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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 21

[Docket No. FAA-2023-0623]

Policy for Type Certification of Very Light Airplanes as a Special Class of Aircraft

AGENCY: Federal Aviation Administration (FAA), Department of Transportation (DOT).

ACTION: Notice of proposed policy, request for comments.

SUMMARY: The FAA is requesting comments on its proposed policy for the type certification of Very Light Airplanes (VLA) as a special class of aircraft under the Federal Aviation Regulations.

DATES: Send comments on or before [INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

ADDRESSES: Send comments identified by Docket No. FAA-2023-0623 using any of the following methods:

Federal eRegulations Portal: Go to https://www.regulations.gov/ and follow the online instructions for sending your comments electronically.

Mail: Send comments to Docket Operations, M-30, U.S. Department of Transportation (DOT), 1200 New Jersey Avenue, SE, Room W12-140, West Building Ground Floor, Washington DC, 20590-0001.

Hand Delivery of Courier: Take comments to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE, Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

Fax: Fax comments to Docket Operations at 202-493-2251.

Docket: Background documents or comments received may be read at https://www.regulations.gov/ at any time. Follow the online instructions for accessing the docket or go to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE, Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: Hieu Nguyen, Product Policy Management, AIR-62B, Policy and Standards Division, Aircraft Certification Service, Federal Aviation Administration; telephone 816-329-4123; e-mail hieu.nguyen@faa.gov.

SUPPLEMENTARY INFORMATION:

Comments Invited

The FAA invites interested people to take part in the development of this proposed policy by sending written comments, data, or views. The most helpful comments reference a specific portion of the proposed policy, explain the reason for any recommended change, and include supporting data.

Before acting on this proposal, the FAA will consider all comments received on or before the closing date for comments. The FAA may consider comments filed late if it is possible to do so without incurring delay. The FAA may change the proposed policy based on the comments received.

Privacy

Except for Confidential Business Information (CBI) as described in the following paragraph, the FAA will post all comments it receives, without change, to https://www.regulations.gov/, including any personal information you provide. Using the search function of the docket website, anyone can find and read the electronic form of all comments received into any FAA docket, including the name of the individual sending the comment (or signing the comment for an association, business, labor union, etc.).

DOT's complete Privacy Act Statement can be found in the Federal Register published on April 11, 2000 (65 FR 19477-19478), as well as at https://www.dot.gov/privacy.

Confidential Business Information

CBI is commercial or financial information that is both customarily and actually treated as private by its owner. Under the Freedom of Information Act (FOIA) (5 U.S.C. 552), CBI is exempt from public disclosure. If your comments responsive to this proposed policy contain commercial or financial information that is customarily treated as private, that you actually treat as private, and that is relevant or responsive to these proposed airworthiness criteria, it is important that you clearly designate the submitted comments as CBI. Please mark each page of your submission containing CBI as "PROPIN." The FAA will treat such marked submissions as confidential under the FOIA, and the indicated comments will not be placed in the public docket for this notice. Send submissions containing CBI to the individual listed under For Further Information Contact. Comments that the FAA receives, which are not specifically designated as CBI, will be placed in the public docket for this notice.

Background

In 1992, the FAA issued Advisory Circular (AC) 21.17-3,[1] "Type Certification of Very Light Airplanes Under [14 CFR] 21.17(b)" (AC 21.17-3), to provide guidance on acceptable means of compliance for type, production, and airworthiness certification for very light airplanes (VLA). AC 21.17-3 designates the Joint Aviation Authorities (JAA) of Europe publication, "Joint Aviation Requirements for Very Light Aeroplanes" (April 26, 1990) (JAR-VLA), as acceptable airworthiness criteria that provides an equivalent level of safety under 14 CFR 21.17(b) for FAA type certification of VLA as a special class of aircraft. After the European Aviation Safety Agency (now the European Union

[1] Available at https://drs.faa.gov.

Aviation Safety Agency) (EASA) was formed, EASA developed its VLA certification standards (CS-VLA) from JAR-VLA, with CS-VLA becoming effective on November 14, 2003.

In 2016, the FAA promulgated amendment 23-64 of 14 CFR part 23, Revision of Airworthiness Standards for Normal, Utility, Acrobatic, and Commuter Category Airplanes. 81 FR 96572.[2] In the preamble to that final rule, the FAA stated that it intended to continue to allow CS-VLA airplanes to be approved as a special, stand-alone class of airplane while also allowing eligibility for certification in accordance with part 23 using accepted means of compliance. In 2017, EASA issued CS-23 Amendment 5 and EASA recognized CS-VLA as an acceptable means of compliance to CS-23 Amendment 5.

AC 21.17-3 considers a VLA as a special class of aircraft, and defines a VLA as an airplane with a single engine (spark- or compression-ignition), not more than two seats, a maximum certificated takeoff weight of not more than 750 kg (approximately 1,654 pounds), and a stalling speed of not more than 45 knots (CAS) in the landing configuration, and limited to normal category maneuvers and day visual flight rule (VFR) operations only. AC 21.17-3 states that, "VLA operations at night and under [instrument flight rule] (IFR) conditions would be acceptable, provided the VLA is certificated to the JAR-VLA requirements plus certain additional [14 CFR] part 23 requirements, including those related to night and IFR operations, and that both the engine and propeller installed [are] type certificated under [14 CFR] part 33 (or JAR-E) and part 35 (or JAR-P)."

This notice of proposed policy contains additional airworthiness criteria that are an acceptable means of compliance for design features that differ from the VLA limits defined in AC 21.17-3 or that are not adequately addressed by CS-VLA or JAR-VLA.

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[2] https://www.regulations.gov; Docket No. FAA-2015-1621

The FAA previously applied some of these additional airworthiness criteria to specific VLA type designs,[3] and these additional airworthiness criteria are among those included in this notice of proposed policy.

Discussion

The FAA establishes airworthiness criteria and issues type certificates to ensure the safe design and operation of aircraft in accordance with 49 U.S.C. 44701(a) and 44704. VLA can be type certificated by the FAA as a special class of aircraft because VLA airworthiness standards have not yet been established by regulation. Under the provisions of 14 CFR 21.17(b), the airworthiness standards for special class aircraft are the portions of the requirements in 14 CFR parts 23, 25, 27, 29, 31, 33, and 35 found by the FAA to be appropriate and applicable to the specific type design and any other airworthiness criteria found by the FAA to provide an equivalent level of safety to the existing standards.

