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MILITARY SPECIFICATION

STALL/POST-STALL/SPIN FLIGHT TEST DEMONSTRATION REQUIREMENTS FOR AIRPLANES

1. SCOPE

1.1 Scope. This specification contains the demonstration requirements of the stall and post-stall flight characteristics of piloted airplanes. Typical demonstration objectives subject to this specification are the verification of service and permissible angle of attack (AOA) limits, evaluation of natural and artificial stall and loss-of-control warning, and determination of out-of-control characteristics and recovery techniques. A purposeful, milestone approach to high AOA flight test is mandatory to determine compliance with the design requirements and obtain suitable information for the Flight Manual. Flight test demonstration requirements will be a function of airplane Class and specific direction from the procuring activity. Resistance to departure from controlled flight and prevention of departures shall be given the same attention as that directed toward recovery from post-stall gyrations (PSG) and spins.

1.2 Classification. An airplane shall be placed in a Class as specified in MIL-F-8785 (6.2.1[b]). When operational missions and design capabilities so indicate, an airplane of one Class may be required by the procuring activity to meet selected demonstration requirements ordinarily specified for airplanes of another Class. Generally, the most stringent demonstration requirements shall apply whenever an airplane fails to come clearly within one of two possible Classes.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

FSC 1500

SPECIFICATIONS

Military

MIL-F-8785	Flying Qualities of Piloted Airplanes
MIL-F-9490	Flight Control Systems - Design, Installation and Test of, Piloted Aircraft, General Specification For

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Application. Unless otherwise specified, the stall/post-stall flight characteristics shall be demonstrated in accordance with the provisions contained herein. Manned airplanes requiring lifting surfaces to cruise within the sensible atmosphere shall be tested in accordance with this specification. Aerospace vehicles whose mission includes boost-return, boost-orbit-reentry, low maneuverability/nonpowered approaches and landings, etc., normally will not be tested in accordance with this specification. V/STOL airplanes normally will be tested in accordance with this specification only when configured for flight in which the lift is derived primarily from free stream dynamic pressure rather than the propulsive system (6.2.1[c]).

3.2 Flight test vehicle. Except as specified in 3.2.1 through 3.2.4, the flight test vehicle shall be representative of the production airplane in all significant respects.

3.2.1 Emergency recovery device. An emergency recovery system, approved by the procuring activity, shall be provided for each Class I and IV stall/spin test vehicle and shall, when necessary, be specified by the procuring activity for

Class II and III test vehicles (6.2.1[d]). Such emergency devices shall be capable of effecting recovery within a reasonable altitude loss established by the contractor and approved by the procuring activity. The emergency recovery system shall be capable of successful operation under the most adverse flight conditions and control positions possible.

3.2.2 Flight test instrumentation. The contractor shall provide onboard instrumentation as approved by the procuring activity (6.2.1[e]). When very high angular rates are anticipated, variable range or additional rate gyros may be required to provide adequate resolution for the pre-stall and post-stall conditions. The frequency response of the instrumentation shall be adequate to measure high-frequency phenomena such as pre-stall buffet. Except when actuated during emergency situations, flight test auxiliary hydraulic and electrical systems shall not restrict the mission time of the test airplane. Actuation of the auxiliary electrical power system shall not interrupt data acquisition. Consideration shall be given to additional instrumentation for structural purposes when predictive studies or initial flight test results indicate that the airframe or store suspension equipment may experience stall/post-stall loads near or above design values.

3.2.3 Cockpit instrumentation and layout. Cockpit displays in the test vehicle, particularly instruments indicating airspeed, altitude, AOA, turn/slip, normal acceleration, stall warning, attitude reference, and engine parameters, shall be those types to be installed on the production airplane. When special AOA, sideslip, and yaw rate indicators are also provided, they shall be easily readable and compatible in operation with production indicators (e.g., dials turning in the same direction). Unless otherwise specified, controls such as switches for the onboard data recording system, voice tape recorder, gyro cage, and cameras shall be capable of operation from the pilot's position and from another crew station or remotely from the ground to alleviate pilot workload (6.2.1[f]). The production pilot restraint system shall be used after predictive studies and sufficient flight test results are available to indicate that crew station angular rates and accelerations will not incapacitate or greatly hinder the pilot during application of recovery controls.

