NAVAL AIR TRAINING COMMAND

NAS CORPUS CHRISTI, TEXAS **CNATRA P-354 (Rev. 03-10)**

FLIGHT TRAINING INSTRUCTION

OUT-OF-CONTROL FLIGHT T-34C

2010

DEPARTMENT OF THE NAVY
CHIEF OF NAVAL AIR TRAINING
CNATRA
250 LEXINGTON BLVD SUITE 102
CORPUS CHRISTI TX 78419-5041

CNATRA P-354
N711
06 APR 10

CNATRA P-354 (Rev. 03-10)

Subj: OUT-OF-CONTROL FLIGHT, T-34C

1. CNATRA P-354 (Rev. 03-10) PAT, "OUT-OF-CONTROL FLIGHT, T-34C), is issued for information, standardization of instruction, and guidance of all flight instructors and student aviators within the Naval Air Training Command.

2. This publication shall be used as an explanatory aid to the Primary Multi-Service Pilot Training System Flight curriculum. It will be the authority for the execution of all flight procedures and maneuvers therein contained.

3. Recommendations for change shall be submitted via CNATRA TCR form 155/19 in accordance with CNATRAINST 1550.6E.

4. CNATRA P-354 (Rev. 10-06) PAT is hereby cancelled and superseded.

JAMES A. CRABBE
Chief of Staff

Distribution:
CNATRA N7 (5) Plus Original
CNATRA N75 (1)

FLIGHT TRAINING INSTRUCTION

FOR

OUT-OF CONTROL FLIGHT

T-34C

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LIST OF EFFECTIVE PAGES

Dates of issue for original and changed pages are:
Original 0...30 Aug 2002
Revision 1…15 Oct 2006
Revision 2…06 Apr 2010

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 52 CONSISTING OF THE FOLLOWING:

Page No.	Change No.	Page No.	Change No.
COVER	0	2-1 – 2-21	0
LETTER	0	2-22 (blank)	0
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iv (blank)	0	A-6 (blank)	0
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viii (blank)	0		
ix - x	0		
1-1 – 1-14	0		

INTERIM CHANGE SUMMARY

The following Changes have been previously incorporated in this manual:

CHANGE NUMBER	REMARKS/PURPOSE

The following interim Changes have been incorporated in this Change/Revision:

INTERIM CHANGE NUMBER	REMARKS/PURPOSE	ENTERED BY	DATE

SAFETY/HAZARD AWARENESS NOTICE

This course does not require any special safety precautions other than those normally found on the flight line.

FORWARD

Terminal Objective:

Upon completion of this course of instruction, the Instructor Under Training (IUT) will be able to perform the Out-of-Control Recoveries and Spins described in this Flight Training Instruction.

Standards:

Conditions and standards are defined in CNATRAINST 1542.61 (series).

Instructional Procedures:

1. This is a flight training course and will be conducted in the aircraft.

2. The IUT will demonstrate a functional knowledge of the material presented through successful completion of the flight maneuvers.

Instructional References:

1. T-34C NATOPS Flight Manual

2. Local Standard Operating Procedures (SOP) Instruction

3. Aerodynamics for Naval Aviators (NAVAIR 00-80T-80)

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CHAPTER ONE
INTRODUCTIONS AND SPINS

100. INTRODUCTION

This Flight Training Instruction (FTI) has been written to provide aerodynamic background information and to establish procedures for recovery from inadvertent Out-of-Control Flight (OCF) and for intentional OCF training encountered in the T-34C. It is designed to provide Instructors Under Training (IUT) with the fundamental knowledge needed to recognize, prevent, and recover from aerodynamic loss of control of the aircraft.

Departure from controlled flight is practiced to familiarize the IUT with those realms of flight that may be encountered as a result of control misapplication by an inexperienced Student Naval Aviator (SNA). The intent is to expose the IUT to disorienting flight regimes and reinforce the essential need for prompt and correct flight conditions analysis. For example, am I spinning? Have I already departed controlled flight or am I just in an unusual attitude? Once you have analyzed the flight condition, you must be prepared to affect the proper recovery procedures.

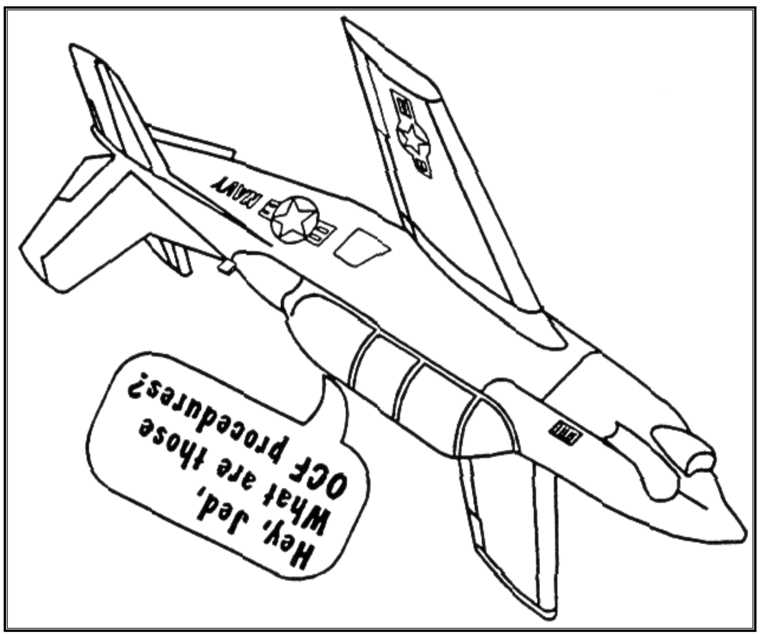


Figure 1-1 OCF Procedures

Flight at high Angles of Attack (AOA) is an inherent part of stall, spin, and aerobatic training. The pilot's confidence, necessary to operate in these regimes effectively, is key to his ability to analyze and recover easily from the occasional out-of-control condition associated with high AOA maneuvering.

It is important to realize the AOA the pilot sees just prior to departure will vary significantly depending upon what kind of maneuver he is performing (i.e., how much yaw rate or sideslip he is generating). The higher the yaw rate or sideslip, the lower the indicated AOA at departure.

The T-34C has proven its capability to enter and recover easily from both post-stall gyrations and spins. The NATOPS Flight Manual is the only source of officially recognized Out-of-Control and Spin Recovery Procedures. Therefore, this FTI is designed to amplify and supplement the NATOPS Manual.

