U.S. Department
of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Stall and Spin Awareness Training | **Date:** 9/20/07 | **AC No:** 61-67C
Initiated by: AFS-810 | **Change:** 1

1. PURPOSE. This advisory circular (AC) has been updated to reflect new resources for sport pilots and warnings about design maneuvering speed.

2. PRINCIPLE CHANGES. This change updates resources for sport pilots and warnings about design maneuvering speed.

a. Paragraph 2b(12) adds Sports Pilot Practical Test Standards.

b. Paragraph 5 contains the proper Internet address for this AC.

c. Paragraph 100f adds information regarding design maneuvering speed.

d. Paragraph 100g adds information regarding load factor.

PAGE CONTROL CHART

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Subject: Stall and Spin Awareness Training **Date:** 9/20/07 **AC No:** 61-67C
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1. PURPOSE. This advisory circular (AC) explains the stall and spin awareness training required under Title 14 of the Code of Federal Regulations (14 CFR) part 61 and offers guidance to flight instructors who provide it. This AC also informs pilots of the airworthiness standards for the type certification of normal, utility, and acrobatic category airplanes prescribed in 14 CFR part 23, § 23.221, concerning spin maneuvers, and it emphasizes the importance of observing restrictions that prohibit the intentional spins of certain airplanes.

2. RELATED READING MATERIAL (current editions).

a. Report No. FAA-RD-77-26, General Aviation Pilot Stall Awareness Training Study. This document may be purchased from the National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161. To order by telephone call: (800) 553-6847. The NTIS identification number is ADA041310.

b. The following documents are available on the Internet at http: www.faa.gov/.

(1) AC 61-65, Certification: Pilots and Flight and Ground Instructors.

(2) FAA-H-8083-1, Aircraft Weight and Balance Handbook.

(3) FAA-H-8083-3, Airplane Flying Handbook.

(4) FAA-H-8083-9, Aviation Instructor's Handbook.

(5) FAA-S-8081-3, Recreational Pilot - Practical Test Standards for Airplane and Rotorcraft.

(6) FAA-S-8081-6, Flight Instructor - Practical Test Standards for Airplane (Single-Engine/ Multiengine).

(7) FAA-S-8081-8, Flight Instructor - Practical Test Standards for Glider.

(8) FAA-S-8081-12, Commercial Pilot - Practical Test Standards for Airplane.

(9) FAA-S-8081-14, Private Pilot - Practical Test Standards for Airplane.

(10) FAA-S-8081-22, Private Pilot - Practical Test Standards for Glider.

(11) FAA-S-8081-23, Commercial Pilot - Practical Test Standards for Glider.

(12) FAA-S-8081-29, Sport Pilot - Practical Test Standards for Airplane, Gyroplane, Glider, Flight Instructor.

(13) FAA-S-8081-31, Sport Pilot - Practical Standards for Weight Shift Control, Powered Parachute, Flight Instructor.

3. BACKGROUND. In January 1980, the Federal Aviation Administration (FAA) announced its policy of incorporating the use of certain distractions during the performance of flight test maneuvers. This policy came about as a result of Report No. FAA-RD-77-26, General Aviation Pilot Stall Awareness Study, which revealed that stall/spin related accidents accounted for approximately one-quarter of all fatal general aviation accidents. National Transportation Safety Board (NTSB) statistics indicate that most stall/spin accidents result when a pilot is distracted momentarily from the primary task of flying the aircraft. Changes to part 61, completed in 1991, included increased stall and spin awareness training for recreational, private, and commercial pilot certificate applicants. The training is intended to emphasize recognition of situations that could lead to an inadvertent stall and/or spin by using realistic distractions such as those suggested in Report No. FAA-RD-77-26 and incorporated into the performance of flight test maneuvers. Although the training is intended to emphasize stall and spin awareness and recovery techniques for all pilots, only flight instructor-airplane and flight instructor-glider candidates are required to demonstrate instructional proficiency in spin entry, spins, and spin recovery techniques as a requirement for certification. Part 61 was extensively updated in 1997. Sections of part 23 (Airworthiness Standards: Normal, Utility, Acrobatic, and Commuter Category Airplanes) that apply to spin requirements and placards have changed. This AC incorporates those changes.

4. COMMENTS INVITED. Comments regarding this publication should be directed to:

Federal Aviation Administration
General Aviation and Commercial Division, AFS-800
800 Independence Ave., S.W.
Washington, DC 20591

Every comment will not necessarily generate a direct acknowledgment to the commenter. Comments received will be considered in the development of upcoming AC revisions or other related technical material.

