



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

Advisory Circular

Subject: 14 CFR Part 23 Type Certification of an Airplane Originally Certificated to Joint Aviation Regulations - Very Light Airplane (JAR-VLA) Standards **Date: 7/14/03** **AC No: 23-11A**
Initiated By: ACE-100 **Change:**

What is the purpose of this Advisory Circular (AC)?

This AC presents one way, but not the only way, to show compliance to Title 14 Code of Federal Regulations (14 CFR) part 23 for the type certification of certain small airplanes.

- This AC does not present mandatory material.
- This AC is not a rule or regulation.
- The material presented in this AC has no legal status.

Who does this AC apply to?

This AC applies to you if you seek any of the following for a Joint Aviation Regulations - Very Light Airplane (JAR-VLA):

- A part 23 normal or utility category type certificate;
 - A type certificate as a “Special Class” airplane, following § 21.17(b).
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Does this AC cancel any previously published ACs?

Yes, the following AC is canceled:

AC 23-11, Type Certification of Very Light Airplanes with Powerplants and Propellers Certificated to Parts 33 and 35 of the Federal Aviation Regulations, dated December 2, 1992.

s/

Michael Gallagher
Manager, Small Airplane Directorate
Aircraft Certification Service

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CHAPTER 1 - INTRODUCTION

1-1. Why is this AC being rewritten?

FAA Order 1320.46C “Advisory Circular System,” chapter 3, paragraph 9, states that an AC cannot add, reduce, or change the burden imposed by a regulation. However, some individuals misinterpreted the original release of AC 23-11. They believed the AC stated that certain small airplanes were exempt from or entitled to a positive finding of Equivalent Level of Safety (ELOS) to certain requirements. In addition, they believed this ELOS could be based solely on the physical characteristics of the airplane. To suggest that the AC could grant an ELOS or exemption would contradict FAA Order 1320.46C. This contradiction was not the intent of those individuals who wrote the original AC 23-11.

By revising this AC, we intend to clarify the issues that surround type certification of a JAR-VLA airplane.

1-2. What is the background behind the certification of very light airplanes?

For a description of the history and background on this subject, see Chapter 6 “Background - 14 CFR part 23 and Joint Aviation Requirements – Very Light Airplanes.”

1-3. What is a “JAR-VLA Airplane?”

Airplanes that meet the regulations specified in the European Joint Aviation Regulations – Very Light Airplanes (JAR-VLA) are known as JAR-VLA airplanes. These airplanes must meet the following limitations:

- Single engine with spark or compression ignition
- Maximum occupancy of two (2)
- Maximum certificated takeoff weight of 1,654 pounds (750 Kg)
- Maximum power-off stall speed of 45 knots Calibrated Air Speed (CAS) in the landing configuration at maximum weight
- Normal category maneuvers only. Per JAR-VLA 3 and § 23.3(a), these maneuvers include:
 - Maneuvers incident to normal flying;
 - Stalls (except whip stalls); and,

- Lazy eights, chandelles, and steep turns in which the angle of bank is not more than 60 degrees.
- Daytime Visual Flight Rule (Day-VFR) Operations only

1-4. Who is “you” and who is “we?”

In general, when the word “you” or “me” is used, it refers to the applicant. When the word “we” or “us” is used, it is referring collectively to the Federal Aviation Administration (FAA). When the terms “you” or “we” would be vague or non-specific, groups or individuals will be referenced by their unique title. For example, the formal title of Airplane Certification Office (ACO) will be used when referring to an action done specifically by the ACO.

1-5. What documents are related to this AC?

a. Orders, Federal Regulations, and ACs.

FAA Order 8110.4B, Type Certification

FAA Order 8100.5, Airplane Certification Directorate Procedures

FAA Order 1320.46C, Advisory Circular System

Title 14 Code of Federal Regulations (CFR) part 21 – Certification Procedures for Products and Parts

Title 14 Code of Federal Regulations, part 23 – Airworthiness Standards: Normal, Utility, Acrobatic, and Commuter Category Airplanes, Subpart C – Structure

Title 14 Code of Federal Regulations, part 33 - Airworthiness Standards: Aircraft Engines

Title 14 Code of Federal Regulations, part 35 – Airworthiness Standards: Propellers

Title 14 Code of Federal Regulations, part 36 – Noise Standards: Aircraft Type and Airworthiness Certification

Title 14 Code of Federal Regulations, part 43 – Maintenance, Preventive Maintenance, Rebuilding, and Alteration

Title 14 Code of Federal Regulations, part 45 – Identification and Registration Marking

Title 14 Code of Federal Regulations, part 91 – General Operating and Flight Rules

FAA Report No. AFS-120-73-2, “Fatigue Evaluation of Wing and Associated Structure on Small Airplanes,” Federal Aviation Administration, Washington, D.C., 1973. (Available from the Small Airplane Directorate, 901 Locust, Suite 301, Kansas City, MO 64106.)

FAA Report, “Fatigue Evaluation of Empennage, Forward Wing and Winglet/Tip Fins on Part 23 Airplanes,” Federal Aviation Administration, Kansas City, Missouri. (Available from the Small Airplane Directorate, 901 Locust, Suite 301, Kansas City, MO 64106.)

