DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 1, 25, 36, and 97

[Docket No. 28404; Notice No. 95–17]

RIN 2120–AD40

1-g Stall Speed as the Basis for Compliance With Part 25 of the Federal Aviation Regulations

AGENCY: Federal Aviation Administration, DOT.

ACTION: Notice of proposed rulemaking.

SUMMARY: The Federal Aviation Administration (FAA) proposes to redefine the reference stall speed for transport category airplanes as the 1-g stall speed instead of the minimum speed obtained in a stalling maneuver. The proposed changes would: provide for a consistent, repeatable reference stall speed; ensure consistent and dependable maneuvering margins; provide for adjusted multiplying factors to maintain approximately the current requirements in areas where use of the minimum speed in the stalling maneuver has proven adequate; and harmonize the applicable regulations with those proposed for the European Joint Aviation Requirements-25 (JAR–25). These changes would result in a higher level of safety for those cases in which current methods would result in artificially low operating speeds.

DATES: Comments must be received on or before May 17, 1996.

ADDRESSES: Comments on this notice may be mailed in triplicate to: Federal Aviation Administration, Office of the Chief Counsel, Attention: Rules Docket (AGC–10), Docket No. 28404, 800 Independence Avenue SW., Washington, DC 20591; or delivered in triplicate to: Room 915G, 800 Independence Avenue SW., Washington, DC 20591. Comments delivered must be marked Docket No. 28404. Comments may be examined in Room 915G weekdays, except Federal holidays, between 8:30 a.m. and 5:00 p.m. In addition, the FAA is maintaining an information docket of comments in the Transport Airplane Directorate (ANM–100), Federal Aviation Administration, Northwest Mountain Region, 1601 Lind Avenue SW., Renton, WA 98055–4056. Comments in the information docket may be examined weekdays, except Federal holidays, between 7:30 a.m. and 4:00 p.m.

FOR FURTHER INFORMATION CONTACT: Don Stimson, Flight Test and Systems Branch, ANM–111, Transport Airplane Directorate, Aircraft Certification Service, FAA, 1601 Lind Avenue SW., Renton, WA 98055–4056; telephone (206) 227–1129; facsimile (206) 227–1320.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to participate in this proposed rulemaking by submitting such written data, views, or arguments as they may desire. Comments relating to any environmental, energy, or economic impact that might result from adopting the proposals contained in this notice are invited. Substantive comments should be accompanied by cost estimates. Commenters should identify the regulatory docket or notice number and submit comments in triplicate to the Rules Docket address above. All comments received on or before the closing date for comments will be considered by the Administrator before taking action on this proposed rulemaking. The proposals contained in this notice may be changed in light of comments received. All comments received will be available in the Rules Docket, both before and after the comment period closing date, for examination by interested persons. A report summarizing each substantive public contact with FAA personnel concerning this rulemaking will be filed in the docket. Persons wishing the FAA to acknowledge receipt of their comments must submit with those comments a self-addressed, stamped postcard on which the following statement is made: ''Comments to Docket No. 28404.'' The postcard will be date stamped and returned to the commenter.

Availability of the NPRM

Any person may obtain a copy of this notice by submitting a request to the Federal Aviation Administration, Office of Public Affairs, Attention: Public Inquiry Center, APA–230, 800 Independence Avenue SW., Washington, DC 20591; or by calling (202) 267–3484. The notice number of this NPRM must be identified in all communications. Persons interested in being placed on a mailing list for future rulemaking documents should also request a copy of Advisory Circular No. 11–2A, Notice of Proposed Rulemaking Distribution System, which describes the application procedure.

Background

The stalling speed (V_2) is defined as the minimum speed demonstrated in the performance stall maneuver described in § 25.103 of 14 CFR part 25 (part 25) of the Federal Aviation Regulations (FAR). V_S has historically served as a reference speed for determining the minimum operating speeds for transport category airplanes. Examples of minimum operating speeds that are based on V_S include the takeoff safety speed (V_2), the final takeoff climb speed, and the landing approach speed. The airworthiness standards of part 25 define these speeds as multiples of V_S. For example, V_2 must be at least 1.2 times V_S, the final takeoff climb speed must be at least 1.25 times V_S, and the landing approach speed must be at least 1.3 times V_S.

The speed margin, or difference in speed, between V_S and each minimum operating speed provides a safety ''cushion'' to ensure that normal operating speeds are sufficiently higher than the speed at which the airplane stalls. Using multiplying factors applied to V_S to provide this speed margin, however, assumes that V_S provides a proper reference stall speed. Since V_S is the minimum speed obtained in the stalling maneuver, it can be less than the lowest speed at which the airplane's weight is still supported entirely by aerodynamic lift. If V_S is significantly less than this speed, applying multiplying factors to V_S to determine the minimum operating speeds may not provide as large a speed margin as intended.

A proper reference stall speed should provide a reasonably consistent approximation of the wing's maximum usable lift. Maximum usable lift occurs at the minimum speed for which the lift provided by the wing is capable of supporting the weight of the airplane. This speed is known as the 1-g stall speed because the load factor (the ratio of airplane lift to weight) at this speed is equal to 1.0 ''g'' (where ''g'' is the acceleration caused by the force of gravity) in the direction perpendicular to the flight path of the airplane. A speed lower than the 1-g stall speed represents a transient flight condition that, if used as a reference for the deriving minimum operating speeds, may not provide the desired speed margin to protect against inadvertently stalling the airplane.

For jet transport airplanes, the minimum speed obtained in the stall maneuver of § 25.103 usually occurs near the point in the maneuver where the airplane spontaneously pitches nose-down or where the pilot initiates recovery after reaching a deterrent level of buffet, i.e., a vibration of a magnitude and severity that is a strong and effective deterrent to further speed reduction. Early generation transport airplanes, which had fairly straight

wings, typically pitched nose-down near the 1-g stall speed. The minimum speed in the maneuver was easy to note and record, and served as an adequate approximation of the speed for maximum lift.