101. THE ERECT SPIN

The motion of an airplane in a spin can involve many complex aerodynamic and inertial forces and moments. However, there are certain fundamental relationships regarding spins with which all aviators should be familiar. Two primary factors must be present for an airplane to spin:

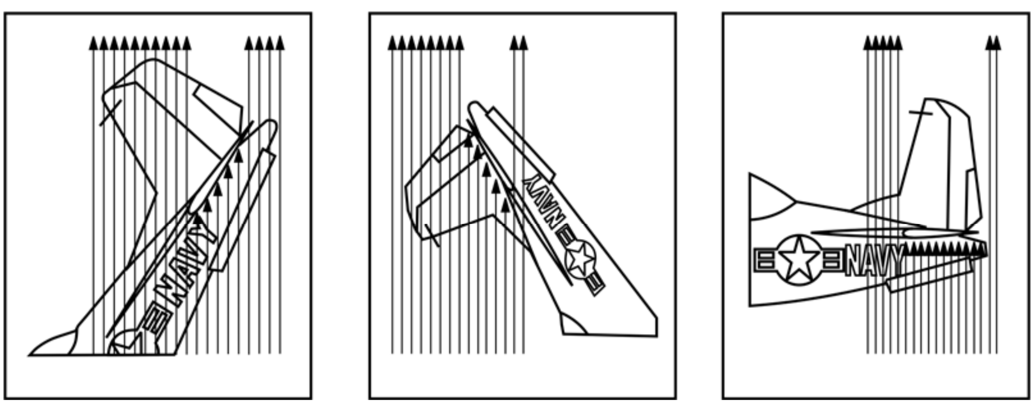
1. Stalled AOA.

2. Yaw (rotation about the vertical axis).

In the case of spins, we are concerned with the aerodynamic characteristics, which take place at an AOA above a stall.

This discussion concerns the spin characteristics of aircraft with moderate to high aspect ratio wings, moderate wing loading and with little or no sweepback (e.g., the T-34C).

In most airplanes, particularly light trainers, the rudder is the principal control for recovery. Therefore, the configuration of the vertical stabilizer and rudder, as well as the placement of the horizontal control surfaces, has a very important effect on spin recovery. Figure 1-2 illustrates the T-34C rudder and horizontal stabilizer in various airflow conditions.



(Airflow Partially Blocked) (No Airflow Blockage) (Complete Airflow Blockage)

Figure 1-2 Rudder and Horizontal Stabilizer

In Figure 1-3, the swept vertical fin is very nearly blanked out by the horizontal stabilizer and there is little, if any, effective rudder to stop rotation. For this reason, if you should enter an inverted spin in an aircraft with a conventional cruciform tail (Figure 1-3), you will probably recover quicker than from an erect spin because of greater rudder effectiveness and undisturbed airflow over the vertical fin and rudder. Conversely, in a T-tail design, the vertical stabilizer and rudder are more effective in an erect spin (Figure 1-3).

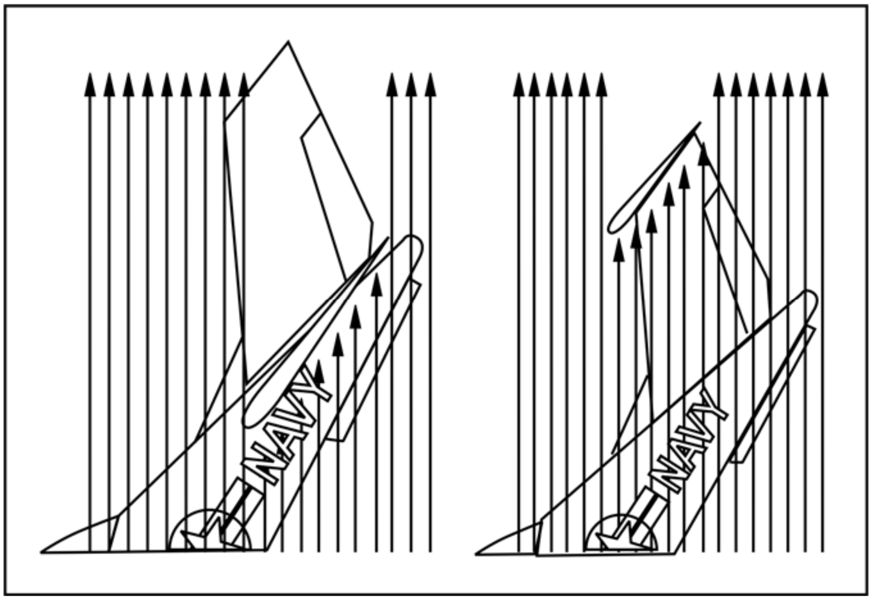


Figure 1-3 Tail Design

On the T-34C, a dorsal fin is added to provide more vertical tail area for directional stability during large sideslip angles. Ventral fins and strakes on the tail are included to improve directional stability and enhance spin characteristics and recovery. They aid in damping oscillations in pitch, surges in rotation, and help to prevent the tail from going to excessively high vertical angles (Figure 1-4).

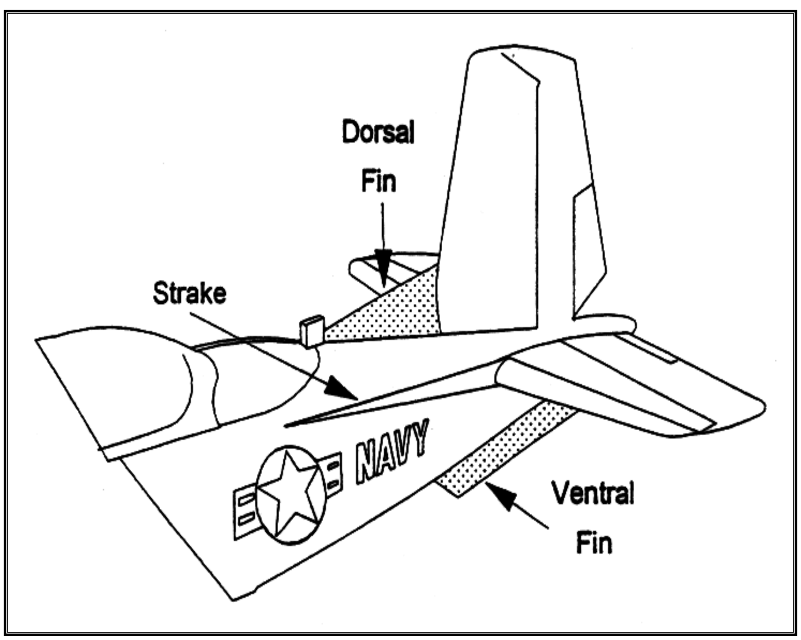


Figure 1-4 Dorsal and Ventral Fins

A number of other factors also influence the spin. Forward Center of Gravity (CG) aids in spin recovery, while aft CG tends to flatten the spin, resulting in less control effectiveness for recovery. In other words, the further aft the CG, the flatter (less nose down) the spin will be. Figures 1-5 and 1-6 show airflow over the fin and rudder in the two CG locations.

