**DEPARTMENT OF TRANSPORTATION**

**Federal Aviation Administration**

**14 CFR Part 23**

**[Docket No. 26269; Amendment No. 23–45]**

**RIN 2120–AD20**

## Small Airplane Airworthiness Review Program Amendment No. 4

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final rule.

**SUMMARY:** This amendment changes airframe and flight airworthiness standards for normal, utility, acrobatic, and commuter category airplanes. The changes are based on a number of recommendations discussed at the Small Airplane Airworthiness Review Conference held on October 22–26, 1984, in St. Louis, Missouri. These updated safety standards will continue to provide an acceptable level of safety in the design requirements for small airplanes used in both private and commercial operations. Some of the changes provide design requirements applicable to advancements in technology being incorporated in current designs. This amendment will also reduce the regulatory burden in showing compliance with some requirements while maintaining an acceptable level of safety.

**EFFECTIVE DATE:** September 7, 1993.

**FOR FURTHER INFORMATION CONTACT:** Kenneth W. Payauys, Aerospace Engineer, Standards Office (ACE–110), Small Airplane Directorate, Federal Aviation Administration, 601 East 12th Street, Kansas City, Missouri 64106, telephone (816) 426–5688.

**SUPPLEMENTARY INFORMATION:**

### Background

On June 15, 1990, the FAA issued a notice of proposed rulemaking (NPRM) that proposed changes to the airframe and flight airworthiness standards for normal, utility, acrobatic, and commuter category airplanes (Notice No. 90–18, 55 FR 26534, June 28, 1990). The FAA based the proposed changes on the Small Airplane Airworthiness Review Program and on the conference that resulted in recommendation based on review proposals.

### History

To encourage public participation in improving and updating the airworthiness standards applicable to small airplanes, the FAA announced the Small Airplane Airworthiness Review Program on January 31, 1983, and invited all interested persons to submit proposals for changes to part 23.

By the close of the proposal period on May 3, 1984, the FAA had received more than 560 proposals. On October 22–26, 1984, the FAA held the Small Airplane Airworthiness Review Program Conference in St. Louis, Missouri. The conference was attended by over 300 persons representing all aspects of the U.S. small airplane industry as well as many international representatives. A copy of the transcripts of all discussions held during the conference is filed in FAA Regulatory Docket 23494.

After reviewing the proposals and the public comments received at the conference, the FAA issued a number of rulemaking documents. These include:

(1) A notice proposing to upgrade cabin safety and occupant protection standards during emergency landing conditions (Notice 86–19, 51 FR 44878, December 12, 1986), which led to amendment 23–36 (53 FR 30802, August 15, 1988).

(2) A notice proposing airworthiness standards for advanced technology in current airplane design (Notice 89–5, 54 FR 9276, March 6, 1989), which led to amendment 23–42 (56 FR 344, January 3, 1991).

(3) A notice proposing airworthiness standards for complex systems critical for safety in small airplanes (Notice 89–6, 54 FR 9338, March 6, 1989), which led to amendment 23–41 (55 FR 43306, October 26, 1990).

(4) A notice of proposed airworthiness standards for powerplant and equipment not included in the above three notices (Notice 90–23, 55 FR 40598, October 3, 1990), which led to Amendment 23–43 entitled Small Airplane Airworthiness Review Program Amendment No. 3 (58 FR 18958, April 9, 1993).

The review program and conference also led to the proposal for this rulemaking action, which updates the airframe and flight airworthiness standards for small airplanes.

The FAA is participating in an important international effort to harmonize part 23 of the Federal Aviation Regulations (FAR) with the Joint Aviation Requirements (JAR) developed by representatives of the Joint Aviation Authorities (JAA). This final rule is a significant step in the harmonization effort, which is being encouraged and supported by the aviation community worldwide.

### Discussion of Comments

*General*

Interested persons were invited to participate in the development of this final rule by submitting written data, views, or arguments to the regulatory docket. Eight commenters responded to Notice No. 90–18. Commenters represent U.S. manufacturers of small aircraft (General Aviation Manufacturers Association, GAMA), Joint Aviation Authorities, JAA, individual airworthiness authorities (United Kingdom, Australia, Transport Canada), the Air Line Pilots Association (ALPA), a representative of the Association of Europeene des Constructeures des Material Aerospatial (AECMA), and one private individual. Most commenters either endorse other comments or comment on only a few of the proposed changes. GAMA comments on a significant number of the proposed changes and JAA comments on virtually every proposed change. AECMA submitted a one-sentence comment endorsing the GAMA comment.

One commenter (ALPA), while supporting "the fundamental intent" of the NPRM and applauding "The FAA for the work and progress" from the 1984 conference, also states a belief that there is a need for a "single regulation to prescribe that all part 25 certification aircraft are used by scheduled commercial airlines."

In general, the commenters agree with the proposed changes and one commenter (GAMA) urges the FAA to issue a final rule as expeditiously as possible.

In the NPRM, the FAA specifically solicited comments on the following subjects:

Conference Proposal 2, § 23.3, Permit installation of turboject engines on commuter category airplanes.

Conference Proposal 7, § 23.65, Require performance limitations based on weight, altitude and temperature.

Conference Proposal 10, § 23.145, Establish control force limits for reduced pilot strength, and

Conference Proposal 29, § 23.307, Require material correction factors during structural tests.

The first two subjects listed above are subjects on which the FAA solicited comments for future rulemaking. No final action is taken in this rulemaking on these two subjects. The discussion of comments on these two subjects follows the proposal-by-proposal discussion at the end of the supplementary information section of this preamble. The second two subjects relate to rulemaking proposal number 10 (§ 23.145) and rulemaking proposal 29 (§ 23.307). Discussion of comments for these subjects is contained in the proposal-by-proposal discussion.

**Discussion of Comments on Specific Sections of Part 23**

As stated above, the majority of the specific comments were received from the GAMA and the JAA. In the following proposal-by-proposal discussion, the basic intent of each proposed change is summarized and substantive comments are addressed individually. Comments and changes of an editorial nature are generally omitted from the discussion.

In this final rule, the FAA has withdrawn a total of three proposals from the NPRM and is amending (for clarification) two sections for which changes were not proposed in the NPRM. The withdrawal of some proposed amendments and the addition of amendments that were not proposed has created a mismatch between the proposal numbers as discussed in this preamble and the amendment numbers included in the amendatory portion of this final rule. The following table provides the necessary cross reference:

| Proposal No. | Amendment No. |
|---|---|
| 1–28 | 1–28. |
| 29 | Not Adopted. |
| 30–47 | 29–46. |
| No proposal | 47 & 48. |
| 48–67 | 49–68. |
| 68 | Not Adopted. |
| 69–72 | 69–72. |
| 73 | Not Adopted. |
| 74–83 | 73–82. |

*Proposal 1*

This proposal contained the authority citation for part 23, for which there was no change.

*Proposal 2*

The FAA proposed a change to § 23.23 that specified the limits for load distribution for weight and balance considerations. The one comment (JAA) received generally agrees with the proposed change but does not agree that the specific reference to lateral center of gravity (c.g.) range limits should be deleted. Also, the JAA does not believe (1) that the proposal treats lateral c.g. consistently and (2) that there is a need for all of the required flight test evaluation with displaced lateral c.g. limits. The JAA notes that requiring all testing to be repeated with fuel asymmetry is unnecessary and impractical but that it would be appropriate to take fuel asymmetry into account for some tests such as minimum control speeds, stall handling, and lateral stability.

The FAA agrees that deleting specific references to lateral c.g. limits may not be appropriate and has revised § 23.23(a) to retain lateral load limits in the regulations. The FAA disagrees that the proposal treats lateral c.g. limits inconsistently. Repeating all testing with fuel asymmetry is unnecessary to find compliance. Accordingly, the FAA adopts § 23.23 with the change discussed above.

*Proposal 3*

The FAA proposed a change to § 23.25 to clarify the criteria used for assuming occupant weights in normal, commuter, utility, and acrobatic category airplanes. The proposed change would no longer permit the certification of normal category airplanes with seats placarded for occupants of less than 170 pounds. Seats limited to some lower weight by the placard installation will be referred to as "child seats" in the remainder of this discussion.

The GAMA and JAA commented on this proposal. The GAMA opposes deleting the provision that allows for the installation of child seats. The GAMA notes that existing provisions of § 23.25 allow the manufacturer to install child seats and establish proper loading provisions for the airplane. GAMA believes that deleting this provision would operationally limit future airplanes. The GAMA also notes that several unacceptable alternatives could result from the proposed deletion, such as carrying less fuel, installing fewer seats, and carrying less safety equipment. The GAMA feels that child seats in airplanes fulfill a consumer need. The GAMA does not agree with the FAA's statement in the NPRM that the lack of specific standards for child seats is appropriate justification for disallowing placarding of child seats. The GAMA states that seat rules can be changed to certify fixed child seats at selected weight limits.

The JAA states that it does not understand the FAA's reasoning for disallowing child seats in normal category airplanes.

The FAA reconsidered this proposal, based on these comments, and agrees that eliminating the approval of child seats in normal category airplanes is inappropriate. However, the FAA points out that future rulemaking to provide safe standards for child seats will be needed in view of changes to § 23.562 made by amendment 23–36 (53 FR 30802, August 15, 1988), which established a safety level for occupants with a nominal weight of 170 pounds.

Although the FAA will allow the installation of child seats, placarding pilot seats for occupants weighing less than 170 pounds or 190 pounds, depending upon airplane category, will not the be allowed because there is no reason to do so. Accordingly, a revision to § 23.25(a)(2) ensures that pilot seats are not placarded for a reduced weight.

The GAMA also pointed out that the minimum fuel requirement of "at least one-half hour" in § 23.25(a)(2)(i), which is a part of the requirement for computing the minimum or maximum weight, is inconsistent with the fuel requirements of part 91. Section 91.151, Fuel requirements for flight in VFR conditions, requires 30 minutes of fuel reserve for day operations and 45 minutes of fuel reserve for night operations. Also, § 91.167, Fuel requirements for flight in IFR conditions, requires the airplane to have enough fuel to: (1) Reach its intended destination; (2) fly to an alternate destination, if required; and (3) allow 45 minutes of further flight at normal cruising speed.

Section 23.25(a)(2)(i) requires the pilot to have all seats occupied, engine oil at full capacity, and enough fuel for continued flight and a safe landing. The 45-minute fuel reserve, required by the operating rules, exceeds the § 23.25(a)(2)(i) fuel requirement of "at least one-half hour." Proposed § 23.25(a)(2)(i) is, therefore, revised to "at least 45 minutes for night VFR and IFR approved airplanes." The FAA adopts § 23.25 with the changes discussed above.

*Proposal 4*

The FAA proposed to change § 23.33 by adding propeller speed and pitch limits for turbine engine/propeller combinations and other requirements applicable to turbopropeller-powered airplanes not covered by the present rule.

The FAA received comments from the JAA and the GAMA. Both commenters questioned the need to add requirements for turbopropeller-powered airplanes (proposed paragraphs (b)(1)(ii) and (b)(2)(ii)) since it is unlikely that a fixed-pitch propeller will be used on a turbine-powered engine.

The FAA has re-examined these proposals and determined that proposed paragraphs (b)(1)(ii) and (b)(2)(ii) are not necessary.

The GAMA states that the proposal for § 23.33(d)(2)(ii) will allow a 2,700 r.p.m. engine to operate at 2,940 r.p.m., or higher, if the governor should fail and that this change does not appear to be in the interest of safety. The FAA is not making any change to the proposed requirement because the information contained in the comment is insufficient. The NPRM documents that there are usually two governors in an engine/propeller system, one controlling the propeller rotational speed and one controlling the overspeed of the turbine engine. This explanation notes that if the propeller governor fails, the overspeed limit will be established by the turbine governor and probably will be 106 to 108 percent. The condition identified by the GAMA is nearly the same as the condition identified in the notice (2,940 r.p.m. is a 108.9 percent overspeed of 2,700 r.p.m.). The GAMA appears to support proposed § 23.33(d)(2)(ii) that would have required a means to limit the engine overspeed to 99 percent of the approved engine overspeed.

The FAA recognizes that a fuel control governor usually controls turbine engine overspeed. Any required margin (such as the proposed 1 percent) would be considered during the establishment of the approved overspeed. Accordingly, it burdens the applicant to require an additional device that arbitrarily limits overspeed to 99 percent. By removing the 99 percent requirement, § 23.33(d)(2)(ii) allows full approved overspeed. The FAA adopts § 23.33 with the changes discussed above.

*Proposal 5*

The FAA proposed to clarify the performance data requirements of § 23.45 and to combine the requirements for reciprocating and turbine-engine-powered airplanes. Since the one comment received from the JAA agreed with the proposed change, the FAA amends § 23.45 as proposed.

*Proposal 6*

The FAA proposed to change § 23.53 to introduce a rotation speed, $V_R$, for multiengine airplanes and to eliminate reference $V_X$ (speed for the best angle of climb) for airspeeds at 50 feet. The FAA received comments on this proposal from the JAA and the GAMA.

The JAA notes that the reference to 1.3 $V_{S1}$ (stalling speed or minimum steady flight speed in a specific configuration) in proposed §§ 23.53 (b)(1)(ii) and (b)(2)(ii) is unnecessary and suggest clearer wording for the proposed change. The proposed language that states, "not less than 1.2 $V_{S1}$," establishes the minimum $V_{S1}$ speed that must be reached by a height of 50 feet above the takeoff surface. The JAA recommends revising the language to read, "1.2 $V_{S1}$, or any other speed shown to be safe * * *." The FAA rejects this suggestion because it would allow the use of a speed below 1.2 $V_{S1}$, which the FAA considers the minimum acceptable margin above the stall speed at the 50 foot point.

The GAMA recommends deleting the words "including turbulence" in proposed § 23.53 (b)(1)(ii) and (b) 2)(ii). The GAMA believes that considering turbulence deviates from the intent of the general requirement of § 23.45 that requires still air performance corrections in a standard atmosphere.

The commenter is partly correct. Most of the performance testing can be done in still air under standard atmospheric conditions, but some tests need to be done under other conditions. Thus, § 23.53 requires turbulent conditions for some, but not all, testing to find safe minimum takeoff speeds. Accordingly, these words are not being deleted from § 23.53 (b)(1)(ii) and (b)(2)((ii).

The GAMA also asks why turbulence is considered for normal, utility, and acrobatic category airplanes and not for commuter category airplanes.

The GAMA is correct that the takeoff speed requirements in § 23.53(c) for commuter category do not specifically address turbulence. However, other requirements applicable to commuter category, such as § 23.45(f)(3), that, in part, address critical-engine-inoperative takeoff performance require this performance to be determined according to the procedures established by the applicant for the operation in service, including turbulence conditions. Therefore, since turbulence for commenter category airplanes is otherwise addressed it has not been nor does it need to be included in § 23.53.

In addition, the FAA has noted that the proposed paragraph § 23.53(a) was not clear in distinguishing between the proposed $V_R$ speed and the $V_R$ speed established by § 23.53(c)(4) for commuter category airplanes. An editorial change to § 23.53(a) clarifies that § 23.53(a) applies only to normal, utility, and acrobatic category airplanes, not to commuter category airplanes. The FAA Adopts § 23.53 with the changes discussed above.

*Proposal 7*

The FAA proposed to delete from § 23.65 the current rate-of-climb requirements and to specify a minimum speed at which the angle-of-climb criteria must be met. The FAA received comments on this proposal from the JAA, GAMA, and ALPA. As previously discussed, the portion of the JAA, GAMA, and ALPA comments that addresses the subject of weight, altitude, and temperature (WAT) requirements for part 23 airplanes is discussed following this proposal-by-proposal discussion.

The GAMA states that the FAA has not justified the proposed change to § 23.65(a)(1) for a minimum all-engine-climb speed of 1.2 $V_{S1}$ and that this restriction appears unnecessary because $V_X$ is usually greater than 1.2 $V_{S1}$. GAMA notes that, if $V_X$ is lower, any questions resulting from attitude and engine failure can easily be dealt with in the flying quality rules.

The JAA believes that the proposed minimum climb speed of 1.2 $V_{S1}$ (stall speed or minimum steady flight speed obtained in a specific configuration) offers an inadequate stall speed margin for an everyday all-engines-operating case and recommends not less than 1.2 $V_{MC}$ (minimum control speed with critical engine inoperative) or 1.3 $V_{S1}$. The GAMA states that the FAA has not justified the proposed minimum all-engine-climb speed of 1.2 $V_{S1}$.

As presented in the NPRM, the FAA finds that 1.2 $V_{S1}$ is an improvement in the minimum performance standards. Deleting climb rate requires considering a minimum speed to ensure an adequate margin between stall speed $V_S$ and the selected climb speed. If $V_X$ is usually greater than 1.2 $V_{S1}$, as the GAMA states, then rule compliance is not a burden. If $V_X$ is lower than 1.2 $V_{S1}$, then $V_X$ provides an insufficient margin with stall speed which cannot be dealt with in the flying quality rules. This position is supported by another commenter. The FAA concludes that 1.2 $V_{S1}$ is adequate and that a $V_{MC}$ based requirement is unnecessary. The FAA adopts § 23.65 as proposed.

*Proposal 8*

The FAA proposed to change § 23.141 to clarify the general requirements for flight characteristics.

The one commenter (JAA) agrees with the proposal but suggests some changes for the paragraph. The first is to insert the phrase "at all practical loading conditions" so that the section will read "through § 23.253 at all practical loading conditions, at all practical operating altitudes."

The FAA notes that the current evaluation of an airplane's flight characteristics must consider all practical loading conditions in accordance with § 23.21. This addition does not add a requirement to flight characteristic testing and does clarify the requirement. The final rule paragraph adds this phrase.

The other suggested change proposes to add a phrase between "under § 23.1527" and "without exceptional piloting skill," which reads, "for which certification has been requested." The FAA agrees and has added the phrase to the final rule. The phrase clarifies that the loading condition and altitudes, checked during the flight characteristics evaluation, are those conditions and altitudes requested by the applicant for approval. The FAA adopts § 23.141 with the changes discussed above.

*Proposal 9*

The FAA proposed to change § 23.143 by replacing the word "Dive" with the word "Descent" because descent more accurately reflects the total phase of flight. No one commented on this proposed change, and the FAA adopts the change to § 23.143 as proposed.

Some comments received on § 23.145 resulted in revisions to the table in § 23.143(c). These comments are discussed in the discussion of § 23.145.

*Proposal 10*

The FAA proposed to change § 23.145 to correct an error created by amendment 23–21 and to correct the trim speeds and procedures.

Although the FAA received no comments on paragraph (a) of § 23.145, the FAA notes that "the airplanes as nearly as possible in trim at 1.3 $V_{S1}$"is a condition specified for both maximum continuous power and power off in § 23.145 (a)(1) and (a)(2). To eliminate redundancy, the FAA moved these words in the final rule to the introductory text of § 23.145(a).

The JAA and the GAMA commented on § 23.145 (b), (c), and (d). The GAMA believes that the one-hand control force of 50 pounds in proposed § 23.145(b) is too stringent but does not provide any further recommendations. The NPRM proposal discusses the reasons for selecting the particular control force and the control force is retained as proposed.

The GAMA also suggested deleting the 50-pound control force in § 23.145(b) or moving it to the table in § 23.145(c). The FAA agrees with the suggestion that the one-hand control force for the wheel should be located in the table in § 23.143(c). This table contains other forces for the control wheel, stick, and rudder pedals. It is appropriate to add this one-hand control force to the table.

The JAA provides extensive comments on § 23.145(b). First, the JAA asks to what the 50-pound control force limit of § 23.145(b) applies. The JAA believes that this force should include any initial out-of-trim force and the change of control force that occurs during the variations in flight conditions. As proposed by the FAA, this requirement does not determine the total control force in the airplane during the maneuvers specified in § 23.145, paragraph (b)(1) through (b)(5). The one-hand control force test verifies that the changing control forces, during the maneuver, do not become higher than the pilot can safely control. The FAA specifies a one-hand control force because, during the maneuvers, the pilot is using one hand to change the power settings or flap positions. Only one hand will be available to correct the resulting control force changes. Accordingly, the requirement for the airplane control force is not limited to a total of 50 pounds, as the JAA advocates. The requirement allows force to be the sum of the initial out-of-trim force plus the allowed 50 pounds to correct the maneuver. In practice, the total control force on the airplane depends upon the direction of the pilot force and the direction of the initial out-of-trim force. The out-of-trim forces may add (or subtract) to the 50-pound force limit.

The JAA also recommends deleting the words "the gear extended" from § 23.145(b) since the demonstration required by paragraph (b)(3) and (b)(4) are with gear retracted.

The FAA re-examined these requirements and agrees that the gear position requirements of § 23.145(b) conflict with § 23.145, paragraph (b)(3) and (b)(4). But, the FAA does not agree that the gear position requirement of § 23.145(b) should be deleted. It is necessary to specify the needed gear position in the maneuvers in § 23.145, paragraphs (b)(1) through (b)(5). To correct these requirements, the FAA removes the words "with the landing gear extended" from § 23.145(b) and adds this phase to § 23.145, paragraphs (b)(1) and (b)(2).

The JAA also believes that proposed § 23.145(b)(2)(i) fails to address properly a normal balked landing demonstration. First, the JAA notes that the proposed initial trim speed 1.2 $V_{SO}$ (stalling speed or minimum steady flight speed in landing configuration) is below the final approach speed of 1.3 $V_{SO}$. Second, mishandled balked landings are covered in § 23.145(b)(2)(ii). Third, it is incorrect to require a speed abuse for the normal demonstration requirements.

The JAA also disagrees with the proposal to require the airplane to maintain the speed used to show compliance with § 23.77. The JAA's reasons for disagreeing are that § 23.77 provides requirements for the balked landing climb case, and it is inappropriate to correlate this climb condition to those for the balked landing demonstration of § 23.145(b)(2)(i), which recommends go-around settings. To support not using the speed of § 23.77, the JAA notes that it could be as low as 1.1 $V_{SO}$, which is not a realistic go-around speed with flaps partly retracted. The JAA recommends a speed of 1.3 $V_{SO}$.

Finally, the JAA disagrees with the reference to § 23.145(b)(1)(i) in proposed § 23.145(b)(2)(iii) because there should be no flap gate positions between fully extended and go-around flaps. The JAA agrees with giving credit for the flap gate positions in the mishandled balked landing requirements of § 23.145(b)(2)(ii), but questions the need to maintain a speed of 1.1 $V_{SO}$. The JAA believes that it is acceptable to retrim between each gate state of flap retraction and that it should be acceptable to allow the airplane to accelerate to 1.1 $V_{SI}$, where $V_{SI}$ is the selected flap setting configuration.

The FAA has reviewed the proposal in light of the comments received on § 23.145(b) concerning airplane trim at 1.2 $V_{SO}$ or 1.3 $V_{SO}$ and agrees that an abuse speed of 1.2 $V_{SO}$ for a normal balked landing is inappropriate. The final rule allows an abuse speed of 1.3 $V_{SO}$ for a normal balked landing. However, the FAA considers an abuse speed 1.2 $V_{SO}$ appropriate for a mishandled balked landing.

The FAA does not agree that it is inappropriate to correlate the balked landing climb in § 23.77 to the balked landing of § 23.145(b)(2)(i). The FAA has evaluated this and determined that a speed showing compliance with the balked landing climb is also safe for a wings level go-around flight. Changes to § 23.77 clarify that the balked landing speed is the minimum speed that must be maintained.