Copies of the current publication of the ACs listed below can be obtained from the U.S. Department of Transportation, Subsequent Distribution Office, DOT Warehouse, SVC 121.23, Ardmore East Business Center, 3341Q 75th Avenue, Landover, MD 20785:

AC 20-73, Aircraft Ice Protection, dated April 21, 1971

AC 20-107A, Composite Aircraft Structure, dated April 25, 1984

AC 21.17-3, Type Certification of Very Light Airplanes Under FAR § 21.17(b), dated December 21, 1992

AC 23-8A, Flight Test Guide for Certification of Part 23 Airplanes, dated February 9, 1989

AC 23-15, Small Airplane Certification Compliance Program, dated January 2, 1997

AC 23.143-1, Ice Contaminated Tailplane Stall (ICTS), dated December 20, 2001

AC 23.1309-1C, Equipment, Systems, and Installations In Part 23 Airplanes, dated March 12, 1999

AC 23.1419-2B, Certification of Part 23 Airplanes for Flight in Icing Conditions, dated September 26, 2002

b. Other References.

JAA Joint Aviation Requirements for Very Light Aeroplanes (JAR-VLA)

JAA Joint Aviation Requirements for Engines, JAR-E

JAA Joint Aviation Requirements for Propellers, JAR-P

Society of Automotive Engineers Aerospace Standard AS8049A, Performance Standards for Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft, dated September 1997

Aircraft Crash Survival Design Guide, Volume 1 – Design Criteria and Checklist, Report Number USAAVSCOM TR 89-D-22A, US Army Aviation Systems Command, dated December 1989

1-6. Definitions

JAR-VLA: Joint Aviation Requirements – Very Light Airplanes (or Aeroplanes), prescribe the airworthiness criteria leading to issuance of a type certificate as instituted by the Joint Airworthiness Authorities (JAA) for certain very light airplanes. The requirements are based on Title 14 CFR part 23.

Special Class Airplane: A special class airplane is an airplane, which may include the installed engines and propellers, for which airworthiness standards have not been issued under 14 CFR part 21 Subpart B – Type Certificates. Following 14 CFR part 21, § 21.17(b), applicable airworthiness requirements are those portions of parts 23, 25, 27, 29, 31, 33, and 35 found appropriate by the Administrator for the airplane. The Administrator may also use airworthiness criteria that provide an equivalent level of safety to those parts.

Normal and Utility Category: Categories of airplanes whose airworthiness standards are defined in 14 CFR part 23. Any JAR-VLA airplane that seeks night VFR or IFR capability must satisfy the requirements listed under part 23 for one of these categories. One of the requirements of part 23 is that the airplane must be equipped with a powerplant and propeller type certificated to 14 CFR parts 33 and 35, respectively.

Equivalent Level of Safety (ELOS) Finding: The FAA will grant a positive finding of ELOS when it determines that an applicant's design does not demonstrate literal compliance to an FAA requirement, but does satisfy the intent of the requirement. A positive finding of ELOS shows no reduction in safety. Title 14 CFR § 21.21(b) permits ELOS findings, and the Small Airplane Directorate has authority over all ELOS findings to any part 23 rule. An ELOS finding is NOT a public process.

In addition, per AC 21.17-3, the Small Airplane Directorate has been assigned national technical policy standardization functions (which includes ELOS findings) concerning the use of JAR-VLA in the U.S., including the type certification of VLA as special class aircraft under 14 CFR § 21.17(b).

Exemption: Exemptions are a public process where the applicant seeks relief from a specific FAA requirement, as guided by 14 CFR § 11.81. The applicant must show that the exemption is in the public interest and that safety is not adversely affected.

The process for seeking an exemption, as described in 14 CFR § 11.81, is more formal than a finding for ELOS.

CHAPTER 2 - DAYTIME VISUAL FLIGHT RULE (DAY-VFR) OPERATIONS

We do not prescribe airworthiness standards specific to very light airplanes (as defined in this AC). However, 14 CFR § 21.17(b) does allow the FAA to use airworthiness criteria that provide an equivalent level of safety appropriate for the airplane. Therefore, you may seek certification of a JAR-VLA airplane as a Special Class airplane under 14 CFR § 21.17(b). In this case, the JAR-VLA regulations serve as the airworthiness criteria. Airplanes certificated to JAR-VLA standards under 14 CFR § 21.17(b) are limited to the conditions stated in JAR-VLA, which includes the limitation of Day-VFR operations only.

2-1. I am an applicant and my airplane is certificated to JAR-VLA regulations. Am I automatically eligible for a Special Class Type Certificate?

No. If you are a foreign (non-United States) applicant, you must earn a Special Class Type Certificate, as required by 14 CFR § 21.29. This is referred to as the validation process.

If you are a United States (U.S.) applicant, and you design your aircraft to the JAR-VLA regulations, you must still earn a Special Class Type Certificate per 14 CFR § 21.17 and § 21.21.

The AC will assume, from this point forward, that an applicant (either foreign or U.S.) has received a Special Class Type Certificate.

