPENDIX B. GLOSSARY

The definitions below are for the purposes of this report only.

Advisory circular. Guidance published by the FAA on acceptable means, but not the only means, of compliance to Title 14, Code of Federal Regulations.

Airworthiness certificate. A certificate issued to an aircraft when it has been shown to be in compliance with an approved design and in condition for safe operation.

Best practices. Design or manufacturing process that experience has shown to be beneficial.

Calibrated airspeed. Indicated airspeed of an aircraft, corrected for position and instrument error. Calibrated airspeed is equal to true airspeed in standard atmosphere at sea level

Civil aviation authority. A government agency from any country with responsibility for civil aviation within that country or jurisdiction.

Conformity. A generic term used in reference to the adherence to the approved design of the manufacture of an aircraft or part thereof.

Consensus standard. A standard or group of standards developed by recognized industry entities. In the context of this report, this term may also refer to ASTM consensus standards and FAA-accepted consensus standards.

Corrective action implementation and feedback system. An element of internal audit systems that incorporates a means to correct deficiencies and verify the implementation of corrections.

Designees. Individuals or companies appointed at the discretion of the FAA for performing authorized functions on behalf of the FAA.

Distributor. A person who sells and distributes LSA but does not sign, except on behalf of another company, FAA Form 8130-15.

Experimental light-sport aircraft. A specific category of airworthiness certificate for certain experimental LSA.

FAA-accepted consensus standard. A consensus standard submitted for review and acceptance by the FAA and published on FAA's public Web site.

FAA rules. A reference to 14 CFR.

First-time LSA models. A first model or derivative model built by an LSA manufacturer that meets the 14 CFR § 1.1 definition of an LSA.

Flutter. A self-feeding and potentially destructive vibration where aerodynamic forces on an object couple with a structure's natural mode of vibration to produce rapid periodic motion.

Indicated airspeed. Speed of an aircraft as shown on its pitot static airspeed indicator calibrated to reflect standard atmosphere adiabatic compressible flow at sea level uncorrected for airspeed system errors..

Industry stakeholders. Any interested party, owner, operator, manufacturer, industry organization, or government entity involved in LSA.

Light-sport. An aircraft, other than a helicopter or powered-lift that, that since its original certification, has continued to meet the following: A maximum takeoff weight of not more than 1,320 pounds (600 kilograms) for aircraft not intended for operation on water; or 1,430 pounds (650 kilograms) for an aircraft intended for operation on water. A maximum airspeed in level fight with maximum continuous power (V_H) of not more than 120 knots CAS under standard atmospheric conditions at sea level. A maximum never-exceed speed (V_{NE})of not more than 120 knots CAS for a glider. A maximum stalling speed or minimum steady flight speed without the use of lift-enhancing devices (V_{S1})of not more than 45 knots CAS at the aircraft's maximum certificated takeoff weight and most critical center of gravity. A maximum seating capacity of no more than two persons, including the pilot. A single, reciprocating engine, if powered. A fixed or ground-adjustable propeller if a powered aircraft other than a powered glider. A fixed or auto feathering propeller system if a powered glider. A fixed-pitch, semi-rigid, teetering, two-blade rotor system, if a gyroplane. A nonpressurized cabin, if equipped with a cabin. Fixed landing gear, except for an aircraft intended for operation on water or a glider. Fixed or retractable landing gear, or a hull, for an aircraft intended for operation on water. Fixed or retractable landing gear for a glider.

LSA DAR. A DAR who has function codes for issuing ELSA or SLSA airworthiness certificates.

LSA facilities. A generic term that includes LSA manufacturers, extensions, and distributors.

Manufacturer. Any person or company that signs and submits an FAA Form 8130-15 attesting to the manufacture of an LSA.

Manufacturer extension. Any person or company that acts on behalf of a manufacturer to complete or otherwise fabricate an LSA.

Material Review Board. A designated group of individuals that review and disposition parts that do not conform to approved data.

Order. A policy document issued by the FAA and available to the public.

Powered parachute. A powered aircraft comprised of a flexible or semi-rigid wing connected to a fuselage so that the wing is not in position for flight until the aircraft is in motion. The fuselage of a powered parachute contains the aircraft engine, a seat for each occupant and is attached to the aircraft's landing gear.

Special light-sport aircraft. A specific category of airworthiness certificate for certain LSA. The 14 CFR §1.1 definition applies.