The last item related to § 23.145(b) is the comment on the credit given for gated flap positions. Upon re-examination of proposed § 23.145(b)(2)(iii), the FAA agrees with this comment. There should not be a flap gate position between the flap fully extended position and the go-around position. If one is provided, it should be bypassed so the go-around setting can be quickly attained. Permitting a gated position conflicts with § 23.145(b)(2)(i) in a normal balked landing. Section 23.145(b)(2)(i) requires the flaps to be retracted as quickly as possible to the go-around position. Section 23.145(b)(2)(iii) omits the provision for flap gate credit from the final rule.

As proposed, § 23.145(b)(2)(ii) would allow the use of flap gate positions for the mishandled balked landing demonstration requirements. The FAA agrees; therefore, it is acceptable to accelerate the airplane to 1.1 times the minimum steady flight speed. The final rule includes this provision.

The JAA concurs with § 23.145, paragraphs (b)(3), (b)(4), and (b)(5), and suggests moving § 23.145(b)(5) to § 23.175 and combining it with § 23.175(d). The FAA reviewed the possibility of combining these two sections, which would require revisions in both. This could create unintended meanings, and since the recommended changes are beyond the scope of the notice, the FAA will consider this proposal for future rulemaking.

Both the GAMA and the JAA offer comments on proposed § 23.145(c). The GAMA notes that this requirement would require a demonstration of an elevated load factor, and suggests that, for reasons of safety, this should be an extrapolation of lower speed data or an analytical finding. The JAA states that the JAA is unclear on the relationship of this proposal to present § 23 335(b)(4)(i) and suggests a paragraph revision that would reference § 23 335(b)(4)(i).

Proposed § 23.145(c) requires a demonstration of 1.5 g pitch maneuver capability up to $V_D/M_D$ (design dive speed/design dive Mach number). The demonstration is necessary and should not be extrapolated from a lower speed test. Calculations may be used to show compliance with § 23.335(b)(4)(i). It is inappropriate to combine the design airspeed with the proposed § 23.145(c) flight demonstration. Also, showing compliance with § 23.335(b)(4)(i) by flight demonstration fails to explore the pitch maneuver capabilities close to $V_D/M_D$. The FAA adopts § 23.145(c) as proposed.

The JAA questions the need for the c.g. conditions contained in § 23.145, paragraphs (d)(1) and (d)(2). Section 23.21 covers these conditions. The FAA's review shows that the specific reference to the c.g. position is unnecessary, and deletes it. The FAA adopts § 23.145 with the changes discussed above.

*Proposal 11*

The FAA proposed changing § 23.147 to delete the existing § 23.147(a), to renumber the remaining requirements, and to delete references to center of gravity.

Since the only comment, from the JAA, agrees with the proposed change, the FAA adopts § 23.147, as proposed.

*Proposal 12*

The FAA proposed to define airworthiness standards for determining the minimum control speed and to reword particular portions of § 23.149 for clarity.

The FAA received comments from the JAA and the GAMA, on § 23.149. Only the JAA addressed the proposed revised definition of $V_{MC}$ in § 23.149(b)(2). The JAA objected to the proposal to change the words "recovering control" to "maintaining control." The FAA intended this proposed revision to eliminate any implication that control is lost when the engine fails. The JAA feels the proposed change is "ill-advised" because the demonstration of $V_{MC}$ results in an airplane handling excursion, in all three axes, followed by a recovery. The JAA identifies the continued use of the word "recovery" in the stall requirements to support this position.

The FAA considered the JAA's comments, and the conference discussion, and concludes that the term "recovering" should not be used. Though excursions may occur in all three axes, those excursions do not mean that complete loss of control of the airplane has occurred. "Maintaining control" includes the action needed to correct these excursions and to continue to fly the airplane with one engine inoperative. It is appropriate for use in this definition. This revision in the $V_{MC}$ definition should not be considered for extension to the stall requirements. Control is lost in a stall; therefore, the term "recovery" is appropriate for the stall requirements.

The JAA also states that the NPRM phrase, "with a yaw of not more than 20 degrees," in the proposed definition of $V_{MC}$ is confusing, since heading excursions are limited to 20 degrees in unchanged § 23.149(d).

The FAA has reviewed this proposed change, along with the text of § 23.149(d), and agrees that the proposed revision does not provide the intended improvements. Accordingly, it is removed in this final rule.

The JAA also comments on proposed § 23.149(b)(5), which would require that in determining minimum control speed the airplane must be in the most critical takeoff configuration The JAA states that JAR 23.149(b)(5) requires that the propeller controls should remain in the recommended take-off setting throughout.

To clarify this requirement and ensure that the proper propeller control setting will be used, final rule § 23.149(b)(5) includes a statement on the propeller control setting consistent with JAR 23.149(b)(5).

The FAA received comments from the GAMA and the JAA on the proposed change to § 23.149(c) to establish an operational limitation for a minimum speed to intentionally render the critical engine inoperative. This proposal for a safe, intentional, one-engine-inoperative speed, $V_{SSE}$, includes language that defines a maximum and a minimum value for this speed. The GAMA opposes the maximum and minimum values proposed and believes that these limits are so small that they defeat the purpose. The JAA does not agree with the establishment of $V_{SSE}$ as a limitation.

The FAA has considered these comments and agrees with the expressed position that $V_{SSE}$ should not be established as a limitation. The FAA is aware of the benefits resulting from informing the pilot of the speed that provides an additional safety margin above $V_{MC}$. This is a especially important in a training environment. Accordingly, § 23.149(c) is revised to require that $V_{SSE}$ must be established and a new § 23.1585(c)(6) requires that this information must be put in the AFM. By establishing this requirement, information recommended by GAMA's Specification No. 1 can be included in the AFM. The FAA adopts § 23.149 with the changes discussed above.

*Proposal 13*

The FAA proposed changes to the landing control requirements in § 23.153. The FAA received comments from the JAA and the GAMA on this proposal.

The GAMA believes that the FAA may have overlooked the effect that the proposed change would have on airplanes weighing 6,000 pounds or less which are not required to meet § 23.153 For these airplanes the GAMA believes that the speed for control during landing should be set in a different way than using the speed used for the demonstration of landing under § 23.75 minus 5 knots.

The FAA disagrees. The FAA considered all airplane weights in the NPRM. Existing § 23.75 does not differentiate landing speed by weight.

The GAMA states that § 23.153(b) adds the steepest approach gradient for landing control. The GAMA believes that the approach gradient is inappropriate because there is no practical way for a pilot to determine the gradient.

The FAA notes that part 23 already requires a pilot to determine the gradient. Section 23.75(a), as amended by amendment 23–42, requires landing distance to be determined for all airplanes. The section also requires that the distances be based on a descent gradient of 5.2 percent at not less than a 1.3 $V_{SI}$ speed. Additionally, an applicant may show a steeper approach gradient if a means is available to display gradient to the pilot.

The JAA states that the proposed changes to § 23.153 bring the requirement substantially into line with JAR 23.153. JAA also concurs with the inclusion of all airplanes and with the inclusion of proposed paragraphs (b) and (c). The JAA states that it is "disturbed that the cross-reference to § 23.143(c) could allow the use of a (two-handed) elevator control force as high as 75 pounds in a landing maneuver."

The FAA agrees with the JAA. To clarify the FAA's intent, final rule § 23.153 specifies a one-handed force. The FAA adopts proposed § 23.153, with this change.

*Proposal 14*

The FAA proposed to change § 23.155 to clarify the conditions used to prove elevator control force.

The JAA submitted the only comment on this proposal, stating its preference for existing § 23.155(b)(2). Also, the JAA states that, if the FAA retains § 23.155(b)(1) as proposed, the words "for level flight" should be changed to "for wings level flight."

The FAA agrees that "for wings level flight" clarifies "level flight condition" and has, therefore, changed the final rule accordingly. In evaluating the suggestion to add the word "wings", the FAA notes that the current § 23.155(b)(2), which this proposal is replacing, uses the words "with wings level." Adding the word "wings" will retain the previously used language. Since the proposals for § 23.155(b)(1) and (b)(2) also contain the words "level flight," the suggested change is also made to these paragraphs. The FAA adopts § 23.155, with the changes discussed above.

*Proposal 15*

The FAA proposed to add a ten-second limit to the equation in § 23.157(a)(2) and a seven-second limit to the equation in § 23.157(c)(2). These proposed limits would restrict all airplanes above 12,500 pounds to a minimum rate of roll, correcting an inadvertent oversight introduced by adding the commuter category in amendment 23–34.

The JAA stated that the proposed change would align § 23.157 with JAR 23.157. The GAMA believes that proposed § 23.157(b)(4) is not clear and suggested reversing the words "and" and "or"

The FAA agrees that it would not be possible to trim the airplane to the greater of "1.2 $V_{S1}$ and 1.1 $V_{MC}$." Accordingly, "and" has been changed to "or" in the final rule.

The FAA adopts § 23.157 with the change discussed.

*Proposal 16*

The FAA proposed to revise the engine power requirements of § 23.175 for the climb conditions.

The comment from the JAA agrees with the proposed change to the required power for reciprocating engines. However, the JAA does not believe that the phrase "or the maximum power or thrust selected by the applicant as an operating limitation for use during cruise * * *" is appropriate. The JAA believes that this limitation can be abused and asks how it should be interpreted in comparison with, for example, maximum continuous power or thrust, if the latter is greater. The JAA notes it is considered unreasonable to "get around" the requirement by declaring a "limitation" while claiming credit for a higher maximum continuous limit under other circumstances. Also, the JAA notes other requirements in part 23 using similar words referring to limits for cruise or climb operations.

The first item addressed by the JAA is that this limitation can be abused; the FAA agrees. This is true of most limitations placed on an airplane. Engine power or thrust limitations are no more likely to be abused than any other limitation. An important aspect of safety in the aviation community is the training of pilots and their understanding that limitations are established to avoid possible unsafe conditions. The FAA does not find the JAA's reasons adequate to change the proposed requirements that would permit the establishment of limitations.

The other JAA position, that limitations are established to allow the holders of a type certificate to "get around" certain other provisions of the requirements, is not valid. There are circumstances, such as where an airframe manufacturer needs to replace the engine on a particular airplane model and the only engine available produces more horsepower than the engine that was originally approved for that airframe. By using the higher powered engine, and establishing limitations, it may be possible to obtain approval without incurring the additional expenses of redesign and testing that would otherwise be needed for using a higher power engine. The regulations permitting the establishment of limitations benefit the public by reducing costs. No known adverse affects on safety have resulted from these provisions.

The JAA also noted that the present § 23.175(d)(3) contains a reference to § 23.161(c)(4), which does not exist. A review of the regulations shows that some publications do reference § 23.161(c)(4) while other publications correctly reference § 23.161(c)(2).

To verify the correct paragraph that should be referenced in § 23.175(d)(3), the FAA reviewed the history of both §§ 23.161 and 23.175. Before the adoption of amendment 23–21 on March 1, 1978, § 23.161 requirements for power approaches were contained in § 23 161(c)(4), and § 23.175(d)(3) correctly referenced in § 23.161(c)(4). When the FAA adopted amendment 23–21, it revised the trim requirements and moved the power approach requirements to § 23.161(c)(2). Amendment 23–21 also revised § 23.175(d)(3) to correctly reference § 23.161(c)(2). This error needs to be corrected in the current publications and, while not included in the NPRM, is included in this final rule.

The FAA adopts § 23.175 with the change discussed above.

*Proposal 17*

The FAA proposed to revise § 23.177(a) to require that static directional stability and lateral stability be shown under more realistic operating conditions expected in service. Changes proposed to § 23.177(a)(1) revise the approach configuration to be used to evaluate the static directional stability. Instead of the maximum continuous power previously required, the engine power necessary to maintain a three degree angle of descent is now specified. Proposed revisions to § 23.177(a)(2) require static lateral stability in the landing configuration at the engine power necessary to maintain a three degree angle of descent. Presently, 75 percent maximum continuous power is used. In addition, the proposal would have deleted the current rule requiring a bank angle of 10 degrees or more.

The JAA and the GAMA address § 23.177(a)(1). The JAA states, "We do not agree with the proposed relaxations in minimum speed (in configurations other than takeoff) and maximum power in the landing configuration for demonstrating positive directional stability." The JAA believes that directional instability is an undesirable characteristic and should not be permitted within, or outside, the normal flight envelope, and that 1.2 $V_{S1}$ is a reasonable lower speed for all configurations. The JAA also states that power settings above that needed for approach are reasonable in the landing configuration, for example, during the initiation of a go-around. The JAA recommends retaining the existing criteria for airspeed and power. Further, the JAA states that the NPRM explanation that the relaxation in minimum airspeed is taken from Conference Proposal 130 "is not valid for directional stability as the proposed relaxation was only applicable to lateral stability demonstrations."

The FAA reviewed Conference Proposal 130 and agrees with the JAA that speed range relaxation was not applicable to directional stability. The FAA also agrees that 1.2 $V_{S1}$ is a reasonable lower speed for all configurations and revises § 23.177(a)(1) accordingly. The FAA disagrees with requiring directional stability in the landing configuration at maximum continuous power, since go-around is a transitory condition and the pilot normally changes the airplane configuration promptly. The power required for the three degree angle of descent is retained.

The GAMA states that § 23.177(a)(1) needs to be clarified. The GAMA states that the proposed language calls for a demonstration at 1.2 $V_{S1}$ for the takeoff configuration and at 1.3 $V_{S1}$ for climb, cruise, and approach configurations in the same sentence. The GAMA states that the next sentence addresses the "landing configuration" (normally a power-off case) as having power to maintain a three degree angle of descent (usually the approach case). The GAMA asks whether the word "landing" should be replaced with the word "approach" for the latter demonstration.

The FAA has determined that, contrary to the GAMA assumption, "landing" is the correct word and as the rule states some power is required in the landing configuration to maintain a three-degree angle of descent. This agrees with the configuration and power in proposed § 23.75.

The GAMA notes that the NPRM proposes showing directional stability "at speeds from 1.2 $V_{S1}$ in the takeoff configuration and 1.3 $V_{S1}$ in other configurations * * *." The GAMA states that rudder force reversal (in the same paragraph) is prohibited "from $V_{S1}$" with no configuration distinction and asks if these are compatible.

The FAA agrees that the rule, as proposed, gave speed ranges that were not compatible. As noted earlier, § 23.177(a) adopts the speed of 1.2 $V_{S1}$ as the lowest for all configurations and this change eliminates the incompatibility. The FAA adopts § 23.177(a)(1) with the changes discussed.

The JAA comment on proposed § 23.177(a)(2), states "we see merit in retaining the existing 10° bank criterion, to define slip angle, provided that a rudder force of 150 lbs. is not exceeded." Section 23.177(a)(2) is adopted as proposed.

However, the JAA also believes that the proposed relaxation in power for the landing configuration demonstration is ill-advised and that the airplane could be laterally unstable in a go-around.

The FAA agrees that relaxation of the engine power requirements could result in lateral instability in a go-around. However, since go-around is a transitory condition where the pilot normally makes prompt changes to the airplane configuration, there is no need for the regulations to address higher engine power in the landing configuration.

Concerning the proposed § 23.177(a)(3), the JAA questions two points. First, in the sentence, "At larger slip angles up to the angle at which full rudder and aileron control is used * * *," the JAA believes that the wording should read "full rudder or aileron." The JAA also believes it is unlikely that rudder and aileron limits would be reached together in a steady sideslip maneuver. Second, the JAA questions the meaning of the sentence, "Enough bank must accompany the sideslip to hold a constant heading." The JAA believes clarification is necessary.

The FAA agrees that the word "or" between the words "rudder" and "aileron" clarifies § 23.177(a)(3). Concerning the second point, the FAA has applied this rule for several years without any questions about its intent or manner of performing the maneuver. The FAA adopts § 23.177(a), with the changes discussed above.

*Proposal 18*

The FAA proposed to remove § 23.179, Instrumented stick force measurements. Since the FAA received only one comment from JAA, which agrees with the proposed change, the FAA is deleting § 23.179, as proposed.

*Proposal 19*

The FAA proposed to revise § 23.181 to account for installed stability augmentation systems, and to require an evaluation of the airplane for phugoid-type oscillations. The FAA received comments on this proposal from the JAA and the GAMA.

The JAA notes that part 25 requires stability and augmentation systems and § 25.181 "does not include the relaxation in stick fixed dynamic stability demonstrations offered by the proposed change to FAR 23.181". JAA apparently bases this conclusion on the phrase "except when compliance with § 23.672 is shown."

The FAA did not intend for this phrase (proposed for § 23.181(a)(2) and (b)(2)) to relax the dynamic stability requirements. If a stability and augmentation system is installed, that system will move the primary controls. Since the JAA comment shows that the proposed wording could be misunderstood, the FAA has removed this wording from the final rule and has added a new § 23.1891(c) to replace it. Proposed paragraph (c) of § 23 181 is paragraph (d) in the fina. rule.

The JAA and the GAMA each comment on proposed § 23.181(c). The JAA states that it will propose the same requirement for JAR 23. The GAMA notes the phugoid oscillation requirement of proposed § 23.181(c) requires the development of guidance material (phugoid is an oscillation in pitch). The FAA recognizes the need for guidance and is revising Advisory Circular 23–8A, Flight Test Guide for the Certification for part 23 Airplanes. The FAA adopts § 23.181 with the changes discussed above.

*Proposal 20*

The FAA proposed to clarify the requirements of § 23.201(c) by stating the time that the elevator control must be held against the stop to consider the airplane in a stall condition. The FAA recognizes the use of artificial stall barrier systems, such as a stick pusher, as an acceptable means of defining stall. When the system activates, the airplane is in a stall condition. The FAA received comments on this proposal from the GAMA and the JAA.

The GAMA questions the FAA's justification for the proposed requirement for a two-second delay after the control reaches the aft stop during stall determination.

The wording proposed by the FAA would replace the current definition, which reads, "or until the control reaches the stop." Several airplanes have been tested where the elevator has been pulled back to achieve the required speed reduction, but a nose pitch down motion and stall did not occur. Instead, the speed reduction continued until the elevator control reached the mechanical stop and the speed reduction simply stopped. In each of these tests, lengthy discussions between the FAA and the manufacturer have occurred on how long the elevator control needs to be held against the stop before this flight condition can be called a stall. This proposed change defines the stall condition. The FAA chose the two-second interval based on conference discussions and testing experience. The FAA adopts this proposal as presented.

The GAMA also suggests that the last line of § 23.201(c) more appropriately belongs in § 23.201(d)(2).

Section 23.201(d)(2) addresses the power application procedure to be used, if required during stall recovery, and is similar to § 23.201(c). The requirements of § 23.201(c) define when the stall evaluation is completed and assure that engine power is not applied too quickly. To clarify the two different statements on the application for power at the completion of the stall, the requirements of § 23.201(c) are adopted as proposed, and § 23.201(d)(2) is revised to use similar wording.

The JAA notes on § 23.201(f) that it is the power loading and not the weight of the airplane that produces the extremely high nose-up attitudes at 75 percent maximum continuous power; therefore, the proposed relaxation for airplanes of over 6,000 pounds should be extended to all weights of airplanes. The JAA believes that the power-on stall problem should be addressed more directly by placing an upper limit of 30 degrees on the pitch attitude.

The FAA does not agree with the recommendation to place an upper limit of 30 degrees on the pitch attitude. An attitude limit would require extensive and costly flight tests to evaluate various airplane configurations and flight attitudes without a corresponding increase in safety.

The FAA agrees with the JAA's position that the relief proposed for airplanes of more than 6,000 pounds should be extended to airplanes of all weights. When these proposals were developed, the FAA was unaware of any airplanes of 6,000 pounds or less that would have engine power-to-weight ratios capable of producing the extremely nose-high stall characteristics experienced in heavier airplanes. Following the development of these proposals, several airplanes of 6,000 pounds or less maximum weight have been developed with similar power-to-weight ratios. There is a need to allow those airplanes to use the same test procedures proposed for airplanes of more than 6,000 pounds. The FAA has re-examined the stall test procedures and notes that airplanes of all weights have been successfully tested at the current 75 percent maximum continuous power requirement. Therefore, there is a need to consider various power-to-weight ratios likely to occur for airplanes of any weight. Accordingly, the final rule language is revised to allow manufacturers to continue testing at 75 percent maximum continuous power for airplanes at any weight. If this test shows undesirable stall characteristics at extremely nose-high attitudes, the testing may be done in accordance with the power and configuration proposed in the notice for airplanes of more than 6,000 pounds. The final rule provides relief for airplanes that encounter extremely nose-high attitudes and undesirable stall characteristics. The FAA revises proposed § 23.201(f)(4) to allow testing airplanes of any weight for the power requirements discussed. The FAA adopts § 23.201 with the changes discussed above.

*Proposal 21*

The FAA proposed to change the § 23.203 roll excursion requirements to clarify the permissible limits for both turning stalls and accelerated stalls. The FAA received two comments on this proposal.

The GAMA asks FAA "to clarify how one can 'regain level flight * * * without increasing power' (§ 23.203(b)) with the power off at the maneuver entry requirement of § 23.203(c)(4)(i)."

The FAA has clarified the requirement by revising § 23.203(b) to read "wings level flight" rather than "level flight."

The GAMA also states that the "FAA has not provided sufficient data to justify the reduction in allowable roll excursion requirements for turning flight stalls" and requests more justification.

As stated in the NPRM, 60 degrees of roll in turning flight stalls would permit a roll to go to 90 degrees, which the FAA considers to be hazardous. The FAA adopts the proposal for § 23.203(b)(4) as proposed.

The JAA concurs with the proposed changes to § 23.203 but notes that the two comments offered on § 23.201(f) relating to power apply equally here.

As discussed in the response to comment on § 23.201(f)(4), the FAA disagrees with the recommendation to place an upper limit of 30 degrees on pitch attitude. An attitude limit would require many tests to evaluate various airplane configurations and flight attitudes without a corresponding increase in safety. Since the NPRM did not address a specific pitch limit, the suggested limit is beyond the scope of the notice and would require additional rulemaking. Also, as previously indicated, the FAA agrees with the JAA recommendation that the relief proposed for airplane weights greater than 6,000 pounds should be applied to all airplane weights. The FAA revises § 23.203(c)(4) to read like § 23.201(f)(4).

The JAA also states that to advocate "normal use of flight controls" in the special circumstances of stall recovery is potentially misleading.

The FAA does not agree. The phrase "normal use of flight controls" has been successfully applied in § 23.202(e) for many years without problems. For example, if ailerons remain effective during the stall, then regaining level flight by using them is appropriate. The FAA adopts § 23.203 with the change discussed above.

*Proposal 22*

The FAA proposed to revise the critical-engine-inoperative stall requirements of § 23.205 to require that critical-engine-inoperative stalls be evaluated with the wing flaps in the climb position.

The comment received, from the JAA, expresses serious reservations about keeping the critical-engine-inoperative stall requirement. The JAA asserts that the real life one-engine-inoperative stall is not represented by limiting power to 75 percent, by maintaining wings level at the stall, and by utilizing a reduced throttle recovery. Conversely, the JAA states that requiring high asymmetric power to be held down to the stall and throughout the recovery would create an unreasonable risk of spinning. The JAA questions whether this requirement can be of significance in ensuring adequate one-engine-inoperative low speed characteristics in service. The JAA observed that the Transport Category Directorate deleted the equivalent part 25 requirement through amendment 25–72.