For the recent generation of high speed transport airplanes with swept wings, however, the minimum speed obtained in the stalling maneuver can be substantially lower than the speed for maximum lift. Furthermore, the point at which the airplane pitches nose down or exhibits a deterrent level of buffet is more difficult to distinguish and can vary with piloting technique. As a result, the minimum speed in the stalling maneuver has become an inappropriate reference for most modern high speed transport airplanes for establishing minimum operating speeds since it may: (1) Be inconsistently determined, and (2) represent a flight condition in which the load factor perpendicular to the flight path is substantially less than 1.0 g.

In recent years, advanced technology transport category airplanes have been developed that employ novel flight control systems. These flight control systems incorporate unique protection features that are intended to prevent the airplane from stalling. They also prevent the airplane from maintaining speeds that are slower than a small percentage above the 1–g stall speed. Because of their unique design features, the traditional method of establishing V_S as the minimum speed obtained in the stalling maneuver was inappropriate for these airplanes. The FAA issued special conditions for these airplanes to define the reference stall speed as the 1–g stall speed for the flight requirements contained in subpart B of part 25 and the noise requirements contained in part 36 of the FAR.

In these special conditions, the multiplying factors used to determine the minimum operating speeds were reduced in order to maintain equivalency with acceptable operating speeds used by previous jet transports. Since the 1–g stall speed is generally higher than the minimum speed obtained in the stalling maneuver, retaining the current multiplying factors would have resulted in higher minimum operating speeds for airplanes using the 1–g stall speed as the reference stall speed. However, increasing the minimum operating speeds would impose costs on operators because payloads would have to be reduced to comply with the regulations at the higher operating speeds. Based on the service experience of the current fleet of jet transports, the costs imposed would not be offset by a commensurate increase in safety.

Several airplane types with conventional flight control systems have also been certificated using the 1–g stall speed as the reference stall speed. Because of the potential deficiencies in using the minimum speed demonstrated in the stalling maneuver, the FAA has been encouraging applicants to use the 1–g stall speed in lieu of the minimum speed obtained in the stalling maneuver. Applicants generally desire to use 1–g stall speeds because the 1–g stall speeds are less dependent on pilot technique and other subjective evaluations. Hence, 1–g stall speeds are easier to predict and provide a higher level of confidence for developing predictions of overall airplane performance. Again, reduced multiplying factors are applied to the 1–g stall speeds to obtain minimum operational service. Using 1–g stall speeds ensures that the airplane's minimum operating speeds will not be unreasonably low.

Discussion of the Proposals

The FAA proposes to define the reference stall speed in § 25.103 as a 1–g stall speed, rather than the minimum speed obtained in the stalling maneuver. This action would provide a consistent basis for use in all type design certification requirements for transport category airplanes. The FAA proposes to introduce the symbol V_{SR} to represent this speed and to indicate that it is different than the minimum speed obtained in the stalling maneuver, V_S.

In addition, the FAA proposes to reduce the multiplying factors that are used in combination with the reference stall speed to determine the minimum operating speeds by approximately 6 percent. This change would result in minimum operating speeds equivalent to those for most current jet transports since the 1–g stall speed for these airplanes is approximately 6 percent higher than the minimum speed obtained in the stalling maneuver. Demonstrating a minimum stalling speed more than 6 percent slower than the 1–g stall speed, which is possible under the current standards, would provide an unacceptable basis for determining the minimum operating speeds. The proposed standards would prevent this situation from occurring. In this respect, the proposed standards would provide a higher level of safety than the existing standards.

However, the reduced factors would allow lower minimum operating speeds to be established for those airplanes that have a minimum speed in the stalling maneuver approximately equal to the 1–g stall speed. One particular class of airplanes for which this applies are airplanes equipped with devices that abruptly push the nose down (e.g., stick pushers) near the angle of attack for maximum lift. These devices are typically installed on airplanes with unacceptable natural stalling characteristics. The abrupt nose down push provides an artificial stall indication and acceptable stall characteristics, and prevents the airplane from reaching a potentially hazardous natural aerodynamic stall. The minimum speed obtained in this maneuver is approximately equal to the 1–g stall speed.

Traditionally, the existing multiplying factors have been applied to these airplanes. The proposal to define the reference stall speed as the 1–g stall speed would not affect these airplanes, but reducing the multiplying factors would allow lower minimum operating speeds to be established. Therefore, this proposal would allow these airplanes to be operated at speeds and angles-of-attack closer to the pusher activation point than has been experienced in operational service.

The FAA considers this reduction in operating speeds for pusher-equipped airplanes to be acceptable, provided the pusher reliably performs its intended function and that unwanted operation is minimized. The FAA intends to propose an acceptable method of addressing these concerns in an upcoming revision to Advisory Circular (AC) 25–7. In this material, the FAA will provide criteria for pusher reliability, the effects of design and manufacturing tolerances on the pusher activation point, design features such as phase advance and filtering, and the affects of atmospheric turbulence and windshear.

In addition to proposing to define the reference stall speed as the 1–g stall speed and to reduce the multiplying factors for establishing the minimum operating speeds, the FAA also proposes to require applicants to demonstrate adequate maneuvering capability during the takeoff climb, en route climb, and landing approach phases of flight. During a banked turn, a portion of the lift generated by the wing provides a force to help turn the airplane. To remain at the same altitude, the airplane must produce additional lift. Therefore, banking the airplane (at a constant speed and altitude) reduces the stall margin, which is the difference between the lift required for the maneuver and the maximum lift capability of the wing. As the bank angle increases, the stall margin is reduced proportionately. This bank angle effect on the stall margin can be determined analytically, and the multiplying factors applied to V_{SR} to

determine the minimum operating speeds are intended to ensure that an adequate stall margin is maintained.