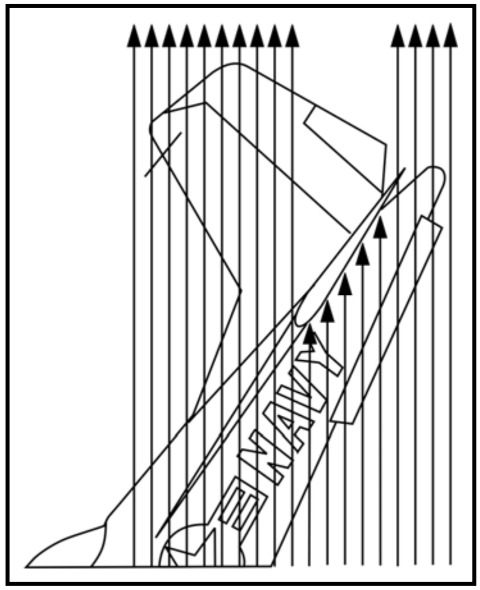


Figure 1-5 Forward CG

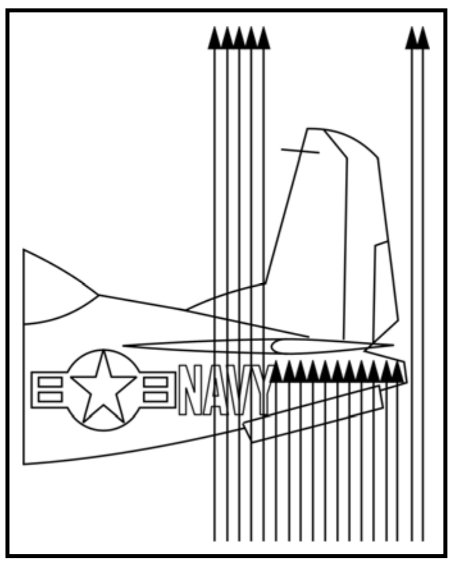


Figure 1-6 Aft CG

Mass distribution is a term which describes the construction technique in which the mass of an airplane is distributed between the fuselage and wings. Roughly assuming aircraft are "flattened" into the XY plane, the maximum moment of inertia invariably occurs around the yaw or the Z axis. Depending on the aircraft's mass distribution, 1_x is either greater or less than 1_y as shown in Figure 1-7. Wing loaded aircraft tend to spin more nose down (T-34C), while fuselage loaded aircraft tend to spin flatter (F-14).

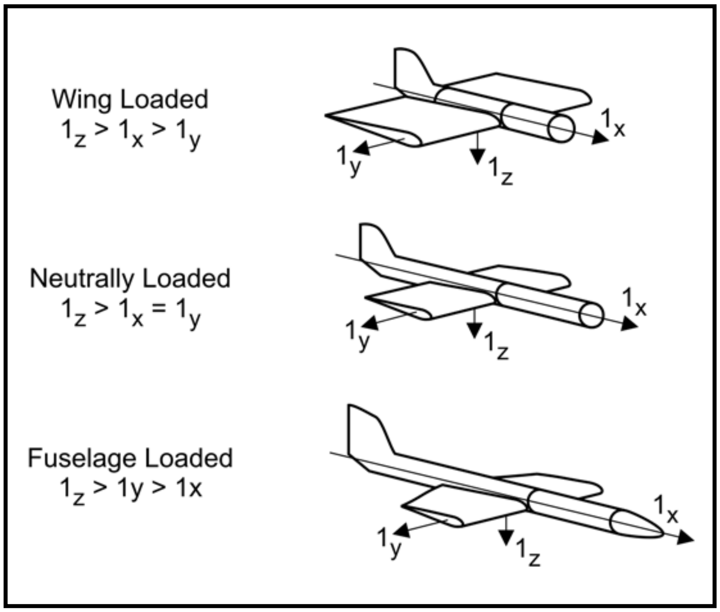


Figure 1-7 Mass Distribution

A stall departure usually begins with a yaw, then can involve a pitch up, nose slice, pitch roll coupling, or some other type of Post-Stall Gyration (PSG) which results in an out-of-control situation. To recover successfully, the pilot must assess the disorienting situation immediately using NATOPS OCF Recovery Procedures.

In a flat spin, the horizontal tail may be stalled and ineffective because of the high AOA on the horizontal stabilizer and elevators. The vertical fin and rudder may also be blanked out with the rudder ineffective because of a lack of airflow (Figure 1-6). Since a flat spin is primarily a yawing motion, there is a high sideslip angle with the possibility of a stalled vertical tail as well and, conversely, an ineffective rudder. If the wing, horizontal stabilizer and vertical tail are all stalled in a flat spin, there is very little you can do with the flight controls to recover because they are all ineffective. Fortunately, there is no tendency for the T-34C to spin flat, so you should never encounter this problem.

Outside visual references cannot be relied upon to determine whether or not you are in a spin. You must interpret the message the cockpit instruments are sending.

Typical indications of an erect, Steady-State Spin are:

1. Airspeed stabilized 80 – 100 KIAS (typically)

2. AOA pegged at 30 units,

3. Turn needle fully deflected in direction of spin.

The altimeter and Vertical Speed Indicator (VSI) will show a rapid rate of descent with the altimeter possibly lagging behind the actual altitude. While the balance ball gives no useful indication of spin direction, the turn needle will be fully deflected in the spin direction.

The turn needle is the only reliable indicator of spin direction.

Figure 1-8 shows the needle pegged in the direction of rotation and the balance ball simply oscillating around the center position, which is typical for the T-34C in an erect spin.