Supplier control. A means of selecting and controlling suppliers of materials and services for the manufacture of aircraft or parts thereof.

Type-certificated product. An aircraft, engine, or propeller manufactured to an FAA-approved type certificate.

Ultralight vehicles. An aircraft used or intended to be used for manned operation in the air by a single occupant, and used or intended to be used for recreation or sport purposes only. Ultralight vehicles do not have any U.S. or foreign airworthiness certificate and, if un powered, weighs less than 155 pounds. If powered, an ultralight vehicle weighs less than 254 pounds empty weight, excluding floats and safety devices intended for deployment in a potentially catastrophic situation. In addition, an ultralight vehicle has a fuel capacity not exceeding 5 U.S. gallons, is not capable of more than 55 knots calibrated airspeed at full power in level flight, and has a power-off stall speed that does not exceed 24 knots calibrated airspeed.

$\mathbf{V_H}$. Maximum speed in level flight with maximum continuous power.

$\mathbf{V_S}$. Stalling speed or minimum steady flight speed at which the aircraft is controllable.

Weight-shift-control aircraft. Powered aircraft with a framed pivoting wing and a fuselage, controllable only in pitch and roll by the pilot's ability to change the aircraft's center of gravity with respect to the wing. Flight control of the aircraft depends on the wing's ability to flexibly deform, rather than the use of control surfaces.

APPENDIX C. PARTICIPATING OFFICES

Role in the Assessment	Affiliation
Sponsor	Manager, AIR-200, Production and Airworthiness Division
Responsible Branch	Manager, AIR-230, Airworthiness Certification Branch
Team Leader	ASI, AIR-230, Airworthiness Certification Branch
Team Member	Manager, AIR-240, Evaluation and Special Projects Branch
Team Member	LSA Program Manager ACE-114, Programs and Procedures Branch
Team Member	ASE, AIR-110, Engineering, Aircraft Certification
Team Member	ASI, AFS-350, Flight Standards
Team Member	Transportation Industry Analyst – Light Sport Prog. ACE-114, Aircraft Certification, Central Region – Small Airplane Directorate
Team Member	ASI, AIR-230, Airworthiness Certification Branch
Team Member	ASI, AIR-240, Evaluation and Special Projects Branch
Team Member	Foreign Affairs Specialist, AIR-40, International Policy Branch

APPENDIX D. FIGURES

The following figures present weighted averages from the assessment, grouped first overall, and then for each of the six major sections of the assessment (assembly procedures, product conformity to regulations, maintenance procedures and documentation, continued airworthiness, quality system, and compliance to design standards).

For the overall chart, the bars represent the weighted averages for each of the six major sections of the assessment, while for the six major section charts, the bars represent the weighted average of each subgroup of questions within the major section.