In addition to the basic effect of bank angle, however, modern wing designs also typically exhibit a significant reduction in maximum lift capability with increasing Mach number. The magnitude of this Mach number effect depends on the design characteristics of the particular wing. For wing designs with a large Mach number effect, the maximum bank angle that can be achieved while retaining an acceptable stall margin can be significantly reduced. Because the effect of Mach number can be significant, and because it can also vary greatly for different wing designs, the multiplying factors applied to V_{SR} are insufficient to ensure that adequate maneuvering capability exists at the minimum operating speeds.

To address this issue, the FAA proposes to require a minimum bank angle capability in a coordinated turn without encountering stall warning or any other characteristic that might interfere with normal maneuvering. This requirement would be added to § 25.143 as a new paragraph (g). The proposed minimum bank angles were derived by adding a 15 degree allowance for wind gusts and inadvertent overshoot to a maneuvering capability the FAA considers necessary for the specific cases identified in the proposed new paragraph. These proposed maneuver margin requirements are intended to ensure that the level of safety in maneuvering flight is not reduced by the proposed change to the reference stall speed and the reduction in the multiplying factors used to determine the minimum operating speeds.

Consistent with the proposed maneuver margin requirements, the FAA proposes adding §§ 25.107(c)(3), 25.107(g)(2), and 25.125(a)(2)(iii) to reference § 25.143(g) in the list of constraints applicants must consider when selecting the minimum takeoff safety speed, final takeoff speed, and reference landing speeds, respectively. The normal all-engines-operating takeoff climb speed selected by the applicant must also provide the minimum bank angle capability specified in the proposed § 25.143(g).

Section 25.145(a) requires that there be adequate longitudinal control available to promptly pitch the airplane's nose down from at or near the stall in order to return to original trim speed. The intent of this requirement is to ensure sufficient pitch control for a prompt recovery if the airplane is inadvertently slowed to the point of stall. The FAA proposes to change the wording of this requirement to replace ''V_S'' with ''the stall,'' ''§ 25.103(b)(1)'' with ''§ 25.103(a)(6),'' and ''at any speed'' with ''at any point.'' These changes would be consistent with the proposed change to the definition of the reference stall speed and the proposed re-formatting of § 25.103.

Although § 25.145(a) must be met both with power off and with maximum continuous power, there is no intention to require flight test demonstrations of full stalls at engine powers above that specified in § 25.201(a)(2). Instead of performing a full stall at maximum continuous power, compliance may be assessed by demonstrating sufficient static longitudinal stability and nose down control margin when the deceleration is ended at least one second past stall warning during a one knot per second deceleration. The static longitudinal stability during the maneuver and the nose down control power remaining at the end of the maneuver must be sufficient to assure compliance with the requirement.

Section 25.207 requires that a warning of an impending stall must be provided in order to prevent the pilot from inadvertently stalling the airplane. The warning must occur at a speed sufficiently higher than the stall speed to allow the pilot time to take action to avoid a stall. The speed difference between the stall speed and the speed at which the stall warning occurs is known as the stall warning margin. The FAA proposes amending the size of the stall warning margin required by § 25.207(c) because of the change in definition of the reference stall speed.

Currently, the stall warning must begin at a speed exceeding V_S by seven knots, or a lesser margin if the stall warning has enough clarity, duration, distinctiveness, or other similar properties. Requiring the same seven knot warning margin to be provided relative to V_{SR} would result in an increase to the minimum operating speeds. This increase in the minimum operating speeds would be necessary to meet the maneuvering margin requirements proposed in § 25.143(g), which are defined relative to the stall warning speed. However, as discussed previously, requiring an increase to the minimum operating speeds would impose costs to airplane operators that cannot be justified by service experience.

On the other hand, if the stall warning margin were reduced to retain approximately the same stall warning speed, the warning would occur only one or two knots prior to reaching the 1-g stall speed. Although reaching the 1-g stall speed is not likely to be a catastrophic occurrence, the FAA considers such a small stall warning margin to be unacceptable. The FAA proposes requiring a stall warning margin of at least 3 knots or 3 percent, whichever is greater, relative to V_{SR}. The FAA considers this margin to represent a reasonable balance between providing the pilot with enough warning to avert an impending stall, and providing adequate maneuvering capability at the minimum operating speeds. This proposal would retain the existing level of safety.

The FAA proposes to require a larger stall warning margin for airplanes equipped with devices that abruptly push the nose down at a selected angle of attack (e.g., stick pushers). Inadvertent operation of such a device, especially close to the ground, can have more serious consequences than a comparable situation in which the pilot of an airplane without the device inadvertently slows to V_{SR}. Therefore, the FAA proposes adding § 25.207(d) to require the stall warning, for airplanes equipped with one of these devices, to occur at least 5 knots or 5 percent, whichever is greater, above the speed at which the device activates. This proposal is intended to retain the existing level of safety for airplanes equipped with such devices.

The FAA proposes to add a new paragraph, § 25.207(e), to require that, in a slow-down turn with load factors up to 1.5 g and deceleration rates up to 3 knots per second, sufficient stall warning must exist to prevent stalling when recovery is initiated not less than one second after stall warning occurs. The FAA considers the proposed requirement necessary to provide adequate stall warning during a dynamic maneuver, such as a collision avoidance maneuver. In addition, this new paragraph would provide a quantitative requirement with which to assess whether ''sufficient margin to prevent inadvertent stalling * * * in turning flight'' has been provided as required by § 25.207(a). This proposal would increase the level of safety during maneuvering flight.

The FAA proposes to add a new paragraph, § 25.207(f), to require that stall warning be provided for abnormal airplane configurations likely to be used following system failures. This proposal adds a requirement currently contained in JAR–25 and is consistent with current transport airplane designs. There would be no impact on the existing level of safety.

On modern jet transports, the natural buffet or vibration caused by the airflow separating and reattaching itself to the wing as the airplane approaches the

stall speed is usually not strong enough by itself to provide an effective stall warning. Therefore, stall warning on modern transport category airplanes is usually provided through an artificial means, such as a stick shaker that shakes the pilot's control column. Production tolerances associated with these systems can result in variations in the size of the stall warning margin for different airplanes manufactured under the same approved type design.