5. INTERNET. AC 61-67C, Stall and Spin Awareness Training, can be accessed on the Internet at http://rgl.faa.gov/.

CONTENTS

CHAPTER 1. GROUND TRAINING: STALL AND SPIN AWARENESS

100. STALL/SPIN EFFECTS AND DEFINITIONS. A stall occurs when the smooth airflow over the airplane's wing is disrupted, and the lift degenerates rapidly. This is caused when the wing exceeds its critical angle of attack. This can occur at any airspeed, in any attitude, with any power setting. If recovery from a stall is not achieved in a timely and appropriate manner by reducing the Angle of Attack (AOA), a secondary stall and/or a spin may result. All spins are preceded by a stall on at least part of the wing. The angle of the relative wind is determined primarily by the aircraft's airspeed and attitude. Factors such as aircraft weight, center of gravity, configuration, and the amount of acceleration used in a turn are also considered. The speed at which the critical angle of the relative wind is exceeded is the stall speed. Stall speeds are listed in the Airplane Flight Manual (AFM) or the Pilot Operating Handbook (POH) and pertain to certain conditions or aircraft configurations, e.g., landing configuration. Other specific operational speeds are calculated based upon the aircraft's stall speed in the landing configuration. Airspeed values specified in the AFM or POH may vary under different circumstances. Factors such as weight, center of gravity, altitude, temperature, turbulence, and the presence of snow, ice, or frost on the wings will affect an aircraft's stall speed. To thoroughly understand the stall/spin phenomenon, some basic factors affecting aircraft aerodynamics and flight should be reviewed with particular emphasis on their relation to stall speeds. Much of the information in this AC is also applicable to gliders. The following terms are defined as they relate to stalls/spins.

a. Angle of Attack. AOA is the angle at which the chord line of the wing meets the relative wind. The chord line is a straight line drawn through the profile of the wing connecting the extremities of the leading edge and trailing edge. The AOA must be small enough to allow attached airflow over and under the airfoil to produce lift. AOA is an element of lift. Change in AOA will affect the amount of lift that is produced. An excessive AOA will disrupt the flow of air over the airfoil. If the AOA is not reduced, a section of the airfoil will reach its critical AOA, lose lift, and stall. Exceeding the critical AOA for a particular airfoil section will always result in a stall of that section.

b. Airspeed. Airspeed is controlled primarily by the elevator or longitudinal control position for a given configuration and power. Conversely, airspeed is controlled by power at a given configuration and AOA. If an airplane's speed is too slow, the AOA required for level flight will be so large that the air can no longer follow the upper curvature of the wing. The result is a separation of airflow from the wing, loss of lift, a large increase in drag, and eventually a stall if the AOA is not reduced. The stall is the result of excessive AOA - not insufficient airspeed. For example, at a 60° banked turn in level coordinated flight, the load factor is 2 G's and the stall speed increases 40 percent over the straight and level stall speed. A stall can occur at any airspeed, in any attitude, at any power setting.

c. Configuration. Flaps, landing gear, and other configuring devices can affect an airplane's stall speed. Extension of flaps and/or landing gear in flight will increase drag. Flap extension will generally increase the lifting ability of the wings, thus reducing the airplane's stall speed. The effect of flaps on an airplane's stall speed can be seen by markings on the airplane's airspeed indicator, where the lower airspeed limit of the white arc (power-off stall speed with gear and flaps in the landing configuration) is less than the lower airspeed limit of the green arc (power-off stall speed in the clean configuration).

d. V_{SO}. V_{SO} is the stall speed or the minimum steady flight speed in the landing configuration.

e. V_{S1}. V_{S1} is the stall speed or the minimum steady flight speed obtained in a specified configuration.

f. V_A. V_A is the design maneuvering speed. Do not use full or abrupt control movements at or above this speed. It is possible to exceed the airplane structural limits at or above V_A. Rapid and large alternating control inputs, especially in combination with large changes in pitch, roll, or yaw (e.g., large side slip angles) may result in structural failures at any speed, even below V_A.

g. Load Factor. Load factor is the ratio of the lifting force produced by the wings to the actual weight of the airplane and its contents. Load factors are usually expressed in terms of “G.” The aircraft's stall speed increases in proportion to the square root of the load factor. For example, an airplane that has a normal unaccelerated stall speed of 45 knots can be stalled at 90 knots when subjected to a load factor of 4 G's. The possibility of inadvertently stalling the airplane by increasing the load factor (i.e., by putting the airplane in a steep turn or spiral) is much greater than in normal cruise flight. When an airplane stalls at a higher indicated air speed due to excessive maneuvering loads, it is called an accelerated maneuver stall. A stall entered from straight and level flight or from an unaccelerated straight climb will not produce additional load factors. In a constant rate turn, increased load factors will cause an airplane's stall speed to increase as the angle of bank increases. Excessively steep banks should be avoided because the airplane will stall at a much higher speed. If the aircraft exceeds maneuvering speed, structural damage to the aircraft may result before it stalls. If the nose falls during a steep turn, the pilot might attempt to raise it to the level flight attitude without shallowing the bank. This situation tightens the turn and can lead to a diving spiral. A feeling of weightlessness will result if a stall recovery is performed by abruptly pushing the elevator control forward, which will reduce the up load on the wings. Recoveries from stalls and spins involve a tradeoff between loss of altitude (and an increase in airspeed) and an increase in load factor in the pullup. However, recovery from the dive following spin recovery generally causes higher airspeeds and consequently higher load factors than stall recoveries due to the much lower position of the nose. Significant load factor increases are sometimes induced during pullup after recovery from a stall or spin. It should be noted that structural damage can result from the high load factors that could be imposed on the aircraft by intentional stalls practiced above the airplane's design maneuvering speed. Large, aggressive control reversals can also lead to loads that can exceed the structural design limits, even at speeds below the airplane’s design maneuvering speed.