OVERALL

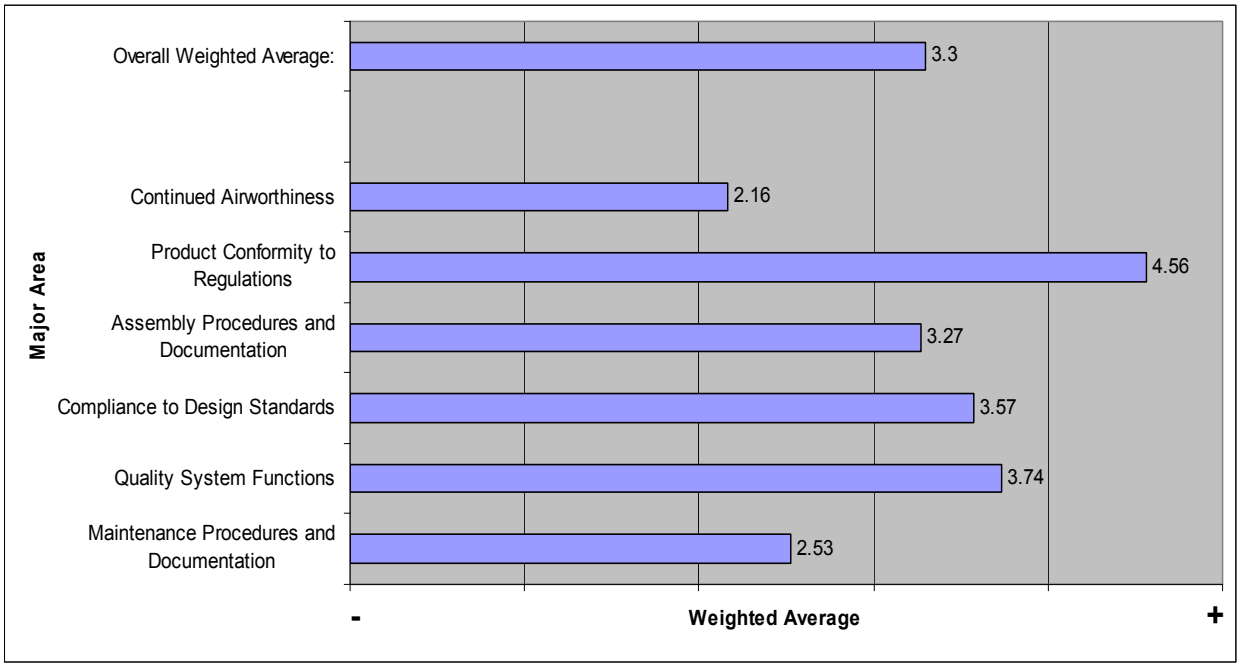

Figure 1. All Facilities (Overall)

MANUFACTURER EXTENSION/DISTRIBUTOR ASSEMBLY PROCEDURES AND DOCUMENTATION SYSTEM (MEDAPD)

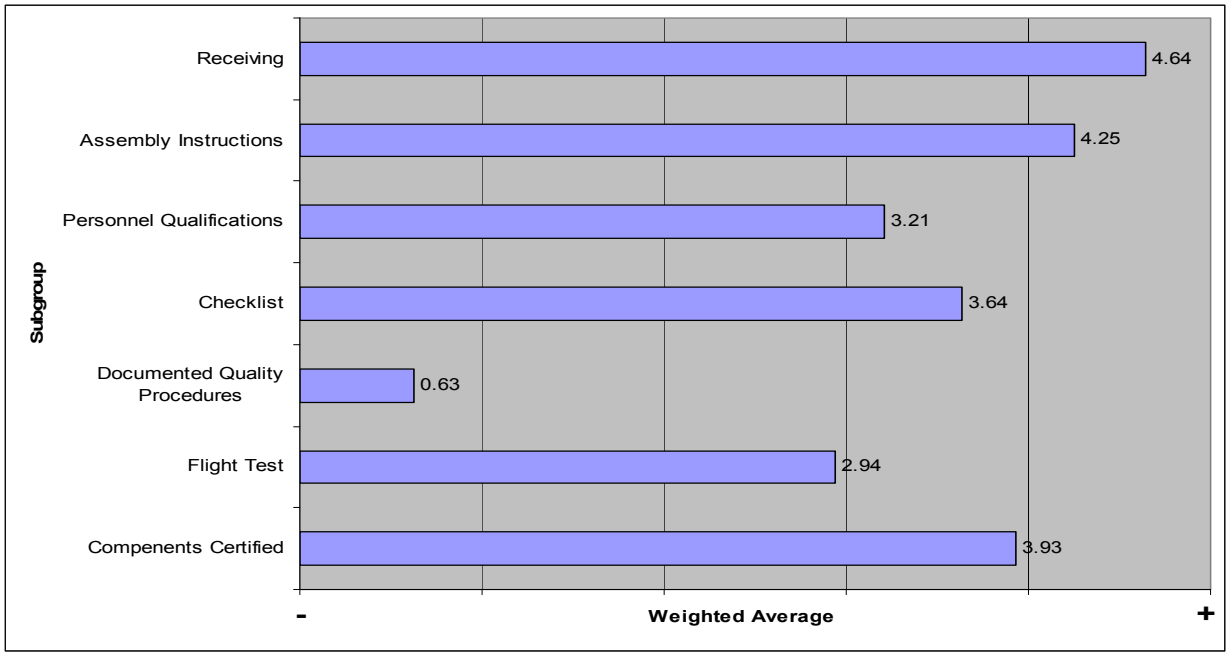

Figure 2. All Facilities (MEDAPD)

PRODUCT CONFORMITY TO REGULATIONS (PCR)