Since this issue was not addressed in the NPRM, the FAA is not taking any action at this time. The FAA adopts proposed § 23.205 as proposed.

*Proposal 23*

The FAA proposed to change § 23.207 to require the current stall warning margins to be applicable to straight stalls, as set forth in § 23.201(c). It also proposed requirements for turning flight and accelerated stalls in a new § 23.207(d). The intent is to ensure that an adequate margin above the stalling speed exists in these two stall conditions.

The FAA received comments from the JAA and the GAMA on this proposal. The GAMA states that the upper stall warning margin should apply to power-off stalls only. The GAMA believes the lead-in of proposed § 23.207(c) should be rewritten to read, "For the power-off stall tests required by § 23.201(c) * * *." According to the GAMA, applying § 23.207(c) to the power-on stall conditions of § 23.201(c) would result in very high deck angles for airplanes with high thrust-to-weight ratios. With a stall warning greater than the 10 knot limit, or 15 percent of the stalling speed limit, the commenter feels that the pilot will be alerted sooner and, thus, avoid excessively high deck angles. The GAMA notes that multiengine airplanes at maximum weight, aft c.g., and high power can fly at airspeeds below $V_{MC}$. If the difference between $V_{MC}$ and the stall speed is greater than 10 knots, or 15 percent of the stall speed, the GAMA believes the airplane could be difficult to recover if the critical engine fails. According to the GAMA, a stall warning greater than 10 knots, or 15 percent of the stall speed, reduces the time the airplane will be below $V_{MC}$ without a stall warning. The GAMA states that an equivalent level of safety can be established for a stall warning in excess of 10 knots, or 15 percent of the stall speed, if there are no nuisance warnings during normal takeoff, climb, approach to landing flare, go-around, or during the emergency procedures of single-engine takeoff and climb, approach, and landing.

The GAMA's suggested changes are beyond the scope of this notice. The proposed revision of § 23.201 would preclude very high deck angle stalls in the power-on condition. Further, the stalls required by § 23.201(c) are one knot/second decelerations and the 10 knot, or 15 percent of the stalling speed, warning is appropriate for this flight condition. New § 23.207(d) addresses higher decelerations; therefore, § 23.207(d) is adopted as proposed.

The JAA concurs with the proposed amendments. However, the JAA is concerned with the FAA's explanation for rejecting conference proposal 160 concerning the audibility of a stall warning when wearing headsets. The JAA believes that regulating the use of headsets, regarded as personal instead of airplane equipment, would be difficult. The JAA states that it would be unusual to see an AFM prohibition on the use of certain types of headsets and questions whether such a limitation would be observed. The JAA states it is therefore essential to ensure that all audio warnings remain adequately audible with any standard of headset that is likely to be used in service. The JAA states that the following words are being considered for JAR 23.1431(d): "If provision is made for the use of headsets, it must be demonstrated that all aural warnings are effective, with all permitted types of such equipment in use under the most adverse conditions." The JAA concludes that the FAA apparently does not intend to regulate this subject.

The FAA discussed this issue in the NPRM but did not make a specific proposal. This issue is under consideration for a future rulemaking.

After publishing the NPRM, the FAA recognized that the second sentence of the proposed § 23.207(d) prohibits a stall warning occurrence when a stall is imminent. The intent of the proposal was to preclude nuisance stall warnings. Revised § 23.207(d) clarifies that stall warnings should not occur when utilizing AFM procedures. The FAA adopts § 23.207 with the change discussed above.

*Proposal 24*

First, the FAA proposed to clarify § 23.233(a) by specifying that the crosswind requirements must be demonstrated. Second, it proposed to revise § 23.233(b) to make the rudder effective at half the touchdown speed. Third, it proposed seaplane directional stability and control requirements to ensure better handling during water operations up to the maximum crosswind velocity of 0.2 $V_{SO}$.

The FAA received comments on this proposal from the JAA and from a private individual. The JAA believes that it is necessary to establish the maximum crosswind conditions under which safe operation has been demonstrated and to publish this information in the AFM. The JAA suggests that, with the addition of the word "taxiing," the words currently proposed for JAR 23.233(a) are preferable. They are: "(a) A 90° cross-component of wind velocity, demonstrated to be safe for taxying, take-off and landing, must be established and must not be less than 0.2 $V_{SO}$." The FAA concurs with this suggestion and revises § 23.233(a) to agree with the JAR wording.

The other commenter states: "Paragraph 23.233 as proposed is unclear and grossly unrealistic. It is not clear that 23.233(a) applies during landing or takeoff as well as taxiing. Moreover, 0.2 $V_{SO}$ is inadequate for normal operation of small airplanes. That velocity is less than seven knots for airplanes offered currently. Small airplanes are routinely operated in crosswinds several times as great." The commenter believes that § 23.233(a) should be revised to read: "(a) It must be demonstrated that there is no uncontrollable ground or water looping tendency in 90° crosswinds, up to a wind velocity of 0.5 $V_{SO}$, but not less than 15 knots, at any speed at which the airplane may be expected to be operated on the ground or water during landing or takeoff." The commenter also notes that many small airports have single runways that are subject to crosswinds substantially exceeding the demonstrated crosswind components of existing airplanes but that operations proceed regularly in these conditions. The commenter concludes, "The regulations should agree with the clear public need."

In response to this commenter, the FAA notes that the change to § 23.233, made in response to the JAA comments, clarifies that § 23.233(a) includes landing, takeoff, and taxiing. Since the FAA did not propose crosswinds above 0.2 $V_{SO}$ in the NPRM, it is inappropriate to apply a more stringent crosswind criterion in the final rule.

The JAA also states that there is no need to address seaplanes separately in a proposed new § 23.233(d), which refers to § 23.233(a). The FAA disagrees. Seaplanes need to be addressed separately. As stated in the NPRM, seaplane step taxi and step turns are conditions that need separate investigation; therefore, § 23.233(d) is adopted as proposed. The FAA adopts § 23.233 with the change discussed above.

*Proposal 25*

The FAA proposed changing the requirements of § 23.235 to require an airplane evaluation during taxi, takeoff, and landing on the roughest surface expected in service. Also, the FAA proposed to require water handling information and information on allowable sea conditions for small airplanes that may be operated from water.

The FAA received comments from the GAMA and the JAA on this proposal. The JAA believes that § 23.235(a) should address the characteristics of the whole airplane, not just the shock-absorbers. The commenter recommends the wording of proposed JAR 23.235. "The airplane shall be demonstrated to have satisfactory characteristics and the shock-absorbing mechanism must not damage the structure of the aeroplane, when the aeroplane is taxied on the roughest ground that may reasonably be expected in normal operation and when takoffs and landings are performed on unpaved runways having the roughest surface that may reasonably be expected in normal operation."

The FAA concurs and changes § 23.235(a) for clarification. The GAMA mentions that § 23.235(a) proposes to cover rough field takeoffs and landings, but the title of the existing rule limits its content to taxi operations. The FAA agrees and has revised the section title.

The GAMA states that the means of compliance is unclear and asks whether takeoffs and landings on rough ground must be demonstrated. The clarification of § 23.235(a) discussed above resolves this issue.

The GAMA also notes that § 23.235(b) proposes inclusion of "allowable" sea conditions for floatplanes in the AFM. The GAMA believes that this establishes an inappropriate limitation of little use to a pilot contemplating a landing. At most, the GAMA states, a statement of demonstrated wave height for operations should be included in the AFM. The FAA concurs with the GAMA's view and § 23.235(b) is revised as suggested.

The JAA wants AFM information to appear in subject G, not subpart B, and suggests transferring the intent of proposed § 23.235(b) to §§ 23.1583 and 23.1585. The FAA concurs and moves the AFM portion of § 23.235(b) to § 23.1585. Sea conditions are not an intended limitation so it is inappropriate to move the AFM portion to § 23.1583. The FAA adopts § 23.235 with the changes discussed above.

*Proposal 26*

The FAA proposed clarifying in § 23.251 that buffeting must not cause structural damage anywhere in the flight envelope and specifying a single value of design dive/mach speed, $V_D/M_D$, rather than the minimum value of design dive speed, $V_D$, permitted in the structural requirements. Since the only comment from the JAA agrees with the proposed change, the FAA adopts § 23.251 as proposed.

*Proposal 27*

The FAA proposed to change § 23.253 to expand the trim condition in § 23.253(a) from "any likely cruise speed" to "any likely speed," which encompasses the descent trim condition. Since the only comment from the JAA agrees with the proposed change, the FAA adopts § 23.253 as proposed.

*Proposal 28*

The FAA proposed to revise § 23.305 to clarify the meaning of failure during static ultimate load test.

The one commenter, the JAA, questions why the "liberal interpretation" mentioned in the NPRM occurs in applications of part 23 regulations and not in part 25. The FAA addressed this issue in the FAR part 23 Airframe Airworthiness Review, which identified inconsistent definitions of failure during ultimate load testing. Advisory Circular 23-6, which resulted from that meeting, addresses this commenter's concerns. The Transport Airplane Directorate, which is responsible for part 25, is aware of the part 23 regulatory action.

The FAA adopts § 23.305 as proposed.

*Proposal 29*

The FAA proposed a new requirement to correct structural test results for material correction factors in § 23.307. The FAA received comments on this proposal from the GAMA, the JAA, and from Transport Canada.

The GAMA states that the proposed amendment is impractical and, perhaps, impossible to meet. The GAMA notes that under current regulations a factor of safety of 1.5 times limit load covers variations in material mechanical properties, construction dimensions, and load predictions. Also, the GAMA notes that the 1.5 factor has proven satisfactory for ultimate strength for more than 60 years. The GAMA recommends withdrawing the proposal.

Transport Canada notes difficulties when accounting for material and dimensional variations of the many subcomponents, determining their effect on the strength tests, and justifying a material correction factor of a singular value. Transport Canada proposes a "practical alternative" for low budget manufacturers of requiring the test specimen to be of lower strength than production articles.

The JAA suggests that this topic should more properly be addressed in FAR part 21 since the topic applies to all products.

No comments addressed composite materials which is a specific issue of this proposal.

Considering the validity of the comments, the complexities of the "practical alternative," and the lack of attention to the composite material issue, the FAA has decided to withdraw the proposed change to § 23.307.

*Proposal 30*

The FAA proposed to amend § 23.321 so the effects of compressibility on flight loads will be considered at each speed within the flight envelope.

The GAMA recommends that § 23.321(b) be rewritten to require consideration of compressibility effects above Mach 0.6. The GAMA argues that the effects of compressibility below Mach 0.6 are insignificant on flight loads. The JAA argues that compressibility needs to be taken into account only if significant and that compressibility is unlikely to be significant if the airplane Mach number is less than 0.5.

The FAA has reviewed the NPRM proposal and the comments received. To simplify certification procedures of lower performance airplanes, small compressibility effects may be neglected below a design dive speed of Mach ($M_D$) 0.40. At Mach numbers above zero, theoretical compressibility effects cause an increase in an airfoil lift curve slope. This increase is proportional to the Prandtl-Glauert factor, $1/\sqrt{(1-M^2)}$, where M is the free stream Mach number. This theory correlates very well with wind tunnel tests of airfoils and wings.

Wind tunnel tests provide low speed airfoil data between Mach 0.2 and 0.4 The experimental data contains the theoretical effects of speed between zero and the test Mach number Taking 0.30 as an average test Mach number, then, according to theory, the lift curve slope will increase by 4 and 10 percent, respectively, at 0.40 and 0.50 Mach numbers. The FAA considers the latter figure to be a significant increase.

Considering this problem, the FAA reviewed the design dive speeds for some light airplanes certificated under Civil Air Regulation (CAR), part 3. It calculated an $M_D$ somewhat less than 0.4 at 15,000 feet in the standard atmosphere. One of the airplanes examined, a turbocharged version, had a maximum operating altitude of 24,000 feet and an $M_D$ somewhat greater than 0.5.

The FAA has decided that the effects of compressibility must be considered by the applicant. Compressibility threshold significance varies due to wind tunnel data and testing methods, altitudes, and airplane design. For these reasons, the FAA establishes no design dive speed Mach number compliance threshold. The original proposal would have revised paragraph (b) of § 23.321 to provide for the effects of compressibility Upon reevaluation, the FAA has concluded that it would be clearer to add this requirement in a new paragraph (c). The FAA adopts § 23.321 with the changes discussed above.

*Proposal 31*

The FAA proposed to correct an error in § 23.361 introduced by amendment 23-26. The error significantly reduced the structural design torque levels required for flight conditions at takeoff power. The intent is that the torque factors of § 23.361(c) apply to all § 23.361(a) conditions.

Since the only comment received, from the JAA, agrees with the proposed change, the FAA adopts § 23.361 as proposed.

*Proposal 32*

The FAA proposed to change the heading of § 23.369 by eliminating the phrase "Special conditions for" at the beginning of the heading. The content of § 23.369 remains unchanged.

The one commenter, the JAA, agrees with the editorial change and asks whether this is the only part of the structure needing special consideration in reversed airflow conditions. The FAA is not aware of any additional need for special consideration based on 30 years of service history The FAA adopts § 23.369 as proposed.

*Proposal 33*

The FAA proposed to include aerodynamic loads in the design of the engine mount with the gyroscopic loads required by § 23.371. The one commenter, the JAA, suggests adding the word "combined" so the introductory statement reads "designed for the combined gyroscopic and aerodynamic loads * * *." The FAA agrees and revises the introductory statement. The proposed § 23.371 is adopted with the change discussed above.

*Proposal 34*

The FAA proposed to increase the minimum rudder force, from 130 pounds to 150 pounds, in the last line of the table of § 23.397(b) to make it compatible with the "strength of pilots" limits shown in § 23.143. Since the only comment received, for the JAA, agrees with the proposed change, § 23.397(b) is adopted as proposed.

*Proposal 35*

The FAA proposed to revise § 23.415 to add requirements defining airplane tie-down loads and to include design criteria for attachment fittings and surrounding structure.

The one commenter, the JAA, submits a recommended "more comprehensive" regulatory paragraph for consideration, and interpretative material based on JAR 23.415(c). The JAA proposes considering all weights between the empty weight and the maximum weight declared for tie-down limit load conditions. The JAA believes the following areas should be included in the consideration: tie-down points stated in the appropriate manual, surrounding structure, control system surfaces, and associated gust locks.

The FAA agrees that all weights should be considered for tie-down points and that structure surrounding the tie-down points should be substantiated for adequate strength. The recommentation to consider these weights is beyond the scope of the notice. The recommendation is retained for a future rulemaking notice. The FAA adopts § 23.415 as proposed.

*Proposal 36*

The FAA proposed to clarify when § 23.473(f) requires a ground load energy absorption test. The FAA received one comment on this proposal. The commenter proposed a wording change that would revise § 23.473(f) and would change the meaning of this requirement. Since the FAA considers the commenter's proposed change beyond the scope of the notice, the FAA adopts § 23.473(f) as proposed.

*Proposal 37*

The FAA proposed to revised § 23.479(c) to add a new requirement for landing gear spring-back loads. Additionally, this proposal allows for loads development based on testing or rational analyses other than that referenced in appendix D. This proposal also restricts the minimum values of the drag component when using the method referenced in appendix D. Since the only comment received, from the JAA, agrees with the proposed change, § 23.479(c) is adopted as proposed.

*Proposal 38*

The FAA proposed to clarify the location and combination of loads in § 23.485. Since the only comment received, from the JAA, agrees with the proposed change, the FAA is amending § 23.485, as proposed.

*Proposals 39–47*

The FAA proposed to amend § 23.521 and to add new §§ 23.523, 23.525, 23.527, 23.529, 23.531, 23.533, 23.535, 23.537, and a new appendix H, to provide a complete new set of water load requirements. Present part 23 refers to Air Force-Navy-Civil (ANC–3) and incorporates by reference the water loads sections of part 25. Since the one comment received, from the JAA, agrees with the proposal, the proposed amendment, new sections and appendix H are adopted as proposed.

*Proposal 48*

The FAA proposed to add a new § 23.573, applicable to composite structure, which would require the applicant to apply a damage tolerance evaluation. It also proposed optional damage tolerance requirements for metallic structures.

The proposed optional damage tolerance requirements caused confusion, so in this final rule the FAA has referenced this optional provision in new §§ 23.571(c) and 23.572(a)(3). Further, in § 23.573, the FAA added a lead sentence informing the applicant that composite structure must be evaluated using § 23.573. Now, when the applicant reads these three sections, it should be clearer that damage tolerance is mandatory for composite structures and optional for metallic structures.

The FAA received substantive comments on this proposal from the GAMA, the JAA, the CAA-Australia, and Transport Canada. The CAA-Australia's views on fiber reinforced plastics (FRP) are:

1. They exhibit very complex failure mechanisms.

2. Fatigue failures usually show multiple defects throughout the specimen; for metallic structures, a single crack is frequently observed

3. Four basic damage modes occur These are matrix cracking, delamination, fiber fracture, and interfacial debonding. These damage modes may occur singly, or in combination, and interact with each other.

Based on these views, the CAA-Australia believes that: (1) Primary structure that has undetectable damage must carry design ultimate load; (2) that this structure must also carry design limit loads if the damage is detectable; and (3) when detectable damage occurs, the airplane must be removed from service unless it can be shown that the structure will always carry ultimate load with that damage.

The CAA-Australia believes that FRP structures should be designed to carry the ultimate load when manufacturing or service damage exists that is not immediately obvious. This position is based on the lack of knowledge about actual damage initiation, propagation rates, inspection difficulties, and material that is vulnerable to invisible accidental damage. The CAA-Australia offers the following additional comments on proposed § 23.573:

1. We are concerned that the damage tolerance approach will be used even where it is not practicable simply to circumvent the consequences of large scatter factors needed in the safe life approach. We believe that with appropriate scatter factors the safe life approach remains acceptable, and perhaps desirable, for FRP in these classes of airplanes.

2. Proposed paragraphs (b) and (k) should not be limited to impact damage because other sources of damage exist.

3. Damaged structure ultimate load capability should also apply to metallic structure despite whether it is damage tolerant. Damaged structure should be removed from service if its strength falls below ultimate load capacity.

4. The proposal is interpreted to require analyses, or proof testing, of production bonded joints in metallic structures, regardless of whether they have been evaluated as safe life or damage tolerant.

5. The words "and/or" in the introductory text of the proposal should be revised to read "and" to clarify that both the wing and pressurized cabin must be evaluated.

6. The primary structure should be inspected even when a "no growth (zero growth)" crack exists. Also, visual inspections may be misleading. The intent of part 25, and the proposal for

part 23, is to maintain safety by inspection given uncertainties in the design process, and errors in manufacturing, maintenance, and operation.

7. The term "barely visible damage" should be avoided. Certain non-destructive inspection (NDI) techniques are believed to "find" defects, to "see" defects. Considering NDI, "visible" is no longer a word associated only with human vision. Also, the commenter notes that, if the unaided eye visual inspection is accepted as a threshold for detecting damage, explicit inspection procedures should be provided. It is not acceptable to use maintenance procedures or the pilot's preflight inspection as the means of accomplishing visual inspection.

The GAMA comments on this proposal:

1. The NPRM heading "Water Loads" for § 23.573 is a typographical error.

2. The proposal would add a requirement that makes the damage tolerance evaluation a requirement for composite structure and an option for metallic structure.

3. Many requirements for composite structure are not appropriate for metallic structure.

4. The proposal contains detailed acceptable means of compliance that should be removed and placed in an Advisory Circular.

Based on the above stated positions, the GAMA submitted a proposed complete revision of § 23.573 that would more clearly present the criteria for composite and metallic structure.

The JAA comment states that the proposed provisions of JAR 23 relating to composites are also based on recently issued FAA special conditions and is therefore largely technically harmonized with the proposed new § 23.573. However, the JAA notes several concerns:

1. Unlike previously issued special conditions, the proposal only addressed pressurized cabin structure and omitted critical fuselage structure.

2. The proposal for § 23.573(k) for structures, where damage tolerance methods are shown to be impractical fails to require previously issued special conditions. These special conditions required a residual strength test to ultimate load after completion of the fatigue test. The JAA recommends inserting this provision because the operator would be unaware of any reduction in strength capability.

3. The editorial layout of proposed § 23.573 is potentially misleading as to its applicability to metallic and composite structures.

The FAA reviewed the above comments and, in general, concurs. Special conditions issued earlier for composite airplanes were used as the basis for this proposed new section. Many of these special conditions were prepared and issued before AC 20–107 was issued. Therefore, there was no guidance available for composite structures and it was appropriate for those special conditions to include acceptable means of compliance. The regulations should be limited to minimum airworthiness standards to be met by an applicant for a type certificate and the acceptable means of compliance should be included in advisory circulars. The FAA finds that AC 20–107 contains much of the guidance needed for compliance with the requirement in proposed § 23.573. If there is a need, the FAA will develop and issue additional guidance. Based on the comments, the FAA has carefully reviewed the proposal and has deleted the redundant material and the guidance material from the final rule.

The FAA agrees with and generally accepts the complete rewrite of proposed § 23.573 submitted by the GAMA. The GAMA rewrite clearly presents mandatory requirements for composite materials, § 23.573(a); optional damage tolerance design standards for metallic structures, § 23.573(b); and inspection provisions, § 23.573(c).

The following paragraphs should assist the reader's understanding of the transition from NPRM to this final rule:

1. Section 23.573(a) of the final rule contains the provisions included in the introductory text in the NPRM. The last sentence of this paragraph comes from proposed § 23.573(j) in the notice. Proposed § 23.573(j) contained general requirements applicable to all composite structures. It also should have been included in the general requirements of the introductory text in the notice. The words "material variability and environmental conditions" in § 23.573(j) cover the list of conditions, such as temperature and humidity, that were spelled out in the proposal and that are removed from the final rule. AC 20–107 contains information about this topic.

2. Section 23.573(a)(1) of the final rule contains the text of the first sentence of proposed § 23.573(b). The FAA guidance material in the second sentence of proposed § 23.573(b) is included in AC 20–107.

3. Section 23.573(a)(2) comes from proposed § 23.573(c). Certain explanatory words were removed from this paragraph. Section 23.573(a)(3) is a combination of § 23.573(g) and (h), in the proposal. Section 23.573(g), for pressurized cabins, and § 23.573(h), for other parts of the airplane, contained common testing requirements that have been combined. The structural items, such as the wing, identified in proposed § 23.573(h) appear in final rule § 23.573(a) and are not repeated in § 23.573(a)(3). The special consideration for pressurized cabin structure in proposed § 23.573(g)(1) and (g)(2), is now included in final rule § 23.573(a)(3)(i) and (a)(3)(ii).

4. Section 23.573(a)(4) is the same as § 23.573(d) in the NPRM. Section 23.573(a)(5) is the same as § 23.573(i) in the NPRM. Verifying the strength of bonded joints by non-destructive testing is added to this paragraph to provide a third acceptable means of approval.

5. Section 23.573(a)(6) comes from § 23.573(k) in the NPRM. This paragraph is rewritten for consistency with the other paragraphs in this section.

6. Instead of the composite damage tolerance requirements proposed for metallic structures by § 23.573(a) in the NPRM, the final rule provides these requirements in § 23.573(b).