3.2.4 Onboard cameras. Forward-looking cameras, both cockpit and external, shall be employed to document airplane motions; these cameras shall operate at 24 frames per second to allow true-time film review, and an adequate film supply shall be provided to insure representative documentation during each test mission. Onboard cameras that serve as an integral part of the quantitative data acquisition system may operate at any appropriate frame rate. Unless otherwise suitably instrumented, the emergency recovery system shall be covered by an onboard camera operating at an appropriate frame rate.

3.3 Accomplishment of flight test. The contractor shall be responsible for demonstrating the flight characteristics of the airplane in accordance with this specification. The contractor and flight test agency of the procuring activity, however, may share a predetermined percentage of the required maneuvers. The flight test agency may be assigned advisory test/engineering functions, witnessing duties, or actual test conduct activities that do not relieve the contractor of the prime demonstration requirements. When the airplane has a single set of controls, the procuring activity shall fly a number of missions agreed to between the contractor and procuring activity, with representative participation in each test phase (6.2.1[g]). When a second seat is available with cockpit controls, the procuring activity may provide a crewmember for all flights; in addition, a qualified service flight test pilot, as airplane commander, shall fly the number of flight test data missions agreed to between the contractor and procuring activity.

3.4 Flight test demonstration. Each airplane type shall demonstrate, by flight test according to table I, the degree of compliance with the stall warning, loss-of-control warning when required, resistance to loss of control, loss-of-control prevention, out-of-control recovery, and spin recovery criteria as specified in MIL-F-8785. Reasonably delayed recovery attempts after a stall or departure, and exaggerated misapplication of controls following a stall or departure, to simulate possible incorrect pilot responses, shall be investigated under the least conservative circumstances to ascertain the degree of spin susceptibility/resistance for operational users.

TABLE I

FLIGHT TEST DEMONSTRATION MANEUVERS

Test Phase	Maneuver Requirements					
	Control Application	Entry Conditions[1]				
		Smooth AOA Rate[3]		Abrupt AOA Rate[4]		Tactical[5]
		One g	Accelerated[2]	One g	Accelerated[2]	
A Stalls	Pitch control applied to achieve the specified AOA rate, roll and yaw controls neutral or small roll and yaw control inputs as normally required for the maneuver task. Recovery initiated after the pilot has a clear indication[6] of: (a) a definite g-break, or (b) a rapid, uncommanded angular motion, or (c) the aft stick stop has been reached and AOA is not increasing, or (d) sustained, intolerable buffet.	Class: I II III IV	Class: I II III IV	Class: I II III IV	Class: I IV	Class: I IV
B Stalls with Aggravated Control Inputs	Pitch control applied to achieve the specified AOA rate, roll and yaw controls as required for the maneuver task. When condition (a), (b), (c), or (d) from above has been attained, controls briefly misapplied,[7] intentionally or in response to unscheduled airplane motions, before recovery attempt is initiated.	Class: I II III IV	Class: I II III IV	Class: I II III IV	Class: I IV	Class: I IV
C Stalls with Aggravated and Sustained Control Inputs[11]	Pitch control applied to achieve the specified AOA rate, roll and yaw controls as required for the maneuver task. When condition (a), (b), (c), or (d) has been attained, controls are misapplied,[7,9] intentionally or in response to unscheduled airplane motions, and held for three seconds[8,9] before recovery attempt is initiated.	Class: I II IV	Class: I II IV	Class: I II IV	Class: I IV	Class: I IV
D Post-Stall Gyration, Spin, and Deep Stall Attempts[11] (this Phase required only for training airplanes which may be intentionally spun and for Class I and IV airplanes in which sufficent departures and developed spins did not result in Test Phase A, B or C to define characteristics of each possible out-of-control mode)	Pitch control applied to achieve the specified AOA rate, roll and yaw controls as required for the maneuver task. When condition (a), (b), (c), or (d) has been attained, controls applied in the most critical[12] manner to attain each possible mode of post-stall motion and held for various lengths of time up to 15 seconds or three spin turns, whichever is longer, before the recovery attempt is initiated.[9,10]	Class: I IV	Class: I IV	Class: I IV	Class: I IV	Class: I IV

TABLE I NOTES:

1. Configurations, loadings, cg's, entry speed/attitude, etc., shall be in accordance with 3.4.1.1. With the airplane configured for the Flight Phase Category C tasks identified in MIL-F-8785, only Test Phases A and B of this specification are required to be accomplished unless the procuring activity specifically requires the next or both remaining Test Phases to be accomplished (6.2.1(h)). An abrupt AOA rate, as a maneuver entry condition, is not required when the airplane is configured for Flight Phase Category C, except as specified at the end of note 4.