The FAA considers the stall warning margins proposed in §§ 25.207(c) and (d) to be the minimum acceptable warning margins, and that these margins should not be reduced by production tolerances associated with a system added to the airplane to provide an artificial stall warning. The FAA intends for the proposed stall warning margins to be available at the most critical tolerance expected in production. Applicants would be expected to demonstrate compliance with the proposed stall warning margin either by flight testing with the stall warning system set to its critical tolerance setting, or by adjusting flight test data obtained at some other setting.

The tolerances associated with the stall warning system must also be considered in relation to the proposed minimum maneuvering requirements of § 25.143(g). As proposed, § 25.143(g) would require that the airplane be capable of reaching a minimum bank angle during a coordinated turn without encountering stall warning. Because the proposed requirements already provide the capability to overshoot the intended bank angle by 15 degrees, the small differences in the speed at which the stall warning system operates due to system tolerances are not as critical. Therefore, the FAA intends for the minimum bank angles in the proposed § 25.143(g) to apply at the designed nominal setting of the stall warning system. To ensure that large production tolerances do not adversely impact the airplane's maneuvering capability free of stall warning, the bank angle capability specified in the proposed § 25.143(g) should not be reduced by more than two degrees with the stall warning system operating at its most critical tolerance. Applicants would be expected to demonstrate this capability either by flight test with the system set to its critical tolerance, or by analytically adjusting flight test data obtained at some other setting.

To be consistent with the proposed revision of the definition of the reference stall speed, the FAA proposes to incorporate reduced multiplying factors throughout part 25, where appropriate, in requirements that use speeds based on a multiple of the reference stall speed. The FAA also proposes numerous minor wording and structural changes to various sections to improve editorial clarity and to harmonize with the wording and structure proposed for JAR–25.

The FAA proposes to add the nomenclature ''final takeoff speed'' and ''reference landing speed'' and the abbreviations ''V_{FTO}'' and ''V_{REF}'' to denote these speeds, respectively, to part 1 of the FAR. These terms and abbreviations, which are commonly used in the aviation industry, would be referenced throughout the proposed amendments to part 25. The reference landing speed would be defined as the speed of the airplane, in a specified landing configuration, at the point where it descends through the landing screen height in the determination of the landing distance for manual landings. The term ''landing screen height'' refers to the height of the airplane at the beginning of the defined landing distance. This height is normally 50 feet above the landing surface (see § 25.125(a)), but approvals have been granted for steep approaches that use a landing screen height of 35 feet. The final takeoff speed would be defined as the speed of the airplane that exists at the end of the takeoff path in the en route configuration with one engine inoperative.

The FAA also proposes to add the abbreviations V_{SR}, V_{SR0}, and V_{SR1} to part 1, and use them in part 25 to denote the reference stall speed corresponding to different airplane configurations. In addition, the FAA proposes adding the abbreviation V_{SW} to part 1 to refer to the stall warning speed.

The FAA proposes to amend § C36.9(e)(1) by replacing ''1.3 V_S + 10 knots'' with ''V_{REF} + 10 knots'' and by removing the words ''or the speed used in establishing the approved landing distance under the airworthiness regulations constituting the type certification basis of the airplane, whichever speed is greatest.'' The words proposed to be deleted would no longer be necessary because V_{REF} would denote the speed used in establishing the approved landing distance under the airworthiness regulations constituting the type certification basis of the airplane. Also, V_{REF} would refer to the speed at the landing screen height, regardless of whether that speed for a particular airplane is 1.3 V_S, 1.23 V_{SR}, or some higher speed.

In the same manner, the FAA proposes to amend § 97.3(b) by replacing ''1.3 V_{S0}'' with ''V_{REF}.'' As noted above, V_{REF} would refer to the speed at the landing screen height used in establishing the approved landing distance under the airworthiness regulations constituting the type certification basis of the airplane, regardless of whether that speed for a particular airplane is 1.3 V_S, 1.23 V_{SR}, or some higher speed.

These proposals have been discussed extensively with the European Joint Aviation Authorities (JAA) with the intent of harmonizing the certification requirements related to stall speed for transport category airplanes. The JAA intend to introduce an equivalent proposal to amend the Joint Aviation Requirements-25 (JAR–25). JAR–25 prescribes the airworthiness standards for transport category airplanes that are accepted by the aviation regulatory authorities of 23 European nations. When it is published, the JAA proposal will be placed in the docket for this rulemaking.

Regulatory Evaluation Summary

Preliminary Regulatory Evaluation, Initial Regulatory Flexibility Determination, and Trade Impact Assessment

Proposed changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 directs that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic effect of regulatory changes on small entities. Third, the Office of Management and Budget directs agencies to assess the effects of regulatory changes on international trade. In conducting these analyses, the FAA has determined that this proposed rule: (1) Would generate benefits that justify its costs and is not a ''significant regulatory action'' as defined in the Executive Order; (2) is not significant as defined in DOT's Regulatory Policies and Procedures; (3) would not have a significant impact on a substantial number of small entities; and (4) would not constitute a barrier to international trade. These analyses, available in the docket, are summarized below.

Regulatory Evaluation Summary

Costs

The proposed requirements would apply to future type certificated transport category airplanes and generally would not impose significant additional costs on manufacturers. One major manufacturer demonstrated adherence to the 1-g stall speed basis in recent FAA special conditions

applicable to several models of advanced technology airplanes. Other manufacturers have requested certification to the 1-g stall speed basis through equivalent safety findings for airplanes with conventional flight control systems.

Cost estimates provided by manufacturers generally did not vary significantly. Data provided by a manufacturer of part 25 small airplanes, however, showed costs several hundred thousand dollars higher than the norm. That manufacturer estimated that short-term costs (mostly non-recurring) to convert to the new stall speed basis would be over $1 million and that increased costs on a program-by-program basis would ''be substantial.'' Because of the gross nature of these estimates and because of the inability to segment them on a per-certification basis, they have not been incorporated into this analysis. The FAA invites manufacturers to provide detailed cost estimates during the public comment period.