2-2. My airplane is certificated to JAR-VLA regulations. My engine and propeller are certificated to 14 CFR parts 33 and 35 (or JAR-E and JAR-P), respectively. I desire daytime Visual Flight Rule operations only. How does this affect me?

This airplane is eligible for a Standard Airworthiness Certificate, Special Class, under 14 CFR § 21.175(a). It is important to note that JAR-VLA is limited to Daytime Visual Flight Rules (Day-VFR) operations only. Therefore, an airplane certificated under these standards is limited to Day-VFR operations.

2-3. My airplane is certificated to JAR-VLA regulations. My engine and propeller are certificated to JAA JAR-22 subparts H and J. I desire daytime Visual Flight Rule operations only. How does this affect me?

JAR-VLA permits the use of engines and propellers that meet the powerplant airworthiness requirements of JAA JAR-22 Sailplanes and Powered Sailplanes, subparts H and J. This is known as approving the engine and propeller as an integral part of the airplane.

This airplane is eligible for a Standard Airworthiness Certificate, Special Class, under 14 CFR § 21.175(a). In addition, this airplane is limited to Daytime Visual Flight Rules (Day-VFR) operations only.

2-4. For Day-VFR operations, does it make a difference if the engine and propeller are certificated to either JAR-22 subparts H and J, 14 CFR parts 33 and 35, or JAR-E and JAR-P?

No, it does not. For Day-VFR operations only, it doesn't matter if the engine and propeller are certificated to 14 CFR parts 33 and 35, JAR-22 subparts H and J, or JAR-E and JAR-P.

2-5. Are there any differences in operational limitations between JAR-VLA airplanes certificated with a JAR-22 engine and propeller, a 14 CFR parts 33 and 35 engine and propeller, or a JAR-E and JAR-P engine and propeller?

All of these airplanes are eligible for a Standard Airworthiness Certificate, Special Class, under 14 CFR § 21.175(a). Each of these airplanes share the same operational limitation, they are **all** limited to Day-VFR operations. (See Section 3 for information regarding Night-VFR or IFR operations).

2-6. My airplane is certificated to JAR-VLA regulations. My engine and propeller are certificated to JAR-22 subparts H and J. Is this airplane eligible for a part 23 type certificate (TC)?

No, your airplane is not eligible for a part 23 TC. Only those JAR-VLA airplanes equipped with an engine and propeller certificated to 14 CFR parts 33 and 35, respectively, would receive further consideration.

Another way to say this would be:

A necessary, but not the only condition for a part 23 TC, is that the airplane have an engine and propeller certificated to 14 CFR parts 33 and 35, respectively.

2-7. I understand the JAR-VLA requirements are based on the 14 CFR part 23 regulations. Is that true?

Yes, that is true. The JAA issued "Joint Aviation Requirements for Very Light Aeroplanes," also known as JAR-VLA, in April 1990. The substance of these regulations has much in common with 14 CFR part 23. However, 14 CFR part 23 contains requirements for several airplane categories. Therefore, changes and deletions to these rules were made when the JAA identified requirements as either impractical or unnecessary for safety, given the design features of JAR-VLA airplanes.

CHAPTER 3 - NIGHTTIME VISUAL FLIGHT RULE (NIGHT-VFR) AND INSTRUMENT FLIGHT RULE (IFR) OPERATIONS

- 3-1. I would like to fly my U.S. Type Certificated JAR-VLA airplane in Night-VFR conditions. Does my Standard Airworthiness Certificate, Special Class allow me to do that?**

No, JAR-VLA airplanes are restricted to Day-VFR operations only.

- 3-2. I would like to fly my U.S. Type Certificated JAR-VLA airplane in IFR conditions. Does my Standard Airworthiness Certificate, Special Class allow me to do that?**

No, JAR-VLA airplanes are restricted to Day-VFR operations only.

- 3-3. What do I need to do to update my JAR-VLA airplane to fly in Night-VFR or IFR conditions?**

- Equip the airplane with an engine certificated to 14 CFR part 33;
- Equip the airplane with a propeller certificated to 14 CFR part 35;
- Obtain a part 23 TC.

- 3-4. If I go through the part 23 certification process to permit Night-VFR or IFR operations, will the Type Certification Data Sheet (TCDS) reflect part 23 or § 21.17?**

The TCDS will reflect a part 23 certification basis. The airplane is certificated under part 23, not the special class category under 14 CFR § 21.17.

- 3-5. To be clear, is it correct to state “To fly my U.S. Type Certificated JAR-VLA airplane in Night-VFR or IFR conditions, the airplane must be certificated under part 23?”**

Yes, that is correct. A manufacturer of a JAR-VLA airplane that desires operations in Night-VFR or IFR conditions must apply for a 14 CFR part 23 normal or utility category TC. The amendment level for the part 23 TC is the amendment level that is current on the date of application, as required by 14 CFR § 21.17. The operation of these airplanes is limited to normal or utility category maneuvers. Applicants seeking utility category certification must address aircraft spin and more stringent structural design criteria. Reference 14 CFR part 23 for further information.

Appendix 1 provides an example of the regulations that govern Night-VFR operations, valid at Amendment level 23-46. However, this list will likely change depending upon the actual certification basis of your airplane. Chapter 4 of this AC explains how we develop the part 23 certification basis for JAR-VLA airplanes.