7. Section 23.573(c) combines the proposed requirements of § 23.573, paragraphs (e) and (1), from the NPRM and makes this a requirement applicable to composite structures. Those inspection requirements also apply to metallic structures subject to the optional damage tolerance provisions of final rule § 23.573(b).

8. Proposed § 23.573(f) is deleted in the final rule. This paragraph described load spectra, load truncation, and types of damage that must be considered in the damage tolerance evaluation. It contained advisory material on testing methods and did not contain any testing requirements. Though this paragraph is removed, the topics identified must be considered and documented in any damage tolerance evaluation.

The FAA adopts § 23.573, with the changes discussed above and includes revisions to §§ 23.571 and 23.572.

*Proposal 49*

The FAA proposed to revise § 23.613 to place into part 23 the probability basis used for establishing material allowables. The probability basis appears in MIL–HDBK–5 and is duplicated in §§ 23.613 and 23.615.

The FAA received comments on this proposal from the GAMA, the JAA, and Transport Canada. The JAA agrees with the proposals because they significantly harmonize with JAR 23.

The GAMA believes that § 23.613(c) should continue to list the various strength authority documents (MIL–

HDBK–5 and others) to make it clear that these references continue to be acceptable. The FAA agrees that these references are still acceptable and concludes that since this material is advisory, it is more appropriate that it be included in an advisory circular.

Transport Canada suggests substitution of the word "design" for the word "strength" in proposed § 23.613(d) on the ground that a "design detail may have high static strength but still be a poor design from the point of view of fatigue." The FAA agrees and has amended the paragraph accordingly. The proposed § 23.613 is adopted with the changes discussed above.

*Proposal 50*

The FAA proposed to remove § 23.615 since it is no longer needed in view of the changes to § 23.613. The two commenters, the GAMA and the JAA, agree with the proposal. Section 23.613 is removed as proposed.

*Proposal 51*

The FAA proposed to provide relief from non-destructive testing requirements for critical castings and to define non-structural casting requirements in § 23.621.

One commenter, the JAA, believes the intent of proposed § 23.621(c)(1)(i) is: "* * * 100 percent inspection by visual, radiographic and either magnetic particle, penetrant or other approved equivalent non-destructive inspection method." The FAA agrees and revises § 23.621(c)(1)(i) accordingly.

The JAA states that it is sympathetic to the FAA's proposed revision to § 23.621(c)(1)(ii) but requests the sharing of FAA's experience concerning the adequacy of a factor of 2.0. All available experience was shared in discussions at the Airworthiness Review Conference; in conference proposals 240, 241, and 242; and in the explanation information contained in the NPRM. The FAA adopts proposed § 23.621(c)(1)(ii) as proposed.

The JAA also states that § 23.621(e), regarding non-structural castings, is redundant since present § 23.621(a) already excludes non-structural castings.

After further review, the FAA has concluded that § 23.621(a) refers to "non-structural" fluid systems castings only. Section 23.621(e) includes those fluid systems castings addressed by § 23.621(a), but it is not limited to them. Section 23.621(e) is adopted as proposed and any redundancy between § 23.621, paragraphs (a) and (e), will be addressed by future rulemaking. The FAA adopts § 23.621 with the changes discussed above.

*Proposal 52*

The FAA proposed to define the dive speed, $V_D$, to reduce the Mach number from 0.6 to 0.5, and to introduce flutter criteria for damaged structure in § 23.629. The FAA received comments on this proposal from the GAMA and from the JAA.

The GAMA recommends that the proposed changes to § 23.629(d)(1) not be made. This commenter recommends that the Mach cut-off references remain at 0.6 and 260 knots (EAS) and that the reference to altitude be eliminated. The JAA states that since "260 kt EAS at 14,000 feet is M=0.5, this has been proposed for JAR 23."

The FAA has determined that the Mach number 0.5 is technically more appropriate (and the JAA agrees) to the 260 knot (EAS) requirement and causes no significant flutter certification problem. After further review, the FAA has decided that the reference to altitude, although technically correct, is irrelevant; therefore, it is removed.

The GAMA proposes that $V_D/M_D$ would be more appropriate than $V_D$ alone. The FAA agrees and changes the proposal accordingly.

The GAMA also asks the FAA to revise § 23.629(g) and (h) to clarify that the phrase "analysis only" is the regulatory requirement.

The FAA disagrees. As proposed, § 23.629(g) and (h) require an analysis and permit certification by testing. An "analysis only" requirement would effectively discourage and prohibit other certification substantiation. The words "by analysis or test" replace the words "by analysis" in paragraphs (g) and (h). By this change, the applicant is required to show that the airplane is free from flutter up to $V_D/M_D$, but is permitted to use analysis or other means that are appropriate for the design.

Finally, the GAMA proposes that the analytical flutter clearance factor of 1.2 $V_D$ in § 23.629(b) be changed to 1.15 $V_D$. Changes to § 23.629(b) are outside the scope of this NPRM. The FAA will consider this in future rulemaking projects.

The JAA observes that $V_D$ is not explicitly stated in proposed § 23.629(h) although it is in proposed § 23.629(g). The FAA agrees that both paragraphs should address $V_D$, and final rule § 23.629(h) is revised accordingly. The FAA adopts § 23.629 with the changes discussed above.

*Proposal 53*

The FAA proposed to extend the installation requirements in § 23.655, currently applicable only to the tail surfaces, to include all control surfaces.

Since the only comment, received from the JAA, agrees with the proposed change, the FAA adopts § 23.655 as proposed.

*Proposal 54*

The FAA proposed to add a new § 23.672 that provides criteria for approval of certain stability augmentation devices, and automatic and power-operated systems.

The FAA received comments on this proposal from the GAMA, the JAA, and the ALPA. The ALPA strongly supports the proposed change. The JAA states that the adoption of proposed FAR 23.672 for JAR 23 is under discussion.

The GAMA recommends that the FAA make it clear that this requirement would not apply to a simple downspring or a bobweight stability device. The FAA agrees with the GAMA that new § 23.672 would not apply to devices such as downsprings and bobweights since they are not "systems" as addressed in this requirement. Since § 23.672 is virtually identical to § 25.672, and since there have been no problems interpreting that section consistent with this position, the FAA concludes that no changes are needed. The FAA adopts § 23.672 as proposed.

*Proposal 55*

The FAA proposed to revise § 23.679 by adding provisions for an automatic-disengage control lock system. The proposal would also add requirements for the locks to be installed so they limit operation of the controls and thereby provide the pilot with an unmistakable warning that the controls are locked at the start of the takeoff roll.

The FAA received comments on this proposal from the GAMA, the JAA, and the ALPA. The ALPA strongly supported the proposed change.

The GAMA believes that the proposal would add to the cost and complexity of the control lock system without a commensurate benefit. The GAMA is unaware of any adverse service history resulting from installed control locks and believes that the current rule provides an adequate level of safety. In support of this position, the GAMA includes an estimated cost of $250,000 to develop a fully automatic gust lock system for a type certificated airplane model.

To evaluate and resolve the GAMA comments, the FAA has reviewed the original conference proposals, numbers 252, 253, and 254. It has also reviewed the record of the public meeting. In response to the GAMA comment concerning any adverse service history, this review shows that the original conference proposals were submitted because accidents were occurring because of control locks that remained installed during takeoff. The economic analysis of the proposals in the notice also identified this accident service history and showed severe airplane damage, pilot injuries, and possible fatalities.

The FAA is aware that an automatically released control lock system would be costly. The proposal did not mandate the installation of an automatic system, but would add an optional provision that would show the acceptance of such systems.

The JAA stated its assumption that the proposed requirement would not be applicable to external locks. Based on the comments received, the FAA has re-examined the proposal. Since the proposal would have eliminated the current § 23.679(a), external systems that use the red warning ribbons as a means of warning the pilot that the locks are in place would no longer be acceptable. The FAA has determined that there is a need to retain the provision of current § 23.679(a), so that presently used locks and their warning systems remain acceptable. The added provision of § 23.679(a)(2) will make it clear that systems that automatically disengage the locks are also acceptable but not mandatory.

The proposal to limit the operation of the airplane when the locks are engaged is being restated since control locks and their warnings can be overlooked and automatic disengage systems will fail. The FAA believes an additional safeguard is required. By requiring a system that will ensure that airplane operation is limited, the pilot will receive a pre-takeoff warning and thus a hazardous takeoff will not be attempted.

In summary, the FAA has considered the comments and has revised the proposed rule language by retaining the current provisions of § 23.679(a) and § 23.679(a)(1), and by adding the provision for accepting automatically disengaged locking systems as an option. The language in proposed § 23.679(a)(2) to require the control surface to be locked so the pilot receives an unmistakable warning at the start of the takeoff if the locks have not been removed is retained as § 23.679(b). The unmistakable warning required by this paragraph may be a tactile warning that the pilot receives by the feel of the controls. Finally, proposed § 23.679(b) is retained as paragraph (c).

The FAA has determined that these changes are not substantive and will clarify this requirement by providing relief from the provisions identified by the commenters. The FAA adopts § 23.679 with the changes discussed above.

*Proposal 56*

The FAA proposed to revise § 23.729, paragraphs (f)(1) and (f)(2), by changing the power and flap settings necessary to warn the pilot that the landing gear is not fully extended and locked.

The FAA received two comments on this proposal from the JAA and the ALPA. The ALPA strongly supported the proposed change.

The JAA generally agrees with the proposal. However, the JAA notes that these requirements are liable to produce nuisance warnings when the throttles are closed for descent from a high altitude or when one throttle is pulled back following an engine failure. The JAA suggests that the FAA consider an approach for part 23 gear warning requirements similar to the approaches proposed for part 25 in Notice No. 89–20 (54 FR 34116, August 17, 1989).

The revision of the landing gear warning requirements proposed for part 25 is beyond the scope of this rulemaking. While no action will be taken on this suggestion now, the FAA will consider this suggestion for future rulemaking.

Nuisance warnings concern the FAA, and the language changes proposed in the NPRM should reduce them. Proposed § 23.729(f)(2) would have required a landing gear warning when the flaps are extended beyond the approach setting. That change would eliminate the nuisance warnings occurring when flaps are set "to" the approach flap position. Subsequent to the issuance of the notice it has come to FAA attention that many airplanes have more than one approach flap setting and that the proposal would be unclear as to which approach flap setting should be used as the threshold for the gear warning. Also, if the lower approach flap setting is used, nuisance warnings could occur because that setting is also frequently used for takeoff flaps. To clarify this requirement, the proposal has been revised to require the gear warning when the flaps are extended beyond the maximum approach flap position. The FAA adopts § 23.729 with the changes discussed above.

*Proposal 57*

The FAA proposed to remove § 23.731(a), which contains a requirement that each main and nose wheel must be approved. Since there is a basic requirement to approve the complete airplane, including all components, parts, and appliances, § 23.731(a) is unnecessary. No comments were received on this proposal, and the FAA adopts § 23.731, as proposed.

*Proposal 58*

The FAA proposed to remove the current § 23.733 reference to the tire rating assigned by the Tire and Rim Association. This would be accomplished by:

1. Stating that tire ratings must be approved.
2. Requiring that static and dynamic ratings be established.
3. Defining the conditions where those ratings are to be used.

The FAA received comments on this proposal from the GAMA and the JAA. The JAA asks the FAA to explain the undiscussed change in the drag reaction from 0.21W to 0.31W.

At least one publication of part 23 regulations contains a typing error that gave this reaction as 0.21W. The FAA has reviewed the history of this requirement and verified that the value of 0.31W that is in § 23.733(a)(2), as published in the Code of Federal Regulations, is correct.

The GAMA questions the removal of the reference to the Tire and Rim Association and recommends its retention. In the NPRM, the FAA identifies the existence of other organizations whose appropriate rating also would be considered. The FAA adopts § 23.733 as proposed.

*Proposal 59*

The FAA proposed to remove the first sentence of § 23.737 that states that each ski must be approved. Since the only commenter, the JAA, agrees with the proposed change, the FAA adopts § 23.737 as proposed.

*Proposal 60*

The FAA proposed to revise § 23.751 to clarify the buoyancy requirements for the main floats of seaplanes. Since the only commenter, the JAA, agrees with the proposed change, the FAA adopts § 23.751 as proposed.

*Proposal 61*

The FAA proposed to remove the words "must be approved" from the main floats design requirements in § 23.753. Since the only commenter, the JAA, agrees with the proposed change, the FAA adopts § 23.753 without change.

*Proposal 62*

The FAA proposed to add wording to the hull requirements for seaplanes in § 23.755 to clarify that airplanes must be kept afloat without capsizing. Since the only commenter, the JAA, agrees with the proposed change, the FAA adopts

§ 23.755(a), introductory text, as proposed.

*Proposal 63*

The FAA proposed to revise the § 23.773 requirements for the pilot compartment view to address the environment expected in all the operations requested for certification.

The JAA states that it will consider this change for JAR 23 but that it proposes to retain present paragraph (b) relating to night flight tests. The GAMA contends that the words "must be shown in all operations for which certification is requested," could be interpreted to mean that the same view must be provided for all operations.

The FAA does not agree with the GAMA interpretation. Section 23.773 (a) and (a)(1) requires the pilot compartment view to be sufficiently extensive, clear, and undistorted to allow the pilot to perform the various functions identified in this proposal. The word "sufficiently" is included because the FAA recognizes that the view needed for one operation may differ from the view needed for another. The intent is also shown by the words "sufficiently large" used in § 23.773(b). The FAA adopts § 23.773 as proposed.

*Proposal 64*

The JAA proposed to clarify the § 23.775 criteria to be used for determining the cleared windshield area that is necessary to ensure safe operation for icing conditions. The proposed new § 23.775 would require that a probable single failure of a transparency heating system may not adversely affect the integrity of the airplane cabin. The FAA received comments on this proposal from the GAMA and the JAA.

The JAA does not find the proposal for § 23.775(f) acceptable for inclusion into JAR 23. The JAA does not provide any suggested changes.

In reviewing this comment, the FAA notes that the proposal for § 23.773 identifies the need for a clear and undistorted view for these same four operations and the ability to "perform any maneuver within the operating limitations of the airplane." If the airplane is approved for operation in known or forecast icing conditions, the requirements of § 23.773 will be applicable. Section 23.775(f) should be the same as § 23.773. Accordingly, § 23.775(f) is revised to be the same as § 23.773.

The JAA also believes that transparency heating systems, covered by proposed § 23.775(g), should be certificated under the principles of § 23.1309. The FAA notes that § 23.1309 applies to all systems, as defined by § 23.1309(f), and would apply to transparency heating systems. The provisions of the proposal for § 23.775(g) identify specific hazards that could occur. These specific hazards would have catastrophic consequences and must be avoided through the use of appropriate designs.

The other commenter, GAMA, notes that its comments on proposal 63 also apply to this proposal to clarify criteria for determining cleared windshield areas. The FAA addresses the concern about the amount of cleared windshield under proposal 63. The response is also applicable to the cleared area needed for the operations identified in this proposal. The FAA adopts § 23.775 with the change discussed above.

*Proposal 65*

The FAA proposed that § 23.851 be revised to require a hand fire extinguisher to be located in the pilot's compartment of all airplane categories. This proposal would also add minimum standards for hand held fire extinguishers. The FAA received comments on this proposal from the JAA and the GAMA.

One commenter, JAA, believes the requirements in current § 23.851, paragraphs (a) and (b), is more appropriate for the operating rules.

The FAA does not agree with this commenter's position. It is incorrect to allow an airplane to be certificated and not include the equipment required for the airplane to be placed in operation. When this occurs, the new owner/operator must then install the required equipment. Such an installation would not only need to meet the operating rules but also would need to meet the requirements of §§ 23.851 and 23.561(b)(3). Because the operator may not have the structural design data for the airplane, finding a suitable location to install a fire extinguisher meeting the load factors of § 23.561 could be difficult. Such installations are more easily accomplished by the airframe manufacturer. The requirements of current § 23.851(a) and (b) will be retained.

The JAA also notes that proposed § 23.851(c)(2) does not ban extinguishers that use toxic agents. The JAA believes that such agents should be banned. The FAA does not agree with this position. The first consideration in evaluating the use of a hand fire extinguisher is its effectiveness in putting out any in-flight fire. If the best agent for the type of fire that may occur causes toxic gas, the concentration of that gas that would result from a completely discharged extinguisher and its hazard to the occupants must be evaluated. If the concentration would be hazardous, it may still be possible to use the extinguisher if the gas can be vented from the area in a short time, and if there would be no adverse affect upon the occupants. To ban such fire extinguishers could lower the level of safety of the airplane by reducing the chance the in-flight fires can be extinguished. The FAA plans no action to ban the use of such fire extinguishing agents at this time.

The other commenter, GAMA, believes the proposal for § 23.851(a), requiring a hand fire extinguisher to be located conveniently in the pilot's compartment, is too restrictive. The GAMA points out that the pilot's compartment is usually small, therefore, it is frequently difficult to find suitable space for a fire extinguisher. The GAMA recommends revising § 23.851(a) to read, "There must be at least one hand fire extinguisher located within easy access of the pilot while seated."

The FAA agrees that the recommended revision would require the same pilot access to the fire extinguisher as intended by the proposal. Because this revision allows the fire extinguisher to be located in the cabin, where the pilot can reach it, it could be confused with the extinguisher required for the cabin. To identify the applicable extinguisher, the proposal is revised to read, "There must be at least one hand fire extinguisher for use in the pilot compartment that is located within easy access of the pilot while seated."

The GAMA also recommends that the FAA develop more explicit guidance criteria concerning the acceptable size, agent, etc., than is now contained in the operating rules in § 91.513. The FAA agrees that better guidance needs to be developed, and will consider future advisory material to develop such guidance.

The FAA observes that § 91.513(c)(3) requires at least one hand fire extinguisher located in the passenger compartment of each airplane accommodating more than six passengers. Accordingly, this operating rule and the NPRM are not compatible. If the requirements in the notice were adopted as proposed, normal category airplanes that accommodate more than six passengers could be certificated without a passenger compartment fire extinguisher. Then, operators of those airplanes would be required to have an extinguisher installed.

The FAA discussed, in the NPRM, the burden that would fall on the operator if that operator needed to install a new fire extinguisher that also must meet other current airworthiness requirements. For consistency with § 91.513(c)(3), the final rule § 23.851 has been revised to require a fire extinguisher in the cabin of airplanes that accommodate more than six passengers. The FAA adopts § 23.851 with the changes discussed above.

*Proposal 66*

The FAA proposed to clarify the existing requirement of § 23.865 by excluding those portions of the engine mount certificated with the engine and by addressing the allowable damage expected on engine isolators. Since the only commenter, JAA, agrees with this proposal, the FAA adopts § 23.685 as proposed.

*Proposal 67*

The FAA proposed a change to § 23.1507 to establish an operating maneuvering speed ($V_O$) different from the design maneuvering speed ($V_A$) established by § 23.335(c). $V_O$ is the maximum speed where, at any given weight, the pilot may apply full control excursion without exceeding the design limit load factor.

The one commenter, the JAA, believes that this new concept of $V_O$ needs further discussion. The JAA also notes that, while proposed § 23.1507(a), establishing an operating limitation, is correctly located, § 23.1507(b), which defines $V_O$, should be moved to become § 23.335(d) while retaining the existing definition of $V_A$, design maneuvering speed, at § 23.335(c).

The FAA disagrees with moving the $V_O$ definition to § 23.335, since it would put an operational definition in the design section of part 23. The $V_O$ definition in § 23.1507 is consistent with the requirements of § § 23.1505 and 23.1511, namely, that the relationships between "operating" speeds and "design" speeds are established. The comment has caused the FAA to reexamine and reword proposed § 23.1507. The revised wording deletes the definitions of computed stall speed ($V_S$) and the limit maneuvering load factor (n) and utilizes those already contained in § 23.335. The final rule section heading includes the word "operating" to maintain a distinction from the design maneuvering speed of § 23.335. The FAA adopts § 23.1507 with the change discussed above.

*Proposal 68*

The FAA proposed to add a new § 23.1516 that establishes an intentional one-engine-inoperative speed for pilot training.

The one commenter, the JAA, refers to its comments on proposed § 23.149. The FAA agrees that $V_{SSE}$ should not be established as a limitation; therefore, it deletes the proposed § 23.1516.

*Proposal 69*

The FAA proposed to change § 23.1521 to ensure that powerplant limitations established for airplane certification do not exceed those established during the certification of the engine or the propeller, and are in accord with limitations used in determining compliance with this part.

The one commenter on this proposal, JAA, notes that examples from FAA experience would be useful in the preparation of interpretations. The FAA's principal experience involves derated engines and some turbopropeller engine installations that have a higher maximum power at cruise than at takeoff. The FAA adopts § 23.1521 as proposed.

*Proposal 70*

The FAA proposed to add a new § 23.1522 that specifies auxiliary power unit (APU) limitations in the operating limitation section of the AFM.

The one commenter, JAA, believes that, without requirements addressing APU's in subpart E of part 23, the introduction of this proposal on operating limitations is premature.

The FAA points out that APU's have been addressed in § 23.901 as amended in Small Airplane Airworthiness Review Program Amendment No. 3, Amendment 23–43 (58 FR 18958, April 9, 1993). The FAA adopts § 23.1522 as proposed.

*Proposal 71*

The FAA proposed to change § 23.1525 to clarify the existing rule which is vague and brief, by requiring the establishment and inclusion of kinds of operations authorized in the AFM, as specified by § 23.1583(h).

The one commenter, JAA, notes that existing § 23.1525 and proposed JAR 23.1525 are statements rather than requirements. The JAA believes that what is needed is a requirement that establishes the kinds of operations authorized and the resulting airplane operational limitations. The JAA suggests a slightly modified version of proposed JAR 23.1525, as follows: "The kinds of operation authorized (such as VFR, IFR, day or night) and the meteorological conditions (such as icing) and the category in which the aeroplane is eligible for certification, appropriate to the installed equipment, must be established." The JAA believes that the requirement to furnish this information in the AFM belongs in § 23.1583(h) and that a cross-reference, as proposed in § 23.1525, is unnecessary.

The FAA concurs with the JAA's comment and the final rule language is changed to closely follow the JAA's suggested version. The FAA adopts § 23.1525 with the change discussed above.

*Proposal 72*

The FAA proposed to change § 23.1527 to clarify that the maximum operating altitude allowed for any part 23 airplane must be established based on those limitations determined by flight, structural, powerplant, functional, or equipment characteristics.

The one commenter, JAA, suggests reversing the order of § 23.1527(a) and (b) for clarity. The FAA concurs and adopts § 23.1527 with this change.

*Proposal 73*

The FAA proposed to change § 23.1545 by deleting current paragraph § 23.1545(b)(6) which requires a red radial mark on the airspeed indicator. This mark identifies the minimum control speed with the critical engine inoperative, $V_{MC}$, on multiengine airplanes.

The one commenter on this proposal, JAA, states that the red radial line on the airspeed indicator at $V_{MC}$ offers useful guidance to the pilot for this class of airplane and should be retained.

For the reasons given by the JAA, the FAA agrees that the red radial should be retained. The proposed amendment to § 23.1545 is withdrawn.

*Proposal 74*

The FAA proposed to change § 23.1549 to expand the current powerplant instrument requirements to include auxiliary power units (APU).

The one comment from JAA on this proposed change refers to the JAA's comments on proposed changes to § 23.1522 in which the JAA opposed referencing APU in the absence of requirements addressing APU in subpart C.