h. Center of Gravity (CG). The CG location has a direct effect on the effective lift and AOA of the wing, the amount and direction of force on the tail, and the degree of stabilizer deflection needed to supply the proper tail force for equilibrium. The CG position, therefore, has a significant effect on stability and stall/spin recovery. As the CG is moved aft, the amount of elevator deflection needed to stall the airplane at a given load factor will be reduced. An increased AOA will be achieved with less elevator control force. This could make the entry into inadvertent stalls easier, and during the subsequent recovery, it would be easier to generate higher load factors due to the reduced elevator control forces. In an airplane with an extremely aft CG, very light back elevator control forces may lead to inadvertent stall entries and if a spin is entered, the balance of forces on the airplane may result in a flat spin. Recovery from a flat spin is often impossible. A forward CG location will often cause the stalling AOA to be reached at a higher airspeed. Increased back elevator control force is generally required with a forward CG location.

i. Weight. Although the distribution of weight has the most direct effect on stability, increased gross weight can also have an effect on an aircraft's flight characteristics, regardless of the

CG position. As the weight of the airplane is increased, the stall speed increases. The increased weight requires a higher AOA to produce additional lift to support the weight.

j. Altitude and Temperature. Altitude has little or no effect on an airplane's indicated stall speed. Thinner air at higher altitudes will result in decreased aircraft performance and a higher true airspeed for a given indicated airspeed. Higher than standard temperatures will also contribute to increased true airspeed for a given indicated airspeed. However, the higher true airspeed has no effect on indicated approach or stall speeds. The manufacturer's recommended indicated airspeeds should therefore be maintained during the landing approach, regardless of the elevation or the density altitude at the airport of landing.

k. Snow, Ice, or Frost on the Wings. Even a small accumulation of snow, ice, or frost on an aircraft's surface can cause an increase in that aircraft's stall speed. Such accumulation changes the shape of the wing, disrupting the smooth flow of air over the surface and, consequently, increasing drag and decreasing lift. Flight should not be attempted when snow, ice, or frost have accumulated on the aircraft surfaces.

l. Turbulence. Turbulence can cause an aircraft to stall at a significantly higher airspeed than in stable conditions. A vertical gust or windshear can cause a sudden change in the relative wind, and result in an abrupt increase in AOA. Although a gust may not be maintained long enough for a stall to develop, the aircraft may stall while the pilot is attempting to control the flightpath, particularly during an approach in gusty conditions. When flying in moderate to severe turbulence or strong crosswinds, a higher than normal approach speed should be maintained. In cruise flight in moderate or severe turbulence, an airspeed well above the indicated stall speed and below maneuvering speed should be used. Maneuvering speed is lower at a lower weight.

101. DISTRACTIONS. Stalls resulting from improper airspeed management are most likely to occur when the pilot is distracted by one or more other tasks, such as locating a checklist or attempting a restart after an engine failure; flying a traffic pattern on a windy day; reading a chart or making fuel and/or distance calculations; or attempting to retrieve items from the floor, back seat, or glove compartment. Pilots at all skill levels should be aware of the increased risk of entering into an inadvertent stall or spin while performing tasks that are secondary to controlling the aircraft.

102. WING CONTAMINATION EFFECTS ON STALL WARNING, STALL SPEED, AND POSTSTALL RECOVERY. Stall speeds and stall characteristics are usually determined with uncontaminated airfoils. For airplanes that are certified for flight in icing conditions, ice shapes may have also been considered for their effects on aircraft. However, not all possible icing conditions and configurations can be tested. Icing is the primary concern, but any contamination or alteration of the leading edge caused by factors such as mud, insect residue, or ice can significantly alter the aerodynamic characteristics of the wing, but it is icing that is of primary concern.

a. In some icing conditions there are adverse changes to the stall speed, stall characteristics, performance, and handling characteristics of the airplane. These adverse changes are potentially hazardous for several reasons. First, aerodynamic stall may occur with little or none of the usual cues in advance. These cues include airframe or control surface buffet, reduced control effectiveness, and activation of the stall warning horn, stick shaker, and stick pusher. Next, because insufficient power or thrust to increase speed while holding constant altitude to reduce the AOA. Finally, postal recovery of a contaminated airplane may be complicated by gross changes in control effectiveness, airplane response characteristics, and abnormal control forces. As a result of these factors, large losses in altitude can occur during recovery.

b. Accordingly, in these conditions, a prompt control input to decrease pitch attitude to recover lateral control, with aggressive power application ensures the most rapid recovery with minimum altitude loss. The AOA must be reduced immediately as the wing, or part of the wing is already stalled and no margin remains to allow holding altitude/ attitude as power is applied. The pilot should note the AOA (or airspeed) at upset and not approach that AOA (airspeed) during the recovery or another upset may occur. This AOA may be well below the normal stall AOA (below shaker AOA) and the airspeed may be well above normal stall airspeed. Stall speed increases as high as 50 knots have been observed in post upset data review.

c. Further complications involve use of the autopilot. The autopilot may apply control inputs that will mask detection of some of these tactile cues by the pilot or attempt to control the airplane in the stall. Sudden autopilot self-disconnect with control surfaces trimmed into extreme positions or with controls trimmed into uncoordinated flight will complicate poststall recovery and may lead to a spin or spiral.