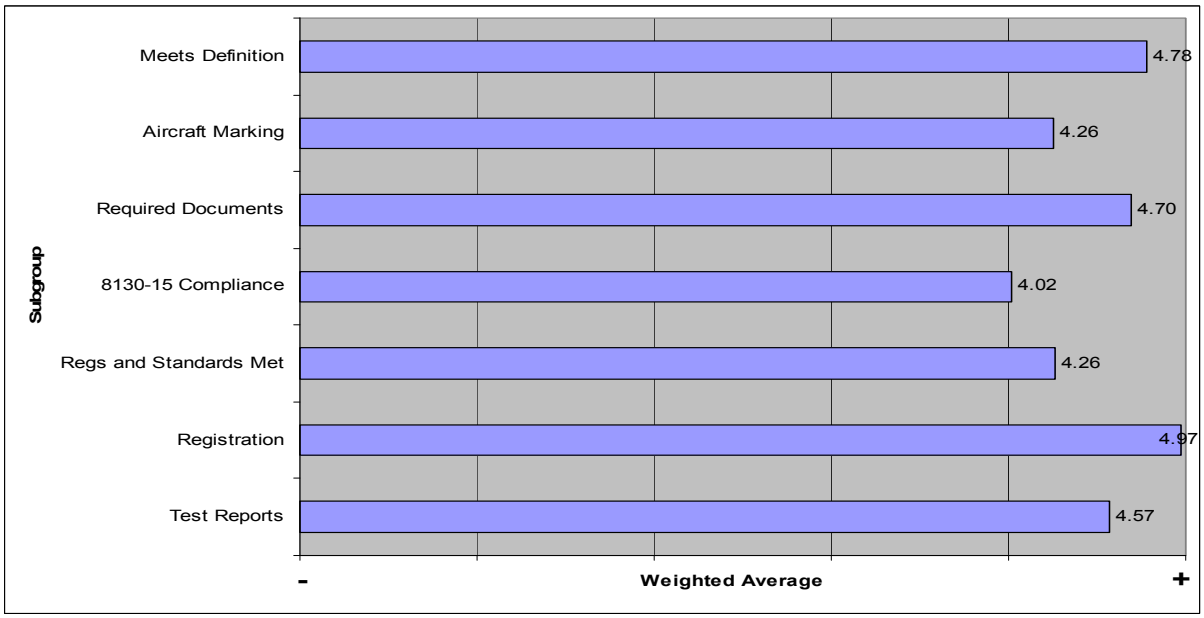

Figure 3. All Facilities (PCR)

MAINTENANCE PROCEDURES AND DOCUMENTATION SYSTEM (MPD)