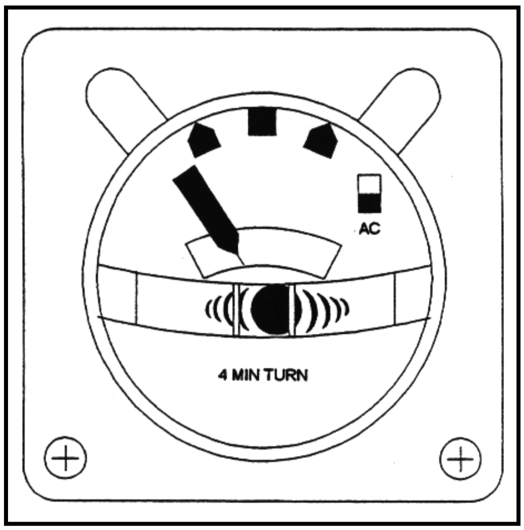


Figure 1-8 Turn Needle

Generally speaking, ailerons are not very effective in light aircraft at stalled AOA and should not be used for entry or recovery. In fact, application of ailerons creates a yawing motion in the opposite direction, known as adverse yaw. At spin initiation, a cross control situation enhances spin entry. Conversely, deflection of ailerons into the spin reduces the autorotation rolling moment by reducing the AOA on the "inside" wing and can produce the adverse yaw necessary to aid rudder yawing moments to effect recovery. Figure 1-9 diagrams the forces, which occur during the spin that cause the aircraft to autorotate.

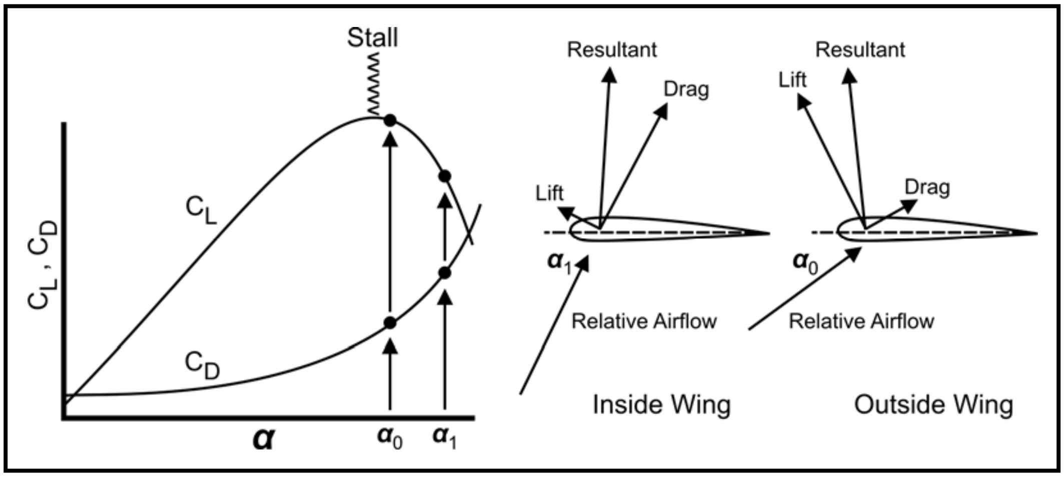


Figure 1-9 Causes of Autorotation

As the AOA increases in normal flight, both lift and drag increase; but as the aircraft stalls, lift drops sharply while drag continues to rise. During the initiation of the spin, as rudder is applied at the stall in the direction of desired spin, the yawing motion increases the speed of the outside wing. The increase in local airflow shallows the relative airflow vector, which in turn, creates a reduction of AOA, an increase in lift, and reduction of drag. These forces result in a rolling motion in the direction of initial yaw input. The inside wing experiences a corresponding reduction in airspeed and lift, an increase in AOA and drag, which adds to the rolling motion. Although the outside wing is still in a stalled condition, it is less stalled than the inside wing (Figure 1-9). Because of the greater lift on the outside wing, the aircraft will roll in the direction of rudder deflection and will generally go slightly inverted or make a barrel roll type maneuver during the spin entry. In Figure 1-9, the inside or downgoing wing has a greater AOA, less lift, and more drag than the outside wing. Figure 1-10 shows how the slightly greater and more forward tilt of the resultant lift-drag vector of the outside wing drives that wing forward and up in a self-sustaining rolling and yawing motion known as autorotation. Therefore, the T-34C spin is described as a nose-low autorotation. In the OCF syllabus, the control release spin is performed to demonstrate this phenomenon.

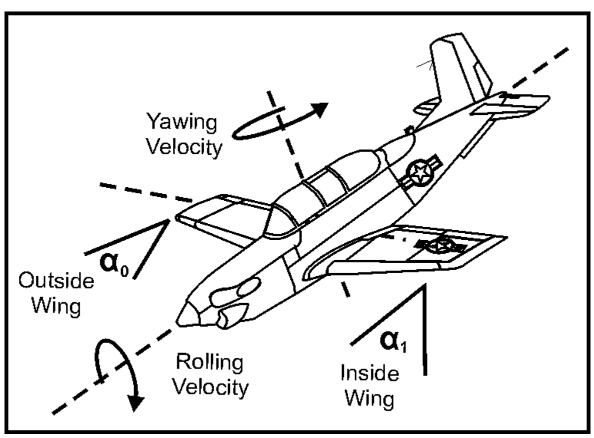


Figure 1-10 Self-Sustaining Autorotation

After about two turns, the rate of rotation stabilizes and, because of high drag at the higher AOA, the rate of descent stabilizes to about 9000 - 12,000 fpm or 360 - 600 feet per turn, depending on direction. The aircraft is now in a Steady-State Spin from which it will not recover without stopping the rotation and breaking the stall. Recovery from an erect spin is accomplished in the following manner:

Perform the first four steps of NATOPS OCF recovery to confirm if aircraft is truly in a spin. If so:

5. Gear/flaps - UP,

6. Rudder - Full OPPOSITE turn needle,

7. Stick - FORWARD OF NEUTRAL (erect spin) – NEUTRAL (inverted spin),

WARNING

> Application of power when not actually in a steady-state spin will result in a rapid increase in rate of descent and airspeed.
>
> If spin recovery is not evident soon after applying anti-spin inputs, pushing the control stick further forward (to the stop, if necessary) may facilitate recovery. If recovery from a steady state spin is not evident within two turns after anti-spin inputs are applied, verify cockpit indications of steady state spin and visually confirm proper spin recovery controls are applied. If no indication of recovery is evident, adding maximum power while maintaining proper spin recovery controls will enhance recovery from an erect steady state spin in either direction.