103. STALL RECOGNITION. There are several ways to recognize that a stall is impending before it actually occurs. When one or more of these indicators is noted, initiation of a recovery should be instinctive (unless a full stall is being practiced intentionally from an altitude that allows recovery at least 1,500 feet above ground level (AGL) for single-engine airplanes and 3,000 feet AGL for multiengine airplanes). One indication of a stall is a mushy feeling in the flight controls and less control effect as the aircraft's speed is reduced. This reduction in control effectiveness is attributed in part to reduced airflow over the flight control surfaces. In fixed pitch propeller airplanes, a loss of revolutions per minute (rpm) may be evident when approaching a stall in power-on conditions. For both airplanes and gliders, a reduction in the sound of air flowing along the fuselage is usually evident. Just before the stall occurs, buffeting, uncontrollable pitching, or vibrations may begin. Many aircraft are equipped with stall warning devices that will alert the pilot 4 to 8 knots prior to the onset of a stall. Finally, kinesthesia (the sensing of changes in direction or speed of motion), when properly learned and developed, will warn the pilot of a decrease in speed or the beginning of a mushing of the aircraft. These preliminary indications serve as a warning to the pilot to increase airspeed by adding power, lowering the nose, and/or decreasing the angle of bank.

104. TYPES OF STALLS. Stalls can be practiced both with and without power. Stalls should be practiced to familiarize the student with the aircraft's particular stall characteristics without putting the aircraft into a potentially dangerous condition. In multiengine airplanes, single-engine stalls must be avoided. Descriptions of some different types of stalls follows:

a. Power-off stalls (also known as approach-to-landing stalls) are practiced to simulate normal approach-to-landing conditions and configuration. Many stall/spin accidents have occurred in these power-off situations, such as crossed control turns from base leg to final approach (resulting in a skidding or slipping turn); attempting to recover from a high sink rate on final approach by using only an increased pitch attitude; and improper airspeed control on final approach or in other segments of the traffic pattern.

b. Power-on stalls (also known as departure stalls) are practiced to simulate takeoff and climbout conditions and configuration. Many stall/spin accidents have occurred during these phases of flight, particularly during go-arounds. A causal factor in such accidents has been the pilot's failure to maintain positive control due to a nose-high trim setting or premature flap retraction, and during short field takeoffs has also been a causal accident factor.

c. Accelerated stalls can occur at higher-than-normal airspeeds due to abrupt and/or excessive control applications. These stalls may occur in steep turns, pullups, or other abrupt changes in flightpath. Accelerated stalls usually are more severe than unaccelerated stalls and are often unexpected because they occur at higher-than-normal airspeeds.

105. STALL RECOVERY. The key factor in recovering from a stall is regaining positive control of the aircraft by reducing the AOA. At the first indication of a stall, the aircraft AOA must be decreased to allow the wings to regain lift. Every aircraft in upright flight may require a different amount of forward pressure or relaxation of elevator back pressure to regain lift. It should be noted that too much forward pressure can hinder recovery by imposing a negative load on the wing. The next step in recovering from a stall is to smoothly apply maximum allowable power (if applicable) to increase the airspeed and to minimize the loss of altitude. Certain high performance airplanes may require only an increase in thrust and relaxation of the back pressure on the yoke to effect recovery. As airspeed increases and the recovery is completed, power should be adjusted to return the airplane to the desired flight condition. Straight and level flight should be established with full coordinated use of the controls. The airspeed indicator or tachometer, if installed, should never be allowed to reach their high speed red lines at anytime during a practice stall.

106. SECONDARY STALLS. If recovery from a stall is not made properly, a secondary stall or a spin may result. A secondary stall is caused by attempting to hasten the completion of a stall recovery before the aircraft has regained sufficient flying speed. When this stall occurs, appropriate forward pressure or the relaxation of back elevator pressure should again be performed just as in a normal stall recovery. When sufficient airspeed has been regained, the aircraft can then be returned to straight and level flight.

107. SPINS. A spin may be defined as an aggravated stall that results in what is termed “autorotation” wherein the airplane follows a downward corkscrew path. As the airplane rotates around a vertical axis, the rising wing is less stalled than the descending wing creating a rolling, yawing, and pitching motion. The airplane is basically being forced downward by gravity, rolling, yawing, and pitching in a spiral path.