   Engine requirements shall include:

   (a) Takeoff (TO) configuration: All engines at TO thrust; critical engine inoperative, others at TO thrust (stall approach, Test Phase A only).
   (b) Power approach (PA) configuration: All engines at normal approach thrust; critical engine inoperative, others at required approach thrust.
   (c) Climb (CL) configuration: All engines at normal climb thrust; critical engine inoperative, others at normal climb thrust.
   (d) Cruise (CR) configuration: All engines at thrust for level flight (TLF); all engines at idle thrust.
   (e) Combat (CO) configuration: All engines at military rated thrust (MRT), maximum augmented thrust (MAT).

   Throttle requirements for those cases where flameouts or compressor stalls occur shall include:

   (f) Throttle retarded to idle from the maneuver entry setting position for a malfunctioning engine (for MAT, MRT, TLF).
   (g) Throttle left at the entry setting position until stall, PSG, or spin recovery has been accomplished (for MAT, MRT, TLF) unless compliance would result in exceeding engine operating limitations.

   Stability and control augmentation requirements shall include:

   (h) All augmentation on.
   (i) Any number of channels disengaged if authorized or considered for service use.

   The airplane shall be trimmed (controls and throttle(s)) at settings consistent with the maneuver task. The effects of each designated flight test variable, from 3.4.1.1 and (a) through (i) above, shall be determined individually in each required Test Phase or until such effects are definitely established and predictable for succeeding Test Phases. Variables need to be tested in combination only when that combination could possibly yield less conservative results from those obtained by individual testing.

2. Accelerated entries, encompassing a representative range of Mach number, dynamic pressure, and allowable load factor, shall include windup turns, constant-altitude turns, and wings-level pullouts from dives appropriate to the airplane Class and mission.

3. Smooth, 1-g entries shall be approached utilizing a slow control rate which would produce a speed deceleration of approximately one knot per second for normal stalls ($\approx$1-g). Smooth, accelerated entries shall be approached utilizing a control rate to achieve an AOA rate of approximately one-half degree per second.

4. In the required abrupt entries, the entry AOA rate for Category A and B Flight Phases shall be at least:

Class I	4 deg/sec
Class II	2 deg/sec
Class III	1 deg/sec
Class IV	8 deg/sec

   except as limited by maximum available control deflection and rate. The magnitudes of the abrupt entry rates for Class I, II and IV airplanes may be graduated in Test Phases A through C, commensurate with the increasing severity of the control requirements, but the stated minimum AOA rates shall be achieved in Test Phase C. For those airplanes designated for Category C Flight Phase investigation beyond Test Phases A and B, abrupt AOA rates suitable to the configuration and Test Phase shall be employed.

TABLE I NOTES (Concluded)

5. These entries shall be initiated from offensive/defensive, ground-attack, or other tactical maneuvers associated with the capability and Class of the airplane. The maneuvers, conducted with a suitable AOA rate, may include:

   (a) Inverted stalls and aborted vertical reversements, loops, or Immelmanns to investigate inverted out-of-control events.
   (b) High AOA turn reversals with roll control only, with coordination attempted, and with yaw control only.
   (c) High pitch attitudes (>45 degrees).
   (d) Head-out-of-cockpit air combat maneuvering or ground-attack maneuvering.
   (e) High-g, supersonic turns/transonic decelerations.
   (f) Sudden idle power/speed brake decelerations.
   (g) Sudden asymmetric thrust transients prior to stall.

6. For those Class II or III airplanes where clear indications of stall are not evident and considerations as identified in MIL-F-8785 define the minimum permissible speed other than stall speed, recovery may be initiated somewhat beyond the arbitrary angle of attack, speed, or load factor limit. Both the arbitrary limit(s) and the respective margins to be tested beyond the limit(s) are subject to the approval of the procuring activity (6.2.1[i]).