As previously stated, since the Small Airplane Airworthiness Review Program Amendment No. 3, Amendment 23–43 (58 FR 18958, April 9, 1993) addresses APU, § 23.1549 is adopted as proposed.

*Proposal 75*

The FAA proposed to change § 23.1557 to clarify the marking requirements for filler openings and to require a marking for the coolant filler opening similar to the requirements for fuel and oil. The FAA also proposed deleting § 23.1557(f) because the AFM and fuel quantity indicator provide this information to the pilot.

The one commenter, JAA, concurs with the proposed changes, except that the JAA believes that § 23.1557(c)(2), which contains marking requirements for oil filter openings, should end with the words "and the permissible oil designations." While the FAA agrees, after further review, the FAA has determined that, as with fuel filler marking, the oil filler marking should permit reference to the AFM as an alternative. The proposed § 23.1557 is adopted with the change discussed above.

*Proposal 76*

The FAA proposed to change § 23.1563(a) by substituting $V_o$ for $V_A$ in conjunction with the change to § 23.1507.

The one commenter, JAA, states that $V_o$ should be further considered later, in the light of discussions on proposed § 23.1507. The concept of $V_o$ was discussed under proposal 67 relating to § 23.1507, and for the reasons stated there the FAA adopts § 23.1563(a) as proposed.

*Proposal 77*

The FAA proposed to change § 23.1581(f) to establish a new requirement for providing a means to record updates to the AFM.

The FAA received comments on this proposal from the ALPA and JAA. The ALPA strongly supports the proposed change.

The JAA agrees with a requirement for a means of recording the amendment status of the AFM, but believes that a "log of revisions" is only one acceptable means of compliance and that a list of effective pages is equally acceptable.

The FAA agrees with the commenter and has determined that the rule text permits the suggested alternative. A change in the heading to read "Revisions and amendments" clarifies this point. The proposed § 23.1581(f) is adopted with the change discussed above.

*Proposal 78*

The FAA proposed an introductory sentence to § 23.1583. During the type certification process, there are limitations required other than those specified by this section. The FAA proposed to expand § 23.1583(h) to identify the kinds of operation that were type certificated, such as icing. Also, the section was proposed to be revised to identify installed equipment that must be operable for aircraft operation in icing conditions. The NPRM also proposed a new § 23.1583(m). Although § 23.1523, Load distribution limits, generally covers it, the effects of an asymmetric fuel load are not emphasized. The effects of lateral fuel imbalance are not usually addressed although the lateral center of gravity limits must be furnished in the AFM.

The FAA received comments on this proposal from the GAMA and the JAA. The commenters on the proposal for § 23.149, which would establish a safe, intentional, one-engine-inoperative speed, $V_{SSE}$, as a limitation in § 23.1583, oppose the inclusion of $V_{SSE}$ in § 23.1583(a)(2). In response to these comments, the FAA agrees that this speed should not be established as a limitation and $V_{SSE}$ is removed from § 23.1583(a)(2). Revisions to § § 23.149 and 23.1585 require manufacturers to determine a safe one-engine-inoperative speed and provide this information in the AFM.

The JAA also notes that the words "of each airplane" in the introductory statement are not necessary and should be removed. The FAA concurs. While reviewing comments on § 23.1583(a)(2), the FAA noted that since $V_A$ is removed as an airspeed limitation in § 23.1507, $V_A$ should also be removed from § 23.1583(a)(2).

The JAA states that, having established the kinds of operation authorized under § 23.1525 (VFR, IFR, day, night, and others), § 23.1583(h) is merely to require that this information be made available in the AFM. The JAA suggests words based on JAR 23.1583, as follows:

"The Aeroplane Flight Manual must contain:

* * * * *

(h) Kinds of operation. A list of the kinds of operation to which the aeroplane is limited under 23.1525 for which approval has been given."

If the FAA retains proposed § 23.1583 as proposed, the JAA suggests replacing "is requested" with "has been given." The JAA also notes the need to identify the required operational status of installed equipment, where this may affect operation limitations, will be proposed as an extension to JAR 23.1583(i).

The GAMA states that "The last sentence of proposed § 23.1583(h) is confusing and subject to multiple interpretations. Certain equipment, such as deicing equipment, might be appropriately included in a listing that affects operating limitations (flight into known icing in this example) but, reference to the kinds of operation for which approval is requested may lead to confusion and continue the argument that has been going on for more than ten years with respect to minimum equipment lists versus what is required (required equipment lists) for a particular operation. Most operators of part 23 airplanes, including operators of single-engine personal use airplane, have traditionally equipped their airplanes according to their personal operational requirements and preferences. This will become even more true in the near future as alternate sole source navigational systems are approved. The proposed wording of the last sentence of paragraph 23.1583(h) appears to require that a detailed minimum equipment list be included in the limitations section of the AFM. This in turn requires a supplemental type certificate for *any* variation from the manufacturer's standard installed equipment list. Such a list might well be appropriate as a 'required' equipment list for various kinds of operations and may be interpreted to provide operational authority for such operations. However, it is more likely that it will perpetuate the confusion of what must be operative and what may be inoperative during a particular flight. This item needs further review."

The FAA agrees that reference in § 23.1583(h) to the kinds of operation within § 23.1525 is appropriate instead of repeating examples of kinds of operations. This change and the other change suggested by the JAA are made in the final § 23.1583(h).

The FAA does not agree with the GAMA that the last sentence in § 23.1583(h) is confusing and subject to multiple interpretation. A Kind of Equipment List (KOEL) has been part of the limitations for many years. A Minimum Equipment List (MEL) is an operational requirement covered by part 91 and the relationship between a KOEL and an MEL is well established and in use by the public.

Except for editorial changes, suggested by the JAA, and minor clarifying editorial changes § 23.1583(h) is adopted as proposed.

*Proposal 79*

The FAA proposed to change § 23.1585 to revise flight procedures and scheduled speeds that are essential for the safe operation of the airplane and the achievement of the scheduled performance. Additionally, the procedures for starting engines in flight are considered necessary for all multi-engine airplanes; therefore, the FAA proposed to eliminate the reference to commuter category and to turbine engines.

The FAA received comments on this proposal from the JAA and the CAA-UK. The CAA-UK comment addresses conference proposals that the FAA rejected and, as previously stated, this preamble does not address comments on rejected conference proposals. The JAA notes that the proposed changes align closely with JAR 23.

The JAA believes that GAMA Specification No. 1 is acceptable and fears that certain of the proposed changes may conflict with it. The FAA recognizes that GAMA Specification No. 1 may need to be revised.

Also, the JAA states that it is "unclear from what the operating procedures 'must be * * * segregated'" in the AFM.

With the addition of abnormal procedures to normal and emergency procedures covered under the present rule, the FAA's intent is that the AFM be organized so that abnormal procedures are clearly separated from normal procedures, etc.

The JAA notes that procedures for maintaining and recovering control following engine failure above or below $V_{MC}$ are still required in spite of the NPRM explanation that these are within the scope of basic airmanship The FAA concurs with the JAA that the explanation in the NPRM shows that recovering of control above and below $V_{MC}$ is within the scope of basic airmanship These procedures were inadvertently left in the text of the proposed rule as § 23.1585(c)(5); therefore, proposed paragraph (c)(5) is omitted from the final rule.

The JAA states: "In spite of the explanation, FAR 23.1585(d) through (g) appear to remain unchanged although (f), not required for JAR 23, requires for all aeroplanes that a restart envelope must be established. In § 23.1585, however, the operating procedures for restarting of the engine(s) must be furnished for multi-engined aeroplanes only This inconsistency will lead to confusion."

The JAA comment on § 23.1585(d) through (g) indicates that the text of the NPRM explanation may have been misunderstood. The NPRM explanation noted that non-flight items were considered for the NPRM but not addressed as the NPRM was aimed at flight items. Thus, the FAA did not intend to change § 23.1585(d) through (g).

The FAA does not understand the JAA's reference to § 23.1585(f) with respect to an engine restart envelope for all airplanes, since § 23.1585(f) concerns unusable fuel and indicator marking. Nor does the FAA understand the inconsistency suggested by the JAA since the proposed restart procedures are in paragraph (c) which only applies to multiengine airplanes.

In response to comments on proposed § 23.235, as discussed under that section, the FAA is amending § 23.1585(a) to add a requirement for seaplane handling procedures and demonstrated wave height.

Also as discussed in proposal 12, the FAA decided that $V_{SSE}$ should not be a limitation; therefore, a new § 23.1585(c)(6) is added to require that $V_{SSE}$ be furnished to the pilot in the AFM. The FAA adopts § 23.1585 with the changes discussed above.

*Proposal 80*

The FAA proposed to reorganize and simplify § 23.1587, which specifies the performance information that must be provided in the AFM.

The one commenter, JAA, states that while the proposed changes move considerably towards the proposed text of JAR 23.1587, the JAA has already decided that "the calculated approximate effect" on performance of altitude and temperature is unacceptable.

The JAA states that the maximum temperature at which compliance with the cooling requirements has been shown is wrongly located in the AFM and that it should appear as a limitation in § 23.1521(e), as in proposed JAR 23. Unlike proposed JAR 23.1587, the JAA notes that there is no proposal to address the effect of factored winds, runway slope, or grass surfaces on takeoff and landing distances or to schedule a flight-over-water speed. The JAA believes data are necessary for meaningful compliance with even the simplest performance operating rules.

Since one of these items were proposed in the NPRM, it is inappropriate for the FAA to include them in the final rule and the proposed § 23.1587 is adopted as proposed.

*Proposal 81*

The FAA proposed to amend § 23.1589(a) to publish the weight and location of each item of equipment that can be easily removed, relocated, or replaced.

Since the only comment received, from the JAA, agrees with the proposed change, the FAA adopts § 23.1589, as proposed.

*Proposal 82*

The FAA proposed to amend appendix D by adding a new paragraph (c), which supports a new requirement in § 23.479(c) concerning dynamic spring-back of the landing gear.

Since the only comment received, from the JAA, agrees with the proposed change, appendix D is adopted as proposed.

*Proposal 83*

The FAA proposed to add a new appendix H that supports amended § 23.521.

Since the only comment received, from the JAA, agrees with the proposed change, appendix H is adopted as proposed.

**Turbojet Engines**

While not proposing any rule change in the NPRM, the FAA requested and received comments about changing part 23 to allow the use of turbojet engines on commuter category airplanes Comments were received from the ALPA and from the JAA The ALPA opposes the use of turbojet engines and believes that the certification of turbojet airplanes should remain under part 25 requirements.

The JAA states that since basic FAR/JAR 23 includes turbojets, "there is no fundamental reason for excluding them from commuter category" airplanes. The JAA believes that turbojets provide enhanced reliability compared to reciprocating engines. The JAA also believes that turbojet engines provide better airplane handling characteristics, with one engine inoperative, than any propeller driven airplane (reciprocating or turbine engine powered) The JAA recognizes that part 23 is intended to provide a simplified airworthiness code appropriate to simple airplane designs. The JAA recognizes that the use of turbojet engines has the potential to convey a performance capability involving design complexities not envisioned in formulating FAR 23. The JAA states that it is not opposed to the use of turbojet engines on airplanes certificated to commuter category requirements, subject to a review of requirements related to a higher performance capability (speed and altitude).

**Performance Limitations Based on Weight, Altitude and Temperature (WAT)**

While not proposing any rule change in the NPRM, the FAA requested comment on the need for WAT criteria, as information or as a limitation on piston-powered twin-engine part 23 airplanes. It also requested comments about WAT criteria on turbine-powered twin-engine part 23 airplanes, specifically during takeoff and landing The FAA received comments from the JAA, the GAMA, and the ALPA. The ALPA supports the requirement that WAT information be furnished during the certification process. The ALPA cites the variety of operational uses, including scheduled air carrier and regional airline service, and the need for "one level" of safety as justification. The GAMA "believes that WAT information is useful but certainly not the only way to present operating data for any airplane" and that making WAT criteria an airplane or operating limitation for part 23 airplanes is "an unnecessary and unjustified expansion or redirection of operating criteria." The JAA generally supports the use of WAT criteria for part 23 airplane certifications. The JAA believes that the chance of a single-engine failure on any airplane is high. Also, the JAA warns that safety considerations include airplane occupants and personnel on the ground. According to the JAA, transport category airplanes do this by limiting the operation of the airplane. Beyond the point where takeoff can be rejected, one-engine-inoperative climb must guarantee obstacle clearance. The JAA recognizes the need for generally similar requirements for commuter category airplanes.

The JAA believes that a continued flight capability would preclude the operation of single-engine airplanes. Also, the JAA believes that airplane size and stall speed provide characteristics that permit safe landings.

The JAA points out that between the two extremes within present part 23 (from single-engine airplanes to commuter category airplanes) lie the light twin-engine reciprocating and turbine engine airplanes, ranging from four to nine seats and 4,000 to 12,500 pounds. The JAA notes that, for these types of airplanes, it would be burdensome to require compliance with full net flight path obstacle clearance. In the JAA's opinion, a safe forced landing becomes less satisfactory with increased takeoff weight, involving longer stopping distances even for the same landing speed. The JAA notes that twin-engine airplanes have other significant adverse characteristics compared to single-engine airplanes. First, an engine failure is twice as probable, second, asymmetric power demands immediate pilot action.

The JAA also points out that the inability to continue flight with one engine inoperative creates the following situation· The chance of a second engine failure is increased; a suitable site for an emergency landing is reduced; and the pilot resists the inevitable forced landing and tries to maintain flight. Training, under more favorable conditions, may have taught the pilot to expect success in these situations. In unfavorable conditions, attempts to maintain flight lead to loss of airspeed at high asymmetric power and, commonly, loss of directional control that results in a stall/spin accident.

The JAA advocates certification and operations criteria for multiengine airplanes that blend the performance requirements for a single-engine airplane and a transport category airplane. The JAA believes that the requirements accept a limited period for risk just before and just after liftoff where engine failure may not be fully accounted for. The JAA believes that the application of WAT limits clearly accounts for actual conditions, although the climb gradient requirements are lower than those of FAR/JAR 25.

The JAA recommends using compensating operational criteria, like transport category airplanes use, for the lower performance commuter category airplanes. Cockpit visibility and a reasonable maximum speed provide adequate compensation for takeoff so the pilot can see and avoid obstacles as the airplane returns for landing. The JAA does not propose a distinction between reciprocating and turbine engines. Where applicable, the WAT criteria should be imposed, in the JAA's opinion, as limitations through the Airplane Flight Manual (AFM).

The JAA does not believe that such proposals would involve costs disproportionate to the benefits. The JAA suggests that the comment from the airworthiness conference, that such criteria would "eliminate the certification of an entire class of airplanes," is an exaggeration. The proposals are achievable, in the JAA's view, by typical modern light twin-engine airplanes with realistic payloads, particularly the more significant executive/air taxi airplanes. It is the JAA's opinion that adopting this concept would instill a greater awareness of performance consideration in pilots from an early stage of their training.

The JAA also believes that the climb and handling qualities requirements of present §§ 23.65 and 23.67 are illogical and unreasonable. The JAA recommends using WAT criteria, so it applies equally to all airplane operations, because it offers improved airplane capability.

The JAA points out that the manufacturers of "WAT type" airplanes routinely determine performance under a wide range of conditions. The JAA also notes that flight manuals produced to the widely accepted General Aviation Manufacturers Association (GAMA) specification already contain performance data beyond the minimum requirements of part 23. Additional testing or scheduled data create no additional costs in the JAA's opinion.

The JAA notes that present draft JAR 23 applies WAT limits only to piston-engine airplanes above 6,000 pounds and turbine-engine airplanes and that it has been proposed to the JAR Operations Group that WAT limits be applied to all JAR 23 airplanes in commercial operation.

**Regulatory Evaluation Summary**

This section summarizes the full regulatory evaluation prepared by the FAA that provides detailed estimates of the economic consequences of this regulatory action. This summary and the full evaluation quantify, to the extent practicable, estimates of the costs and benefits to the private sector, consumers, and Federal, State, and local governments.

Executive Order 12291, dated February 17, 1981, directs Federal agencies to promulgate new regulations or to modify existing regulations only if potential benefits to society outweigh potential costs for each regulatory change. The order also requires the preparation of a Regulatory Impact Analysis of all "major" rules except those responding to emergency situations or other narrowly-defined exigencies. A "major" rule is one that is likely to have an annual impact on the economy of $100 million or more, to have a major increase in consumer costs, or to have a significant adverse effect on competition.

The FAA has determined that this rule is not major as defined in the Executive Order. This section contains a summary of the regulatory evaluation, a regulatory flexibility determination as required by the 1980 Regulatory Flexibility Act, and an international trade impact assessment. The complete regulatory evaluation, which contains more detailed economic information than this summary provides, is available in the docket.

**Cost-Benefit Analysis**

*Costs*

Of the rule's 79 amendments, only six will result in more than negligible costs of compliance for airplane manufacturers. Each of these six amendments requires additional testing or analysis, costing about $5,800 per airplane certification. One of the amendments, § 23.851, also requires a fire extinguisher in all part 23 airplanes that are produced under future certifications. Other regulations already require fire extinguishers in airplanes with greater than six passengers and in commuter airplanes. For purposes of estimating the cost of this requirement, the FAA assumes a worst case scenario under which all future part 23 certifications will involve airplanes with six or fewer passengers. The FAA estimates that a fire extinguisher and a suitable bracket cost $40.

The FAA assumes that an average of five airplanes will be certified under part 23 each year during the period of analysis from 1993–2012. Based on discussions with industry, the FAA also assumes that, during the first year following certification, 60 airplanes will be produced per certification. In the second, third, and fourth years following certification, 120 airplanes per year are assumed to be produced. In the fifth and subsequent years, 100 airplanes per year are assumed to be produced. Based on this assumption, the costs of the rule over the 20-year period of analysis total $3.7 million ($1.5 million discounted) or about $48 per airplane produced.

*Benefits*

The benefits of the rule are two-fold. First, the rule is expected to enhance safety. An examination of accidents that might have been prevented by this rule include those involving control locks that were not removed prior to flight (seven accidents over a five-year period with five fatalities, three airplanes destroyed, and four substantially damaged) and multiengine stall/spin accidents (four accidents over eight years, resulting in nine fatalities and all airplanes destroyed). Had those accidents been avoided by the rule, the benefits would be $5.4 million per year.

Other safety benefits will be realized from the rule. The requirement to demonstrate 1.5g pitch maneuver capability will ensure that a pilot can make 30-degree banked turns and slow down from potential overspeed conditions without encountering low-speed buffeting. Determination of spin-up and spring-back loads will ensure that landing gear fore and aft drag loads, which affect both landing gear and wing strength, will be considered in the design of new part 23 airplanes. The requirement that airplanes be free from flutter will ensure that this dangerous phenomenon does not occur, even after fatigue failure. The rule also requires that additional information about procedures, speeds, and configurations for a glide following an engine failure for single-engine airplanes and procedures for restarting engines in flight for multiengine airplanes be included in the airplane flight manual. This information can lessen the consequences of emergency landings after engine failures. Although the FAA has not quantified the benefits of these requirements, the benefits exceed the generally minor costs.

There were 108 recorded accidents that occurred from January 1989 through April 1991 in which there was fire after impact. Although the number of fatalities and injuries in these accidents that could have been avoided cannot be determined, it is likely that the presence of a fire extinguisher could have mitigated the consequences in at least some of these fires.

Less than $194,000 in average annual accident losses needs to be averted annually to render this rule cost-beneficial. For those control system lock and multiengine stall/spin accidents that could have been prevented or mitigated by the provisions of this rule, the annual losses averaged $5.4 million. This exceeds the $194,000 threshold value, thus, the rule is cost-beneficial. In addition, the avoidance of fatalities because of the presence of fire extinguishers in affected airplanes will further increase the benefits. Finally, other requirements, such as those discussed above, will provide additional safety benefits.

Another valuable additional benefit of this rule is that it comports to a large extent with international requirements, particularly the Joint Aviation Requirements (JAR) of the Joint Aviation Authorities (JAA). The creation of common international standards, or harmonization, will benefit manufacturers in the U.S. and those in the countries of the JAA.

The rule modifies certain testing requirements and allows optional evaluations and analysis. This may result in cost savings. However, the FAA does not have sufficient information to quantify such savings.

**Regulatory Flexibility Determination**

The Regulatory Flexibility Act of 1980 (RFA) requires Federal agencies to review rules that may have a "significant economic impact on a substantial number of small entities." FAA Order 2100.14A, Regulatory Flexibility Criteria and Guidance, contains criteria for determining whether a proposed or existing rule has a significant economic impact on substantial number of small entities.

The entities that will be affected by this rule are the manufacturers of airplanes certificated under part 23. Based on the Regulatory Flexibility Criteria and Guidance, the size threshold for manufacturers is 75 or fewer employees and the cost threshold is $18,200 in 1992 dollars.

Approximately 14 affected manufacturers are considered to be small entities. The annual cost of the rule per certification during peak production is estimated to be $5,700, which is substantially less than the cost threshold limit cited above. Therefore, the FAA has determined that the rule will not have a significant economic impact on a substantial number of small entities.

**International Trade Impact Assessment**

The rule will have little or no impact on international trade. Both foreign and domestic manufacturing seeking type certification in the United States will be required to comply with the rule. The Joint Aviation Authorities (JAA) is including many of the sections in this rule to harmonize with U.S. aviation regulations. It is expected that other countries will also adopt these requirements.

**Federalism Implications**

The regulations herein will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order 12612, it is determined that this regulation will not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

**Conclusion**

The FAA is revising the airworthiness standards for normal, utility, acrobatic, and commuter category airplanes as a result of comments received in reply to the Small Airplane Airworthiness Review Program Notice No. 4 dated June 28, 1990. The notice, which addresses airframe and flight items, was published as a result of recommendations discussed at the Small Airplane Airworthiness Review Conference held on October 22–26, 1984 in St. Louis, Missouri. Originally, the proposals reflected updated safety standards and advancements in technology while reducing the regulatory burden for some requirements and maintaining an acceptable level of safety. Harmonization with the European Joint Aviation Authorities Joint Airworthiness Requirements became a dominant factor at the close of the extended Notice of Proposed Rulemaking comment period, December 14, 1990. Considerable effort was invested to harmonize these airworthiness standards because aircraft industry estimates indicate reduced overall certification costs. These airworthiness standards will continue to provide adequate levels of safety for small airplanes used in both private and commercial operations.

For the reasons discussed in the preamble, and based on the findings in the Regulatory Flexibility Determination and the International Trade Impact Analysis, the FAA has determined that this regulation is not major under Executive Order 12291. In addition, the FAA certifies that this regulation will not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act. This regulation is considered significant under DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). A regulatory evaluation of the regulation, including a Regulatory Flexibility Determination and International Trade Impact Analysis, has been placed in the docket. A copy may be obtained by contacting the person identified under "FOR FURTHER INFORMATION CONTACT."

**List of Subjects in 14 CFR Part 23**

Aircraft, Air transportation, Aviation safety, Safety.

Issued in Washington, DC, on July 28, 1993.