With the adoption of performance-based regulations in part 23, amendment 23-64, VLA airplanes are eligible for certification as normal category airplanes in accordance with part 23 using accepted means of compliance. Or, applicants may seek type certification of VLA airplanes as a "special class" under § 21.17(b) using CS-VLA or JAR-VLA requirements. The FAA accepts CS-VLA and JAR-VLA airworthiness criteria as providing an equivalent level of safety under § 21.17(b) for special class type certification of VLA airplanes. Special class certification may include airplane designs that differ from the limits defined in AC 21.17-3 (e.g., engine mount, winglets, night-VFR, increased maximum certificated takeoff weight of not more than 850 kg (1,874 pounds), increased stall speed of not more than 50 KCAS, or lithium battery installation)

[3] Aquila GmbH Engine Mount Connection Design Criteria and Winglets for the Aquila GmbH AT01 JAR-VLA Airplane (68 FR 63841, October 20, 2003); Night VFR Under the Special Class (JAR-VLA) Regulations, Aquila Aviation by Excellence GmbH, Model AT01 (78 FR 50313, August 19, 2013); Advanced Avionics Under the Special Class (JAR-VLA) Regulations; Aquila Aviation by Excellence GmbH, Model AT01-100 (78 FR 68687, November 15, 2013).

provided the airplane was certificated to CS-VLA or JAR-VLA and the certification basis includes additional design requirements applicable and appropriate for the specific type design. The FAA plans to revise AC 21.17-3 to incorporate the additional acceptable airworthiness criteria proposed in this policy.

VLA airplanes meeting the limits defined in AC 21.17-3 are certificated to CS-VLA or JAR-VLA requirements. VLA airplane designs that differ from the limits defined in AC 21.17-3 or designs that incorporate features not adequately addressed by CS-VLA or JAR-VLA requirements may be certificated to CS-VLA or JAR-VLA with additional airworthiness criteria applicable and appropriate for the specific type design. Specifically, this proposed policy contains additional airworthiness criteria for such features as advanced avionic displays, engine mount to composite airframe, winglets, night VFR operations, increased maximum certificated takeoff weight and increased stall speed from those defined in AC 21.17-3, and rechargeable lithium ion battery installations.

The following are the proposed acceptable airworthiness criteria that provide an equivalent level of safety for VLA special class type certification under 21.17(b), in addition to the requirements in CS-VLA or JAR-VLA, that the FAA finds to be appropriate and applicable for specific type designs. Each of the new criteria use a "VLA.XXX" section-numbering scheme.

Advanced Avionic Displays

In addition to being certificated to CS-VLA or JAR-VLA requirements, designs incorporating advanced avionic displays would also need to meet the requirements of 14 CFR 23.1307, Miscellaneous Equipment, amendment 23-49; § 23.1311, Electronic Display Instrument Systems, amendment 23-62; § 23.1321, Arrangement and Visibility, amendment 23-49; and § 23.1359, Electrical System Fire Protection, amendment 23-49.

Winglets

In addition to being certificated to CS-VLA or JAR-VLA requirements, airplanes with winglets on the wings would also need to meet the requirements of JAR 23.445,[4] amendment 1, Outboard Fins or Winglets.

Engine Mount to Composite Airframe

In addition to being certificated to CS-VLA or JAR-VLA requirements, designs with engine mounting to composite airframe would also need to meet design requirements to address fire protection of the connection between the metal structure of an engine mount and composite airframe by demonstrating that the composite airframe can withstand a fire while carrying loads.

Night-VFR Operations

In addition to being certificated to CS-VLA or JAR-VLA, for certification for night VFR operations, the airplane would also need to meet design requirements to address the flight performance, design and construction, powerplant installation, equipment, and operating limitations and information, that are necessary for night VFR operations.

Increased Maximum Certificated Takeoff Weight and Increased Stall Speed

In addition to being certificated to CS-VLA or JAR-VLA, for approval of airplane designs with an increased maximum certificated takeoff weight of not more than 850 kg (1,874 pounds) and increased stall speed of not more than 50 KCAS, the airplane would also need to meet design requirements to address the flight performance, structure, crashworthiness, and performance information, that are necessary for the increased weight and stall speed.

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[4] JAR-23 amendment 1: Normal, Utility, Aerobatic, and Commuter Category Aeroplanes, can be found in Docket No. FAA-2023-0623 at https://www.regulations.gov.

(a) If an Equivalent Level of Safety (ELOS) to CS-VLA 1143(g) and CS-VLA 1147(b) is requested, the airplane would need to meet additional design requirements to incorporate design features to increase reliability, and maintenance items that make the engine controls attachment not likely to separate in flight, which are necessary to ensure that if the mixture control separates at the engine fuel metering device, the airplane is capable of continued safe flight and landing.

(b) Instead of the stall-characteristics requirements in CS-VLA 201(c), CS-VLA 201(f), and CS-VLA 203(c)(4), the requirements from CS 23.201(c), CS 23.201(e), and CS 23.203(c)(4)(ii), respectively, would need to be used.

(c) In place of the handling quality attributes in CS-VLA 177(a)(2) and CS-VLA 177(a)(3), neutral lateral stability would need to be achieved by showing compliance with the requirements in VLA.170.

(d) If an ELOS to CS-VLA 161(b)(2)(ii) is requested, additional airworthiness criteria from CS 23.161(c)(4), CS 23.73 (a), CS 23.75 (a)(1), (b), (c), and (d), CS 23.77(a), CS 23.145 (b)(5) and (d), CS 23.153(a), (b), (c), and (d), CS 23.157(c) and (d), and CS 23.175(c), would need to be met to address airplane trim requirements.

Rechargeable Lithium Ion Battery

In addition to being certificated to CS-VLA or JAR-VLA, airplanes with rechargeable lithium ion battery would need to meet airworthiness criteria containing safety objectives necessary to address design and installation of rechargeable lithium ion batteries.

The contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies.

Authority Citation

The authority citations for these airworthiness criteria are as follows:

Authority**:** 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

Policy

The FAA proposes to continue to allow type certification of VLA as a special class of aircraft under 14 CFR 21.17(b) using CS-VLA or JAR-VLA requirements, while also allowing eligibility for certification as a normal category airplane in accordance with part 23 using accepted means of compliance. The FAA accepts CS-VLA and JAR-VLA airworthiness criteria as providing an equivalent level of safety under § 21.17(b) special class type certification of VLA airplanes. The FAA would consider proposals for airplane designs that differ from the VLA limits defined in AC 21.17-3 for type certification as a special class of aircraft under § 21.17(b), provided the VLA were certificated to the JAR-VLA or CS-VLA requirements plus additional airworthiness criteria the FAA finds appropriate and applicable for the proposed design. Additional design requirements may include but are not limited to the airworthiness criteria identified in the following paragraphs. Other additional airworthiness criteria may be required to address specific design proposals.

Advanced Avionic Displays

If the airplane has advanced avionic displays installed, the following requirements from 14 CFR part 23 apply:

- 14 CFR 23.1307 at amendment 23-49, Miscellaneous Equipment.
- 14 CFR 23.1311 at amendment 23-62, Electronic Display Instrument Systems.
- 14 CFR 23.1321 at amendment 23-49, Arrangement and Visibility.
- 14 CFR 23.1359 at amendment 23-49, Electrical System Fire Protection.

Winglets

If the airplane has any outboard fins or winglets installed, the design must comply with JAR 23.445.

Engine Mount to Composite Airframe

VLA.001

The requirements in this section are applicable to airplanes with an engine mounting to composite airframe. Tests must be performed that demonstrate that the interface between the metallic engine mount and the glass fiber reinforced plastic fuselage withstand a fire for 15 minutes while carrying loads under the following conditions:

(a) With one lost engine mount fitting the loads are distributed over the remaining three engine mount fittings. The most critical of these fittings must be chosen for the test. The loads are:

(1) In Z-direction the mass of the propulsion unit multiplied by a maneuvering load factor resulting from a 30° turn for 15 minutes, superimposed by a maneuvering load of 3 seconds representing the maximum positive limit maneuvering load factor of n=3.8 from JAR-VLA 337(a).

(2) In X-direction the engine propulsion force at maximum continuous power for 5 minutes.

(b) The flame to which the component test arrangement is subjected must provide a temperature of 500° C within the target area.

(c) The flame must be large enough to maintain the required temperature over the entire test zone, i.e., the fitting on the engine compartment side.

(d) It must be shown that the test equipment, e.g., burner and instrumentation are of sufficient power, size, and precision to yield the test requirements arising from paragraphs (a) through (c) of this section.

Night-VFR Operations

VLA.005

The requirements in sections VLA.005 through VLA.105 are applicable to airplanes with a single engine (spark- or compression-ignition) having not more than two seats, with a maximum certificated takeoff weight of not more than 750 kg and a stalling speed in the landing configuration of not more than 83 km/h (45 knots)(CAS), to be approved for day-VFR [visual flight rules] or for day-and night-VFR.

VLA.010

(a) Any short period oscillation not including combined lateral-directional oscillations occurring between the stalling speed and the maximum allowable speed appropriate to the configuration of the airplane must be heavily damped with the primary controls—

(1) Free; and

(2) In a fixed position.

(b) Any combined lateral-directional oscillations ("Dutch roll") occurring between the stalling speed and the maximum allowable speed appropriate to the configuration of the airplane must be damped to 1/10 amplitude in 7 cycles with the primary controls—

(1) Free; and

(2) In a fixed position.

(c) Any long period oscillation of the flight path (phugoid) must not be so unstable as to cause an unacceptable increase in pilot workload or otherwise endanger the airplane. When under the conditions specified in CS-VLA 175, the longitudinal control force required to maintain speeds differing from the trimmed speed by at least plus or minus 15% is suddenly released, the response of the airplane must not exhibit any dangerous characteristics nor be excessive in relation to the magnitude of the control force released.

VLA.015

The pilot compartment must be free from glare and reflections that could interfere with the pilot’s vision under all operations for which the certification is requested. The pilot compartment must be designed so that—

(a) The pilot's view is sufficiently extensive, clear, and undistorted, for safe operation;

(b) The pilot is protected from the elements so that moderate rain conditions do not unduly impair the pilot’s view of the flight path in normal flight and while landing; and

(c) Internal fogging of the windows covered under paragraph (a) of this section can be easily cleared by the pilot unless means are provided to prevent fogging.

VLA.020

(a) The airplane must be so designed that unimpeded and rapid escape is possible in any normal and crash attitude.

(b) The opening system must be designed for simple and easy operation. It must function rapidly and be designed so that it can be operated by each occupant strapped in their seat, and also from outside the cockpit. Reasonable provisions must be provided to prevent jamming by fuselage deformation.

(c) The exit must be marked for easy location and operation even in darkness.

VLA.025

(a) The engine must meet the specifications of CS-E, amendment 6,[5] or 14 CFR part 33, amendment 33-36, for night-VFR operation.

(b) Restart capability. An altitude and airspeed envelope must be established for the airplane for in-flight engine restarting and the installed engine must have a restart capability within that envelope.

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[5] CS-E amendment 6: Certification Specifications and Acceptable Means of Compliance for Engines can be found in Docket No. FAA-2023-0623 at https://www.regulations.gov.

VLA.030

(a) For day-VFR operation, the propeller must meet the specifications of CS-22 Subpart J, amendment 3. For night-VFR operations the propeller and its control system must meet the specifications of CS-P, amendment 2,[6] or 14 CFR part 35, amendment 35-10, except for fixed pitch propellers, for which CS-22[7] subpart J is sufficient.

(b) Engine power and propeller shaft rotational speed may not exceed the limits for which the propeller is certificated or approved.