7. Misapplied controls shall consist of moving controls in the most critical directions an amount significantly greater than that expected during operational use. This shall generally require full deflection for Class I and IV airplanes and somewhat less for other Classes depending upon the mission and expected pilot reaction. The magnitude of the control misapplication shall be approved by the procuring activity (6.2.1[j]).

8. This time requirement may be increased for airplanes that do not exhibit a clear indication to the pilot of impending loss of control.

9. The test pilot shall insure that routine familiarity with stalls, post-stall gyrations, and spins does not negate the intent of the delay/misapplication simulation and does not result in premature application of spin recovery controls before a developed spin has been attained (as subsequently confirmed by flight records when necessary).

10. For trainer airplanes, recovery shall also be demonstrated from a fully developed spin if such a spin is attainable within a limited number of turns after spin entry.

11. In addition to the demonstration of a satisfactory spin recovery procedure, the effect of delayed application of the out-of-control recovery procedure shall be investigated briefly during the final phase of testing. The effects of premature application of the spin recovery procedure(s) under consideration, if different from the out-of-control recovery procedure, shall also be determined.

12. With respect to spin attempts, "critical" control positions shall include, but not be necessarily restricted to full pro-spin settings. For some combinations of airplane state and entry test variables, the spinning motion may be sustained with controls in positions (neutral, out-of-control recovery settings, or stick forward, for example) other than full pro-spin positions, and a recovery attempt with controls displaced from the former positions may result in recovery capability, duration, or reversal tendency materially different from that which would occur if recovery were initiated from the full pro-spin condition. If it appears possible to encounter these circumstances in service use, then "critical" controls shall be any set necessary to define all out-of-control modes and determine recovery characteristics specifically applicable to operational users.

When spins do result as a natural consequence of testing through departures (6.3.9) from controlled flight or as a result of deliberate spin attempts, a satisfactory spin recovery technique shall be demonstrated in accordance with MIL-F-8785. Unless otherwise specified, the use of prolonged pro-spin controls to sustain a developed spinning condition for more than three turns shall not be required except for trainer type airplanes to be cleared for intentional spins (6.2.1[k]).

3.4.1 General requirements for all Class airplanes.

3.4.1.1 Stall/spin flight test variables. The contractor shall establish, with the approval of the procuring activity (6.2.1[l]), what ranges and increments of the following variables are to be tested for influence on stall and post-stall flight characteristics:

(a) Configuration.

(b) Gross weight.

(c) Center of gravity.

(d) Stability and control augmentation system status.

(e) Loadings, both internal and with external stores; critical combinations of aerodynamic and inertial loadings to include:

(1) Symmetric, fuselage heavy.

(2) Symmetric, wing heavy.

(3) Asymmetric (maximum allowable asymmetry).

(4) Any other loadings found critical in preliminary tests and analyses.

(f) Stall and departure speed, altitude, and attitude.

(g) Thrust and engine gyroscopic effects.

3.4.1.2 Natural stall warning. It shall be determined if natural stall warning (6.3.2) meets the requirements of MIL-F-8785.

3.4.1.3 Artificial stall warning. When installed, artificial stall warning shall be evaluated to determine whether it meets the requirements of MIL-F-8785.

The flight test demonstration shall determine if:

(a) the output from tactile stall warning devices, such as stick shakers, is not masked by airframe buffet or flight control system dynamics and is readily discernible with the body in any normally anticipated position.

(b) visual stall warning devices are readily discernible near peripheral vision limits, for any normally anticipated head position, during day or night operation.

(c) aural stall warning signals are easily distinguishable from gear, flap, malfunction tones or other aural signals and do not block voice communication channels.

3.4.1.4 Natural loss-of-control warning. The effectiveness of loss-of-control warning or indication (6.3.8) shall be determined for representative flight conditions when different from natural stall warning.

3.4.1.5 Artificial loss-of-control warning. When artificial loss-of-control warning or indication is provided, it shall be demonstrated whether the devices are effective in allowing the pilot to prevent departure by application of pitch control during the most abrupt maneuvering permitted in service use. The flight test demonstrations shall determine if warning signals satisfy those characteristics noted in 3.4.1.3 and are clearly distinguishable from stall warning.