8. Controls - Neutralize when rotation stops, and

When aircraft regains controlled flight:

9. Recover from unusual attitude.

WARNING

> Lower power settings reduce torque effect, restrict onset of rapid airspeed buildup, and enhance controllability. However, departures from controlled flight in close proximity to the ground may require rapid power addition upon OCF recovery.

Application of spin recovery controls when not in a Steady-State Spin (as verified by AOA, airspeed, and turn needle) MAY further aggravate the OCF condition.

"Popping" down elevator CAN result in the spin going inverted in some airframes. A "smooth" forward movement of the stick is best for most light aircraft.

Spin recoveries using anti-spin controls and power will NOT appreciably increase rate of descent (while maintaining stalled AOA). However, significant altitude loss will result during the ensuing nose-low recovery. Power application to recover from spins should be used in emergency situations only. Upon recovery, controls should be neutralized expeditiously and power reduced to idle to minimize altitude loss and rapid airspeed buildup.

102. INVERTED SPINS

Inverted spins are an interesting and spectacular realm of flight; a realm with which most pilots are unfamiliar. Aerodynamically, the inverted spin is quite similar to the erect spin, since the conditions required to enter an inverted spin are:

1. A stall at negative AOA, and

2. Yaw.

An inverted stall is more difficult to enter than an erect stall, although it CAN be done either deliberately or inadvertently. In some aircraft, elevator authority is insufficient to induce the negative load factor required to stall in level, inverted flight. However, inverted stalls can be achieved in nose-high, slow airspeed, and inverted flight. For example, the T-34C can enter an inverted stall from an inverted, 30 - 40 degrees noseup attitude by applying full forward stick.

Naval Air Test Center (NATC) evaluations of the T-34C spin characteristics revealed that while recovery from an inverted spin was easily accomplished, the spin itself proved to be very disorienting to the pilot. For this reason, the T-34C is not cleared for intentional inverted spins. Disorientation experienced by the pilot during an inverted spin is primarily because the yaw and roll occur in opposite directions. Pilots are more sensitive to motion about the longitudinal axis than the vertical axis and are consequently more likely to interpret an inverted spin in the direction of roll rather than the direction of yaw. Regardless of whether the aircraft is spinning erect or inverted, the turn needle will always deflect fully in the direction of spin and is the only reliable indication of spin direction.

In the T-34C Steady-State, inverted spins are characteristically flatter than erect spins with the nose of the aircraft approximately 25° below the horizon.

Typical indications of an inverted, Steady-State Spin are:

1. Zero airspeed,

2. Two to three units AOA, and

3. Turn needle fully deflected in direction of spin.

The pilot will experience a load factor of negative one "G." In a standard inverted spin, the average spin rate is approximately 140° per second and the aircraft will lose roughly 310 feet per turn, descending at 8700 feet per minute (fpm).

After performing the first four steps of NATOPS OCF Recovery Procedure and you confirm your aircraft is in an inverted spin, accomplish recovery in the following manner:

5. Gear/Flaps - Check UP,

6. Rudder - Full OPPOSITE turn needle,

7. Stick - FORWARD OF NEUTRAL (erect spin) - NEUTRAL (inverted spin),

8. Controls - Neutralize when rotation stops, and

9. Recover from unusual attitude.

The stick will "float" near the full forward position, so you will have to apply a pull force of about 30 lbs. to place the stick in the neutral position. The aircraft will recover to a steep, inverted, nosedown unusual attitude.

As stated earlier, although they are not encountered frequently, inverted spins can be extremely disorienting!

103. OUT-OF-CONTROL RECOGNITION

Loss of control of an aircraft can be a confusing and disorienting experience. Sound familiar? A rapid analysis of the specific phase of OCF is essential for executing a prompt recovery. Visual and "seat of the pants" cues are not sufficient to differentiate among the Departure, PSG, and Incipient Spin or Steady-State Spin phases.

Even the seemingly obvious determination of whether or not the aircraft is in an erect or inverted attitude may not always be possible through sensory cues. In an erect spin, the airplane may spin in a relatively nose-low attitude with a high rate of roll, or it may spin in a flat attitude with a high yaw but very little roll rate. In a Steady-State Spin, the flight path is vertical (i.e., straight down). The axis of the spin or the center of the spin rotation is also straight down.

In a steep, nosedown attitude, the axis of rotation lies forward; in extreme cases, the axis may be forward of the entire aircraft! As the nose rises to a flatter attitude, the axis of rotation moves aft. If it moves behind the cockpit and if at the same time a high yaw rate is present, the pilot will experience high transverse (eyeballs out) "G" forces. These transverse "G" forces may be interpreted by the pilot as negative "G's" (Figure 1-11).

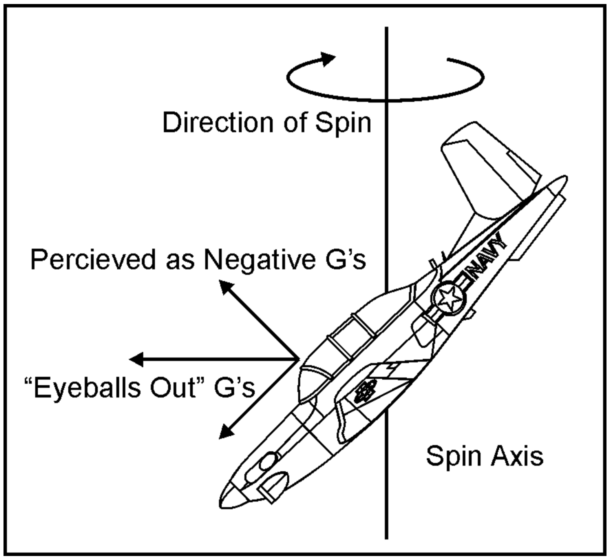


Figure 1-11 "G" Forces

The problem is further compounded when roll, pitch, and yaw oscillations cause variations in the direction and magnitude of "G" forces and literally tumble the pilot about the cockpit.

Since outside visual and sensory cues cannot be relied upon to determine the mode of flight, intuitive responses must be ignored. The ONLY satisfactory means to analyze the situation and thereby recover from OCF properly is by referencing your flight instruments. You must reference the altimeter to determine how much "time" is available for recovery. If you have not recovered by 5000 feet AGL in the T-34C, **bailout is your only alternative!**

The AOA indicator primarily enables you to determine whether the flight mode is upright or inverted. The instrument will be pegged at 30 units if upright and 2 - 3 units if inverted. If the AOA indicator is indicating neither of the above indications, the aircraft has not yet entered a Steady-State Spin.