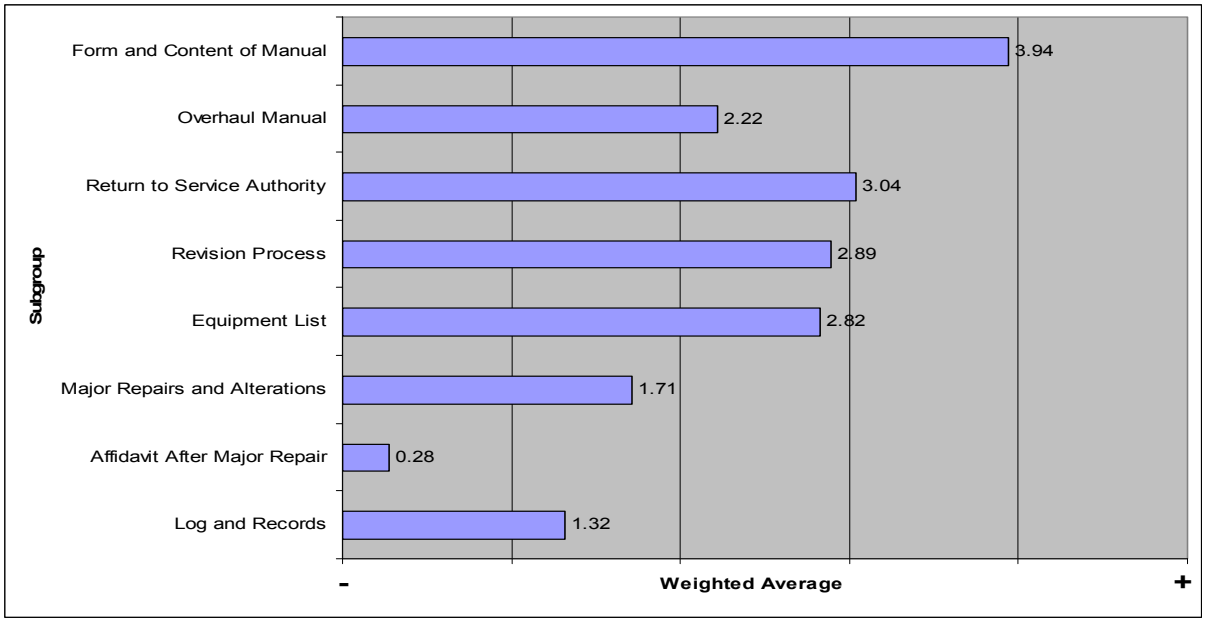

Figure 4. All Facilities (MPD)

CONTINUED AIRWORTHINESS SYSTEM (CA)

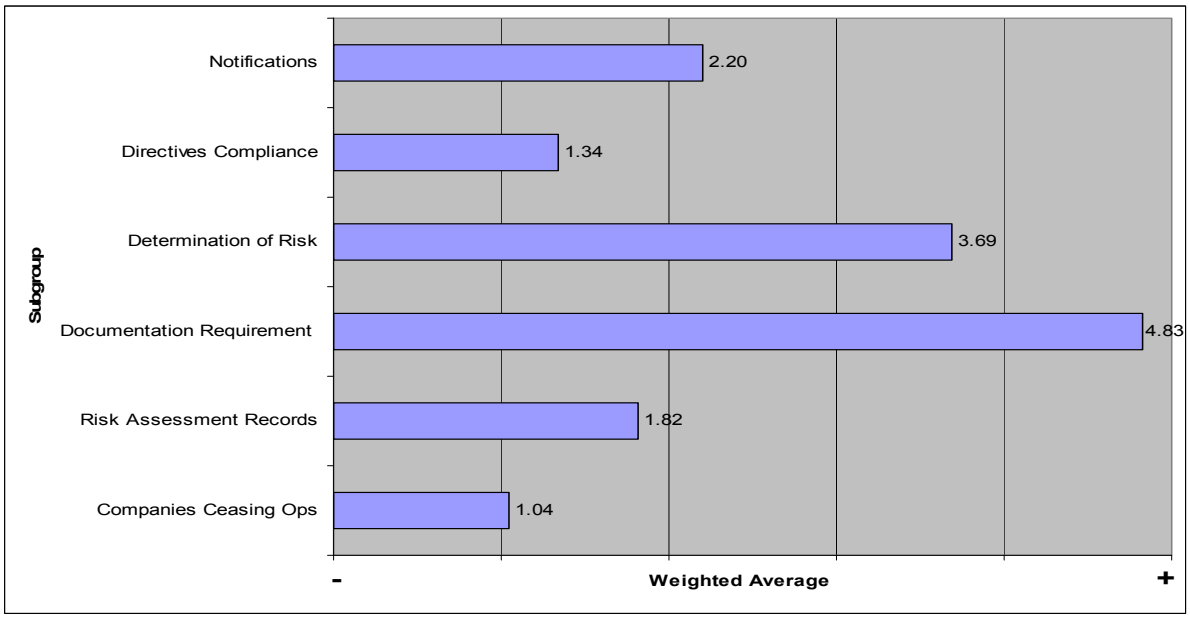

Figure 5. All Facilities (CA)

MANUFACTURER'S QUALITY SYSTEMS (QS)