3.4.1.6 Artificial loss-of-control prevention device. When a loss-of-control prevention device has been installed, it shall be demonstrated whether the device effectively prevents departures under critical combinations of test parameters and maneuvering circumstances and whether restrictions are imposed on the various flight envelopes.

3.4.1.7 Permissible flight limit AOA. The results of sections 3.4.1.2, 3.4.1.3, 3.4.1.4, 3.4.1.5, and 3.4.1.6 shall be used to establish a permissible flight limit AOA.

3.4.1.8 Demonstration of departure/spin resistance. The degree of departure/spin resistance (6.3.13 - 6.3.16) for all Class airplanes specified in 1.2 shall be determined by the test phase in which departures/spins first occur while performing those maneuvers listed in table I. Refer to table II for susceptibility/resistance classification.

TABLE II

SUSCEPTIBILITY/RESISTANCE CLASSIFICATION

TEST PHASE	CLASSIFICATION	
	Departures	Spins
A - Stalls	extremely susceptible	extremely susceptible
B - Stalls with aggravated control inputs	susceptible	susceptible
C - Stalls with aggravated and sustained control inputs	resistant	resistant
D - Post-stall gyration, spin, and deep stall attempts	extremely resistant	extremely resistant

3.4.2 Out-of-Control recovery procedure. When an airplane is subject to departure from controlled flight while performing the maneuvers outlined in table I, a simple out-of-control recovery procedure, acceptable to the procuring activity, shall be demonstrated. The out-of-control recovery procedure shall be the first reaction required of a pilot in response to a departure from controlled flight. Such a recovery procedure shall not require the pilot to determine the nature or the direction of the post-stall motion in order to properly execute the recovery steps. No other recovery procedures shall be recommended unless they are for a deep stall condition, erect spin, or inverted out-of-control events (6.2.1[m]). With the accepted recovery procedure, the brief recovery dynamics that can be associated with a rapid unloading to zero or negative normal acceleration are allowable. A production device, such as a drag chute, may be qualified as a recovery aid. The altitude loss values associated with the out-of-control events shall be determined. It shall be determined if the airplane is subject to any appreciable recovery-inhibiting effects due to asymmetric thrust or drag for possible failed-engine characteristics. It shall also be determined whether flight control systems as specified in MIL-F-9490 adversely affect the control surface displacements that are intended during high AOA flight before and following a stall or departure.

3.4.3 Spin recovery-Class I and IV airplanes. When a departure from controlled flight or a deliberate spin attempt results in a spin while performing the maneuvers outlined in table I, a satisfactory spin recovery technique shall be demonstrated. Turns for recovery or altitude loss in spin recovery shall not exceed those values specified in MIL-F-8785. Under normal application circumstances, the recovery procedure shall not subject the airplane to (a) spin reversals, or (b) a change of spin mode that prolongs recovery. The spin recovery procedure shall be compatible with the out-of-control recovery procedure and possess a minimum of changes or additions. The accomplishment of the recovery procedure shall not be compromised by accelerations at the crew station. Control forces shall not exceed those values specified in MIL-F-8785.

3.4.4 Engine operating characteristics. Engine operating characteristics shall be documented while performing the maneuvers outlined in table I. When engine malfunction occurs during the post-stall interval of flight, it shall be demonstrated that recovery from the existing or ensuing out-of-control mode(s) can be accomplished at least 10 seconds prior to the projected time at which loss of ability to position the flight controls would occur because of the engine malfunction. This requirement shall be met with the throttles remaining in the least conservative position.

3.4.5 Recovery characteristics. Recovery dynamics and maximum effort dive pullout characteristics shall be thoroughly determined. Altitude loss in post-stall events and total recovery altitude values shall be reported over a wide range of post-stall maneuvers and store loadings. The contractor shall also examine steep rolling maneuvers and erect and inverted spirals to determine if these motions may appear similar to out-of-control or recovery events. When potential misinterpretation of the maneuvers can lead to improper control application, the contractor shall identify all cues to the pilot that will allow proper recognition.