Appendix 1 serves only as an example of how to document the certification basis. There may be additional part 23 rules, not identified in Appendix 1, required for IFR operations.

3-6. I am seeking approval for flight in icing conditions. I know I will need to earn a part 23 TC, showing compliance to the part 23 rules applicable for IFR operations. Are there additional rules I will need to address for flight in icing conditions?

Yes. As of amendment level 23-50, an applicant that seeks approval for flight in icing conditions will need to show compliance, as a minimum, to the following rules:

14 CFR Part 23 Rule	Title
23.775(f)	Windshields and windows
23.929	Engine installation ice protection
23.1095*	Carburetor deicing fluid flow rate
23.1097*	Carburetor deicing fluid system capacity
23.1099*	Carburetor deicing fluid system detail design
23.1323(d)	Airspeed indicating system
23.1325(g)	Static pressure system
23.1326	Pitot heat indication systems
23.1416*	Pneumatic de-icer boot system
23.1419	Ice protection

** If applicable*

The following ACs provide additional information:

- AC 20-73 Aircraft Ice Protection
- AC 23.143-1 Ice Contaminated Tailplane Stall
- AC 23.1419-2B Certification of Part 23 Airplanes for Flight in Icing Conditions

3-7. Where can I find additional information on the various Airworthiness Certificates available for these types of airplanes?

AC 21.17-3, Type Certification of Very Light Airplanes Under FAR 21.17(b), should be consulted for further information. It provides guidance on the Airworthiness Certificates available for JAR-VLA airplanes, depending upon the purpose of the airplane and its airworthiness standard.

CHAPTER 4 - 14 CFR PART 23 TYPE CERTIFICATION

4-1. How is the part 23 certification basis for my JAR-VLA airplane established?

There are four (4) steps that you (the applicant) and we (the FAA) must execute to establish a part 23 TC certification basis for airplanes originally certificated under § 21.17(b), Special Class. These four steps are discussed below.

STEP 1 Differences in Part 23 Due to Amendment Levels

The certification basis for any JAR-VLA airplane seeking a part 23 TC is the part 23 amendment level in effect at the time of application for certification. We will make a comparison between the part 23 requirements at this amendment level and the JAR-VLA regulations (dated April 26, 1990).

We will identify those part 23 rules that are part of the current amendment level, are applicable to JAR-VLA airplanes, and were not in effect in April 1990. You will need to demonstrate compliance to these additional part 23 rules.

You can show compliance to a part 23 rule by one of the following actions:

- Literal compliance;
- ELOS; or
- Exemption.

A formal process exists that governs a showing of compliance to a part 23 regulation by use of an ELOS or an exemption. Both require coordination with the Small Airplane Directorate (the Directorate). Further information on the ELOS process can be located in FAA Order 8110.4B, paragraph 2-10. 14 CFR part 11, § 11.81 gives additional information on the exemption process.

STEP 2 JAR-VLA and Part 23 Regulations – Content Difference

There are rules present in JAR-VLA and in 14 CFR part 23 that have the same rule number and section title, but they are substantively different in content. That is, these two regulatory documents prescribe a *different* level of safety for the *same* rule.

An established method exists that identifies and resolves significant regulatory and administrative differences: the Issue Paper (Reference FAA Order 8100.5, Appendix 3). Once documented in the Issue Paper, the FAA-ACO, the Directorate, and the Applicant can work to reach a satisfactory resolution to those JAR-VLA and part 23 rules that provide different levels of safety.

AC 23-15 Small Airplane Certification Compliance Program, provides historically acceptable means of compliance to selected 14 CFR part 23 rules. STEP 4 provides additional information on this subject.

STEP 3 Part 23 Regulations Not Provided in JAR-VLA

This step covers the instance when no JAR-VLA rule comparable to a part 23 section exists. There are numerous rules in part 23 that were not included in JAR-VLA because it was obvious the rules were not applicable. For example, any rules governing twin engine operations or performance, or turbine engine requirements, are clearly not applicable. Those rules are not the topic of this section.

Rules addressed by part 23 and not listed in JAR-VLA, but deemed as necessary for part 23 type certification, must be identified in an Issue Paper. The methods of compliance to these specific rules will be documented in the Issue Paper.

STEP 4 Rules Specific to Nighttime or Instrument Operations

The 14 CFR part 23 regulations specific for the desired Night VFR and/or IFR operations must be addressed. The applicant will be required to show compliance to these regulations. You may find a listing of those rules specific to Night-VFR operations, applicable at Amendment level 23-46, in Table 3 of Appendix 1.

4-2. I am an Aircraft Certification Office (ACO) Program Manager. Does an Issue Paper template exist that can be used for each JAR-VLA airplane that seeks part 23 type certification?

Yes, Appendix 1 of this AC contains a sample Issue Paper. This Issue Paper was generated during a recent JAR-VLA/part 23 certification program. It should serve as an excellent starting point for the ACO Program Manager, and improve coordination between the Applicant, ACO Program Manager, and Directorate Project Officer.