Although several sections of part 25 would be revised by the proposal, only five merit analysis: Sections 25.103 (Stall speed), 25.107 (Takeoff speeds), 25.125 (Landing), 25.143 (General) (under Controllability and Maneuverability), and 25.207 (Stall warning).

Section 25.103 (Stall Speed)

The proposal to redefine the reference stall speed as a 1-g stall speed could result in a net reduction in certification costs for part 25 large airplanes. In some recent airplane designs, manufacturers have used the 1-g stall speed as the reference stall speed. Calculation of the reference stall speed (V_{SR}) is within the range of instrumentation currently available and additional instrumentation would not be required. Existing techniques to determine minimum speed in the stalling maneuver require six to eight independent stalls at various flap settings; determination of 1-g stall speed could require approximately half as many. Cost-savings could be in the range of $50,000 to $100,000 per type certification.

Recent part 25 small transport category airplane certifications, on the other hand, have not been based on the 1-g stall speed. Consequently, additional instrumentation and analysis would be required. Incremental one-time costs for a part 25 small airplane design would be approximately $70,000. However, cost savings attributable to reduced testing could be realized in future certifications (see previous paragraph re part 25 large airplanes).

Section 25.107 (Takeoff Speeds)

The proposed changes to this section, by virtue of the new maneuvering requirements of § 25.143(g), could affect airplane operators if the proposed maneuvering requirements necessitate higher takeoff/climb speeds and lower passenger/cargo capacity on length-limited runways. Because of the myriad combinations of airplanes, runways, passenger/cargo loads, etc., the FAA is unable to estimate potential capacity limitations. The FAA invites interested parties to provide estimates of such effects during the public comment period.

Section 25.125 (Landing)

As in the case of § 25.107 above, the proposed changes to this section could potentially affect operators by virtue of the new maneuvering requirements in § 25.143(g). Again, the FAA invites interested parties to submit cost estimates during the public comment period.

Section 25.143 (General)

Incremental costs that would be incurred by manufacturers to determine minimum maneuvering margins are estimated to total approximately $150,000 per part 25 large airplane type certification and approximately $50,000 per part 25 small airplane type certification.

Section 25.207 (Stall Warning)

Incremental costs that would be incurred by manufacturers to provide sufficient stall warning at the various proposed slow-down speeds and configurations are estimated to total approximately $120,000 per part 25 large airplane type certification and approximately $200,000 per part 25 small airplane type certification.

Total Costs

Manufacturers of part 25 large airplanes have already incurred the major portion of the start-up costs to convert to a 1-g stall speed system and would therefore experience lower incremental costs than manufacturers of part 25 small airplanes. The estimated costs to meet the revised standards would total approximately $195,000 per part 25 large airplane type certification (costs associated with §§ 25.143 and 25.207 reduced by the midpoint of the cost-savings range of § 25.103). Assuming 500 airplanes produced under one type certification, this would equate to $390 per airplane.

Manufacturers of part 25 small airplanes would experience one-time costs of $70,000 in conjunction with § 25.103. In addition, costs for each future type certification would total approximately $250,000 (attributable to §§ 25.143 and 25.207), or about $500 per airplane over a 500 airplane production run. A portion of these costs may be offset by reduced testing requirements per revised § 25.103. The potential operating costs of proposed §§ 25.107 and 25.125 have not been estimated in this evaluation; the FAA invites interested parties to provide cost estimates during the public comment period.

Benefits

Redefining the airplane reference stall speed as the 1-g stall speed would result in a higher level of safety in those cases where current methods could result in artificially low operating speeds. New requirements for minimum maneuvering margins would assure that safe margins are obtained at the minimum operating speeds, thus diminishing the possibility of inadvertent stalls at critical flight stages.

A review of National Transportation Safety Board accident reports for the years 1983–1992 does not indicate that any accidents have been caused by inconsistent/inappropriate reference stall speeds. There were several accidents in which inadvertent stalls were cited as a contributing factor, but pilot error (e.g., airspeed not properly maintained) was the probable cause rather than inherent problems with the reference stall speed. In spite of the absence of directly aligned accidents, the FAA postulates that, without the revisions in stall speed as proposed or effected through special conditions, safety could reach unacceptably low levels. The benefits associated with avoiding a single accident would far exceed the costs of the proposed rule.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to insure that small entities are not unnecessarily or disproportionately burdened by Government regulations. The RFA requires agencies to determine whether proposed rules would have ''a significant economic impact on a substantial number of small entities'' and, in cases where they would, to conduct a Regulatory Flexibility Analysis. As prescribed in implementing FAA Order 2100.14A, the size threshold for a small aircraft manufacturer is one having 75 or fewer employees. Since there are no manufacturers of part 25 airplanes with 75 or fewer employees, the proposed rule would not have a significant economic impact on a substantial number of small entities.

International Trade Impact Assessment

The proposed rule would not constitute a barrier to international trade, including the export of U.S. airplanes to foreign markets and the import of foreign airplanes into the U.S. Instead, the proposed changes would harmonize with corresponding proposals of the European Joint Aviation Authorities, thereby lessening restraints on trade.

Federalism Implications

The amended regulations proposed in this rulemaking would 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 proposal would not have sufficient federalism implications to warrant preparing a Federalism Assessment.

Conclusion

Because the proposed changes to redefine the reference stall speed for transport category airplanes as the 1-g stall speed are not expected to result in substantial economic cost, the FAA has determined that this proposed regulation would not be significant under Executive Order 12866. Because this is an issue which has not prompted a great deal of public concern, the FAA has determined that this action is not significant under DOT Regulatory Policies and Procedures (44 FR 11034, February 25, 1979). In addition since there are no small entities affected by this proposed rulemaking, the FAA certifies, under the criteria of the Regulatory Flexibility Act, that this rule, if adopted, will not have a significant economic impact, positive or negative, on a substantial number of small entities. An initial regulatory evaluation of the proposal, including a Regulatory Flexibility Determination and 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

14 CFR Part 1

Air transportation.