3.4.6 Training maneuvers. The contractor shall establish flight training maneuvers, appropriate to the airplane Class and mission, to illustrate the high AOA flight characteristics near the limits of the permissible AOA envelope; inverted flight shall be included as required. It shall be possible for service pilots to safely practice these maneuvers established by the contractor. Specific guidelines concerning the type of training maneuvers to be defined by the contractor will be provided by the procuring activity (6.2.1[n]).

3.4.7 Baseline stability tests. When the procuring activity anticipates that special modifications may significantly alter the basic properties of the test airplane, high AOA longitudinal and lateral-directional stability flight tests shall be conducted early in the demonstration program to compare test results with similar data from a production configured airplane (6.2.1[o]).

3.5 Interpretation of qualitative requirements. In several instances throughout the specification, qualitative terms such as "intolerable buffet," "normally anticipated," "clear indication," "significantly greater," "premature application," "compatible spin recovery procedure," and "reasonably delayed" have been employed to permit latitude where absolute quantitative criteria might be unduly inflexible for all airplanes to be tested. Final determination of compliance with requirements so worded shall be made by the procuring activity.

4. QUALITY ASSURANCE PROVISIONS

4.1 Compliance demonstration. Compliance with the associated high AOA requirements specified in MIL-F-8785 and MIL-F-9490 shall be demonstrated through flight test demonstration maneuvers in accordance with this specification.

4.2 Presentation of predictive studies. Those predictive analytical/laboratory studies contracted for by the procuring activity shall be accomplished and reported sufficiently prior to scheduled initiation of the flight test program to allow for direction and limitation of scope in test planning. Predictive studies can include high AOA wind tunnel tests, dynamic model tests, and computer simulations.

5. PREPARATION FOR DELIVERY

5.1 Section 5 is not applicable to this specification.

6. NOTES

6.1 Intended use. This specification contains the flight test demonstration requirements for determination of piloted airplane compliance with the stall and post-stall design requirements. A concurrent objective of this specification is the reporting of detailed information for inclusion in the Emergency and Flight Characteristics sections of the airplane Flight Manual.

6.2 Ordering data. Purchasers should exercise any desired options offered herein, and procurement documents should specify the following:

6.2.1 Procurement requirements.

(a) Title, number, and date of this specification.

(b) Classification of airplane (1.2).

(c) V/STOL airplane configuration (3.1).

(d) Emergency recovery device (3.2.1).

(e) Onboard instrumentation (3.2.2).

(f) Onboard data switches (3.2.3).

(g) Service participation (3.3).

(h) Test phases to be accomplished for Flight Phase Category C tasks (table I).

(i) Margin beyond arbitrary limit(s) (table I).

(j) Magnitude of control misapplication (table I).

(k) Prolonged pro-spin controls (3.4).

(l) Stall and post-stall variables (3.4.1.1).

(m) Deep stall condition, erect spin, or inverted out-of-control events (3.4.2).

(n) Guidelines for training maneuvers (3.4.6).

(o) Baseline stability tests (3.4.7).

6.2.2 Contract data requirements. Data conforming to Data Item Descriptions DI-T-3718 (Test Reports - General), DI-A-3012/M-108-1 (Complete Motion Picture Film Reports), DI-A-3010/M-106-1 (Motion Picture Film Clips), and DI-A-3013/M-109-1 (Motion Picture Coverage [Footage]) will usually be required for delivery in connection with this specification. When so required, such data will be specified for delivery on a DD Form 1423 included in the contract.

6.2.2.1 Documentation of test results. The contractor shall provide documentation of stall/post-stall studies and demonstrations to the procuring activity. This can entail documenting three areas: (1) predictive studies, (2) flight test demonstration, and (3) flight test confirmation of predictive studies.

6.2.2.1.1 Predictive studies. The contractor shall provide documentation by way of a written report of those studies for which the contractor is responsible. The impact of related stall/post-stall studies conducted by other agencies shall be acknowledged by the contractor in a suitable manner.

6.2.2.1.2 Flight test demonstration. The flight test stall/post-stall/spin demonstration shall be documented with a written technical report and preparation of appropriate flight characteristics descriptions and emergency procedures for the Flight Manual. In addition, a motion picture presentation shall be required if specified by the procuring activity.