VLA.035

If an air filter is used to protect the engine against foreign material particles in the induction air supply—

(a) Each air filter must be capable of withstanding the effects of temperature extremes, rain, fuel, oil, and solvents to which it is expected to be exposed in service and maintenance; and

(b) Each air filter must have a design feature to prevent material separated from the filter media from re-entering the induction system and interfering with proper fuel metering operation.

VLA.040

(a) Each exhaust system must ensure safe disposal of exhaust gases without fire hazard or carbon monoxide contamination in the personnel compartment.

(b) Each exhaust system part with a surface hot enough to ignite flammable fluids or vapours must be located or shielded so that leakage from any system carrying flammable fluids or vapours will not result in a fire caused by impingement of the fluids or vapours on any part of the exhaust system including shields for the exhaust system.

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[6] CS-P amendment 2: Certification Specifications and Acceptable Means of Compliance for Propellers can be found in Docket FAA-2023-0623 at https://www.regulations.gov.

[7] CS-22 amendment 3: Certification Specifications, Acceptable Means of Compliance and Guidance Material for Sailplanes and Powered Sailplanes can be found in Docket No. FAA-2023-0623 at https://www.regulations.gov.

(c) Each exhaust system component must be separated by fireproof shields from adjacent flammable parts of the airplane that are outside the engine compartment.

(d) No exhaust gases may discharge dangerously near any fuel or oil system drain.

(e) Each exhaust system component must be ventilated to prevent points of excessively high temperature.

(f) Each exhaust heat exchanger must incorporate means to prevent blockage of the exhaust port after any internal heat exchanger failure.

(g) No exhaust gases may be discharged where they will cause a glare seriously affecting the pilot's vision at night.

VLA.045

(a) The power or supercharger control must give a positive and immediate responsive means of controlling its engine or supercharger.

(b) If a power control incorporates a fuel shut-off feature, the control must have a means to prevent the inadvertent movement of the control into the shut-off position. The means must—

(1) Have a positive lock or stop at the idle position; and

(2) Require a separate and distinct operation to place the control in the shut-off position.

(c) Each power or thrust control must be designed so that if the control separates at the engine fuel metering device, the airplane is capable of continuing safe flight and landing.

VLA.050

(a) The control must require a separate and distinct operation to move the control toward lean or shut-off position.

(b) Each manual engine mixture control must be designed so that, if the control separates at the engine fuel metering device, the airplane is capable of continuing safe flight and landing.

VLA.055

If warning, caution, or advisory lights are installed in the cockpit, they must be—

(a) Red, for warning lights (lights indicating a hazard which may require immediate corrective action);

(b) Amber, for caution lights (lights indicating the possible need for future corrective action);

(c) Green, for safe operation lights; and

(d) Any other color, including white, for lights not described in paragraphs (a) through (c) of this section, provided the color differs sufficiently from the colors prescribed in paragraphs (a) through (c) of this section to avoid possible confusion.

(e) If warning, caution, or advisory lights are installed in the cockpit, they must be effective under all probable cockpit lighting conditions.

VLA.060

(a) Each instrument provided with static pressure case connections must be so vented that the influence of airplane speed, the opening and closing of windows, moisture, or other foreign matter, will not significantly affect the accuracy of the instruments.

(b) The design and installation of a static pressure system must be such that—

(1) Positive drainage of moisture is provided;

(2) Chafing of the tubing, and excessive distortion or restriction at bends in the tubing, is avoided; and

(3) The materials used are durable, suitable for the purpose intended, and protected against corrosion.

(c) Each static pressure system must be calibrated in flight to determine the system error. The system error, in indicated pressure altitude, at sea-level, with a standard atmosphere, excluding instrument calibration error, may not exceed ±9 m (± 30 ft) per 185 km/h (100 knots) speed for the appropriate configuration in the speed range between 1.3 V_{SO} with flaps extended and 1.8 V_{S1} with flaps retracted. However, the error need not be less than ±9 m (± 30 ft).

VLA.065

For each airplane—

(a) Each gyroscopic instrument must derive its energy from power sources adequate to maintain its required accuracy at any speed above the best rate-of-climb speed;

(b) Each gyroscopic instrument must be installed so as to prevent malfunction due to rain, oil, and other detrimental elements; and

(c) There must be a means to indicate the adequacy of the power being supplied to the instruments.

(d) For Night VFR operation there must be at least two independent sources of power and a manual or an automatic means to select each power source for each instrument that uses a power source.

VLA.070

(a) Electrical system capacity. Each electrical system must be adequate for the intended use. In addition—

(1) Electric power sources, their transmission cables, and their associated control and protective devices, must be able to furnish the required power at the proper voltage to each load circuit essential for safe operation; and

(2) Compliance with paragraph (a)(l) of this section must be shown by an electrical load analysis, or by electrical measurements, that account for the electrical

loads applied to the electrical system in probable combinations and for probable durations.

(b) Functions. For each electrical system, the following apply:

(1) Each system, when installed, must be—

(i) Free from hazards in itself, in its method of operation, and in its effects on other parts of the airplane;

(ii) Protected from fuel, oil, water, other detrimental substances, and mechanical damage; and

(iii) So designed that the risk of electrical shock to occupants and ground personnel is reduced to a minimum.

(2) Electric power sources must function properly when connected in combination or independently.

(3) No failure or malfunction of any electric power source may impair the ability of any remaining source to supply load circuits essential for safe operation.

(4) Each electric power source control must allow the independent operation of each source, except that controls associated with alternators that depend on a battery for initial excitation or for stabilization need not break the connection between the alternator and its battery.

(5) Each generator must have an overvoltage control designed and installed to prevent damage to the electrical system, or to equipment supplied by the electrical system, that could result if that generator were to develop an overvoltage condition.

(d) Instruments. There must be a means to indicate to the pilot that the electrical power supplies are adequate for safe operation. For direct current systems, an ammeter in the battery feeder may be used.

(e) Fire resistance. Electrical equipment must be so designed and installed that in the event of a fire in the engine compartment, during which the surface of the firewall adjacent to the fire is heated to l,l00°C for 5 minutes or to a lesser temperature substantiated by the applicant, the equipment essential to continued safe operation and located behind the firewall will function satisfactorily and will not create an additional fire hazard. This may be shown by test or analysis.