A Word About Compliance and our Understanding of the Simplicity of a JAR-VLA Airplane

If you seek a part 23 TC, you should be prepared to demonstrate literal compliance to each rule. However, we understand the inherent level of safety that is fundamental to this airplane, and we believe that the use of an ELOS (or an exemption) may also show compliance to a rule.

A JAR-VLA airplane is not automatically entitled to either of these two methods of compliance. In the case of an ELOS, you will need to demonstrate a safety *equivalence*, with the understanding that very prescriptive rules are not well suited for findings of ELOS.

In the case of an exemption, you will likely need to incorporate mitigating factors into the airplane design to ensure safety is not adversely affected. You will also need to show how an exemption would be in the public's interest.

In summary, we feel that a simplified method of compliance to certain 14 CFR part 23 rules may be in order (see AC 23-15). However, it is not an option to relax the applicable requirements of 14 CFR part 23. This has been the single largest source of confusion governing the certification of these airplanes.

AC 23-15 provides rationale that supports simplified methods of compliance to part 23 regulations. This AC does not attempt to identify every 14 CFR part 23 rule not covered by JAR-VLA standards. Rather, it provides a rationale that should be considered when evaluating small airplanes (like JAR-VLA airplanes), with a focus on the inherent level of safety expected of these airplanes.

We understand that many certification requirements in 14 CFR part 23 are not necessary for JAR-VLA airplanes. A careful and deliberate attempt to establish a valid certification basis will ensure that rules deemed unnecessary for a light, single-reciprocating-engine/propeller airplane are not included in the certification basis.

4-3. Is there a process that I should follow to receive FAA certification of my product?

You should follow the certification procedures identified in FAA Order 8110.4B.

4-4. Can I apply for a type certificate (TC) in the utility or acrobatic category?

Airplanes that were previously certificated to JAR-VLA regulations, and that are presented for part 23 type certification, are eligible for type certificates in the normal and utility categories. If you apply for a normal category TC only, then your airplane is limited to the normal category maneuvers described in Section 1.3.

If you apply for a utility category TC only, then your airplane must meet the part 23 utility category requirements and be limited to utility category maneuvers. Per 14 CFR § 23.3(b), utility category maneuvers include:

- Maneuvers permitted under the normal category;
- Spins (if approved for the particular type of airplane);
- Lazy eights, chandelles, and steep turns, or a similar maneuver, with bank angles greater than 60 degrees but less than 90 degrees.

You cannot convert a JAR-VLA approval to a part 23 acrobatic category airplane. If your airplane shows full compliance to all part 23 acrobatic category requirements, then your airplane may be eligible for a type certificate in this category. However, this is well

beyond the scope of this AC. We are not aware of any airplane that earned a JAR-VLA approval and then sought a part 23 acrobatic category type certificate.

CHAPTER 5 – RULES OF INTEREST

5-1. Is there any additional information you can provide for 14 CFR, § 23.562, Emergency Landing Dynamic Conditions?

Yes. This rule has garnered the interest of applicants with JAR-VLA airplanes seeking part 23 certification. Previous guidance on this subject has been misinterpreted, leaving applicants to believe that the physical characteristics of the airframe will provide ELOS to this particular rule. This is not true.

For a very prescriptive rule like § 23.562, you should either demonstrate literal compliance to the rule or pursue an exemption. An exemption to § 23.562 is possible provided:

- You can show it is in the public's interest, and
- You can show safety is not adversely affected.

To show that safety is not adversely affected, you must provide the following mitigating factors in the airframe:

SEAT/RESTRAINT DESIGN

- Each seat is to be equipped with a 4-point harness (a 5-point harness is also acceptable).
- Each seat/harness system must be statically tested to an ultimate load of 3,060 pounds (Note that 18G multiplied by 170 pounds = 3,060 pounds). The lapbelt should react 60 percent of this load, and the upper torso restraint should react 40 percent of this load. You may reference the Society of Automotive Engineers Aerospace Standard AS8049A, pages 16 through 19, for additional information.

HEAD STRIKE (INSTALLATION CONSIDERATIONS)

- The head strike path will be conservatively determined from actual test data, specifically, "Airplane Crash Survival Design Guide, Volume 1 – Design Criteria and Checklists," report number USAAVSCOM TR 89-D-22A. This report is available, for a fee, from the National Technical Information Service. You may reach them at 1-888-584-8322 or (703)-605-6050.
- The applicant should overlay the flail envelope from Figure 43 of this document with the cockpit of the airplane.
- The overlay of the head strike path with the cockpit must show that a head strike will not occur.

A request for exemption is a public process, and the public may comment on the exemption request. While we intend to issue an exemption if you satisfy the criteria in this Section, we must either be able to resolve the comments in a successful manner or deny the grant of exemption. You should refer to § 11.81 for further details on the exemption process.

5-2. Is there any additional information you can provide for 14 CFR, § 23.572, Metallic Wing, Empennage, and Associated Structure?

Yes. For part 23 certification, you must show compliance to 14 CFR § 23.572 for metallic wing, empennage, and associated structures.