**Joseph N. Del Balzo,**
*Acting Administrator.*

**The Amendment**

Accordingly, the Federal Aviation Administration amends 14 CFR part 23 of the Federal Aviation Regulations as follows:

## PART 23—AIRWORTHINESS STANDARDS: NORMAL, UTILITY, ACROBATIC, AND COMMUTER CATEGORY AIRPLANES

1. The authority citation for part 23 continues to read as follows:

**Authority:** 49 U.S.C. 1344, 1354(a), 1355, 1421, 1423, 1425, 1428, 1429, and 1430; 49 U.S.C. 106(g).

2. Section 23.23 is revised to read as follows:

**§ 23.23 Load distribution limits.**

(a) Ranges of weights and centers of gravity within which the airplane may be safely operated must be established. If a weight and center of gravity combination is allowable only within certain lateral load distribution limits that could be inadvertently exceeded, these limits must be established for the corresponding weight and center of gravity combinations.

(b) The load distribution limits may not exceed any of the following:

(1) The selected limits;

(2) The limits at which the structure is proven; or

(3) The limits at which compliance with each applicable flight requirement of this subpart is shown.

3. Section 23.25 is amended by revising paragraph (a)(2)(i) to read as follows:

**§ 23.25 Weight limits.**

(a) * * *

(2) Not less than the weight with—

(i) Each seat occupied, assuming a weight of 170 pounds for each occupant for normal and commuter category airplanes, and 190 pounds for utility and acrobatic category airplanes, except that seats other than pilot seats may be placarded for a lesser weight; and

(A) Oil at full capacity, and

(B) At least enough fuel for maximum continuous power operation of at least 30 minutes for day-VFR approved airplanes and at least 45 minutes for night-VFR and IFR approved airplanes; or

* * * * *

4. Section 23.33 is amended by revising paragraph (d)(2) to read as follows:

**§ 23.33 Propeller speed and pitch limits.**

* * * * *

(d) * * *

(2) With the governor inoperative, the propeller blades at the lowest possible pitch, with takeoff power, the airplane stationary, and no wind, either—

(i) A means to limit the maximum engine speed to 103 percent of the maximum allowable takeoff r.p.m., or

(ii) For an engine with an approved overspeed, a means to limit the maximum engine and propeller speed to not more than the maximum approved overspeed.

5. Section 23.45 is amended by removing paragraph (e), by redesignating paragraph (f) as paragraph (e), by amending the cross-reference in newly redesignated paragraph (e)(2) from (f)(3) to (e)(3), by amending the cross-references in newly redesignated paragraph (e)(5) introductory text from (f)(3) and (f)(4) to (e)(3) and (e)(4), respectively, and by revising paragraphs (b) and (d) to read as follows:

**§ 23.45 General.**

* * * * *

(b) The performance data must correspond to the propulsive power or thrust available under the particular ambient atmospheric conditions, the particular flight condition, and the relative humidity specified in paragraph (d) of this section.

* * * * *

(d) The performance, as affected by engine power or thrust, must be based on a relative humidity of—

(1) 80 percent, at and below standard temperature; and

(2) 34 percent, at and above standard temperature, plus 50°F.

(3) Between the two temperatures listed in paragraphs (d)(1) and (d)(2) of this section, the relative humidity must vary linearly.

* * * * *

6. Section 23.53 is amended by revising paragraphs (a), (b)(1)(ii), and (b)(2) to read as follows:

**§ 23.53 Takeoff speeds.**

(a) For multiengine normal, utility, and acrobatic category airplanes, the rotation speed, $V_R$, may not be less than $V_{MC}$ determined in accordance with § 23.149.

(b) * * *

(1) * * *

(ii) Any lesser speed, not less than 1.2 $V_{S1}$, that is shown to be safe for continued flight or land-back, if applicable, under all conditions, including turbulence and complete failure of the critical engine.

(2) For single-engine airplanes, any speed, not less than 1.2 $V_{S1}$, that is shown to be safe under all conditions, including turbulence and complete engine failure.

* * * * *

7. Section 23.65 is amended by revising paragraph (a) to read as follows:

**§ 23.65 Climb: All engines operating.**

(a) Each airplane must have a steady angle of climb at sea level of at least 1:12 for landplanes or 1:15 for seaplanes and amphibians with—

(1) A speed not less than 1.2 $V_{S1}$;

(2) Not more than maximum continuous power on each engine;

(3) The landing gear retracted;

(4) The wing flaps in the takeoff position; and

(5) The cowl flaps or other means for controlling the engine cooling air supply in the position used in the cooling tests required by §§ 23.1041 through 23.1047.

* * * * *

8. Section 23.141 is revised to read as follows:

**§ 23.141 General.**

The airplane must meet the requirements of §§ 23.143 through 23.253 at all practical loading conditions and operating altitudes for which certification has been requested, not exceeding the maximum operating altitude established under § 23.1527, and without requiring exceptional piloting skill, alertness, or strength.

9. Section 23.143 is amended by removing the word "Dive" in paragraph

(a)(4) and inserting the word "Descent" in its place, and by revising the force table in paragraph (c) to read as follows:

§ 23.143 General.

* * * * *

(c) * * *

| Values in pounds of force as applied to the stick, control wheel, or rudder pedals | Pitch | Roll | Yaw |
|---|---|---|---|
| (a) For temporary application: | | | |
| Stick | 60 | 30 | .......... |
| Wheel (Two hands on rim) | 75 | 60 | .......... |
| Wheel (One hand on rim) | 50 | .......... | .......... |
| Rudder Pedal | .......... | .......... | 150 |
| (b) For prolonged application | 10 | 5 | 20 |

10. Section 23.145 is revised to read as follows:

§ 23.145 Longitudinal control.

(a) With the airplane as nearly as possible in trim at 1.3 $V_{S1}$, it must be possible, at speeds below the trim speed, to pitch the nose downward so that the rate of increase in airspeed allows prompt acceleration to the trim speed with—

(1) Maximum continuous power on each engine;

(2) Power off; and

(3) Wing flap and landing gear—

(i) retracted, and

(ii) extended.

(b) No change in trim or exertion of more control force, as specified in § 23.143(c), than can be readily applied with one hand for a short period of time may be required for the following maneuvers:

(1) With the landing gear extended, the flaps retracted, and the airplanes as nearly as possible interim at 1.4 $V_{S1}$, extend the flaps as rapidly as possible and allow the airspeed to transition from 1.4$V_{SO}$ to 1.4 $V_{SO}$:

(i) With power off; and

(ii) With the power necessary to maintain level flight in the initial condition.

(2) With the landing gear and flaps extended—

(i) With power off and the airplane as nearly as possible in trim at 1.3 $V_{SO}$, quickly apply takeoff power or thrust and retract the flaps as rapidly as possible to the recommended go-around setting while attaining and maintaining, as a minimum, the speed used to show compliance with § 23.77. Retract the gear when positive rate of climb is established; and

(ii) With power off and in level flight at 1.1$V_{SO}$, and the airplane as nearly as possible in trim at 1.2 $V_{SO}$, it must be possible to maintain approximately level flight while retracting the flaps as rapidly as possible with simultaneous application of not more than maximum continuous power. If gated flap positions are provided, the airplane may be retrimmed between each stage of retraction, and the airplane may accelerate to a speed that is 1.1 times the minimum steady flight speed obtained for the flap gate position.

(3) With maximum takeoff power, landing gear retracted, flaps in the takeoff position, and the airplane as nearly as possible in trim at $VV_{FE}$, appropriate to the takeoff flap position, retract the flaps as rapidly as possible while maintaining constant speed.

(4) With power off, flaps and landing gear retracted, and the airplane as nearly as possible trim at 1.4 $V_S$, apply takeoff power rapidly while maintaining the same airspeed.

(5) With power off, landing gear and flaps extended, and the airplane as nearly as possible in trim at 1.4 $V_{SO}$, obtain and maintain airspeeds between 1.1 $V_{SO}$ and either 1.7 $V_{SO}$ or $V_{FE}$, whichever is lower.

(c) At speeds above $V_{MO}/M_{MO}$ and up to $V_D/M_D$, a maneuvering capability of 1.5 g must be demonstrated to provide a margin to recover from upset or inadvertent speed increase.

(d) It must be possible, with a pilot control force of not more than 10 pounds, to maintain a speed of not more than 1.3 $V_{SO}$, during a power-off glide with landing gear and wing flaps extended, for any weight of the airplane, up to and including the maximum weight.

(e) By using normal flight and power controls, except as otherwise noted in paragraphs (e)(1) and (e)(2) of this section, it must be possible to establish a zero rate of descent at an attitude suitable for a controlled landing without exceeding the operational and structural limitations of the airplane, as follows:

(1) For single-engine and multiengine airplanes, without the use of the primary longitudinal control system.

(2) For multiengine airplanes—

(i) Without the use of the primary directional control; and

(ii) If a single failure of any one connecting or transmitting link would affect both the longitudinal and directional primary control system, without the primary longitudinal and directional control system.

11. Section 23.147 is revised to read as follows:

§ 23.147 Directional and lateral control.

For each multiengine airplane, it must be possible, while holding the wings level within 5 degrees, to make sudden changes in heading safely in both directions. This must be shown at 1.4 $V_{S1}$ with heading changes up to 15 degrees (except that the heading change at which the rudder force corresponds to the limits specified in § 23.143 need not be exceeded), with the—

(a) Critical engine inoperative and its propeller in the minimum drag position;

(b) Remaining engines at maximum continuous power;

(c) Landing gear—

(1) Retracted; and

(2) Extended; and

(d) Flaps in the most favorable climb position.

12. Section 23.149 is amended by replacing the word "recovery" in paragraph (d) with the words "the maneuver" and by revising paragraphs (a), (b), and (c), to read as follows:

§ 23.149 Minimum control speed.

(a) $V_{MC}$ is the calibrated airspeed at which, when the critical engine is suddenly made inoperative, it is possible to maintain control of the airplane with that engine still inoperative and then maintain straight flight at the same speed with an angle of bank of not more than 5 degrees. The ability to maintain straight flight at $V_{MC}$ in a static condition with a bank angle of not more than 5 degrees must also be demonstrated. The method used to simulate critical engine failure must represent the most critical mode of powerplant failure, with respect to controllability expected in service.

(b) $V_{MC}$ may not exceed 1.2 $V_{S1}$, where $V_{S1}$ is determined at the maximum takeoff weight, with—

(1) Maximum available takeoff power or thrust on the engines;

(2) The most unfavorable center of gravity;

(3) The airplane trimmed for takeoff;

(4) The maximum sea level takeoff weight, or any lesser weight necessary to show $V_{MC}$;

(5) The airplane in the most critical takeoff configuration, with the propeller controls in the recommended takeoff position and the landing gear retracted; and

(6) The airplane airborne and the ground effect negligible.

(c) A minimum speed to intentionally render the critical engine inoperative must be established and designated as the safe, intentional, one-engine-inoperative speed, $V_{SSE}$.

* * * * *

13. Section 23.153 is revised to read as follows:

§ 23.153 Control during landings.

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

(a) At a speed 5 knots less than the speed used in complying with the requirements of § 23.75 and with the airplane in trim, or as nearly as possible in trim, and without the trimming control being moved throughout the maneuver;

(b) At an approach gradient equal to the steepest recommended for operational use; and

(c) With only those power or thrust changes that would be made when landing normally from an approach at 1.3 $V_{S1}$.

14. Section 23.155 is amended by revising paragraph (b) to read as follows:

**§ 23.155 Elevator control forces in maneuvers.**

* * * * *

(b) The requirement of paragraph (a) of this section must be met at 75 percent of maximum continuous power for reciprocating engines, or the maximum power or thrust selected by the applicant as an operating limitation for use during cruise for reciprocating or turbine engines, and with the wing flaps and landing gear retracted—

(1) In a turn, with the trim setting used for wings level flight at $V_A$; and

(2) In a turn with the trim setting used for the maximum wings level flight speed, except that the speed may not exceed $V_{NE}$ or $V_{MO}/M_{MO}$, whichever is appropriate.

* * * * *

15. Section 23.157 is amended by adding the phrase "but not more than 10 seconds," after the word "seconds," and before the word "where" in paragraph (a)(2); by adding the phrase "but not more than 7 seconds," after the word "seconds," and before the word "where" in paragraph (c)(2); and by revising paragraph (b) to read as follows:

**§ 23.157 Rate of roll.**

* * * * *

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

(1) Flaps in the takeoff position;

(2) Landing gear retracted;

(3) For a single-engine airplane, at maximum takeoff power; and for a multiengine airplane with the critical engine inoperative and the propeller in the minimum drag position, and the other engines at maximum takeoff power; and

(4) The airplane trimmed at a speed equal to the greater of 1.2 $V_{S1}$ or 1.1 $V_{MC}$, or as nearly as possible in trim for straight flight.

* * * * *

16. Section 23.175 is amended by revising paragraphs (a)(3) and (d)(3) to read as follows:

**§ 23.175 Demonstration of static longitudinal stability.**

* * * * *

(a) * * *

(3) All reciprocating engines operating at maximum continuous power, or turbine engines operating at the maximum power selected by the applicant as an operating limitation for use during climb; and

* * * * *

(d) * * *

(3) The airplane trimmed at a speed in compliance with § 23.161(c)(2).

* * * * *

17. Section 23.177 is amended by revising paragraphs (a)(1), (a)(2) and (a)(3) to read as follows:

**§ 23.177 Static directional and lateral stability.**

(a) * * *

(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, approach, and landing configurations. This must be shown with symmetrical power up to maximum continuous power, and at speeds from 1.2 $V_{S1}$ up to the maximum allowable speed for the condition being investigated in the takeoff, climb, cruise, and approach configurations. For the landing configuration, the power must be up to that necessary to maintain a three degree angle of descent in coordinated flight. The angle of sideslip for these tests must be appropriate to the type of airplane. At larger angles of sideslip, up to that at which full rudder is used or a control force limit in § 23.143 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 sideslip, must be positive for any landing gear and flap position. This must be shown with symmetrical power, up to 75 percent of maximum continuous power, at speeds above 1.2 $V_{S1}$ in the takeoff configuration and 1.3 $V_{S1}$ in other configurations, up to the maximum allowable speed for the configuration being investigated in the takeoff, climb, approach, and cruise configurations. For the landing configuration, the power must be up to that necessary to maintain a three degree angle of descent in coordinated flight. The angle of bank for these tests must be appropriate to the type of airplane but in no case may the constant heading sideslip angle be less than that obtainable with 10° bank, or, if less, the maximum bank angle obtainable with full rudder deflection or 150 pounds rudder force. The static lateral stability must not be negative at 1.2 $V_{S1}$.

(3) In straight, steady slips at 1.2 $V_{S1}$ for any landing gear and flap positions, and for any symmetrical power conditions up to 50 percent of maximum continuous power, the aileron and rudder control movements and forces must increase steadily, but not necessarily in constant proportion, 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 § 23.143 is obtained, the aileron and rudder control movements and forces must not reverse as the angle of sideslip is increased. Enough bank must accompany the sideslip to hold a constant heading. Rapid entry into, and recovery from, a maximum sideslip considered appropriate for the airplane must not result in uncontrollable flight characteristics.

* * * * *

**§ 23.179 [Removed]**

18. Section 23.179 is removed.

19. Section 23.181 is amended by adding new paragraphs (c) and (d) to read as follows:

**§ 23.181 Dynamic stability.**

* * * * *

(c) If it is determined that the function of a stability augmentation system, reference § 23.672, is needed to meet the flight characteristic requirements of this part, the primary control requirements of paragraphs (a)(2) and (b)(2) of this section are not applicable to the tests needed to verify the acceptability of that system.

(d) During the conditions as specified in § 23.175, when the longitudinal control force required to maintain speeds differing from the trim speed by at least plus and minus 15 percent 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. Any long-period oscillation of flight path, phugoid oscillation, that results must not be so unstable as to increase the pilot's workload or otherwise endanger the airplane.

20. Section 23.201 is amended by revising paragraphs (c), (d)(2) (f)(4), and (f)(5) to read as follows:

**§ 23.201 Wings level stall.**

* * * * *

(c) The wings level stall characteristics must be demonstrated in flight as follows: Starting from a speed above the stall warning speed, the elevator control must be pulled back so that the rate of speed reduction will not exceed one knot per second until a stall is produced, as shown by an uncontrollable downward pitching motion of the airplane, until the control reaches the stop or until the activation of an artificial stall barrier, for example, stick pusher. Normal use of the elevator control for recovery is allowed after the pitching motion has unmistakably developed or after the control has been against the stop for not less than two seconds. In addition, engine power may not be increased for recovery until the speed has increased to approximately 1.2 $V_{S1}$.

(d) * * *

(2) If power is required during stall recovery, the power used must be that used under the normal operating procedures selected by the applicant for this maneuver; however, the power used to regain level flight may not be increased until the speed has increased to approximately 1.2 $V_{S1}$.

* * * * *

(f) * * *

(4) *Power:* Power off, and 75 percent maximum continuous power. If the power-to-weight ratio at 75 percent continuous power provides undesirable stall characteristics at extremely nose-high attitudes, the test may be accomplished with the power or thrust required for level flight in the landing configuration at maximum landing weight and a speed of 1.4 $V_{SO}$, but the power may not be less than 50 percent of maximum continuous power.

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

* * * * *

21. Section 23.203 is amended by revising paragraph (b) introductory text, (b)(4), (b)(5), (c)(1), (c)(4), and (c)(5) to read as follows:

**§ 23.203 Turning flight and accelerated stalls.**

* * * * *

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

* * * * *

(4) Exceeding a bank angle of 60 degrees in the original direction of the turn or 30 degrees in the opposite direction in the case of turning flight stalls, and without exceeding a bank angle of 90 degrees in the original direction of the turn or 60 degrees in the opposite direction in the case of accelerated stalls; and

(5) Exceeding the maximum permissible speed or allowable load factor.

(c) * * *

(1) *Wing Flaps:* Retracted, fully extended, and in each intermediate position, as appropriate.

* * * * *

(4) *Power:* Power or thrust off, and 75 percent maximum continuous power or thrust. If the power-to-weight ratio at 75 percent continuous power or thrust provides undesirable stall characteristics at extremely nose-high attitudes, the test may be accomplished with the power or thrust required for level flight in the landing configuration at maximum landing weight and a speed of 1.4 $V_{SO}$, but the power may not be less than 50 percent of maximum continuous power.

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

22. Section 23.205 is amended by revising paragraphs (b)(1) and (b)(6) to read as follows:

**§ 23.205 Critical-engine-inoperative stalls.**

* * * * *

(b) * * *

(1) *Wing flaps:* Retracted and set to the position used to show compliance with § 23.67.

* * * * *

(6) *Trim:* Level flight, critical engine inoperative, except that for an airplane of 6,000 pounds or less maximum weight that has a stalling speed of 61 knots or less and cannot maintain level flight with the critical engine inoperative, the airplane must be trimmed for straight flight, critical engine inoperative, at a speed as near 1.5 $V_{S1}$ as practicable.

23. Section 23.207 is amended by revising paragraph (c) and by adding a new paragraph (d) to read as follows:

**§ 23.207 Stall Warning.**

* * * * *

(c) For the stall tests required by § 23.201(c), the stall warning must begin at a speed exceeding the stalling speed by a margin of not less than 5 knots, but not more than the greater of 10 knots or 15 percent of the stalling speed, and must continue until the stall occurs.

(d) For all other stall tests, the stall warning must begin at not less than 5 knots above the stall speed and be sufficiently in advance of the stall for the stall to be averted by action after the stall warning first occurs. In addition, when following the procedures of § 23.1585, the stall warning must not operate during a normal takeoff, a takeoff continued with one engine inoperative or approach to landing.

24. Section 23.233 is amended by revising paragraphs (a) and (b), and by adding a new paragraph (d) to read as follows:

**§ 23.233 Directional stability and control.**

(a) A 90 degree cross-component of wind velocity, demonstrated to be safe for taxiing, takeoff and landing must be established and must not be less than 0.2 $V_{SO}$.

(b) The airplane must be satisfactorily controllable in power-off landings at normal landing speed, without using brakes or engine power to maintain a straight path until the speed has decreased to at least 50 percent of the speed at touchdown.

* * * * *

(d) Seaplanes must demonstrate satisfactory directional stability and control for water operations up to the maximum wind velocity specified in paragraph (a) of this section.

25. Section 23.235 is revised to read as follows:

**§ 23.235 Taxiing, takeoff, and landing condition.**

(a) The airplane must be demonstrated to have satisfactory characteristics and the shock-absorbing mechanism must not damage the structure of the airplane when the airplane is taxied on the roughest ground that may be reasonably expected in normal operation, and when takeoffs and landings are performed on unpaved runways having the roughest surface that may reasonably be expected in normal operation.

(b) A wave height, demonstrated to be safe for operation, and any necessary water handling procedures for seaplanes and amphibians, must be established.

26. Section 23.251 is revised to read as follows:

**§ 23.251 Vibration and buffeting.**

There must be no vibration or buffeting severe enough to result in structural damage, and each part of the airplane must be free from excessive vibration, under any appropriate speed and power conditions up to $V_D/M_D$. In addition, there must be no buffeting in any normal flight condition severe enough to interfere with the satisfactory control of the airplane or cause excessive fatigue to the flight crew. Stall warning buffeting within these limits is allowable.

27. Section 23.253 is amended by revising paragraph (a) and the introductory text of paragraph (b) to read as follows:

**§ 23.253 High speed characteristics.**

* * * * *

(a) Operating conditions and characteristics likely to cause inadvertent speed increases (including upsets in pitch and roll) must be simulated with the airplane trimmed at any likely speed up to $V_{MO}/M_{MO}$. These conditions and characteristics include gust upsets, inadvertent control movements, low stick force gradients in relation to control friction, passenger movement, leveling off from climb, and descent from Mach to airspeed limit altitude.

(b) Allowing for pilot reaction time after occurrence of the effective inherent or artificial speed warning specified in § 23.1303, it must be shown that the airplane can be recovered to a normal attitude and its speed reduced to $V_{MO}/M_{MO}$, without—

* * * * *

28. Section 23.305 is amended by revising paragraph (b) to read as follows:

**§ 23.305 Strength and deformation.**

* * * * *

(b) The structure must be able to support ultimate loads without failure for at least three seconds, except local failures or structural instabilities between limit and ultimate load are acceptable only if the structure can sustain the required ultimate load for at least three seconds. However when proof of strength is shown by dynamic tests simulating actual load conditions, the three second limit does not apply.

29. Section 23.321 is amended by adding a new paragraph (c) to read as follows:

**§ 23.321 General.**

* * * * *

(c) When significant, the effects of compressibility must be taken into account.

30. Section 23.361 is amended by revising the introductory text of paragraph (a), paragraph (a)(2), and the introductory text of paragraph (c) to read as follows:

**§ 23.361 Engine torque.**

(a) Each engine mount and its supporting structure must be designed for the effects of—

* * * * *

(2) A limit engine torque corresponding to maximum continuous power and propeller speed acting simultaneously with the limit loads from flight condition A of § 23.333(d); and

* * * * *

(c) The limit engine torque to be considered under paragraph (a) of this section must be obtained by multiplying the mean torque by a factor of—

* * * * *

31. Section 23.369 is amended by revising the heading to read as follows:

**§ 23.369 Rear lift truss.**

* * * * *

32. Section 23.371 is amended by revising the heading and the introductory text of this section to read as follows:

**§ 23.371 Gyroscopic and aerodynamic loads.**

For turbine-powered airplanes, each engine mount and its supporting structure must be designed for the combined gyroscopic and aerodynamic loads that result, with the engines at maximum continuous r.p.m., under either of the following conditions:

* * * * *

**§ 23.397 [Amended]**

33. Section 23.397(b) is amended by removing the words "130 pounds" in the last line of the table and inserting the words "150 pounds" in its place.