6.2.2.1.2.1 Technical report. The written report shall include, but not be limited to, the information that follows:

(a) Test airplane: a description of the airplane shall be included, detailing instrumentation, special modifications such as recovery devices, and differences from production vehicles.

(b) Stall/post-stall terminology: terminology shall be included as defined in 6.3.

(c) Test and evaluation: test variables considered, and test techniques used, in conducting the flight test demonstration, as outlined in accordance with this specification, shall be detailed within the report. The results of the flight test demonstration shall be substantiated by sufficient time histories of maneuvers so as to encompass all entry conditions and airplane states. As a function of airplane Class and extent of the maneuvers expected or encountered, the procuring activity may direct that special data presentations supplement time histories for reporting of test results. The report shall include operational training maneuvers as determined by flight test.

6.2.2.1.2.2 Flight Manual synopses. Results of the flight test demonstration shall be consolidated into a pilot-oriented presentation for the Flight Characteristics and, when necessary, Emergency Procedures sections of the Flight Manual.

6.2.2.1.2.3 Motion picture. A technical briefing film summary of the flight test demonstration results shall be prepared with extensive coverage of in-flight demonstrations of stall/post-stall flight characteristics and out-of-control recovery techniques. At the discretion of the procuring activity, and within the scope of contractual agreement, a formal aircrew training film will be produced. This film shall include sufficient information to thoroughly instruct a pilot in high AOA maneuvering, stall and loss-of-control warning, out-of-control and, when applicable, spin recovery procedures.

6.2.2.1.3 Evaluation of predictive studies. A comprehensive evaluation of the overall development and flight test stall/post-stall/spin demonstrations shall be prepared, in which predictive studies are to be evaluated and compared to flight test results, conclusions, and recommendations.

6.3 Definitions. The following standard terminology shall be applied whenever possible. Terms and definitions stated in 6.3.13 through 6.3.16 may be used to qualify degree of departure susceptibility or resistance for a given flight condition. The same terminology used to qualify degrees of departure susceptibility or resistance will be used to define the susceptibility or resistance of the airplane to spin entry.

6.3.1 Stall angle of attack: the AOA for maximum usable lift at a given flight condition (α_S defined in MIL-F-8785).

6.3.2 Stall warning: that natural airplane behavior or artificial signal(s) that indicates to the pilot the approach of maximum usable lift. Normally, the onset and development of stall warning shall be described as a function of AOA or airspeed for a given airplane state.

6.3.3 Wing rock: uncommanded lateral-directional motion, viewed by the pilot primarily as roll oscillation.

6.3.4 Bucking: uncommanded pitching oscillation.

6.3.5 Nose Slice: uncommanded lateral-directional motion viewed by the pilot primarily as a divergence in yaw.

6.3.6 Pitch-up: uncommanded, sudden increase in AOA.

6.3.7 Post-Stall: the flight regime involving angles of attack greater than nominal stall angles of attack. The airplane characteristics in the post-stall regime may consist of several more or less distinct types of airplane motion: departure, post-stall gyration, spin, and deep stall.

6.3.8 Loss-of-Control Warning: that natural airplane behavior or artificial signal(s) that indicate to the pilot the approach of loss of control. As per stall warning, the onset and development of loss-of-control warning shall be described as a function of AOA or airspeed for a given airplane state.

Note: Natural stall warning and loss-of-control warning encompass successive AOA ranges. For some designs or flight conditions, departure may occur with only a slight increase in AOA beyond that for maximum usable lift. In such cases, stall warning and loss-of-control warning become practically synonymous and descriptions of flight characteristics should emphasize this fact when appropriate. However, in those cases when departure occurs at a significantly higher AOA than that for maximum usable lift, natural stall warning and loss-of-control warning should be independently discussed.

6.3.9 Departure: the event in the post-stall flight regime which precipitates entry into a post-stall gyration, spin, or deep stall condition. The departure may be characterized by divergent, large-amplitude, uncommanded aircraft motions, such as nose slice or pitch-up. Departure is synonymous with complete loss of control.