Airspeed in a Steady-State Spin will either be stable or it will oscillate above and below a constant airspeed. Any airspeed above or below the characteristic range (80 - 100 KIAS) or a steadily increasing airspeed indicates the aircraft has not yet reached a Steady-State Spin. Instead, airspeed outside the characteristic indicates the aircraft is in some other flight mode that will not develop into a spin, such as a high-speed spiral.

The turn needle will be fully pegged in the direction of the spin, but it does not provide other information about the phase of flight. For example, the needle may also be fully pegged during a PSG or a high-speed spiral! The turn needle, therefore, can only be relied on to indicate the direction of rotation since the pilot may misinterpret visual cues during the extreme disorientation that often accompanies OCF.

104. OUT-OF-CONTROL RECOVERY TECHNIQUE

The proper recovery technique from a loss of control situation depends upon an accurate analysis of the condition. Erroneous analysis and subsequent improper control inputs have often resulted in the pilot worsening the situation and losing the aircraft. Figure 1-12 presents an overview of the typical OCF sequence.

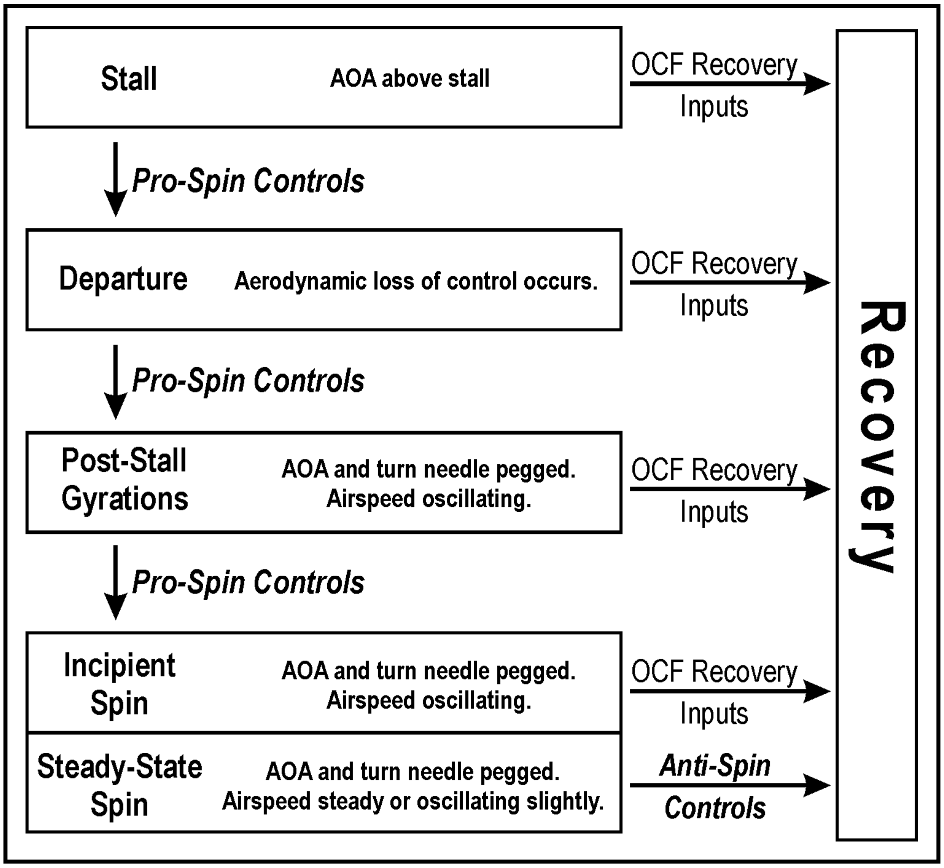


Figure 1-12 Out-of Control Sequence

The recovery procedure from the Stall, Departure, PSG, or Incipient Spin phase is to FIRST, <u>neutralize the controls</u>. Then VISUALLY come inside the cockpit and neutralize the controls. Any other control input will only aggravate the situation. Even slight deviations from neutral may prevent recovery.

Since you may be thrown about the cockpit under varying positive and negative "G's" and since control forces will probably differ from those you normally experience, neutralizing the controls may not be a simple matter. In addition, your natural instinct upon losing control may be an attempt to counter a roll with aileron, which will only make matters worse.

105. PILOT FACTORS IN OUT-OF-CONTROL FLIGHT

Now that OCF aerodynamics and some design problems have been discussed, there are several factors, affecting a pilot's performance when the aircraft departs controlled flight, which should be reviewed.

Time Distortion. Studies show the average pilot, under the stress of OCF, perceives time to be passing about five times faster than it really is. This misconception leads to the pilot's reluctance to maintain proper recovery control inputs long enough to be effective. Instead, the pilot feels the control inputs have been held long enough, recovery should have taken place; therefore, it must be necessary to "try something else" and recovery is thereby delayed or even prevented. The only sure way to avoid problems brought about by time distortion is to analyze the problem accurately, know the aircraft's recovery procedures, maintain recovery inputs, and be patient. The altimeter will indicate when it is time to stop attempting recovery and execute Bailout.

"G" Force Distortion. "G" force distortion, or perceived "seat of the pants" cues can cause you to analyze a situation incorrectly and apply improper recovery inputs. Disregard perceived "G" forces! Look at the instruments! Believe them!

Control Inputs. The pilot's natural tendency usually will be contrary to necessary and proper control application, primarily in the use of ailerons. For example, upon experiencing a wing drop or roll during departure, the pilot's instinct is to counter with ailerons, which induces adverse yaw, aggravates the departure and can lead to a spin. All control positioning must be done deliberately to ensure they are properly placed and the pilot should visually check all the controls for correct position.

Seat Restraint. OCF may cause the pilot to be thrown out of reach of the controls. Keeping lap belts as tight as possible will help prevent this problem. However, under heavy negative "G" loads, reaching the controls will take a definite effort even if the lap belts are tight.

106. SUMMARY

Every pilot must be prepared to handle uncontrolled flight by:

Knowing the aircraft. Study the NATOPS Flight Manual.

Knowing the procedures. OCF Recovery Procedures must become second nature.

Neutralizing the controls. Immediately upon losing control, position controls to neutral until recovery or a Steady-State Spin has been positively confirmed.

Power to Idle. Failure to do this can delay the recovery, which neutral controls should bring about.