108. WEIGHT AND BALANCE. Minor weight or balance changes can affect an aircraft's spin characteristics. For example, the addition of a suitcase in the aft baggage compartment will affect the weight and balance of the aircraft. An aircraft that may be difficult to spin intentionally in the utility category (restricted aft CG and reduced weight) could have less resistance to spin entry in the normal category (less restricted aft CG and increased weight) due to its ability to generate a higher AOA and increased load factor. Furthermore, an aircraft that is approved for spins in the utility category, but loaded in the normal category, may not be recoverable from a spin that is allowed to progress beyond one turn or 3-second spin, whichever is longer (refer to § 23.221(a)).

109. PRIMARY CAUSE. The primary cause of an inadvertent spin is exceeding the critical AOA while applying excessive or insufficient rudder and, to a lesser extent, aileron. Insufficient or excessive control inputs to correct for Power Factor (PF), or asymmetric propeller loading, could aggravate the precipitation of a spin. At a high AOA the downward moving blade, which is normally on the right side of the propeller arc, has a higher AOA and therefore higher thrust than the upward moving blade on the left. This results in a tendency for the airplane to yaw around the vertical axis to the left. If insufficient or excessive rudder correction is applied to counteract PF, uncoordinated flight may result. A classic situation where PF could play an important role in a stall/spin accident is during a go-around or short field takeoff where the airplane is at a high pitch attitude, high power setting, and low airspeed. In an uncoordinated maneuver, the pitot/static instruments, especially the altimeter and airspeed indicator, are unreliable due to the uneven distribution of air pressure over the fuselage. The pilot may not be aware that a critical AOA is approaching until the stall warning device activates. If a stall recovery is not promptly initiated, the airplane is more likely to enter an inadvertent spin. For example, stall/spin accidents have occurred during a turn from base to final because the pilot attempted to rudder the airplane around (skid) so as not to overshoot the runway nor use excessive bank angle in the traffic pattern. The spin that occurs from cross controlling an aircraft usually results in rotation in the direction of the rudder being applied, regardless of which wingtip is raised. In a skidding turn, where both aileron and rudder are applied in the same direction, rotation will be in the direction the controls are applied. However, in a slipping turn, where opposite aileron is held against the rudder, the resultant spin will usually occur in the direction opposite the aileron that is being applied.

110. TYPES OF SPINS.

a. An incipient spin is that portion of a spin from the time the airplane stalls and rotation starts, until the spin becomes fully developed. Incipient spins that are not allowed to develop into a steady state spin are commonly used as an introduction to spin training and recovery techniques.

b. A fully developed, steady state spin occurs when the aircraft angular rotation rate, airspeed, and vertical speed are stabilized from turn-to-turn in a flightpath that is close to vertical.

c. A flat spin is characterized by a near level pitch and roll attitude with the spin axis near the CG of the airplane. Recovery from a flat spin may be extremely difficult and, in some cases, impossible.

111. SPIN RECOVERY. Before flying any aircraft, in which spins are to be conducted, the pilot should be familiar with the operating characteristics and standard operating procedures, including spin recovery techniques, specified in the approved AFM or POH. The first step in recovering from an upright spin is to close the throttle completely to eliminate power and minimize the loss of altitude. If the particular aircraft spin recovery techniques are not known, the next step is to neutralize the ailerons, determine the direction of the turn, and apply full opposite rudder. When the rotation slows, briskly move the elevator control forward to approximately the neutral position. Some aircraft require merely a relaxation of back pressure; others require full forward elevator control pressure. Forward movement of the elevator control will decrease the AOA. Once the stall is broken, the spinning will stop. Neutralize the rudder when the spinning stops to avoid entering a spin in the opposite direction. When the rudder is neutralized, gradually apply enough aft elevator pressure to return to level flight. Too much or abrupt aft elevator pressure and/or application of rudder and ailerons during the recovery can result in a secondary stall and possibly another spin. If the spin is being performed in an airplane, the engine will sometimes stop developing power due to centrifugal force acting on the fuel in the airplane's tanks causing fuel interruption. It is, therefore, recommended to assume that power is not available when practicing spin recovery. As a rough estimate, an altitude loss of approximately 500 feet per each 3-second turn can be expected in most small aircraft in which spins are authorized. Greater losses can be expected at higher density altitudes.

112. SPIRAL MODE RECOVERY. The spiral mode is an autorotation mode similar to a spin. The center of rotation is close to the centerline of the airplane but the airplane is not stalled. Many airplanes and gliders will not spin at forward CG locations but will spiral. Many airplanes will enter a spin but the spin will become more vertical and degenerate into a spiral. It is important to note that when the spin transitions into the spiral the airspeed will increase as the nose goes down to near vertical. The side forces on the airplane build very rapidly and recovery must be effected immediately before exceeding the structural limits of the airplane. Release the back pressure on the stick (yoke), neutralize the rudder and recover from the steep dive. As in stall and spin recovery, avoid abrupt or excessive elevator inputs that could lead to a secondary stall.