One acceptable method of compliance to § 23.572 is to establish a fatigue safe-life. For wing structure, we advise establishing a safe-life using the methods contained in FAA report AFS-120-73-2, Fatigue Evaluation of Wing and Associated Structure on Small Airplanes. For empennage structure, we advise using FAA report ACE-100-1, Fatigue Evaluation of Empennage, Forward Wing, and Winglets/Tip Fins on Part 23 Airplanes.

Other acceptable methods of showing compliance to § 23.572 include demonstrating that a structural element will have an “infinite” fatigue life. You can do this by showing that the stresses produced by an appropriate usage loading spectra will not cause fatigue damage to accumulate. You could use a graphical representation of appropriate material S-N data to demonstrate that fatigue damage will not accumulate.

The S-N data you use in this analysis should provide the same probability of a fatigue crack-free life as provided by the AFS-120 report, 99.98 percent probability (equivalent to a 99.82 percent probability with 95 percent confidence). You may need to adjust your S-N data to achieve the AFS-120 probability level using your S-N curve’s statistical properties. Your S-N data should also accurately reflect the stress concentrations, K_t ’s, found in your structure.

You should base an appropriate usage spectra on the anticipated usage and an adequate database that defines the loadings expected for that usage. Published sources, including FAA publications, are acceptable databases. Flight test data may be acceptable if statistically significant data is available. However, in some instances, such as water loads on an amphibian airplane, flight data may be necessary to define the usage spectrum.

For aluminum structures, you may use the S-N curve from the AFS-120-73-2 report. At your discretion, a different S-N curve may be used if the S-N curve is for the same material and for the same stress concentration factor, K_t , found in the structure.

5-3. Is there any additional information you can provide for 14 CFR, § 23.573, Damage Tolerance and Fatigue Evaluation of Structure?

14 CFR part 23, § 23.573, addresses both the Damage Tolerance/Fatigue evaluation of the composite airframe structure and the development of the maintenance program for part 23 aircraft.

You will need to use static and fatigue tests to substantiate repairs. You will need to perform these tests on coupons, subcomponents, and full-scale articles. The following is a synopsis of how 14 CFR part 23 addresses repairs for composite aircraft.

14 CFR part 23, § 23.573 requires composite structures and bonded joints to be damage tolerant. The basic building block for damage tolerant design is selecting the largest defect and unrepaired damage allowed in components and assemblies during manufacturing and service. You must be able to inspect for these damage levels. You must also include this damage in the static strength and damage tolerant test articles.

You may use an impact survey to select the appropriate damage criteria to determine the "Threshold of detectability." The testing accomplished will help develop criteria for imparting and inspecting impact damage.

Test specimens from the impact survey form the basis for development of inspection criteria for the quality assurance program. Typical repairs for the damaged specimens are developed and substantiated in the damage tolerant test articles.

Per 14 CFR, part 23, § 23.573 (a)(1): The damaged test article is statically tested up to ultimate load to show sufficient capability with impact damage up to the threshold of detectability.

Per 14 CFR, part 23, § 23.573(a)(2): The test article has damage and is tested under repeated loading to establish the growth rate or no-growth rate of damage that may occur from fatigue, manufacturing flaws or impact damage. You may establish the criteria for "no growth" by visual and ultrasonic inspection. No change in the structural stiffness or strain response may also indicate "no growth." During this part of the test, you may repair some of the defects in order to validate repairs that will become part of the OEM Structural Repair Manual (SRM).

Per 14 CFR, part 23, § 23.573 (a)(3): You will conduct limit load testing at the conclusion of the repeated loading. This will substantiate the residual strength of the aircraft. You must also address loads such as the critical limit flight loads with the combined effects of normal operating pressure and the expected external aerodynamic pressures that the structure must sustain when the airplane is pressurized.

Per 14 CFR, part 23, § 23.573 (a)(4): Based on the data collected during cycle testing, you must establish a rational probability based inspection interval. This interval is

specified in the aircraft's Continued Airworthiness Instructions contained in the FAA approved sections of the Aircraft Maintenance Manual.

Per 14 CFR, part 23, § 23.573 (a)(5): You must substantiate the maximum disbonds of each bonded joint for limit load residual strength as indicated by § 23.573 (a)(3). You may determine this by test, analysis or both. A maximum disbond means an entire bondline is missing between any two primary structural components such as the spar/skin, skin/skin, rib/skin or rib/spar.

Per 14 CFR, part 23, § 23.573 (a)(6): Damage tolerant criteria may be impractical for a particular structural component. If so, you must perform a sufficient number of component, subcomponent, element, or coupon tests to establish the fatigue scatter factor and the environmental effects for this component. You must show by tests, or analysis supported by tests, that the component will withstand the repeated loads of variable magnitude expected in service.

In addition, you must perform component, subcomponent, element or coupon tests to establish the fatigue scatter factor and the environmental effects for these structural components.

You may consult AC 20-170A for additional information.

5-4. Do I need to perform a flight flutter test?

Yes. A flight flutter test is required for all part 23 airplane categories. JAR-VLA airplanes that seek part 23 certification will not be exempt from this requirement. Reference 14 CFR § 23.629 for additional information and requirements.

5-5. Is there any information you can provide for 14 CFR, § 23.1309, Equipment, Systems, and Installation?