Being patient. Hasty control applications can further aggravate the OCF condition and delay recovery. Also, be patient with the control inputs you have applied (i.e., neutral) when an aircraft experiences OCF.

Checking the altimeter. If sufficient altitude is not available, BAILOUT. There is no reason to spend the rest of your life trying to recover the aircraft. Do not waste time when you have made your decision. If you have not recovered by 5000 feet and you bail out at that altitude, you are extremely time-limited, since the aircraft will impact the ground in less than 30 seconds. Observations made during T-34C bailout training show that it takes 12 - 15 seconds to get out of the aircraft, which puts you at about 2500 feet as you clear the plane.

CHAPTER TWO
UNUSUAL ATTITUDES AND OUT-OF-CONTROL FLIGHT

200. INTRODUCTION TO OUT-OF-CONTROL FLIGHT

Intentional OCF maneuvers are conducted to enhance pilot proficiency in OCF recovery. OCF training shall only be conducted on NATOPS training flights (C7001-C7005), NATOPS check flights (C7190), OCF semi-annual refresher flights, or as part of an approved curriculum training flight authorized by unit commanding officers or higher authority. All intentional departures shall be done with ground reference, clear of clouds and with a discernable horizon. OCF maneuvers shall not be conducted directly above a broken or overcast layer. Clearing turns and the Preaerobatic Checklist shall be accomplished prior to initiating any practice OCF maneuver. All maneuvers shall be recovered above 5000 feet AGL.

CAUTION

> Rapid airspeed buildups may occur during OCF recovery. Take care when performing maneuvers with the landing gear extended and the flaps down to avoid overspeeds.

201. OUT-OF-CONTROL FLIGHT

OCF is the seemingly random motion of the airplane about one or more axes. OCF originates from a stalled condition if the inertial forces on the airplane exceed the aerodynamic control authority. It is for this reason OCF cannot be halted by any application of controls. In fact, certain control applications may intensify the motions. OCF usually results from stalls in accelerated or out-of-balanced flight or from stalls where improper recovery control inputs are applied. OCF, in general, can be divided into three categories:

1. PSGs are the random motions of the airplane about one or more axes immediately following a stall. A PSG can occur at normal flying speed (from an accelerated stall) or at slow speed following a normal stall. The PSG can be extended through continued application of post-stall controls or misapplication of stall recovery controls. At normal flying speeds, a PSG will dissipate kinetic energy so that the aircraft tends to slow to a potential incipient spin condition. At slow airspeeds, the post-stall condition is accompanied by flight controls ineffective compared to the inertial forces present. PSGs may be extremely violent and disorienting. The intuitive response of rapidly applying controls in all axes in an attempt to stop the PSG is generally ineffective or exacerbates the random motions. PSGs are aggravated by maintenance of aft stick and rapid cycling of the rudder pedals. A pilot can usually identify a PSG by noting an uncommanded (and often rapid) aircraft motion about any axis, an immediate feeling of lost control authority, stalled or near-stalled AOA, random (usually transient) airspeed and random turn needle deflection.

2. Incipient Spin is the motion occurring between a PSG and a fully developed spin. Additionally, the reversal phase of a progressive spin is also an incipient spin. Any stall can progress to an incipient spin if steps are not taken to recover the aircraft at either the stall or PSG. An incipient spin is a spin-like motion in which the aerodynamic and inertial forces are not yet in

balance, but where there is sustained, unsteady yaw rotation. As a result, an incipient spin is characterized by oscillations in pitch, roll, and yaw attitudes and rates. In an incipient spin, the nose attitude will likely fluctuate from the horizon to the vertical (nose down), the yaw rate will increase toward the Steady-State value, and the wings will rock about a nearly level attitude. The incipient phase lasts approximately two turns. A pilot can usually identify an incipient spin by noting stalled AOA, airspeed accelerating or decelerating towards a Steady-State Spin value, and fully deflected turn needle. Visual indications are misleading and may lead to the false impression of a Steady-State Spin.

3. Steady-State Spin motion is considered to be OCF because control input in any one of the three axes does not affect an immediate response about that axis. To develop a Steady-State Spin in the T-34C requires maintaining pro-spin control inputs during the incipient spin phase. With such a dedicated effort required to develop a Steady-State Spin, one might conclude there is no danger of developing one inadvertently. Unfortunately, this is not the case. There are several documented instances (some resulting in mishaps) in which pilots have attempted to recover from OCF in its earliest stages and because they used improper technique, forced the aircraft into a spin. To identify a Steady-State Spin properly, the pilot must depend on certain cockpit indications and avoid the natural instinct to rely on visual cues. For instance, hanging in the straps while the aircraft is upside down and spinning around does not equate to an inverted spin. Understanding of this extremely important point is somewhat obscured by the out-of-date notion that a "good" pilot can always depend on visual cues to determine what is happening to his aircraft. To really identify a Steady-State Erect Spin, one must note a stalled (pegged) AOA, a stabilized airspeed, typically of 80 - 100 KIAS, and a fully deflected turn needle. Indications of an inverted spin are 2 - 3 units AOA, zero airspeed, and a fully deflected turn needle. Any indications other than these signify something other than a Steady-State Spin.

202. PROGRESSIVE SPIN

1. **Discussion.** This maneuver is introduced in order to familiarize the IUT with the OCF characteristics and disorienting effects associated with a progressive spin, which results from a misapplication of spin recovery control inputs. For example, a reversal of rudder direction during a Steady-State Spin while maintaining full back stick will result in a progressive spin.

The progressive spin is characterized by an initial increase in nosedown pitch and spin rate, followed by a rapid reversal in spin direction. The number of turns, which occur prior to spin direction reversal, varies depending upon the initial spin direction and the location of the aircraft's CG. Spins to the left typically reverse after fewer rotations and tend to be the more intensely disorienting than spins initiated to the right. NATC flight departure investigations revealed that reversals consistently occurred 1 1/3 - 1 1/4 turn after full opposite rudder was applied. Because of the increased potential for disorientation, it is once again important to emphasize, "The turn needle is the only reliable indicator of spin direction".

The reversal phase also involves the motion, which occurs between Steady-State Spins in opposite directions and is similar to the incipient spin phase. The reversal phase continues for approximately 3 turns following initial reversal of spin direction. Aircraft motions during this phase become oscillatory and airspeed may go as high as 140 KIAS.