34. Section 23.415 is amended by adding a new paragraph (c) to read as follows:

**§ 23.415 Ground gust conditions.**

* * * * *

(c) The tie-down attachment fittings and the surrounding structure must be designed for limit load conditions resulting from wind speeds up to 65 knots horizontally from any direction for the weight determined to be critical for tie-down.

35. Section 23.473 is amended by revising paragraph (f) to read as follows:

**§ 23.473 Ground load conditions and assumptions.**

* * * * *

(f) Energy absorption tests (to determine the limit load factor corresponding to the required limit descent velocities) must be made under § 23.723(a) unless specifically exempted by that section.

* * * * *

36. Section 23.479 is amended by revising paragraphs (b) and (c) to read as follows:

**§ 23.479 Level landing conditions.**

* * * * *

(b) When investigating landing conditions, the drag components simulating the forces required to accelerate the tires and wheels up to the landing speed (spin-up) must be properly combined with the corresponding instantaneous vertical ground reactions, and the forward-acting horizontal loads resulting from rapid reduction of the spin-up drag loads (spring-back) must be combined with vertical ground reactions at the instant of the peak forward load, assuming wing lift and a tire-sliding coefficient of friction of 0.8. However, the drag loads may not be less than 25 percent of the maximum vertical ground reactions (neglecting wing lift).

(c) In the absence of specific tests or a more rational analysis for determining the wheel spin-up and spring-back loads for landing conditions, the method set forth in appendix D of this part must be used. If appendix D of this part is used, the drag components used for design must not be less than those given by appendix C of this part.

* * * * *

37. Section 23.485 is amended by adding a new paragraph (d) to read as follows:

**§ 23.485 Side load conditions.**

* * * * *

(d) The side loads prescribed in paragraph (c) of this section are assumed to be applied at the ground contact point and the drag loads may be assumed to be zero.

38. Section 23.521 is amended by revising paragraphs (b) and (c) to read as follows:

**§ 23.521 Water load conditions.**

* * * * *

(b) Unless the applicant makes a rational analysis of the water loads, §§ 23.523 through 23.537 apply.

(c) Floats previously approved by the FAA may be installed on airplanes that are certificated under this part, provided that the floats meet the criteria of paragraph (a) of this section.

39. A new § 23.523 is added under the heading "Water Loads" to read as follows:

**§ 23.523 Design weights and center of gravity positions.**

(a) *Design weights.* The water load requirements must be met at each operating weight up to the design landing weight except that, for the takeoff condition prescribed in § 23.531, the design water takeoff weight (the maximum weight for water taxi and takeoff run) must be used.

(b) *Center of gravity positions.* The critical centers of gravity within the limits for which certification is requested must be considered to reach maximum design loads for each part of the seaplane structure.

40. A new § 23.525 is added under the heading "Water Loads" to read as follows:

**§ 23.525 Application of loads.**

(a) Unless otherwise prescribed, the seaplane as a whole is assumed to be subjected to the loads corresponding to the load factors specified in § 23.527.

(b) In applying the loads resulting from the load factors prescribed in § 23.527, the loads may be distributed over the hull or main float bottom (in order to avoid excessive local shear loads and bending moments at the location of water load application) using pressures not less than those prescribed in § 23.533(b).

(c) For twin float seaplanes, each float must be treated as an equivalent hull on a fictitious seaplane with a weight equal to one-half the weight of the twin float seaplane.

(d) Except in the takeoff condition of § 23.531, the aerodynamic lift on the seaplane during the impact is assumed to be ⅔ of the weight of the seaplane.

41. A new § 23.527 is added under the heading "Water Loads" to read as follows:

**§ 23.527 Hull and main float load factors.**

(a) Water reaction load factors $n_w$ must be computed in the following manner:

(1) For the step landing case

$$n_w = \frac{C_1 V_{SO}^2}{(\mathrm{Tan}^{2/3}\beta)\, W^{1/3}}$$

(2) For the bow and stern landing cases

$$n_w = \frac{C_1 V_{SO}^2}{(\mathrm{Tan}^{2/3}\beta)\, W^{1/3}} \times \frac{K_1}{(1+r_x^2)^{2/3}}$$

(b) The following values are used:

(1) $n_w$=water reaction load factor (that is, the water reaction divided by seaplane weight).

(2) $C_1$=empirical seaplane operations factor equal to 0.012 (except that this factor may not be less than that necessary to obtain the minimum value of step load factor of 2.33).

(3) $V_{SO}$=seaplane stalling speed in knots with flaps extended in the appropriate landing position and with no slipstream effect.

(4) 9β=Angle of dead rise at the longitudinal station at which the load factor is being determined in accordance with figure 1 of appendix H of this part.

(5) W=seaplane landing weight in pounds.

(6) $K_1$=empirical hull station weighting factor, in accordance with figure 2 of appendix H of this part.

(7) $r_x$=ratio of distance, measured parallel to hull reference axis, from the center of gravity of the seaplane to the hull longitudinal station at which the load factor is being computed to the radius of gyration in pitch of the seaplane, the hull reference axis being a straight line, in the plane of symmetry, tangential to the keel at the main step.

(c) For a twin float seaplane, because of the effect of flexibility of the attachment of the floats to the seaplane, the factor $K_1$ may be reduced at the bow and stern to 0.8 of the value shown in figure 2 of appendix H of this part. This reduction applies only to the design of the carrythrough and seaplane structure.

42. A new § 23.529 is added under the heading "Water Loads" to read as follows:

**§ 23.529 Hull and main float landing conditions.**

(a) *Symmetrical step, bow, and stern landing.* For symmetrical step, bow, and stern landings, the limit water reaction load factors are those computed under § 23.527. In addition—

(1) For symmetrical step landings, the resultant water load must be applied at the keel, through the center of gravity, and must be directed perpendicularly to the keel line;

(2) For symmetrical bow landings, the resultant water load must be applied at the keel, one-fifth of the longitudinal distance from the bow to the step, and must be directed perpendicularly to the keel line; and

(3) For symmetrical stern landings, the resultant water load must be applied at the keel, at a point 85 percent of the longitudinal distance from the step to the stern post, and must be directed perpendicularly to the keel line.

(b) *Unsymmetrical landing for hull and single float seaplanes.* Unsymmetrical step, bow, and stern landing conditions must be investigated. In addition—

(1) The loading for each condition consists of an upward component and a side component equal, respectively, to 0.75 and 0.25 tan β times the resultant load in the corresponding symmetrical landing condition; and

(2) The point of application and direction of the upward component of the load is the same as that in the symmetrical condition, and the point of application of the side component is at the same longitudinal station as the upward component but is directed inward perpendicularly to the plane of symmetry at a point midway between the keel and chine lines.

(c) *Unsymmetrical landing; twin float seaplanes.* The unsymmetrical loading consists of an upward load at the step of each float of 0.75 and a side load of 0.25 tan β at one float times the step landing load reached under § 23.527. The side load is directed inboard, perpendicularly to the plane of symmetry midway between the keel and chine lines of the float, at the same longitudinal station as the upward load.

43. A new § 23.531 is added under the heading "Water Loads" to read as follows:

**§ 23.531 Hull and main float takeoff condition.**

For the wing and its attachment to the hull or main float—

(a) The aerodynamic wing lift is assumed to be zero; and

(b) A downward inertia load, corresponding to a load factor computed from the following formula, must be applied:

$$n = \frac{C_{TO} V_{S1}^2}{(\mathrm{Tan}^{2/3}\beta) W^{1/3}}$$

Where—

n=inertia load factor;

$C_{TO}$=empirical seaplane operations factor equal to 0.004;

$V_{S1}$=seaplane stalling speed (knots) at the design takeoff weight with the flaps extended in the appropriate takeoff position;

β=angle of dead rise at the main step (degrees); and

W=design water takeoff weight in pounds.

44. A new § 23.533 is added under the heading "Water Loads" to read as follows:

**§ 23.533 Hull and main float bottom pressures.**

(a) *General.* The hull and main float structure, including frames and bulkheads, stringers, and bottom plating, must be designed under this section.

(b) *Local pressures.* For the design of the bottom plating and stringers and their attachments to the supporting structure, the following pressure distributions must be applied:

(1) For an unflared bottom, the pressure at the chine is 0.75 times the pressure at the keel, and the pressures between the keel and chine vary linearly, in accordance with figure 3 of appendix H of this part. The pressure at the keel (p.s.i.) is computed as follows:

$$P_K = \frac{C_2 K_2 V_{S1}^2}{\mathrm{Tan}\,\beta_k}$$

where—
$P_k$=pressure (p.s.i.) at the keel;
$C_2$=0.00213;
$K_2$=hull station weighing factor, in accordance with figure 2 of appendix H of this part;
$V_{S1}$=seaplane stalling speed (knots) at the design water takeoff weight with flaps extended in the appropriate takeoff position; and
$\beta_K$=angle of dead rise at keel, in accordance with figure 1 of appendix H of this part.

(2) For a flared bottom, the pressure at the beginning of the flare is the same as that for an unflared bottom, and the pressure between the chine and the beginning of the flare varies linearly, in accordance with figure 3 of appendix H of this part. The pressure distribution is the same as that prescribed in paragraph (b)(1) of this section for an unflared bottom except that the pressure at the chine is computed as follows:

$$P_{ch} = \frac{C_3 K_2 V_{S1}^2}{\operatorname{Tan} \beta}$$

where—
$P_{ch}$=pressure (p.s.i.) at the chine;
$C_3$=0.0016;
$K_2$=hull station weighing factor, in accordance with figure 2 of appendix H of this part;
$V_{S1}$=seaplane stalling speed (knots) at the design water takeoff weight with flaps extended in the appropriate takeoff position; and
$\beta$=angle of dead rise at appropriate station.

The area over which these pressures are applied must simulate pressures occurring during high localized impacts on the hull or float, but need not extend over an area that would induce critical stresses in the frames or in the overall structure.

(c) *Distributed pressures*. For the design of the frames, keel, and chine structure, the following pressure distributions apply:

(1) Symmetrical pressures are computed as follows:

$$P = \frac{C_4 K_2 V_{SO}^2}{\operatorname{Tan} \beta}$$

where—
P=pressure (p.s.i.);
$C_4$=0.078 $C_1$ (with $C_1$ computed under § 23.527);
$K_2$=hull station weighing factor, determined in accordance with figure 2 of appendix H of this part;
$V_{SO}$=seaplane stalling speed (knots) with landing flaps extended in the appropriate position and with no slipstream effect; and
$\beta$=angle of dead rise at appropriate station.

(2) The unsymmetrical pressure distribution consists of the pressures prescribed in paragraph (c)(1) of this section on one side of the hull or main float centerline and one-half of that pressure on the other side of the hull or main float centerline, in accordance with figure 3 of appendix H of this part.

(3) These pressures are uniform and must be applied simultaneously over the entire hull or main float bottom. The loads obtained must be carried into the sidewall structure of the hull proper, but need not be transmitted in a fore and aft direction as shear and bending loads.

45. A new § 23.535 is added under the heading "Water Loads" to read as follows:

**§ 23.535 Auxiliary float loads.**

(a) *General*. Auxiliary floats and their attachments and supporting structures must be designed for the conditions prescribed in this section. In the cases specified in paragraphs (b) through (e) of this section, the prescribed water loads may be distributed over the float bottom to avoid excessive local loads, using bottom pressures not less than those prescribed in paragraph (g) of this section.

(b) *Step loading*. The resultant water load must be applied in the plane of symmetry of the float at a point three-fourths of the distance from the bow to the step and must be perpendicular to the keel. The resultant limit load is computed as follows, except that the value of L need not exceed three times the weight of the displaced water when the float is completely submerged:

$$L = \frac{C_5 V_{SO}^2 W^{2/3}}{\operatorname{Tan}^{2/3} \beta_s (1 + r_y^2)^{2/3}}$$

where—
L=limit load (lbs.);
$C_5$=0.0053;
$V_{SO}$=seaplane stalling speed (knots) with landing flaps extended in the appropriate position and with no slipstream effect;
W=seaplane design landing weight in pounds;
$\beta_s$=angle of dead rise at a station 3/4 of the distance from the bow to the step, but need not be less than 15 degrees; and
$r_y$=ratio of the lateral distance between the center of gravity and the plane of symmetry of the float to the radius of gyration in roll.

(c) *Bow loading*. The resultant limit load must be applied in the plane of symmetry of the float at a point one-fourth of the distance from the bow to the step and must be perpendicular to the tangent to the keel line at that point. The magnitude of the resultant load is that specified in paragraph (b) of this section.

(d) *Unsymmetrical step loading*. The resultant water load consists of a component equal to 0.75 times the load specified in paragraph (a) of this section and a side component equal to 3.25 tan $\beta$ times the load specified in paragraph (b) of this section. The side load must be applied perpendicularly to the plane of symmetry of the float at a point midway between the keel and the chine.

(e) *Unsymmetrical bow loading*. The resultant water load consists of a component equal to 0.75 times the load specified in paragraph (b) of this section and a side component equal to 0.25 tan $\beta$ times the load specified in paragraph (c) of this section. The side load must be applied perpendicularly to the plane of symmetry at a point midway between the keel and the chine.

(f) *Immersed float condition*. The resultant load must be applied at the centroid of the cross section of the float at a point one-third of the distance from the bow to the step. The limit load components are as follows:

$$\text{vertical} = \rho g V$$

$$\text{aft} = \frac{C_X \rho V^{2/3} (K V_{SO})^2}{2}$$

$$\text{side} = \frac{C_Y \rho V^{2/3} (K V_{SO})^2}{2}$$

where—
P=mass density of water (slugs/ft.[3])
V=volume of float (ft.[3]);
$C_X$=coefficient of drag force, equal to 0.133;
$C_y$=coefficient of side force, equal to 0.106;
K=0.8, except that lower values may be used if it is shown that the floats are incapable of submerging at a speed of 0.8 $V_{so}$ in normal operations;
$V_{so}$=seaplane stalling speed (knots) with landing flaps extended in the appropriate position and with no slipstream effect; and
g=acceleration due to gravity (ft/sec[2]).

(g) *Float bottom pressures*. The float bottom pressures must be established under § 23.533, except that the value of $K_2$ in the formulae may be taken as 1.0. The angle of dead rise to be used in determining the float bottom pressures is set forth in paragraph (b) of this section.

46. A new § 23.537 is added under the heading "Water Loads" to read as follows:

**§ 23.537 Seawing loads.**

Seawing design loads must be based on applicable test data.

47. Section 23.571 is amended by removing the word "either" from the introductory paragraph and replacing it with the word "one" and by adding a new paragraph (c) to read as follows:

**§ 23.571 Pressurized cabin.**

* * * * *

(c) The damage tolerance evaluation of § 23.573(b).

48. Section 23.572 is amended by removing the word "either" from paragraph (a) and replacing it with the word "one" and by adding a new paragraph (a)(3) to read as follows:

**§ 23.572 Wing, empennage, and associated structures.**

(a) * * *

(3) The damage tolerance evaluation of § 23.573(b).

* * * * *

49. Under the heading "Fatigue Evaluation," a new § 23.573 is added to read as follows:

**§ 23.573 Damage tolerance and fatigue evaluation of structure.**

(a) *Composite airframe structure.* Composite airframe structure must be evaluated under this paragraph instead of §§ 23.571 and 23.572. The applicant must evaluate the composite airframe structure, the failure of which would result in catastrophic loss of the airplane, in each wing (including canards, tandem wings, and winglets), empennage, their carrythrough and attaching structure, moveable control surfaces and their attaching structure fuselage, and pressure cabin using the damage-tolerance criteria prescribed in paragraphs (a)(1) through (a)(4) of this section unless shown to be impractical. If the applicant establishes that damage-tolerance criteria is impractical for a particular structure, the structure must be evaluated in accordance with paragraphs (a)(1) and (a)(6) of this section. Where bonded joints are used, the structure must also be evaluated in accordance with paragraph (a)(5) of this section. The effects of material variability and environmental conditions on the strength and durability properties of the composite materials must be accounted for in the evaluations required by this section.

(1) It must be demonstrated by tests, or by analysis supported by tests, that the structure is capable of carrying ultimate load with damage up to the threshold of detectability considering the inspection procedures employed.

(2) The growth rate or no-growth of damage that may occur from fatigue, corrosion, manufacturing flaws or impact damage under repeated loads expected in service, must be established by tests or analysis supported by tests.

(3) The structure must be shown by residual strength tests, or analysis supported by residual strength tests, to be able to withstand critical limit flight loads, considered as ultimate loads, with the extent of detectable damage consistent with the results of the damage tolerance evaluations. For pressurized cabins, the following loads must be withstood:

(i) Critical limit flight loads with the combined effects of normal operating pressure and expected external aerodynamic pressures.

(ii) The expected external aerodynamic pressures in 1g flight combined with a cabin differential pressure equal to 1.1 times the normal operating differential pressure without any other load.

(4) The damage growth, between initial detectability and the value selected for residual strength demonstrations, factored to obtain inspection intervals, must allow development of an inspection program suitable for application by operation and maintenance personnel.

(5) The limit load capacity of each bonded joint must be substantiated by one of the following methods:

(i) The maximum disbonds of each bonded joint consistent with the capability to withstand the loads in paragraph (a)(3) of this section must be determined by analysis, tests, or both. Disbonds of each bonded joint greater than this must be prevented by design features; or

(ii) Proof testing must be conducted on each production article that will apply the critical limit design load to each critical bonded joint; or

(iii) Repeatable and reliable non-destructive inspection techniques must be established that ensure the strength of each joint.

(6) Structural components for which the damage tolerance method is shown to be impractical must be shown by component fatigue tests (or analysis supported by tests) to be able to withstand the repeated loads of variable magnitude expected in service. Sufficient component, subcomponent, element, or coupon tests must be done to establish the fatigue scatter factor and the environmental effects. Damage up to the threshold of detectability and ultimate load residual strength capability must be considered in the demonstration.

(b) *Metallic airframe structure.* If the applicant elects to use § 23.571(c) or § 23.572(a)(3), then the damage tolerance evaluation must include a determination of the probable locations and modes of damage due to fatigue, corrosion, or accidental damage. The determination must be by analysis supported by test evidence and, if available, service experience. Damage at multiple sites due to fatigue must be included where the design is such that this type of damage can be expected to occur. The evaluation must incorpor[illegible]e repeated load and static analyses supported by test evidence. The exte[illegible] of damage for residual strength evaluation at any time within the operational life of the airplane must be consistent with the initial detectability and subsequent growth under repeated loads. The residual strength evaluation must show that the remaining structure is able to withstand critical limit flight loads, considered as ultimate, with the extent of detectable damage consistent with the results of the damage tolerance evaluations. For pressurized cabins, the following load must be withstood:

(1) The normal operating differential pressure combined with the expected external aerodynamic pressures applied simultaneously with the flight loading conditions specified in this part, and

(2) The expected external aerodynamic pressures in 1g flight combined with a cabin differential pressure equal to 1.1 times the normal operating differential pressure without any other load.

(c) *Inspection.* Based on evaluations required by this section, inspections or other procedures must be established as necessary to prevent catastrophic failure and must be included in the Airworthiness Limitations section of the Instructions for Continued Airworthiness required by § 23.1529.

50. Section 23.613 is amended by revising paragraphs (b) and (c) and by adding paragraphs (d) and (e) to read as follows:

**§ 23.613 Material strength properties and design values.**

* * * * *

(b) Design values must be chosen to minimize the probability of structural failure due to material variability. Except as provided in paragraph (e) of this section, compliance with this paragraph must be shown by selecting design values that ensure material strength with the following probability:

(1) Where applied loads are eventually distributed through a single member within an assembly, the failure of which would result in loss of structural integrity of the component; 99 percent probability with 95 percent confidence.

(2) For redundant structure, in which the failure of individual elements would result in applied loads being safely distributed to other load carrying members; 90 percent probability with 95 percent confidence.

(c) The effects of temperature on allowable stresses used for design in an essential component or structure must be considered where thermal effects are significant under normal operating conditions.

(d) The design of the structure must minimize the probability of catastrophic fatigue failure, particularly at points of stress concentration.

(e) Design values greater than the guaranteed minimums required by this section may be used where only guaranteed minimum values are normally allowed if a "premium selection" of the material is made in which a specimen of each individual item is tested before use to determine that the actual strength properties of that particular item will equal or exceed those used in design.

**§ 23.615 [Removed]**

51. Section 23.615 is removed.

52. Section 23.621 is amended by revising paragraph (c)(1) and the introductory text of paragraph (d), and by adding a new paragraph (e) to read as follows:

**§ 23.621 Casting factors.**

* * * * *

(c) * * *

(1) Each critical casting must either—

(i) Have a casting factor of not less than 1.25 and receive 100 percent inspection by visual, radiographic, and either magnetic particle, penetrant or other approved equivalent non-destructive inspection method; or

(ii) Have a casting factor of not less than 2.0 and receive 100 percent visual inspection and 100 percent approved non-destructive inspection. When an approved quality control procedure is established and an acceptable statistical analysis supports reduction, non-destructive inspection may be reduced from 100 percent, and applied on a sampling basis.

* * * * *

(d) *Non-critical castings.* For each casting other than those specified in paragraph (c) or (e) of this section, the following apply:

* * * * *

(e) *Non-structural castings.* Castings used for non-structural purposes do not require evaluation, testing or close inspection.

53. Section 23.629 is amended by revising paragraph (d)(1) and by adding new paragraphs (g) and (h) to read as follows:

**§ 23.629 Flutter.**

* * * * *

(d) * * *

(1) $V_D/M_D$ for the airplane is less than 260 knots (EAS) and less than Mach 0.5,

* * * * *

(g) For airplanes showing compliance with the fail-safe criteria of §§ 23.571 and 23.572, the airplane must be shown by analysis or test to be free from flutter to $V_DM_D$ after fatigue failure, or obvious partial failure of a principle structural element.

(h) For airplanes showing compliance with the damage-tolerance criteria of § 23.573, the airplane must be shown by analysis or test to be free from flutter to $V_D/M_D$ with the extent of damage for which residual strength is demonstrated.

54. Section 23.655 is amended by revising paragraph (a) to read as follows:

**§ 23.655 Installation.**

(a) Movable surfaces must be installed so that there is no interference between any surfaces, their bracing, or adjacent fixed structure, when one surface is held in its most critical clearance positions and the others are operated through their full movement.

* * * * *

55. A new § 23.672 is added to read as follows:

**§ 23.672 Stability augmentation and automatic and power-operated systems.**

If the functioning of stability augmentation or other automatic or power-operated systems is necessary to show compliance with the flight characteristics requirements of this part, such systems must comply with § 23.671 and the following:

(a) A warning, which is clearly distinguishable to the pilot under expected flight conditions without requiring the pilot's attention, must be provided for any failure in the stability augmentation system or in any other automatic or power-operated system that could result in an unsafe condition if the pilot was not aware of the failure. Warning systems must not activate the control system.

(b) The design of the stability augmentation system or of any other automatic or power-operated system must permit initial counteraction of failures without requiring exceptional pilot skill or strength, by either the deactivation of the system or a failed portion thereof, or by overriding the failure by movement of the flight controls in the normal sense.