14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

14 CFR Part 36

Agriculture, Aircraft, Noise control.

14 CFR Part 97

Air traffic control, Airports, Navigation (air), Weather.

The Proposed Amendments

Accordingly, the Federal Aviation Administration (FAA) proposes to amend 14 CFR parts 1, 25, 36, and 97 of the Federal Aviation Regulations (FAR) as follows:

PART 1—DEFINITIONS AND ABBREVIATIONS

1. The authority citation for part 1 is revised to read as follows:

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

2. Section 1.1 is amended by adding new definitions in alphabetical order to read as follows:

§ 1.1 General definitions.

* * * * *

Final takeoff speed means the speed of the airplane that exists at the end of the takeoff path in the en route configuration with one engine inoperative.

* * * * *

Reference landing speed means the speed of the airplane, in a specified landing configuration, at the point where it descends through the landing screen height in the determination of the land distance for manual landings.

* * * * *

3. Section 1.2 is amended by adding new terms in alphabetical order to read as follows:

§ 1.2 Abbreviations and symbols.

* * * * *

V_{FTO} means final takeoff speed.

* * * * *

V_{REF} means reference landing speed.

* * * * *

V_{SR} means reference stall speed.

V_{SR0} means reference stall speed in the landing configuration.

V_{SR1} means reference stall speed in a specific configuration.

V_{SW} means speed at which onset of natural or artificial stall warning occurs.

* * * * *

PART 25—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

4. The authority citation for part 25 is revised to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 22704.

5. Section 25.103 is revised to read as follows:

§ 25.103 Stall speed.

(a) The reference stall speed, V_{SR}, is a calibrated airspeed as defined in paragraph (c) of this section. V_{SR} is determined with—

(1) Engines idling, or, if that resultant thrust causes an appreciable decrease in stall speed, not more than zero thrust at the stall speed;

(2) Propeller pitch controls (if applicable) in the takeoff position;

(3) The airplane in other respects (such as flaps and landing gear) in the condition existing in the test in which V_{SR} is being used;

(4) The weight used when V_{SR} is being used as a factor to determine compliance with a required performance standard;

(5) The center of gravity position that results in the highest value of reference stall speed; and

(6) The airplane trimmed for straight flight at a speed selected by the applicant, but not less than 1.13 V_{SR} and not greater than 1.3 V_{SR}.

(b) Starting from the stabilized trim condition, apply elevator control to decelerate the airplane so that the speed reduction does not exceed one knot per second.

(c) The reference stall speed, V_{SR}, is a calibrated airspeed determined in the stalling maneuver. V_{SR} may not be less than a 1-g stall speed. V_{SR} is expressed as:

$$V_{SR} \geq \frac{V_{CL_{MAX}}}{\sqrt{n_{ZW}}}$$

where—

$V_{CL_{MAX}}$ = Speed occurring when lift coefficient is first a maximum. In addition, if the stalling maneuver is limited by a device that commands an abrupt nose down pitch (e.g., a stick pusher), $V_{CL_{MAX}}$ may not be less than the speed existing at the instant the device operates; and

n_{ZW} = Flight patch normal load factor (not greater than 1.0) at $V_{CL_{MAX}}$.

6. Section 25.107 is amended by revising paragraphs (b)(1) introductory text, (b)(2) introductory text, (c)(1) and (c)(2), and by adding new paragraphs (c)(3) and (g) to read as follows:

§ 25.107 Takeoff speeds.

* * * * *

(b) * * *

(1) 1.13 V_{SR} for—

* * * * *

(2) 1.08 V_{SR} for—

* * * * *

(c) * * *

(1) V_{2MIN};

(2) V_R plus the speed increment attained (in accordance with § 25.111(c)(2)) before reaching a height of 35 feet above the takeoff surface; and

(3) A speed that provides the maneuvering capability specified in § 25.143(g).

* * * * *

(g) V_{FTO}, in terms of calibrated airspeed, must be selected by the applicant to provide at least the gradient of climb required by § 25.121(c), but may not be less than—

(1) 1.18 V_{SR}; and

(2) A speed that provides the maneuvering capability specified in § 25.143(g).

7. Section 25.111 is amended by revising paragraph (a) introductory text to read as follows:

§ 25.111 Takeoff path.

(a) The takeoff path extends from a standing start to a point in the takeoff at which the airplane is 1,500 feet above the takeoff surface, or at which the transition from the takeoff to the en route configuration is completed and V_{FTO} is reached, whichever point is higher. In addition—

* * * * *

8. Section 25.119 is amended by revising the section heading and paragraph (b) to read as follows:

§ 25.119 Landing climb: All-engines-operating.

* * * * *

(b) A climb speed of not more than V_{REF}.

9. Section 25.121 is amended by revising paragraphs (c) introductory text, (d) introductory text, (d)(2) and (d)(3), and by adding paragraph (d)(4) to read as follows:

§ 25.121 Climb: One-engine-inoperative.

* * * * *

(c) *Final takeoff.* In the en route configuration at the end of the takeoff path determined in accordance with § 25.111, the steady gradient of climb may not be less than 1.2 percent for two-engine airplanes, 1.5 percent for three-engine airplanes and 1.7 percent for four-engine airplanes, at V_{FTO} and with—

* * * * *

(d) *Approach.* In a configuration corresponding to the normal all-engines-operating procedure in which V_{SR} for this configuration does not exceed 110 percent of the V_{SR} for the related all-engines-operating landing configuration, the steady gradient of climb may not be less than 2.1 percent for two-engine airplanes, 2.4 percent for three-engine airplanes, and 2.7 percent for four engine airplanes, with—

(1) * * *

(2) The maximum landing weight;

(3) A climb speed established in connection with normal landing procedures, but not more than 1.4 V_{SR}; and

(4) Landing gear retracted.

10. Section 25.125 is amended by revising paragraph (a)(2) to read as follows:

§ 25.125 Landing.