Yes. System reliability may be a significant issue when expanding a Day VFR airplane to a Night VFR airplane. The applicant will need to show compliance to § 23.1309 for some of these systems. A thorough discussion on this topic is available in AC 23.1309-1C. We encourage you to review this document, focusing on those areas that discuss Class I applications.

CHAPTER 6 - BACKGROUND OF 14 CFR PART 23 AND JOINT AVIATION REQUIREMENTS – VERY LIGHT AIRPLANES

In the early 1990's, we attempted to address the burden that the general aviation industry felt was being placed on very light single engine airplanes with low stall speeds. Their concern was that the certification requirements of 14 CFR part 23 were unnecessarily burdensome to these simple, low speed airplanes.

Our action followed a rule making activity undertaken by the JAA, known as "Joint Aviation Requirements for Very Light Aeroplanes," or JAR-VLA, dated April 26, 1990.

In developing the JAR-VLA standards, the JAA used 14 CFR part 23 to form the basis of the regulation. In an attempt to address the design features of these airplanes, changes and deletions were made to those requirements deemed as either impractical or unnecessary.

Subsequently, we, in conjunction with industry, developed a simplified method to certificate very light airplanes. These airplanes would be treated as a "special class" of airplane under 14 CFR § 21.17(b). The requirements of JAR-VLA would stand as suitable airworthiness criteria for certification of these airplanes, with the following restrictions:

- The airplanes are limited to normal category maneuvers, and
- The airplanes are limited to Day-VFR operations only under 14 CFR part 91.

In addition, JAR-VLA permits the use of engines and propellers certificated to JAR-22, Powered Sailplanes, Subparts H and J. The FAA agrees that these engine and propeller requirements are suitable for JAR-VLA airplanes operating under Day-VFR conditions. Therefore, a JAR-VLA airplane, equipped with an engine and propeller certificated to JAR-22, Subparts H and J, may earn FAA certification as a special class of airplane under 14 CFR § 21.17(b).

14 CFR part 23 type certification, required for Night-VFR or IFR operations, is a more robust process. The material provided in previous sections of this AC provides guidance to applicants who seek this level of certification.

<i>ISSUE PAPER</i>

PROJECT: Acme Aircraft Company – Model 123 Night
VFR Approval
Project No. BR-AWN22

ITEM: G-1

STAGE: 2

REG.REF.: 14 CFR parts 21 & 23
(14 CFR part 21, § 21.17(b), JAR-VLA, VLA-Special
Class Category, & 14 CFR part 23)

DATE: May 23, 2001

NATIONAL

ISSUE STATUS: Open

POLICY REF.: Order 8110.4A, Advisory Circulars
21.17-3 and 23.11-2

SUBJECT: Night-VFR Certification Basis

BRANCH ACTION: As required

COMPLIANCE

TARGET: Pre-ATC

<i>Night-VFR Certification Basis</i>

Acme Aircraft Company (AAC) has applied for Night-VFR certification for the Model 123 airplane. The country of origin has certificated the Model 123 airplane to the JAR-VLA regulations. The applicable airworthiness regulations, including special conditions as necessary (i.e., the type certification basis), must be designated in accordance with 14 Code of Federal Regulations (CFR) part 21, § 21.101.

BACKGROUND:

The Model 123 is designed and manufactured by AAC. It is a fixed gear, two seat, side-by-side composite aircraft. A conventional elevator on the horizontal stabilizer provides pitch control. It uses a conventional yoke. The propulsion system consists of a TCM IO-240-B engine and a McCauley fixed pitch propeller - both FAA certified. Its maximum weight is 1,500 pounds (680 kg).

If AAC requested Day-VFR operations only, the aircraft could be certificated as a § 21.17(b) aircraft in the VLA-Special Class category. This method of certification is described in Advisory Circular (AC) 21.17-3, Type Certification of Very Light Airplanes Under Federal Aviation Regulations § 21.17(b), which are eligible for Day-VFR operation only.

However, AAC has made application to include Night-VFR certification in the U.S. type certificate of the Model 123 aircraft.

FAA POSITION:

The applicable airworthiness regulations must be designated in accordance with § 21.101 of the Federal Aviation Regulations.

The four (4) FAA steps for updating the § 21.17(b) VLA-Special Class airplane to include night certification, as described in AC 23-11-A, are:

Step 1

Review the original application of the Model 123 to determine what the Federal Aviation Regulations part 23 certification basis would have been – which amendment level. Compare this amendment level with Federal Aviation Regulations part 23 amendment 42 (the amendment level of Federal Aviation Regulations part 23 when the JAR-VLA rules were adopted by the FAA) and review the effect on the basic JAR-VLA rules. Update the basic JAR-VLA rules as necessary to reflect the (application date) Federal Aviation Regulations 23 certification basis amendment level.

The application date was 11/11/94. This would have resulted in a certification basis of Federal Aviation Regulations part 23, amendment 46. There are no changes to the basic JAR-VLA as a result of Federal Aviation Regulations part 23, amendments 23-43 through 46.

Step 2

Where JAR-VLA and Federal Aviation Regulations part 23 contain the same rule number but they are substantively different, demonstrate compliance with the Federal Aviation Regulations part 23 rule, request an Equivalent Level of Safety finding, or an exemption, if applicable. AC 23-15 describes simplified methods of compliance for certain Federal Aviation Regulations part 23 requirements.