(f) External power. If provisions are made for connecting external power to the airplane, and that external power can be electrically connected to equipment other than that used for engine starting, means must be provided to ensure that no external power supply having a reverse polarity, or a reverse phase sequence, can supply power to the airplane's electrical system. The location must allow such provisions to be capable of being operated without hazard to the airplane or persons.

VLA.075

(a) Each storage battery must be designed and installed as prescribed in this section.

(b) Safe cell temperatures and pressures must be maintained during any probable charging and discharging condition. No uncontrolled increase in cell temperature may result when the battery is recharged (after previous complete discharge)—

(1) At maximum regulated voltage or power;

(2) During a flight of maximum duration; and

(3) Under the most adverse cooling condition likely to occur in service.

(c) Compliance with paragraph (b) of this section must be shown by tests unless experience with similar batteries and installations has shown that maintaining safe cell temperatures and pressures presents no problem.

(d) No explosive or toxic gases emitted by any battery in normal operation, or as the result of any probable malfunction in the charging system or battery installation, may accumulate in hazardous quantities within the airplane.

(e) No corrosive fluids or gases that may escape from the battery may damage surrounding structures or adjacent essential equipment.

(f) Each nickel cadmium battery installation capable of being used to start an engine or auxiliary power unit must have provisions to prevent any hazardous effect on structure or essential systems that may be caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells.

(g) Nickel cadmium battery installations capable of being used to start an engine or auxiliary power unit must have –

(1) A system to control the charging rate of the battery automatically so as to prevent battery overheating;

(2) A battery temperature sensing and over-temperature warning system with a means for disconnecting the battery from its charging source in the event of an overtemperature condition; or

(3) A battery failure sensing and warning system with a means for disconnecting the battery from its charging source in the event of battery failure.

(h) In the event of a complete loss of the primary electrical power generating system, the battery must be capable of providing 30 minutes of electrical power to those loads that are essential to continued safe flight and landing. The 30-minute time period includes the time needed for the pilot(s) to recognize the loss of generated power and to take appropriate load shedding action.

VLA.080

The instrument lights must—

(a) Make each instrument and control easily readable and discernible;

(b) Be installed so that their direct rays, and rays reflected from the windshield or other surface, are shielded from the pilot’s eyes; and

(c) Have enough distance or insulating material between current carrying parts and the housing so that vibration in flight will not cause shorting. (A cabin dome light is not an instrument light.)

VLA.085

Each taxi and landing light must be designed and installed so that—

(a) No dangerous glare is visible to the pilots;

(b) The pilot is not seriously affected by halation;

(c) It provides enough light for night operations; and

(d) It does not cause a fire hazard in any configuration.

VLA.090

(a) Electronic equipment and installations must be free from hazards in themselves, in their method of operation, and in their effects on other components.

(b) For operations for which electronic equipment is required, compliance must be shown with CS-VLA 1309.

VLA.095

(a) A placard meeting the requirements of this section must be installed on or near the magnetic direction indicator.

(b) The placard must show the calibration of the instrument in level flight with the engine operating.

(c) The placard must state whether the calibration was made with radio receivers on or off.

(d) Each calibration reading must be in terms of magnetic headings in not more than 30° increments.

(e) If a magnetic non-stabilized direction indicator can have a deviation of more than 10° caused by the operation of electrical equipment, the placard must state which electrical loads, or combination of loads, would cause a deviation of more than 10° when turned on.

VLA.100

The following placards must be plainly visible to the pilot:

(a) A placard stating the following airspeeds (IAS):

(1) Design maneuvering speed, V_A;

(2) The maximum landing gear operating speed, V_{LO}.

(b) A placard stating the following approved operation:

(1) For day-VFR only operation, a placard stating, "This airplane is classified as a very light airplane approved for day-VFR only, in non-icing conditions. All aerobatic maneuvers, including intentional spinning, are prohibited. See Flight Manual for other limitations."

(2) If night-VFR operation is approved, a placard stating, "This airplane is classified as a very light airplane approved for day- and night-VFR operation, in non-icing conditions. All aerobatic maneuvers, including intentional spinning, are prohibited. See Flight Manual for other limitations."

VLA.105

(a) Airspeed limitations. The following information must be furnished—

(1) Information necessary for the marking of the airspeed limits on the indicator, as required in CS-VLA 1545, and the significance of the color coding used on the indicator.

(2) The speeds V_A, V_{LO}, V_{LE} (maximum landing gear extended speed) where appropriate.

(b) Weights. The following information must be furnished:

(1) The maximum weight.

(2) Any other weight limits, if necessary.

(c) Center of gravity. The established c.g. limits required by CS-VLA 23 must be furnished.

(d) Maneuvers. Authorized maneuvers established in accordance with CS-VLA 3 must be furnished.

(e) Flight load factors. Maneuvering load factors: the following must be furnished—

(1) The factors corresponding to point A and point C in the figure for CS-VLA 333(b), stated to be applicable at V_A.

(2) The factors corresponding to point D and point E of figure 1 of CS-VLA 333(b) to be applicable at never exceed speed, V_{NE}.

(3) The factor with wing flaps extended as specified in CS-VLA 345.

(f) The kinds of operation (day-VFR or day- and night-VFR, whichever is applicable) in which the airplane may be used, must be stated. The minimum equipment required for the operation must be listed.

(g) Powerplant limitations. The following information must be furnished:

(1) Limitation required by CS-VLA 1521.

(2) Information necessary for marking the instruments required by CS-VLA 1549 through 1551.

(3) Fuel and oil designation.

(4) For two-stroke engines, fuel/oil ratio.

(h) Placards. Placards required by CS-VLA 1555 through 1561 must be presented.

Increased Maximum Certificated Takeoff Weight and Increased Stall Speed

VLA.110

If the maximum certificated takeoff weight is higher than 750 kg, but not more than 850 kg, the requirements in sections VLA.120 through VLA.210 apply.

VLA.115

If the stall speed in landing configuration is higher than 45 knots, but not more than 50 knots (CAS), the requirements in section VLA.120 through VLA.210 apply.