113. THRU 199. RESERVED.

CHAPTER 2. FLIGHT TRAINING: STALLS

200. STALL TRAINING. Flight instructor-airplane and flight instructor-glider applicants must be able to give stall training. The flight instructor should emphasize that techniques and procedures for each aircraft may differ and that pilots should be aware of the flight characteristics of each aircraft flown. The most effective training method contained in Report No. FAA-RD-77-26, General Aviation Pilot Stall Awareness Study, is the simulation of scenarios that can lead to inadvertent stalls by creating distractions while the student is practicing certain maneuvers. Stall demonstrations and practice, including maneuvering during slow flight and other maneuvers with distractions that can lead to inadvertent stalls, should be conducted at a sufficient altitude to enable recovery above 1,500 feet AGL in single-engine airplanes and 3,000 feet AGL in multiengine airplanes. Because of the possible catastrophic consequences, single-engine stalls should not be demonstrated or practiced in multiengine airplanes. Airplanes with normally aspirated engines will lose power as altitude increases because of the reduced density of the air entering the induction system of the engines. This loss of power will result in a V_{MC} lower than the stall speed at higher altitudes. (V_{MC} is the minimum control speed with the critical engine inoperative). Also, some airplanes have such an effective rudder that even at sea level V_{MC} is lower than stall speed. For these airplanes, demonstrating loss of directional control may be safely conducted by limiting rudder travel to simulate maximum rudder available. Limiting rudder travel should be accomplished well above the power-off stall speed (approximately 20 knots). This will avoid the hazards of stalling one wing with the maximum allowable power applied to the engine on the other wing. The flight training required by part 61 does not entail the actual practicing of spins for other than flight instructor-airplane and flight instructor-glider applicants, but emphasizes stall and spin avoidance. The following training elements are based on Report No. FAA-RD-77-26:

a. Stall Avoidance Practice at Slow Airspeeds.

(1) Assign a heading and an altitude. Have the student reduce power and slow to an airspeed just above the stall speed, using trim as necessary.

(2) Have the student maintain heading and altitude with the stall warning device activated.

(3) Demonstrate the effect of elevator trim (use neutral and full noseup settings) and rudder trim, if available.

(4) Note the left turning tendency and rudder effectiveness for lateral/directional control.

(5) Emphasize how right rudder pressure is necessary to center the ball indicator and maintain heading.

(6) Release the rudder and advise the student to observe the left yaw.

(7) Adverse yaw demonstration. While at a low airspeed, have the student enter left and right turns without using rudder pedals.

(8) Have the student practice turns, climbs, and descents at low airspeeds.

(9) Demonstrate the proper flap extension and retraction procedures while in level flight to avoid a stall at low airspeeds. Note the change in stall speeds with flaps extended and retracted.

(10) Utilize realistic distractions at low airspeeds. Give the student a task to perform while flying at a low airspeed. Instruct the student to divide his/her attention between the task and flying the aircraft to maintain control and avoid a stall. The following distractions can be used:

(a) Drop a pencil. Ask the student to pick it up.

(b) Ask the student to determine a heading to an airport using a chart.

(c) Ask the student to reset the clock to Universal Coordinated Time.

(d) Ask the student to get something from the back seat.

(e) Ask the student to read the outside air temperature.

(f) Ask the student to call the Flight Service Station (FSS) for weather information.

(g) Ask the student to compute true airspeed with a flight computer.

(h) Ask the student to identify terrain or objects on the ground.

(i) Ask the student to identify a field suitable for a forced landing.

(j) Have the student climb 200 feet and maintain altitude, then descend 200 feet and maintain altitude.

(k) Have the student reverse course after a series of S-turns.

(11) Fly at low airspeeds with the airspeed indicator covered. Use various flap settings and distractions.

b. Power-on (Departure) Stall.

(1) At a safe altitude, have the student attempt coordinated power-on (departure) stalls straight ahead and in turns. Emphasize how these stalls could occur during takeoff.

(2) Ask the student to demonstrate a power-on (departure) stall and distract him/her just before the stall occurs. Explain any effects the distraction may have had on the stall or recovery.

c. Engine Failure in a Climb Followed by a Gliding Turn. This demonstration will show the student how much altitude the airplane loses following a power failure after takeoff and during a turn back to the runway and why returning to the airport after losing an engine is not a recommended procedure. This can be performed using either a medium or a steep bank in the turn, but emphasis should be given to stall avoidance.

(1) Set up best rate of climb (V_Y). Directly below you there should be a straight line landmark (i.e., road or power line) parallel to your flightpath.

(2) Reduce power smoothly to idle as the airplane passes through a cardinal altitude.

(3) Lower the nose to maintain the best glide speed and make a 260° turn at the best glide speed. Emphasize that this turn should be into the wind (if there is a crosswind).

(4) Re-intercept your final outbound course over the landmark you chose, inbound with an 80° turn in the opposite direction.

(5) Point out the altitude loss and emphasize how rapidly airspeed decreases following a power failure in a climb attitude.