(c) It must be shown that, after any single failure of the stability augmentation system or any other automatic or power-operated system—

(1) The airplane is safely controllable when the failure or malfunction occurs at any speed or altitude within the approved operating limitations that is critical for the type of failure being considered;

(2) The controllability and maneuverability requirements of this part are met within a practical operational flight envelope (for example, speed, altitude, normal acceleration, and airplane configuration) that is described in the Airplane Flight Manual (AFM); and

(3) The trim, stability, and stall characteristics are not impaired below a level needed to permit continued safe flight and landing.

56. Section 23.679 is revised to read as follows:

**§ 23.679 Control system locks.**

If there is a device to lock the control system on the ground or water:

(a) There must be a means to—

(1) Give unmistakable warning to the pilot when lock is engaged; or

(2) Automatically disengage the device when the pilot operates the primary flight controls in a normal manner.

(b) The device must be installed to limit the operation of the airplane so that, when the device is engaged, the pilot receives unmistakable warning at the start of the takeoff.

(c) The device must have a means to preclude the possibility of it becoming inadvertently engaged in flight.

57. Section 23.729 is amended by revising paragraphs (f)(1) and (f)(2) to read as follows:

**§ 23.729 Landing gear extension and retraction system.**

* * * * *

(f) * * *

(1) A device that functions continuously when one or more throttles are closed beyond the power settings normally used for landing approach if the landing gear is not fully extended and locked. A throttle stop may not be used in place of an aural device. If there is a manual shutoff for the warning device prescribed in this paragraph, the warning system must be designed so that when the warning has been suspended after one or more throttles are closed, subsequent retardation of any throttle to, or beyond, the position for normal landing approach will activate the warning device.

(2) A device that functions continuously when the wing flaps are extended beyond the maximum approach flap position, using a normal landing procedure, if the landing gear is not fully extended and locked. There may not be a manual shutoff for this warning device. The flap position sensing unit may be installed at any suitable location. The system for this device may use any part of the system (including the aural warning device) for the device required in paragraph (f)(1) of this section.

**§ 23.731 [Amended]**

58. Section 23.731 is amended by removing paragraph (a), and by redesignating paragraphs (b) and (c) as paragraphs (a) and (b), respectively.

59. Section 23.733 is amended by revising paragraph (a) to read as follows:

**§ 23.733 Tires.**

(a) Each landing gear wheel must have a tire whose approved tire ratings (static and dynamic) are not exceeded—

(1) By a load on each main wheel tire) to be compared to the static rating approved for such tires) equal to the corresponding static ground reaction under the design maximum weight and critical center of gravity; and

(2) By a load on nose wheel tires (to be compared with the dynamic rating approved for such tires) equal to the reaction obtained at the nose wheel, assuming the mass of the airplane to be concentrated at the most critical center of gravity and exerting a force of 1.0 W downward and 0.31 W forward (where W is the design maximum weight), with the reactions distributed to the nose and main wheels by the principles of statics and with the drag reaction at the ground applied only at wheels with brakes.

* * * * *

60. Section 23.737 is revised to read as follows:

**§ 23.737 Skis.**

The maximum limit load rating for each ski must equal or exceed the maximum limit load determined under the applicable ground load requirements of this part.

61. Section 23.751 is amended by revising paragraph (a) to read as follows:

**§ 23.751 Main float buoyancy.**

(a) Each main float must have—

(1) A buoyancy of 80 percent in excess of the buoyancy required by that float to support its portion of the maximum weight of the seaplane or amphibian in fresh water; and

(2) Enough watertight compartments to provide reasonable assurance that the seaplane or amphibian will stay afloat without capsizing if any two compartments of any main float are flooded.

* * * * *

62. Section 23.753 is revised to read as follows:

**§ 23.753 Main float design.**

Each seaplane main float must meet the requirements of § 23.521.

**§ 23.755 [Amended]**

63. The introductory text of § 23.755(a) is amended by inserting the words "without capsizing" between the words "afloat" and "in".

64. Section 23.773 is revised to read as follows:

**§ 23.773 Pilot compartment view.**

(a) Each pilot compartment must be—

(1) Arranged with sufficiently extensive, clear and undistorted view to enable the pilot to safely taxi, takeoff, approach, land, and perform any maneuvers within the operating limitations of the airplane.

(2) Free from glare and reflections that could interfere with the pilot's vision. Compliance must be shown in all operations for which certification is requested; and

(3) Designed so that each 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.

(b) Each pilot compartment must have a means to either remove or prevent the formation of fog or frost on an area of the internal portion of the windshield and side windows sufficiently large to provide the view specified in paragraph (a)(1) of this section. Compliance must be shown under all expected external and internal ambient operating conditions, unless it can be shown that the windshield and side windows can be easily cleared by the pilot without interruption of moral pilot duties.

65. Section 23.775 is amended by adding new paragraphs (f) and (g) to read as follows:

**§ 23.775 Windshields and windows.**

* * * * *

(f) Unless operation is known or forecast icing conditions is prohibited by operating limitations, a means must be provided to prevent or to clear accumulations of ice from the windshield so that the pilot has adequate view for taxi, takeoff, approach, landing, and to perform any maneuvers within the operating limitations of the airplane.

(g) In the event of any probable single failure, a transparency heating system must be incapable of raising the temperature of any windshield or window to a point where there would be—

(1) Structural failure that adversely affects the integrity of the cabin; or

(2) There would be a danger of fire.

66. Section 23.851 is revised to read as follows:

**§ 23.851 Fire extinguishers.**

(a) There must be at least one hand fire extinguisher for use in the pilot compartment that is located within easy access of the pilot while seated.

(b) There must be at least one hand fire extinguisher located conveniently in the passenger compartment—

(1) Of each airplane accommodating more than 6 passengers; and

(2) Of each commuter category airplane.

(c) For hand fire extinguishers, the following apply:

(1) The type and quantity of each extinguishing agent used must be appropriate to the kinds of fire likely to occur where that agent is to be used.

(2) Each extinguisher for use in a personnel compartment must be designed to minimize the hazard of toxic gas concentrations.

67. Section 23.865 is revised to read as follows:

**§ 23.865 Fire protection of flight controls, engine mounts, and other flight structure.**

Flight controls, engine mounts, excluding those portions that are certificated as part of the engine, and other flight structure located in the engine compartment must be constructed of fireproof material or shielded so that they are capable of withstanding the effects of a fire. Engine vibration isolators must incorporate suitable features to ensure that the engine is retained if the non-fireproof portions of the isolators deteriorate from the effects of a fire.

68. Section 23.1507 is revised to read as follows:

**§ 23.1507 Operating maneuvering speed.**

The maximum operating maneuvering speed, $V_O$, must be established as an operating limitation. $V_O$ is a selected speed that is not greater than $V_S\sqrt{n}$ established in § 23.335(c).

69. Section 23.1521 is amended by revising paragraph (a) to read as follows:

**§ 23.1521 Powerplant limitations.**

(a) *General.* The powerplant limitations prescribed in this section must be established so that they do not exceed the corresponding limits for which the engines or propellers are type certificated. In addition, other powerplant limitations used in determining compliance with this part must be established.

* * * * *

70. A new § 23.1522 is added to read as follows:

**§ 23.1522 Auxiliary power unit limitations.**

If an auxiliary power unit is installed, the limitations established for the auxiliary power must be specified in the operating limitations for the airplane.

71. Section 23.1525 is revised to read as follows:

**§ 23.1525 Kinds of operation.**

The kinds of operation authorized (e.g. VFR, IFR, day or night) and the meteorological conditions (e.g. icing) to which the operation of the airplane is limited or from which it is prohibited, must be established appropriate to the installed equipment.

72. Section 23.1527 is revised to read as follows:

**§ 23.1527 Maximum operating altitude.**

(a) The maximum altitude up to which operation is allowed, as limited by flight, structural, powerplant, functional or equipment characteristics, must be established.

(b) A maximum operating altitude limitation of not more than 25,000 feet must be established for pressurized airplanes unless compliance with § 23.775(e) is shown.

73. Section 23.1549 is amended by revising the heading, introductory text of the section, and paragraph (d) to read as follows:

**§ 23.1549 Powerplant and auxiliary power unit instruments.**

For each required powerplant and auxiliary power unit instrument, as appropriate to the type of instruments—

* * * * *

(d) Each engine, auxiliary power unit, or propeller range that is restricted because of excessive vibration stresses must be marked with red arcs or red lines.

74. Section 23.1557 is amended by removing paragraph (f) and by revising paragraph (c) to read as follows:

**§ 23.1557 Miscellaneous markings and placards.**

* * * * *

(c) *Fuel, oil, and coolant filler openings.* The following apply:

(1) Fuel filter openings must be marked at or near the filler cover with—

(i) For reciprocating engine-powered airplanes—

(A) The word "Avgas"; and

(B) The minimum fuel grade.

(ii) For turbine engine-powered airplanes—

(A) The words "Jet Fuel"; and

(B) The permissible fuel designations, or references to the Airplane Flight Manual (AFM) for permissible fuel designations.

(iii) For pressure fueling systems, the maximum permissible fueling supply pressure and the maximum permissible defueling pressure.

(2) Oil filler openings must be marked at or near the filler cover with the word "Oil" and the permissible oil designations, or references to the Airplane Flight Manual (AFM) for permissible oil designations.

(3) Coolant filler openings must be marked at or near the filler cover with the word "Coolant".

* * * * *

75. Section 23.1563 is amended by revising paragraph (a) to read as follows:

**§ 23.1563 Airspeed placards.**

* * * * *

(a) The operating maneuvering speed, $V_O$; and

* * * * *

76. Section 23.1581 is amended by adding a new paragraph (f) to read as follows:

**§ 23.1581 General.**

* * * * *

(f) *Revisions and amendments.* Each Airplane Flight Manual (AFM) must contain a means for recording the incorporation of revisions and amendments.

77. Section 23.1583 is amended by adding introductory text to the section, by revising paragraphs (a)(2) and (h), and by adding a paragraph (m) to read as follows:

**§ 23.1583 Operating limitations.**

Operating limitations determined during type certification must be stated, including the following:

(a) * * *

(2) The speeds $V_{MC}$, $V_O$, $V_{LE}$, and $V_{LO}$, if established, and their significance.

* * * * *

(h) *Kinds of operation.* A list of the kinds of operation to which the airplane is limited or from which it is prohibited under § 23.1525, and also a list of installed equipment that affects any operating limitation and identification as to the equipment's required operational status for the kinds of operation for which approval has been given.

* * * * *

(m) *Allowable lateral fuel loading.* The maximum allowable lateral fuel loading differential must be furnished if less than the maximum possible.

78. Section § 23.1585 is amended by revising paragraphs (a) and (c), and adding paragraph (b), to read as follows:

**§ 23.1585 Operating procedures.**

(a) For each airplane, information concerning normal, abnormal, and emergency procedures and other pertinent information necessary for safe operation and the achievement of the scheduled performance must be identified and segregated, including—

(1) The maximum demonstrated values of crosswind velocity for takeoff and landing and procedures and information pertinent to operations in crosswinds;

(2) The speeds, configurations, and procedures for making a normal takeoff and the subsequent climb;

(3) Procedure for abandoning a takeoff due to engine failure or other cause;

(4) The recommended climb speeds, and any variation with altitude;

(5) An explanation of significant or unusual flight or ground handling characteristics of the airplane;

(6) A recommended speed for flight in rough air. This speed must be chosen to protect against the occurrence, as a result of gusts, of structural damage to the airplane and loss of control (for example, stalling); and

(7) For seaplanes and amphibians, water handling procedures and the demonstrated wave height.

(b) For single-engine airplanes, the procedures, speeds, and configurations for a glide following an engine failure and subsequent forced landing.

(c) For multiengine airplanes, the information must include—

(1) Procedures and speeds for continuing a takeoff following failure of the critical engine and the conditions under which takeoff can be safely continued, or a warning against attempting to continue the takeoff;

(2) Procedures, speeds, and configurations for continuing a climb following engine failure after takeoff or en route;

(3) Procedures, speeds, and configurations for making an approach and landing with one engine inoperative;

(4) Procedures, speeds, and configurations for making a go-around with one engine inoperative and the conditions under which the go-around can safely be executed, or a warning against attempting the go-around maneuver;

(5) Procedures for restarting engines in flight, including the effects of altitude, must be set forth in the Airplane Flight Manual (AFM); and

(6) The $V_{SSE}$ determined in § 23.149.

* * * * *

79. Section 23.1587 is amended by adding the introductory text and by revising paragraphs (a), (b), and (c) to read as follows:

**§ 23.1587 Performance information.**

The following information must be furnished:

(a) For normal, utility, and acrobatic category airplanes:

(1) The takeoff distance determined under § 23.51 and the kind of runway surface used in the tests.

(2) The climb gradient determined under §§ 23.65 and 23.77, with the associated airspeed, power, and the airplane configuration.

(3) The landing distance determined under § 23.75.

(4) The one engine inoperative en route climb/descent gradients determined under § 23.67 for multiengine airplanes.

(5) The calculated approximate effect on takeoff distance, landing distance, and climb performance for variations in—

(i) Altitude from sea level to 10,000 feet in a standard atmosphere and cruise configuration; and

(ii) Temperature, at those altitudes from 60°F below standard to 40°F above standard.

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

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

(2) The climb performance is not critical; and

(3) The climb reduction in the skiplane configuration does not exceed 50 feet per minute.

(c) For each airplane:

(1) Any loss of altitude more than 100 feet, or any pitch more than 30 degrees below level flight attitude, occurring during the recovery part of maneuvers prescribed in §§ 23.201(c) and 23.305, if applicable.

(2) The stalling speed, $V_{SO}$, at maximum weight.

(3) The stalling speed, $V_{S1}$, at maximum weight and with the landing gear and wing flaps retracted and the effect upon this stalling speed of angles of bank up to 60 degrees.

(4) The speed used in showing compliance with the cooling and climb requirements of §§ 23.1041 through 23.1047 if this speed is greater than the best rate of climb with one engine inoperative for multiengine airplanes and the maximum atmospheric temperature at which compliance with the cooling requirements has been shown.

* * * * *

80. Section 23.1589 is amended by revising paragraph (a) to read as follows.

**§ 23.1589 Loading information.**

* * * * *

(a) The weight and location of each item of equipment that can be easily removed, relocated, or replaced and that is installed when the airplane was weighed under the requirement of § 23.25.

* * * * *

81. Appendix D of part 23 is amended by revising the heading and by adding a paragraph (c) to read as follows:

## Appendix D to Part 23—Wheel Spin-Up and Spring-Back Loads

* * * * *

(c) Dynamic spring-back of the landing gear and adjacent structure at the instant just after the wheels come up to speed may result in dynamic forward acting loads of considerable magnitude. This effect must be determined, in the level landing condition, by assuming that the wheel spin-up loads calculated by the methods of this appendix are reversed. Dynamic spring-back is likely to become critical for landing gear units having wheels of large mass or high landing speeds.

82. A new appendix H is added to part 23 to read as follows:

## Appendix H to Part 23—Seaplane Loads

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## Appendix H

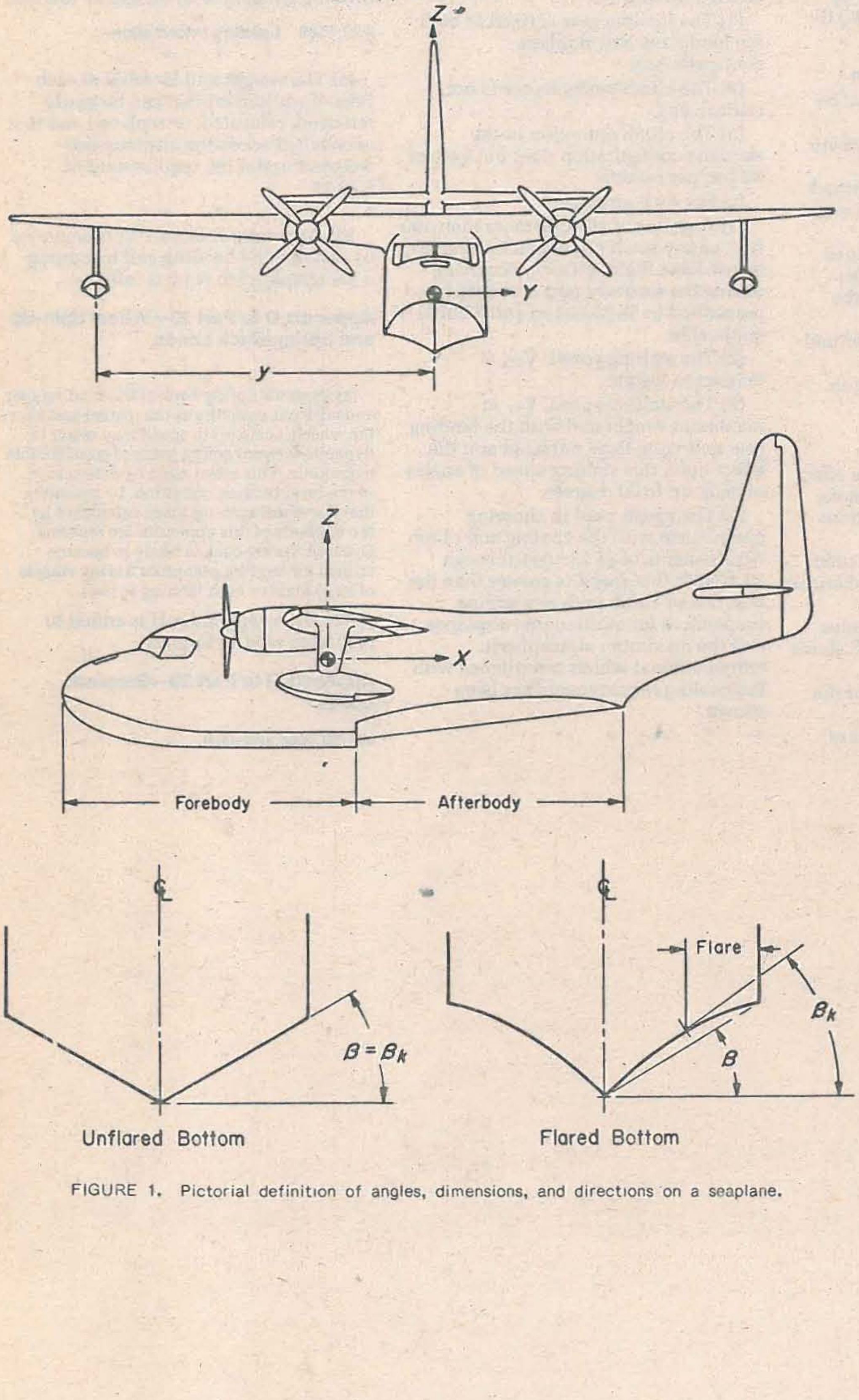


FIGURE 1. Pictorial definition of angles, dimensions, and directions on a seaplane.

## Appendix H (continued)

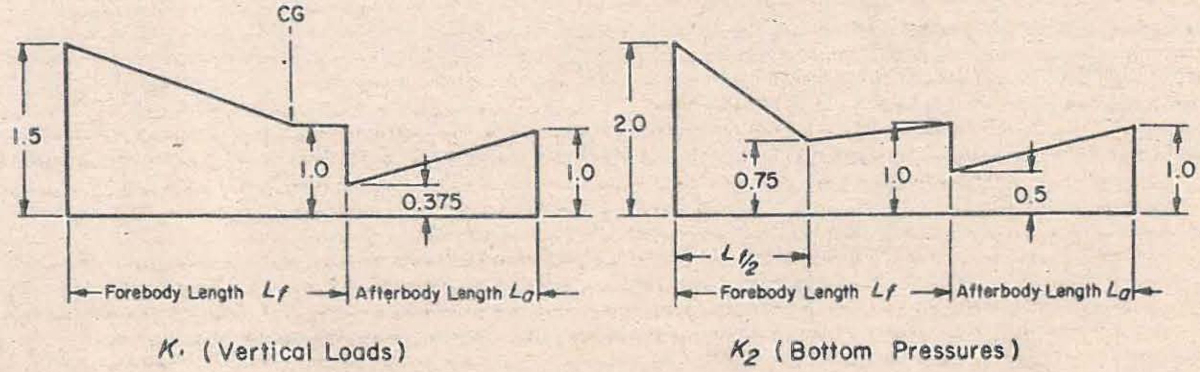


FIGURE 2. Hull station weighing factor.

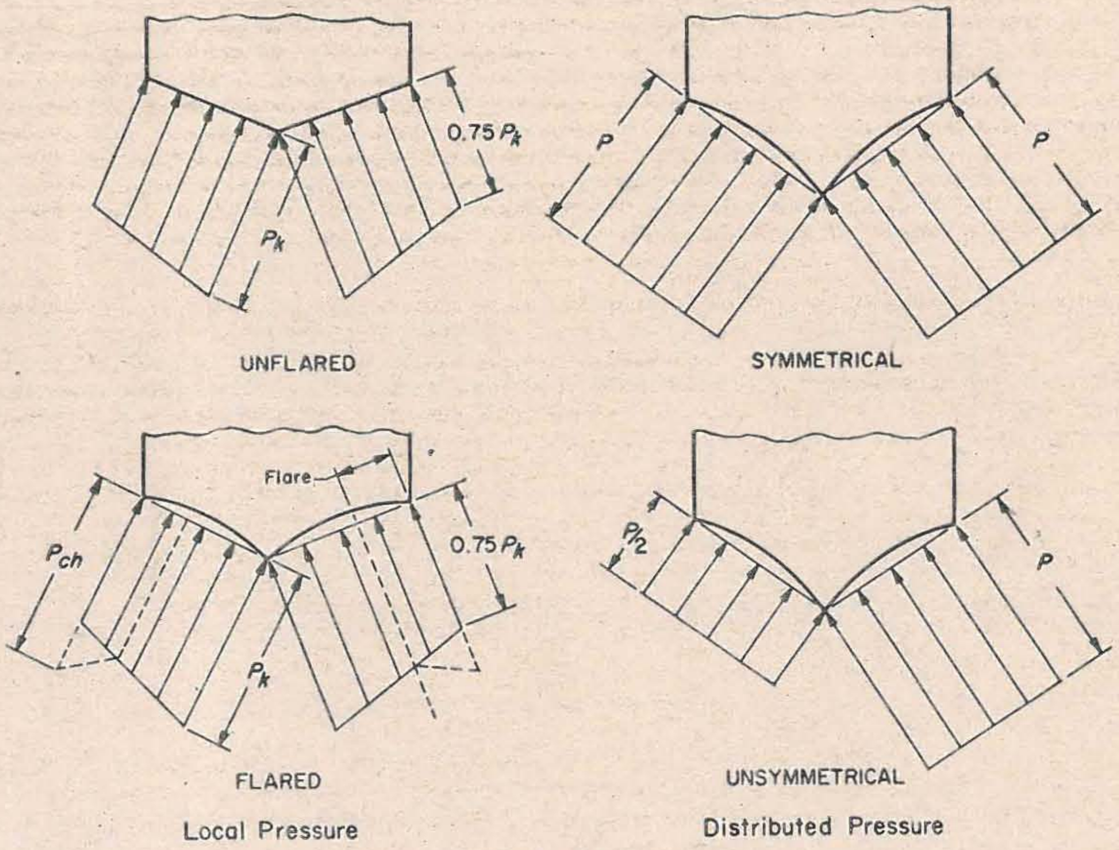


FIGURE 3. Transverse pressure distributions.

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