VLA.120

The maximum horizontal distance traveled in still air, in km per 1,000 m (nautical miles per 1,000 ft) of altitude lost in a glide, and the speed necessary to achieve this, must be determined with the engine inoperative and its propeller in the minimum drag position, and landing gear and wing flaps in the most favorable available position.

VLA.125

(a) Each seat is to be equipped with at least a 4-point harness system;

(b) The applicant shall evaluate the head strike path with validated methods, and minimize the risk of injury in case of a head contact with the aircraft structure or interior.

(c) The design shall provide reasonable precautions to minimize the lumbar compression loads experienced by occupants in survivable crash landings;

(d) Each seat/harness system shall be statically tested to an ultimate inertia load factor of 18g forward, considering an occupant's mass of 77 kg. The lapbelt should react 60% of this load, and the upper torso restraint should react 40% of this load.

VLA.130

(a) The airplane, although it may be damaged in emergency landing conditions, must be designed as prescribed in this section to protect each occupant under those conditions.

(b) The structure must be designed to give each occupant reasonable chances of escaping injury in a minor crash landing when—

(1) Proper use is made of seat belts and shoulder harnesses; and

(2) The occupant experiences the ultimate inertia forces listed below:

(i) Upward 3.0g

(ii) Forward 9.0g

(iii) Sideward 1.5g.

(c) Each item of mass within the cabin that could injure an occupant if it came loose must be designed for the ultimate inertia load factors:

(1) Upward, 3.0g;

(2) Forward, 18.0g; and

(3) Sideward, 4.5g.

Engine mount and supporting structure are included in the above analysis if they are installed behind and above the seating compartment.

(d) The structure must be designed to protect the occupants in a complete turnover, assuming, in the absence of a more rational analysis—

(1) An upward ultimate inertia force of 3g; and

(2) A coefficient of friction of 0.5 at the ground.

(e) Each airplane with retractable landing gear must be designed to protect each occupant in a landing—

(1) With the wheels retracted;

(2) With moderate descent velocity; and

(3) Assuming, in the absence of a more rational analysis;

(i) A downward ultimate inertia force of 3g; and

(ii) A coefficient of friction of 0.5 at the ground.

VLA.135

(a) Each baggage compartment must be designed for its placarded maximum weight of contents and for the critical load distributions at the appropriate maximum load factors corresponding to the flight and ground load conditions for the airplane.

(b) There must be means to prevent the contents of any baggage compartment from becoming a hazard by shifting, and to protect any controls, wiring, lines, equipment, or accessories whose damage of failure would affect safe operations.

(c) Baggage compartments must be constructed of materials which are at least flame resistant.

(d) Designs which provide for baggage to be carried must have means to protect the occupants from injury under the ultimate inertia forces specified in CS-VLA 561(b)(2).

(e) If there is no structure between baggage and occupant compartments, the baggage items located behind the occupants and those which might become a hazard in a crash must be secured for 1.33 x 18g.

VLA.140

(a) General. For each airplane, the following information must be furnished:

(1) The takeoff distance determined under CS-VLA 51, the airspeed at the 15 m height, the airplane configuration (if pertinent), the kind of surface in the tests, and the pertinent information with respect to cowl flap position, use of flight path control devices, and use of the landing gear retraction system.

(2) The landing distance determined under CS-VLA 75, the airplane configuration (if pertinent), the kind of surface used in the tests, and the pertinent information with respect to flap position and the use of flight path control devices.

(3) The steady rate or gradient of climb determined under CS-VLA 65 and 77, the airspeed, power, and the airplane configuration.

(4) The calculated approximate effect on takeoff distance (paragraph (a)(1) of this section), landing distance (paragraph (a)(2) of this section), and steady rates of climb (paragraph (a)(3) of this section), of variations in altitude and temperature.

(5) The maximum atmospheric temperature at which compliance with the cooling provisions of CS-VLA 1041 through 1047 is shown.

(6) The glide performance determined under VLA.120.

(b) Skiplanes. For skiplanes, a statement of the approximate reduction in climb performance may be used instead of new data for skiplane configuration, if—

(1) The landing gear is fixed in both landplane and skiplane configurations;

(2) The climb requirements are not critical; and

(3) The climb reduction in the skiplane configurations is small (0.15 to 0.25 m/s (30 to 50 feet per minute)).

(c) The following information concerning normal procedures must be furnished:

(1) The demonstrated crosswind velocity and procedures and information pertinent to operation of the airplane in crosswinds, and

(2) The airspeeds, procedures, and information pertinent to the use of the following airspeeds:

(i) The recommended climb speed and any variation with altitude.

(ii) V_X (speed for best angle of climb) and any variation with altitude.

(iii) The approach speeds, including speeds for transition to the balked landing condition.

(d) An indication of the effect on takeoff distance of a grass surface as determined from at least one takeoff measurement on short mown dry grass must be furnished.

VLA.145

(a) The rotation speed V_R, is the speed at which the pilot makes a control input with the intention of lifting the airplane out of contact with the runway.

(b) V_R must not be less than stalling speed, V_{S1}.

(c) The Airplane Flight Manual must provide the rotation speed established above for normal takeoff procedures.

If an Equivalent Level of Safety (ELOS) to CS-VLA 1143(g) and CS-VLA 1147(b) is requested, VLA.150 and VLA.155 are applicable.

VLA.150

Power or supercharger control attachment design must include:

(a) Features which are not likely to separate in flight (i.e., a large load-bearing washer adjacent to the outside face of the power control cable rod end fitting which attaches to the fuel-metering device);

(b) Mandatory inspection intervals;

(c) Inspection procedures;

(d) Component replacement criteria.

VLA.155

Mixture control attachment design must include:

(a) Features which are not likely to separate in flight (i.e., a large load-bearing washer adjacent to the outside face of the power control cable rod end fitting which attaches to the fuel-metering device);

(b) Mandatory inspection intervals;

(c) Inspection procedures;

(d) Component replacement criteria.

VLA.160

(a) For an airplane with independently controlled roll and directional controls, it must be possible to produce and to correct roll by unreversed use of the rolling control and to produce and to correct yaw by unreversed use of the directional control, up to the time the airplane stalls.