(a) * * *

(2) A stabilized approach, with a calibrated airspeed of V_{REF}, must be maintained down to the 50 foot height. V_{REF} may not be less than—

(i) 1.23 V_{SR0},

(ii) V_{MCL} established under § 25.149(f); and

(ii) A speed that provides the maneuvering capability specified in § 25.143(g).

* * * * *

11. Section 25.143 is amended by adding a new paragraph (g) to read as follows:

§ 25.143 General.

* * * * *

(g) The maneuvering capabilities in a constant speed coordinated turn at forward center of gravity, as specified in the following table, must be free of stall warning or other characteristics that might interfere with normal maneuvering:

Configuration	Speed	Maneuvering bank angle in a coordinated turn	Thrust/power setting
Takeoff	V_2	30°	Asymmetric WAT-limited.[1]
Takeoff	V_2+XX[2]	40°	All-engines-operating climb.[3]
En route.	V_{FTO}	40°	Asymmetric WAT-limited.[1]
Landing.	V_{REF}	40°	Symmetric for −3° flight path angle.

[1] A combination of weight, altitude, and temperature (WAT) such that the thrust or power setting produces the minimum climb gradient specified in § 25.121 for the flight condition.

[2] Airspeed approved for all-engines-operating initial climb.

[3] That thrust or power setting which, in the event of failure of the critical engine and without any crew action to adjust the thrust or power of the remaining engines, would result in the thrust or power specified for the takeoff condition at V_2, or any lesser thrust or power setting that is used for all engines-operating initial climb procedures.

12. Section 25.145 is amended by revising paragraphs (a) introductory text, (a)(1), (b)(1), (b)(4), (b)(6), and (c) introductory text to read as follows:

§ 25.145 Longitudinal control.

(a) It must be possible, at any point between the trim speed prescribed in § 25.103(a)(6) and the stall, to pitch the nose downward so that the acceleration to this selected trim speed is prompt with—

(1) The airplane trimmed at the trim speed prescribed in § 25.103(a)(6);

* * * * *

(b) * * *

(1) With power off, flaps retracted, and the airplane trimmed at 1.3 V_{SR1}, extend the flaps as rapidly as possible while maintaining the airspeed at approximately 30 percent above the reference stall speed existing at each instant throughout the maneuver.

* * * * *

(4) With power off, flaps retracted, and the airplane trimmed at 1.3 V_{SR1}, rapidly set go-around power or thrust while maintaining the same airspeed.

* * * * *

(6) With power off, flaps extended, and the airplane trimmed at 1.3 V_{SR1}, obtain and maintain airspeeds between V_{SW} and either 1.6 V_{SR1} or V_{FE}, whichever is lower.

(c) It must be possible, without exceptional piloting skill, to prevent loss of altitude when complete retraction of the high lift devices from any position is begun during steady, straight, level flight at 1.08 V_{SR1} for propeller powered airplanes, or 1.13 V_{SR1} for turbojet powered airplanes, with—

* * * * *

§ 25.147 [Amended]

13. Section 25.147 is amended in paragraphs (a) introductory text, (a)(2), (c) introductory text, and (d) by revising the expression ''1.4 V_{S1}'' to read ''1.3 V_{SR1}''.

§ 25.149 [Amended]

14. Section 25.149 is amended in paragraph (c) introductory text by revising the expression ''1.2 V_S'' to read ''1.13 V_{SR}.''

§ 25.161 [Amended]

15. Section 25.161 is amended in paragraphs (b), (c)(1), (c)(2), (c)(3) and (d) introductory text by revising the expression ''1.4 V_{S1}'' to read ''1.3 V_{SR1}''; and in paragraph (e)(3) by revising the expression ''0.013 V_{S0}^2'' to read ''0.013V_{SR0}^2''.

§ 25.175 [Amended]

16. Section 25.175 is amended in paragraphs (a)(2), (b)(1) introductory text, (b)(2) introductory text, (b)(3)

introductory text and (c)(4) by revising the expression ''1.4 V_{S1}'' to read ''1.3 V_{SR1}'', in paragraph (b)(2)(ii) by revising the expression ''V_{MO}+1.4 V_{S1}/2'' to read ''(V_{MO}+1.3 V_{SR1})/2'', in paragraph (c) introductory text by revising the expressions ''1.1 V_{S1}'' to read ''V_{SW}'' and ''1.8 V_{S1}'' to read ''1.7 V_{SR1}'', in paragraph (d) introductory text by revising the expressions ''1.1 V_{S0}'' to read ''V_{SW}'' and ''1.3 V_{S0}'' to read ''1.7 V_{SR0}'', and in paragraph (d)(5) by revising the expression ''1.4 V_{SO}'' to read ''1.3 V_{SR0}''.

§ 25.177 [Amended]

17. Section 25.177 is amended in paragraph (c) by revising the expression ''1.2 V_{S1}'' to read ''1.13 V_{SR1}''.

§ 25.181 [Amended]

18. Section 25.181 is amended in paragraphs (a) introductory text and (b) by revising the reference ''1.2 V_S'' to read ''1.13 V_{SR}''.

19. Section 25.201 is amended by revising paragraphs (a)(2) and (b)(4) to read as follows:

§ 25.201 Stall demonstration.

(a) * * *

(2) The power necessary to maintain level flight at 1.5 V_{SR1} (where V_{SR1} corresponds to the reference stall speed with flaps in the approach position, the landing gear retracted, and the maximum landing weight).

(b) * * *

(4) The airplane trimmed for straight flight at the speed prescribed in § 25.103(a)(6).

* * * * *

20. Section 25.207 is amended by revising paragraphs (b) and (c), and by adding new paragraphs (d), (e), and (f) to read as follows:

§ 25.207 Stall warning.

* * * * *

(b) The warning must be furnished either through the inherent aerodynamic qualities of the airplane or by a device that will give clearly distinguishable indications under expected conditions of flight. However, a visual stall warning device that requires the attention of the crew within the cockpit is not acceptable by itself. If a warning device is used, it must provide a warning in each of the airplane configurations prescribed in paragraph (a) of this section at the speed prescribed in paragraphs (c) and (d) of this section.