Listed in Table 1 below are the Federal Aviation Regulations part 23 rules that must be addressed and that are substantively different from the corresponding JAR-VLA rules.

TABLE 1

No.	Federal Aviation Regulations part 23, amendment 23-46
1	23.45 Performance
2	23.77 Balked Landing
3	23.145 Longitudinal Control
4	23.561 Emerg. Landing Condition, General
5	23.572 Wing, Empennage, & Associated Structure
6	23.629 Flutter
7	23.677 Trim System
8	23.733 Tires
9	23.783 Doors
10	23.807 Emergency Exits
11	23.965 Fuel Tank Tests
12	23.971 Fuel Tank Sump
13	23.1309 Equipment, Systems, and Installations
14	23.1529 Instructions for Continued Airworthiness

Step 3

The JAR-VLA rules address most of the Federal Aviation Regulations part 23 rules that would be applicable for an airplane of this size. Review and address the differences between the JAR-VLA and Federal Aviation Regulations part 23 requirements (at the appropriate Federal Aviation Regulations part 23 amendment level – see Step 1).

Listed in Table 2 below are the Federal Aviation Regulations part 23, amendment 46 rules that must be addressed but are not contained in the JAR-VLA rules:

TABLE 2

No.	Federal Aviation Regulations part 23, amendment 23-46
1	23.3 Special Retroactive Requirements
2	23.31 Removable Ballast
3	23.53 Takeoff Speeds
4	23.253 High Speed Characteristics
5	23.302 Canard or Tandem Wing Configurations
6	23.507 Jacking loads
7	23.509 Towing Loads
8	23.511 Ground Load; Unsymmetrical Loads on Multiple-Wheel Units
9	23.562 Emergency Landing Dynamic Conditions
10	23.573 Damage Tolerance and Fatigue Evaluation of Structure
11	23.851 Fire Extinguishers
12	23.867 Lightning Protection of Structure
13	23.954 Fuel System Lightning Protection
14	23.997 Fuel Strainer or Filter
15	23.1043 Cooling Tests
16	23.1107 Induction System Filters
17	23.1157 Carburetor Air Temperature Controls
18	23.1181 Designated Fire Zones; Regions Included
19	23.1311 Electronic Display Instrument Systems
20	23.1329 Automatic Pilot System
21	23.1335 Flight Director System
22	23.1391 Minimum Intensities in the Horizontal Plane of Position Lights
23	23.1393 Minimum Intensities in any Vertical Plane of Position Lights
24	23.1397 Color Specifications
25	23.1413 Safety Belts and Harnesses
26	23.1441 Oxygen Equipment and Supply
27	23.1443 Minimum Mass Flow of Supplemental Oxygen
28	23.1445 Oxygen Distribution System
29	23.1447 Equipment Standards for Oxygen Dispensing Units
30	23.1449 Means for Determining Use of Oxygen
31	23.1523 Minimum Flight Crew
32	23.1524 Maximum Passenger Seating Configuration
33	23.1527 Maximum Operating Altitude
34	23.1553 Fuel Quantity Indicator
35	23.1563 Airspeed Placards
36	23.1567 Flight Maneuver Placard

Step 4

The night specific Federal Aviation Regulations part 23 rules must be addressed.

The night specific Federal Aviation Regulations part 23, amendment 23-46 rules that must be addressed are listed in Table 3:

TABLE 3

No.	Federal Aviation Regulations part 23, amendment 23-46 rule
1	23.1309 Equipment, Systems and Installations (listed in Table 2 also)
2	23.1321 Arrangement and Visibility
3	23.1351 Electrical Systems & Equipment, General
4	23.1357 Circuit Protection Devices
5	23.1381 Instrument Lights
6	23.1383 Landing Lights
7	23.1385 Position Light System Installation
8	23.1387 Position Light System Dihedral Angles
9	23.1389 Position Light Distribution and Intensities
10	23.1395 Maximum Intensities in Overlapping Beams of Position Lights
11	23.1401 Anticollision Light System
12	23.1431 Electronic Equipment
13	23.1525 Kinds of Operation
14	23.1555 Control Markings
15	23.1559 Operating Limitations Placards

If changes have been made which affect the noise level of the aircraft, compliance with part 36 will be required.

By performing Steps 1, 2, and 3 above, the airplane will have addressed the applicable FAR part 23 rules for Day-VFR operations. With the addition of Step 4, the aircraft will be eligible for Night-VFR operations.

APPLICANT'S POSITION:

Compliance with the night specific rules (Step 4) will be demonstrated to the FAA at FAR 23, amendment 46. Steps 1, 2, and 3 in the FAA Position will be addressed with the FAA for resolution.

CONCLUSION:

AAC agrees with the FAA's position as defined above.

Small Airplane Directorate
Aircraft Certification Service

Date

CONTACTS:

TITLE	NAME	PHONE
Originator	A. Smith	(816) 555-1212
Project Manager	M. Jones	(816) 555-1313
Project Officer	F. Johnson	(816) 555-1414