(b) For an airplane with interconnected lateral and directional controls (2 controls) and for an airplane with only one of these controls, it must be possible to produce and correct roll by unreversed use of the rolling control without producing excessive yaw, up to the time the airplane stalls.

(c) The wing level stall characteristics of the airplane must be demonstrated in flight as follows: The airplane speed must be reduced with the elevator control until the speed is slightly above the stalling speed, then the elevator control must be pulled back so that the rate of speed reduction will not exceed 1.9 km/h (one knot) per second until a stall is produced, as shown by an uncontrollable downward pitching motion of the airplane, or until the control reaches the stop. Normal use of the elevator control for recovery is allowed after the control has been held against the stop for not less than two seconds.

(d) Except where made inapplicable by the special features of a particular type of airplane, the following apply to the measurement of loss of altitude during a stall:

(1) The loss of altitude encountered in the stall (power on or power off) is the change in altitude (as observed on the sensitive altimeter testing installation) between the altitude at which the airplane pitches and the altitude at which horizontal flight is regained.

(2) If power or thrust is required during stall recovery, the power or thrust used must be that which would be used under the normal operating procedures selected by the applicant for this maneuver. However, the power used to regain level flight may not be applied until flying control is regained.

(e) During the recovery part of the maneuver, it must be possible to prevent more than 15° of roll or yaw by the normal use of controls.

(f) Compliance with the requirements of this section must be shown under the following conditions:

(1) Wing flaps. Retracted, fully extended and each intermediate normal operating position;

(2) Landing gear. Retracted and extended;

(3) Cowl flaps. Appropriate to configuration;

(4) Power

(i) Power off; and

(ii) 75% maximum continuous power. If the power-to-weight ratio at 75% of maximum continuous power results in extreme nose-up attitudes, the test may be carried out with the power required for level flight in the landing configuration at maximum landing weight and a speed of 1.4 stalling speed, V_{S0}, but the power may not be less than 50% maximum continuous power.

(5) Trim. The airplane trimmed at a speed as near 1.5 V_{S1} as practicable.

(6) Propeller. Full increase rpm position for the power off condition.

VLA.165

Turning flight and accelerated stalls must be demonstrated in tests as follows:

(a) Establish and maintain a coordinated turn in a 30° bank. Reduce speed by steadily and progressively tightening the turn with the elevator until the airplane is stalled or until the elevator has reached its stop. The rate of speed reduction must be constant, and—

(1) For a turning flight stall, may not exceed 1.9 km/h (one knot) per second; and

(2) For an accelerated stall, be 5.6 to 9.3 km/h (3 to 5 knots) per second with steadily increasing normal acceleration.

(b) When the stall has fully developed or the elevator has reached its stop, it must be possible to regain level flight by normal use of controls and without—

(1) Excessive loss of altitude;

(2) Undue pitchup;

(3) Uncontrollable tendency to spin;

(4) Exceeding 60° of roll in either direction from the established 30° bank; and

(5) For accelerated entry stalls, without exceeding the maximum permissible speed or the allowable limit load factor.

(c) Compliance with the requirements of this sectionmust be shown with—

(1) Wing Flaps. Retracted and fully extended for turning flight and accelerated entry stalls, and intermediate, if appropriate, for accelerated entry stalls;

(2) Landing Gear. Retracted and extended;

(3) Cowl Flaps. Appropriate to configuration;

(4) Power. 75% maximum continuous power. If the power-to-weight ratio at 75% of maximum continuous power results in extreme nose-up attitudes, the test may be carried out with the power required for level flight in the landing configuration at maximum landing weight and a speed of 1.4 V_{S0}, but the power may not be less than 50% maximum continuous power.

(5) Trim. 1.5 V_{S1} or minimum trim speed, whichever is higher.

VLA.170

(a) Three-control airplanes. The stability requirements for three-control airplanes are as follows:

(1) The static directional stability, as shown by the tendency to recover from a skid with the rudder free, must be positive for any landing gear and flap position appropriate to the takeoff, climb, cruise, and approach configurations. This must be shown with power up to maximum continuous power, and at speeds from 1.2 V_{S1} up to maximum allowable speed for the condition being investigated. The angle of skid for these tests must be appropriate to the type of airplane. At larger angles of skid up to that at which full rudder is used or a control force limit in CS-VLA 143 is reached, whichever occurs first, and at speeds from 1.2 V_{S1} to V_A, the rudder pedal force must not reverse.

(2) The static lateral stability, as shown by the tendency to raise the low wing in a slip, must not be negative for any landing gear and flap positions. This must be shown

with power up to 75% of maximum continuous power at speeds above 1.2 V_{S1}, up to the maximum allowable speed for the configuration being investigated. The static lateral stability may not be negative at 1.2 V_{S1}. The angle of slip for these tests must be appropriate to the type of airplane, but in no case may the slip angle be less than that obtainable with 10° of bank.

(3) In straight, steady slips at 1.2 V_{S1} for any landing gear and flap positions, and for power conditions up to 50% of maximum continuous power, the rudder control movements and forces must increase steadily (but not necessarily linearly) as the angle of slip is increased up to the maximum appropriate to the type of airplane. At larger slip angles up to the angle at which full rudder or aileron control is used or a control force limit contained in CS-VLA 143 is obtained, aileron control movements and forces must not reverse. Enough bank must accompany slipping to hold a constant heading. Rapid entry into, or recovery from, a maximum slip may not result in uncontrollable flight characteristics. The applicant must demonstrate that lateral static stability characteristics do not result in any unsafe handling qualities.

(b) Two-control (or simplified control) airplanes. The stability requirements for two-control airplanes are as follows:

(1) The directional stability of the airplane must be shown by showing that, in each configuration, it can be rapidly rolled from a 45° bank in one direction to a 45° bank in the opposite direction without showing dangerous skid characteristics.

(2) The lateral stability of the airplane must be shown by showing that it will not assume a dangerous attitude or speed when the controls are abandoned for 2 minutes. This must be done in moderately smooth air with the airplane trimmed for straight level flight at 0.9 V_H (maximum speed in level flight with maximum continuous power) or V_C (design cruising speed), whichever is lower, with flaps and landing gear retracted, and with a rearward center of gravity.