(c) When the speed is reduced at rates not exceeding one knot per second, with engines idling and throttles closed, stall warning must begin, in each normal configuration, at a speed, V_{SW}, exceeding the reference stall speed by not less than three knots or three percent, whichever is greater. For the purposes of this paragraph, the reference stall speed is as defined in § 25.103, except that § 25.103(a)(5) does not apply. Stall warning must continue throughout the demonstration, until the angle of attack is reduced to approximately that at which stall warning is initiated.

(d) In addition to the requirements of paragraph (c) of this section, when devices that abruptly push the nose down at a selected angle of attack (e.g., stick pushers) are installed, the stall warning must occur at a speed not less than five knots or five percent, whichever is greater, above the speed at which the device activates.

(e) In slow-down turns up to 1.5g at entry rates up to 3 knots per second, with the flaps and landing gear in any normal position, the stall warning margin must be sufficient to allow the pilot to prevent stalling when recovery is initiated not less than one second after the onset of stall warning.

(f) Stall warning must also be provided in each abnormal configuration of the high lift devices that is likely to be used in flight following system failures (including all configurations covered by Airplane Flight Manual procedures).

§ 25.231 [Amended]

21. Section 25.231 is amended in paragraph (a)(2) by revising the word ''altitude'' to read ''attitude'' and by revising the expression ''80 percent of V_{S1}'' to read ''75 percent of V_{SR1}''.

§ 25.233 [Amended]

22. Section 25.233 is amended in paragraph (a) by revising the reference ''0.2 V_{S0}'' to read ''0.2 V_{SR0}''.

§ 25.237 [Amended]

23. Section 25.237 is amended in paragraphs (a), (b)(1), and (b)(2) by revising the reference ''0.2 V_{S0}'' to read ''0.2 V_{SR0}''.

24. Action 25.735 is amended by revising paragraphs (f)(2) and (g) to read as follows:

§ 25.735 Brakes.

* * * * *

(f) * * *

(2) Instead of a rational analysis, the kinetic energy absorption requirements for each main wheel brake assembly may be derived from the following formula, which must be modified in the case of unequal braking distribution, which assumes an equal distribution of braking between main wheels:

$KE=0.0443 (WV^2/N)$

where—

KE=Kinetic energy per wheel (ft.-lb.);

W=Design landing weight (lb.);

$V=V_{REF}/1.3$

V_{REF}=Airplane steady landing approach speed, in knots, at the maximum design landing weight and in the landing configuration at sea level; and

N=Number of main wheels with brakes.

(g) The minimum speed rating of each main wheel-brake assembly (that is, the initial speed used in the dynamometer tests) may not be more than the V used in the determination of kinetic energy in accordance with paragraph (f) of this section, assuming that the test procedures for wheel-brake assemblies involve a specified rate of deceleration, and, therefore, for the same amount of kinetic energy, the rate of energy absorption (the power absorbing ability of the brake) varies inversely with the initial speed.

§ 25.773 [Amended]

25. Section 25.773 is amended in paragraph (b)(1)(i) by revising the expression ''1.6 V_{S1}'' to read ''1.5 V_{SR1}''.

§ 25.1001 [Amended]

26. Section 25.1001 is amended in paragraphs (c)(1) and (c)(3) by revising the expression ''1.4 V_{S1}'' to read ''1.3 V_{SR1}''.

§ 25.1323 [Amended]

27. Section 25.1323 is amended in paragraph (c)(1) by revising the expression ''1.3 V_{S1}'' to read ''1.23 V_{SR1}'' and in paragraph (c)(2) by revising the expression ''1.3 V_{S0}'' to read ''1.23 V_{SR0}''.

§ 25.1325 [Amended]

28. Section 25.1325 is amended in paragraph (e) by revising the expressions ''1.3 V_{S0}'' and ''1.8 V_{S1}'' to read ''1.23 V_{SR0}'' and ''1.7 V_{SR1}'', respectively.

§ 25.1587 [Amended]

29. Section 25.1587 is amended in paragraph (b)(2) by revising the expression ''V_S'' to read ''V_{SR}''.

PART 36—NOISE STANDARDS: AIRCRAFT TYPE AND AIRWORTHINESS CERTIFICATION

30. The authority citation for part 36 continues to read as follows:

Authority: 42 U.S.C. 4321 *et seq.*, 49 U.S.C. 106(g), 40113, 44701–44702, 44704, 44715; sec. 305, Pub. L. 96–193, 94 Stat. 50, 57; E.O. 11514, 35 FR 4247, 3 CFR, 1966–1970 comp., p. 902.

31. Appendix C to part 36, Section C36.9 is amended by revising paragraph (e)(1) to read as follows:

Appendix C to Part 36—Noise Levels for Transport Category and Turbojet Powered Airplanes Under § 36.201

* * * * *

Sec. C36.9 Approach Reference and Test Limitations

* * * * *

(e) * * *

(1) For subsonic airplanes a steady approach speed of V_{REF} + 10 knots must be established and maintained over the approach measuring point.

* * * * *

PART 97—STANDARD INSTRUMENT APPROACH PROCEDURES

32. The authority citation for part 97 is revised to read as follows:

Authority: 49 U.S.C. 106(g), 40103, 40106, 40113, 40114, 40120, 44502, 44514, 44701, 44719, 44721–44722.

33. Section 97.3 is amended by revising the first two sentences of paragraph (b) introductory text to read as follows:

§ 97.3 Symbols and terms used in procedures.

* * * * *

(b) *Aircraft approach category* means a grouping of aircraft based on a speed of V_{REF} at the maximum certificated landing weight. V_{REF} and the maximum certificated landing weight are those values as established for the aircraft by the certification authority of the country of registry. * * *

* * * * *

Issued in Washington, DC on November 29, 1995.

Thomas E. McSweeny,

Director, Aircraft Certification Service.

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