6.3.10 Post-Stall Gyration (PSG): uncontrolled motion about one or more airplane axes following departure. While this type of airplane motion involves angles of attack higher than the stall angle, lower angles may be encountered intermittently in the course of the motion. When the airplane motion is other than random about all axes, a further classification of the PSG may be used for descriptive purposes. Such terms as snap roll, rolling departure or tumble may be appropriate; however, they should all imply a PSG. The PSG is differentiated from a spin by the lack of a predominant, sustained yawing motion and by the potential for exhibiting sub-stall angles of attack.

6.3.11 Spin: a sustained yaw rotation at AOA's above stall. The rotary motions of the spin may have oscillations in pitch, roll and yaw superimposed upon them. The incipient spin is the initial, transitory phase of the motion during which it is not possible to identify the spin mode. The developed spin is the phase of the spin during which it is possible to identify the spin mode. The fully developed spin is attained when the trajectory has become vertical and no significant change is noted in the spin characteristics from turn to turn.

Note: Spin modes may be identified by average values of AOA and body axis yaw rate and by the magnitude of the three-axis angular oscillations. One modifier from each group listed in table III may be used to characterize the mode:

TABLE III

SPIN MODE MODIFIERS

Sense	Attitude	Rate	Oscillations
Erect	Extremely steep	Slow	Smooth
Inverted	Steep	Fast	Mildly oscillatory
	Flat	Extremely rapid	Oscillatory
			Highly oscillatory
			Violently oscillatory

6.3.12 Deep stall: an out-of-control flight condition in which the airplane is sustained at an angle of attack well beyond that for α_S while experiencing negligible rotational velocities. The deep stall may be distinguished from a PSG by the lack of significant motions other than a high rate of descent.

6.3.13 Extremely susceptible to departure: departure from controlled flight will generally occur with the normal application of pitch control alone or with small roll and yaw control inputs.

6.3.14 Susceptible to departure: departure from controlled flight will generally occur with the application or brief misapplication of pitch and roll and yaw controls that may be anticipated in operational use.

6.3.15 Resistant to departure: departure from controlled flight will only occur with a large and reasonably sustained misapplication of pitch and roll and yaw controls.

6.3.16 Extremely resistant to departure: departure from controlled flight can only occur after an abrupt and inordinately sustained application of gross, abnormal, pro-departure controls.

6.3.17 Recovery: the transition from out-of-control conditions to controlled flight. This is normally considered to be that period between pilot initiation of recovery controls and that point when the AOA is at a value below stall and no significant, uncommanded angular motions remain.

Note: The out-of-control recovery procedure requirements specified in 3.4.2 are directed primarily toward departures at a positive AOA rather than at a negative AOA. Erect flight is emphasized because out-of-control occurrences in training and operational activities usually take place more often and with more susceptibility at a positive AOA. Also, recovery capabilities from erect out-of-control conditions (positive AOA) are usually less favorable than from inverted situations (negative AOA) and the recommended recovery procedures correspondingly more extensive. The out-of-control recovery procedure shall always apply to loss of control from erect flight, but it may serve for both erect and inverted flight if the recovery procedures are identical (neutral controls for example). Or, an airplane may experience a departure at negative AOA that can be easily countered by a simple relaxation of pro-departure controls. In this instance, a bold-face, inverted out-of-control recovery procedure may not be warranted since an adequate flight characteristics description in the Flight Manual would suffice. However, if the airplane exhibits a departure at negative AOA that requires an intricate recovery procedure, consideration should be given to specifying both an erect and inverted out-of-control recovery procedure.

Roll and yaw control displacements are allowable steps in the recovery procedures for erect and inverted spins in the event the out-of-control recovery procedure does not satisfy spin recovery requirements.

A separate recovery procedure may be proposed for the deep stall since this out-of-control mode is of a unique nature and may require recovery techniques (prolonged nose down pitch control, control stick pumping, asymmetric thrust, configuration changes, for example) that are significantly more extensive than normal stall recovery techniques and totally distinct from the out-of-control and spin recovery requirements.

6.3.18 Dive Pullout: the transition from the termination of recovery to level flight.

6.3.19 Total Recovery Altitude: the sum of the altitude losses during the recovery and dive pullout.

6.3.20 Recovery Rolls: uncommanded rolling motions near or below stall AOA that may occur during the recovery phase of the spin or PSG.

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