If an ELOS to CS-VLA 161(b)(2)(ii) is requested, VLA.175 through VLA.210 are applicable.

VLA.175

Longitudinal trim. The airplane must maintain longitudinal trim under each of the following conditions:

(a) Approach with landing gear extended and with—

(i) A 3° angle of descent, with flaps retracted and at a speed of 1.4 V_{S1};

(ii) A 3° angle of descent, flaps in the landing position(s) at reference landing approach speed, V_{REF}; and

(iii) An approach gradient equal to the steepest used in the landing distance demonstrations of CS 23.75, flaps in the landing position(s) at V_{REF}.

VLA.180

For normal, utility and aerobatic category reciprocating engine-powered airplanes of 2,722 kg (6,000 lb) or less maximum weight, the reference landing approach speed, V_{REF}, must not be less than the greater of minimum control speed, V_{MC}, determined under CS 23.149(b) with the wing flaps in the most extended takeoff setting, and 1.3 V_{SO}.

VLA.185

(a) A steady approach at not less than V_{REF}, determined in accordance with CS 23.73(a), (b) or (c) as appropriate, must be maintained down to 15 m (50 ft) height and—

(1) The steady approach must be at a gradient of descent not greater than 5.2% (3°) down to the 15 m (50 ft) height.

(b) A constant configuration must be maintained throughout the maneuver.

(c) The landing must be made without excessive vertical acceleration or tendency to bounce, nose-over, ground loop, porpoise, or water loop.

(d) It must be shown that a safe transition to the balked landing conditions of CS 23.77 can be made from the conditions that exist at the 15 m (50 ft) height, at maximum landing weight, or the maximum landing weight for altitude and temperature of CS 23.63(c)(2) or (d)(2), as appropriate.

VLA.190

(a) Each normal, utility, and aerobatic category reciprocating engine-powered airplane of 2,722 kg (6,000 lb) or less maximum weight must be able to maintain a steady gradient of climb at sea-level of at least 3.3% with—

(1) Takeoff power on each engine;

(2) The landing gear extended;

(3) The wing flaps in the landing position, except that if the flaps may safely be retracted in 2 seconds or less without loss of altitude and without sudden changes of angle of attack, they may be retracted; and

(4) A climb speed equal to V_{REF}, as defined in CS 23.73(a).

VLA.195

(a) It must be possible to carry out the following maneuvers without requiring the application of single-handed control forces exceeding those specified in CS 23.143(c), unless otherwise stated. The trimming controls must not be adjusted during the maneuvers:

(1) With power off, landing gear and flaps extended and the airplane as nearly as possible in trim at V_{REF}, obtain and maintain airspeeds between 1.1 V_{S0} and either 1.7 V_{S0} or V_{FE} (maximum flap extended speed), whichever is lower, without requiring the application of two-handed control forces exceeding those specified in CS 23.143(c).

(b) It must be possible, with a pilot control force of not more than 44.5 N (10 lbf), to maintain a speed of not more than V_{REF} during a power-off glide with landing gear and wing flaps extended.

VLA.200

It must be possible, while in the landing configuration, to safely complete a landing without exceeding the one-hand control force limits specified in CS 23.143(c) following an approach to land—

(a) At a speed of V_{REF} 9.3 km/h (5 knots);

(b) With the airplane in trim, or as nearly as possible in trim and without the trimming control being moved throughout the maneuver;

(c) At an approach gradient equal to the steepest used in the landing distance demonstration of CS 23.75;

(d) With only those power changes, if any, which would be made when landing normally from an approach at V_{REF}.

VLA.205

(a) Approach - It must be possible using a favorable combination of controls, to roll the airplane from a steady 30° banked turn through an angle of 60°, so as to reverse the direction of the turn within—

(1) For an airplane of 2,722 kg (6,000 lb) or less maximum weight, 4 seconds from initiation of roll; and

(2) For an airplane of over 2,722 kg (6,000 lb) maximum weight, 1,000/W+1,300 but not more than 7 seconds, where W is weight in kg. (W + 2800/ 2200 but not more than 7 seconds where W is weight in lb.).

(b) The requirement of paragraph (a) of this section must be met when rolling the airplane in each direction in the following conditions—

(1) Flaps in the landing position(s);

(2) Landing gear extended;

(3) All engines operating at the power for a 3° approach; and

(4) The airplane trimmed at V_{REF}.

VLA.210

(a) Landing. The stick force curve must have a stable slope at speeds between 1.1 V_{S1} and 1.8 V_{S1} with—

(1) Flaps in the landing position;

(2) Landing gear extended; and

(3) The airplane trimmed at—

(i) V_{REF}, or the minimum trim speed if higher, with power off; and

(ii) V_{REF} with enough power to maintain a 3° angle of descent.

Rechargeable Lithium Ion Battery

VLA.215

The applicant must consider the following safety objectives when showing compliance with regulations applicable to the rechargeable lithium ion battery.

Each rechargeable lithium ion battery installation must:

(a) Be designed to maintain safe cell temperatures and pressures under all foreseeable operating conditions to prevent fire and explosion;

(b) Be designed to prevent the occurrence of self-sustaining, uncontrollable increases in temperature or pressure, and automatically control the charge rate of each cell to protect against adverse operating conditions, such as cell imbalance, back charging, overcharging, and overheating;

(c) Not emit explosive or toxic gases, either in normal operation or as a result of its failure, that may accumulate in hazardous quantities within the airplane;

(d) Meet the requirements of 14 CFR 23.2325(g);

(e) Not damage surrounding structure or adjacent systems, equipment, components, or electrical wiring from corrosive or any other fluids or gases that may escape in such a way as to cause a major or more-severe failure condition;

(f) Have provisions to prevent any hazardous effect on airplane structure or systems caused by the maximum amount of heat it can generate due to any failure of it or its individual cells;

(g) Have a failure sensing and warning system to alert the flightcrew if its failure affects safe operation of the airplane;

(h) Have a monitoring and warning feature that alerts the flightcrew when its charge state falls below acceptable levels if its function is required for safe operation of the airplane;

(i) Have a means to disconnect from its charging source in the event of an over-temperature condition, cell failure, or battery failure.

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