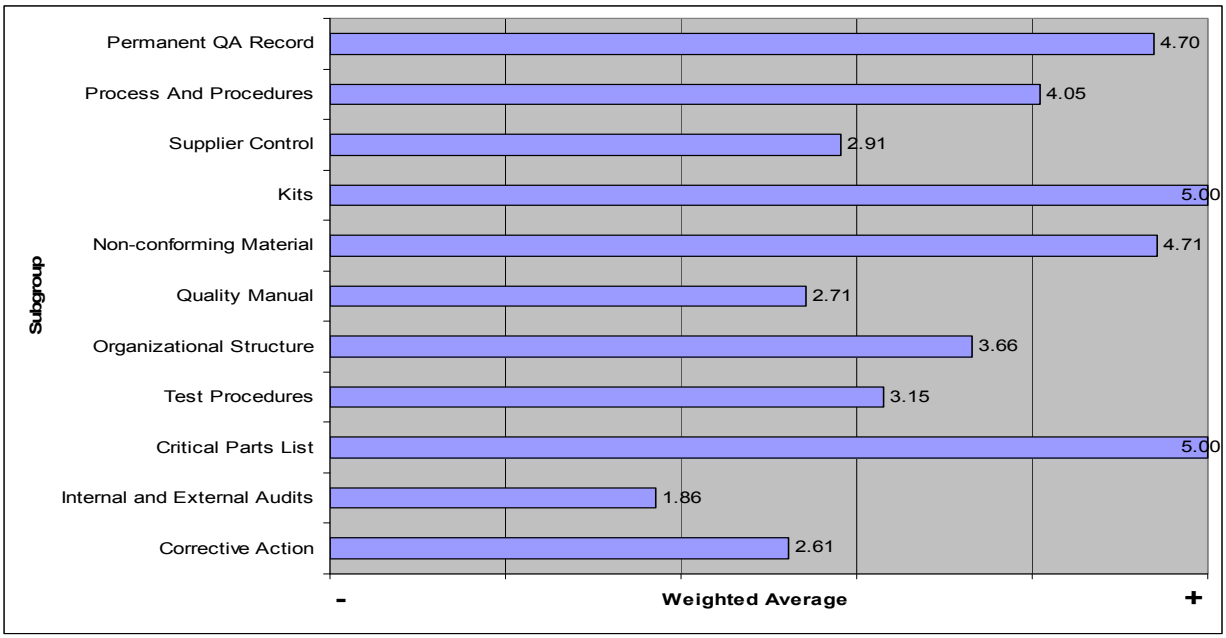

Figure 6. All Facilities (QS)

COMPLIANCE TO ASTM DESIGN STANDARDS (CDS)

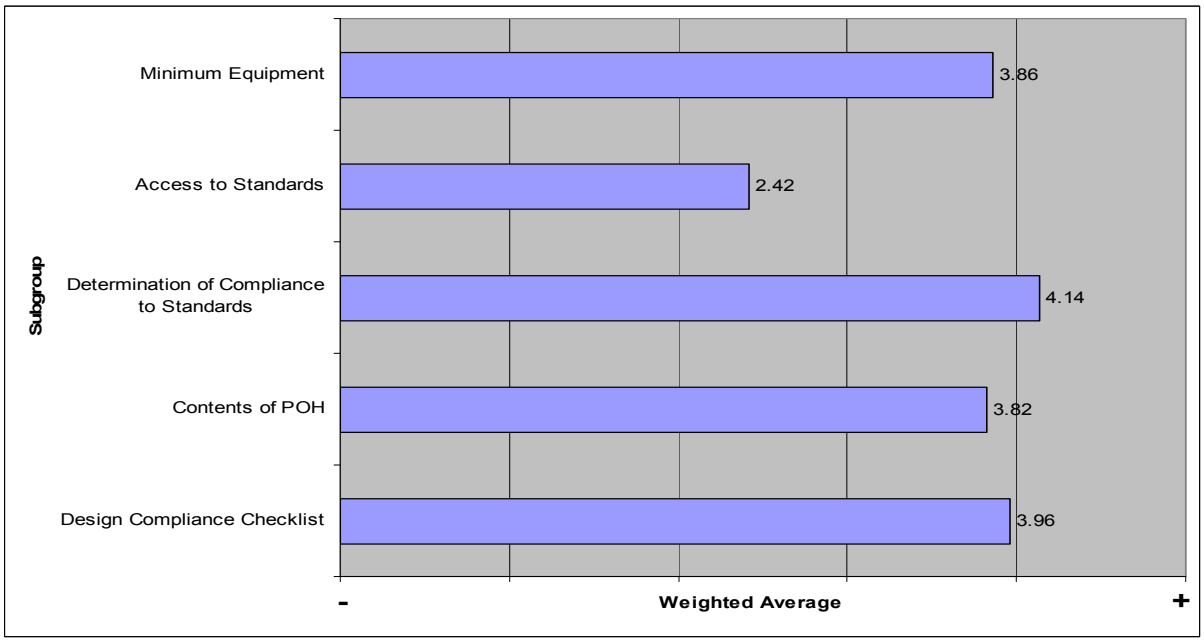

Figure 7. All Facilities (CDS)