NOTE: Depending on winds, length of runway, and altitude the 260/80° turns may need to be modified (250/70° or 270/90°) to meet the existing situation.

d. Cross Controlled Stalls in Gliding Turns. Perform stalls in gliding turns to simulate turns from base to final. Perform the stalls from a properly coordinated turn, a slipping turn, and a skidding turn. Explain the difference between slipping and skidding turns. Explain the ball indicator position in each turn and the aircraft behavior in each of the stalls.

e. Power-off (Approach-To-Landing) Stalls.

(1) Have the student perform a full-flap, gear extended, power-off stall with the correct recovery and cleanup procedures. Note the loss of altitude.

(2) Have the student repeat this procedure and distract the student during the stall and recovery and note the effect of the distraction. Show how errors in flap retraction procedure can cause a secondary stall.

f. Stalls During Go-arounds.

(1) Have the student perform a full-flap, gear extended, power-off stall, then recover and attempt to climb with flaps extended. If a higher than normal climb pitch attitude is held, a secondary stall will occur. (In some airplanes, a stall will occur if a normal climb pitch attitude is held).

(2) Have the student perform a full-flap, gear extended, power-off stall, then recover and retract the flaps rapidly as a higher than normal climb pitch attitude is held. A secondary stall or settling with a loss of altitude may result.

g. Elevator Trim Stall.

(1) Have the student place the airplane in a landing approach configuration, in a trimmed descent.

(2) After the descent is established, initiate a go-around by adding full power, holding only light elevator and right rudder pressure.

(3) Allow the nose to pitch up and torque to swerve the airplane left. At the first indication of a stall, recover to a normal climbing pitch attitude.

(4) Emphasize the importance of correct attitude control, application of control pressures, and proper trim during go-arounds.

201. THRU 299. RESERVED.

CHAPTER 3. FLIGHT TRAINING: SPINS

300. SPIN TRAINING. Spin training is required for flight instructor-airplane and flight instructor-glider applicants only. Upon completion of the training, the applicant's log book or training record should be endorsed by the flight instructor who provided the training. A sample endorsement of spin training for flight instructor applicants is available in the current edition of AC 61-65, Certification: Pilots and Flight and Ground Instructors.

a. Spin training must be accomplished in an aircraft that is approved for spins. Before practicing intentional spins, the AFM or POH should be consulted for the proper entry and recovery techniques.

b. The training should begin by practicing both power-on and power-off stalls to familiarize the applicant with the aircraft's stall characteristics. Spin avoidance, incipient spins, actual spin entry, spin, and spin recovery techniques should be practiced from an altitude above 3,500 feet AGL.

c. Spin avoidance training should consist of stalls and maneuvering during slow flight using realistic distractions such as those listed in chapter 2. Performance is considered unsatisfactory if it becomes necessary for the instructor to take control of the aircraft to avoid a fully developed spin.

d. Incipient spins should be practiced to train the instructor applicant to recover from a student's poorly performed stall or unusual attitude that could lead to a spin. Configure the aircraft for a power-on or power-off stall, and continue to apply back elevator pressure. As the stall occurs, apply right or left rudder and allow the nose to yaw toward the stalled wing. Release the spin inducing controls and recover as the spin begins by applying opposite rudder and forward elevator pressure. The instructor should discuss control application in the recovery.

e. Spin entry, spin, and spin recovery should be demonstrated by the instructor and repeated in both directions by the applicant.

(1) Apply the entry procedure for a power-off stall. As the airplane approaches a stall, smoothly apply full rudder in the direction of desired spin rotation and continue to apply back elevator to the limit of travel. The ailerons should be neutral.

(2) Allow the spin to develop, and be fully recovered no later than one full turn. Observe the airspeed indicator during the spin and subsequent recovery to ensure that it does not reach the red line (V_{NE}).

(3) Follow the recovery procedures recommended by the manufacturer in the AFM or POH. In most aircraft, spin recovery techniques consist of retarding power (if in a powered aircraft), applying opposite rudder to slow the rotation, neutralizing the ailerons, applying positive forward elevator movement to break the stall, neutralizing the rudder as the spinning stops, and returning to level flight.

f. During spin training if a spin is not fully developed, the aircraft may instead go into a spiral. A spiral may be recognized by a rapidly increasing airspeed after the attempted spin entry.

(In an actual spin, the airspeed normally stabilizes below stall speed). The pilot must recognize a spiral and initiate immediate recovery to prevent exceeding structural limits of the airplane.

301. SPIN TRAINING AND PARACHUTES. Part 91, § 91.307(c), prohibits the pilot of a civil aircraft from executing any intentional maneuver that exceeds 60° of bank relative to the horizon, or exceeds 30° noseup or nosedown attitude relative to the horizon, unless an approved parachute is worn by each occupant (other than a crewmember). Section 91.307(d) states, in part, that § 91.307(c) does not apply to flight tests for a pilot certificate or rating; or spins and other flight maneuvers required by the regulations for any certificate or rating when given by a certified flight instructor (CFI) or an airline transport pilot (ATP) instructing in accordance with § 61.167.

a. Section 61.183(i) requires an applicant for a flight instructor certificate or rating to receive flight training in stall awareness, spin entry, spins, and spin recovery procedures. The applicant must also possess and demonstrate instructional proficiency in these areas to receive the certificate or rating.

b. Because spin entry, spins, and spin recovery are required for a flight instructor certificate or rating, a person receiving instruction from a CFI (or an ATP instructing in accordance with § 61.167) need not wear an approved parachute while instruction is being provided in these maneuvers. This provision applies regardless of the certificate or rating for which the person is receiving training and also if the person is receiving instruction that is not being provided for the purpose of obtaining any additional certificate or rating. The instructor providing the training is also not required to wear an approved parachute while providing this flight training.

c. Any pilot or required crewmember may perform a maneuver that exceeds the limits prescribed in § 91.307(c) without wearing an approved parachute, provided there are no other occupants in the aircraft or the other occupants are wearing approved parachutes.

302. THRU 399. RESERVED.

CHAPTER 4. AIRWORTHINESS STANDARDS

400. OPERATING LIMITATIONS. Operating limitations are imposed for the safety of pilots and their passengers. Operations contrary to these restrictions are a serious compromise of safety. It is important that all pilots and flight and ground instructors, and pilot examiners apply the following information on spins to pilot training and flight operations.

a. Normal Category. These airplanes are not approved for performing acrobatic maneuvers, including spins, and are placarded against intentional spins. However, to provide a margin of safety when recovery from a stall is delayed, normal category airplanes are tested during certification and must be able to recover from a one turn spin or a 3-second spin, whichever takes longer, in no longer than one additional turn with the controls used in the normally used for recovery or demonstrating the airplane's resistance to spins. In addition for airplanes demonstrating compliance with one turn or 3-second requirements:

(1) For both the flaps retracted and flaps extended conditions, the applicable airspeed limit and positive limit maneuvering load factor must not be exceeded;

(2) No control forces or characteristic encountered during the spin of the recovery may adversely affect prompt recovery;

(3) It must be impossible to obtain uncontrollable spins with any use of the flight or engine power controls either at the entry or during the spin; and

(4) In extended condition, the flaps may be retracted during recovery but not before the rotation has ceased.

NOTE: Since airplanes certificated in the normal category have not been tested for more than a one turn or 3-second spin, their performance characteristics beyond these limits are unknown. This is the reason they are placarded against intentional spins.

b. Acrobatic Category. An acrobatic category airplane must meet the spin requirements for normal category aircraft and the following additional requirements:

(1) The airplane must recover from any point in a spin, up to and including six turns, or any greater number of turns for which certification is requested, in no more than one and a half additional turns after initiation of the first control action for recovery. However, beyond three turns, the spin may be discontinued if spiral characteristics appear.

(2) The applicable airspeed limits and limit maneuvering load factor must not be exceeded. For the flaps extended configuration for which approval is requested, the flaps must not be retracted during recovery.

(3) It must be impossible to obtain uncontrollable spins with any use of the flight or engine power controls either at the entry or during the spin.

(4) There must be no characteristics during the spin (such as excessive rates of rotation or extreme oscillatory motion) that might prevent a successful recovery due to disorientation or incapacitation of the pilot.

NOTE: Unless a greater number of turns are requested for certification acrobatic category airplanes have not been tested for more than six turns. The recovery characteristics for additional turns are unknown.

c. Utility Category. A utility category airplane must meet the spin requirements for both normal and acrobatic category airplanes and the applicable emergency exit requirements of § 23.807 if the aircraft is approved for spins.

401. PLACARDS. Under § 23.1567, all airplanes type-certificated under part 23 must have a flight maneuver placard containing the following information:

a. For normal category airplanes, there must be a placard in front of and in clear view of the pilot stating, "No acrobatic maneuvers, including spins, approved."

b. For utility category airplanes that meet the spin requirements, there must be a placard in front of and in clear view of the pilot stating, "Acrobatic maneuvers are limited to the following (list approved maneuvers and the recommended entry speed for each)."

c. For utility category airplanes that do not meet the spin requirements for acrobatic category airplanes, there must be an additional placard in clear view of the pilot stating: "Spins Prohibited."

d. For acrobatic category airplanes, there must be a placard in clear view of the pilot listing the approved acrobatic maneuvers and the recommended entry airspeed for each. If inverted flight maneuvers are not approved, the placard must include a notation to this effect.

e. For acrobatic category airplanes and utility category airplanes approved for spin, there must be a placard in clear view of the pilot listing the control actions for the recovery from spinning maneuvers; and stating that recovery must be initiated when spiral characteristics appear, or after not more than six turns or not more than any greater number of turns for which the airplane has been certificated.

402. PILOT AWARENESS. The pilot of an airplane placarded against intentional spins should assume that the airplane may become uncontrollable in a spin. In addition, stall warning devices should not be deactivated for pilot certification flight tests in airplanes for which they are required equipment.

403. THRU 499. RESERVED.