Recoveries initiated during the reversal phase were evaluated by NATC to determine the optimum recovery technique to be used in the event of intentional or inadvertent progressive spin entry. Both neutral control and NATOPS anti-spin control techniques were used to effect recoveries initiated up to 2 1/2 turns after the reversal of spin direction. Recovery using the NATOPS anti-spin technique was slightly more rapid than use of neutral controls, but was also qualitatively evaluated as having the potential for entry into a second progressive spin. In the event of inadvertent progressive spin entry, neutralization of the controls will result in sufficiently rapid recovery without disorientation effects to the pilot. The neutral control technique should be applied while assessing the aircraft's flight condition. In the event recovery has not occurred within two turns, applying the proper NATOPS anti-spin controls will affect a rapid recovery. Minimum entry altitude for a Progressive Spin maneuver is 13,500 feet AGL.

NOTE

Both the Anti-Spin Recovery Procedures listed below and the NATOPS OCF Recovery Procedures should be practiced by the IUT.

2. **Procedures**

a. Perform the procedures for a normal, erect spin entry in either direction.

b. After confirming steady state spin as noted by cockpit indications, smoothly apply full rudder opposite the direction of turn needle deflection while continuing to hold full back stick.

c. Continue to hold these control inputs until the aircraft has stabilized in a Steady-State Spin opposite the initial spin direction. Recover in accordance with the NATOPS Out-of-Control Recovery Procedures or proceed as follows:

i. Apply full rudder opposite the turn needle.

ii. Position the stick forward of neutral (ailerons neutral).

iii. Neutralize the controls as rotation stops.

iv. Recover from the ensuing unusual attitude.

203. CONTROL RELEASE SPIN

1. **Discussion.** This maneuver is introduced to thoroughly familiarize the IUT with the erect spin characteristics and cockpit indications of the T-34C. In this maneuver, the aircraft is established in a Steady-State Spin in either direction and the controls subsequently released. The rudder pedals will float near the neutral position and the stick will remain near the full aft position. AOA, airspeed, altimeter, turn needle, and VSI are scanned for erect spin indications.

Once this check is complete, the IUT will again take the controls, reconfirm the spin direction by noting the turn needle, and recover the aircraft by utilizing the Normal Erect Spin Recovery Procedures. Minimum entry altitude for the Control Release Spin maneuver is 9000 feet AGL.

2. **Procedures**

a. Perform the procedures to enter a normal erect spin in either direction.

b. After confirming steady state spin as noted by cockpit indications, release the controls and conduct a systematic check of cockpit indications and control positions.

c. Once the cockpit check is complete, reconfirm spin direction by referencing the turn needle.

d. Take the controls and apply full rudder opposite the turn needle.

e. Position the stick forward of neutral (ailerons neutral).

f. Neutralize the controls as rotation stops.

g. Recover from the ensuing unusual attitude.

204. OUT-OF-CONTROL FLIGHT RECOVERY

Recovery from PSG and Incipient Spins (including the reversal phase of the Progressive Spin) is accomplished through prompt, positive neutralization of flight controls in all axes. Patience and the maintenance of neutral controls are vital, since an immediate aircraft response to neutralizing may not be apparent to the pilot. In addition, cycling the controls or applying anti-spin controls prematurely can aggravate aircraft motions and prevent recovery. Attempting to fly the aircraft in a gyration or Incipient Spin may be innately satisfying, but it is very likely to delay or prevent recovery and increase altitude loss without accomplishing any positive results.

An important distinction must be made between stalls and OCF. A stall precedes OCF, but a stall per se is not OCF. A stall by itself is mild and is associated with the partial or apparent complete loss of control authority in one axis (almost exclusively the lateral axis as the nose drops). OCF includes a rapid uncommanded motion that accompanies or follows a stall as well as a more complete loss of control effectiveness. Stall recovery techniques are not appropriate for OCF and should be abandoned once it has been determined the aircraft has departed controlled flight. For example, an Approach Turn Stall (ATS) that exhibits the normal characteristic of the nose pitch-down should be recovered using the stall recovery technique. If, however, during the stall or recovery, the aircraft begins a rapid and uncommanded roll, the stall recovery technique should be abandoned and out-of-control recovery should be initiated (neutral controls, etc.).

Just as important as the distinction between stalls and OCF, is the distinction between Steady-State Spins and other categories of OCF. Recovery from a Steady-State Spin by maintaining neutral controls is uncertain. Consequently, after neutralizing the flight controls, if cockpit indications are that a Steady-State Spin has developed, the appropriate anti-spin control inputs must be made to ensure recovery from the spin.

Recovery from OCF will be accomplished in the following manner:

1. Controls - Positively neutralize.

2. Power Control Lever (PCL) - Idle.

3. Altitude - Check.

WARNING

If recovery from out-of-control flight cannot be accomplished by 5000 feet AGL, **BAIL OUT**.

4. AOA, airspeed, and turn needle - Check.

WARNING

Application of spin recovery controls when not in a steady state spin (as verified by AOA, airspeed, and turn needle) may further aggravate the OCF condition.

If in a steady state spin:

5. Gear/flaps - Up.

6. Rudder - Full OPPOSITE turn needle.

7. Stick - FORWARD OF NEUTRAL (erect spin) - NEUTRAL (inverted spin).

WARNING

Application of power when not actually in a steady-state spin will result in a rapid increase in rate of descent and airspeed.

If spin recovery is not evident soon after applying anti-spin inputs, pushing the control stick further forward (to the stop, if necessary) may facilitate recovery. If recovery from a steady state spin is not evident within two turns after anti-spin inputs are applied, verify cockpit indications of steady state spin and visually confirm proper spin recovery controls are applied. If no indication of recovery is evident, adding maximum power while maintaining proper spin recovery controls will enhance recovery from an erect steady state spin in either direction.

8. Controls - Neutralize when rotation stops.

When aircraft regains controlled flight:

9. Recover from unusual attitude.

WARNING

> Lower power settings reduce torque effect, restrict onset of rapid airspeed buildup, and enhance controllability. However, departures from controlled flight in close proximity to the ground may require rapid power addition upon OCF recovery.

There are no dark and hidden implications in the above procedures. Quite the opposite; in spite of their apparent complexity, the steps are simple, but must be fully understood to be so.

1. Positively neutralize the controls.

<u>This step requires your right hand, both feet, and a visual check to confirm the controls at the neutral position.</u> It is possible you will have to work against stick forces to neutralize. Experience has shown that neutralizing controls abruptly, but smoothly, is more effective than doing so slowly. Visual confirmation of neutral stick is vital, because the natural position to which your hand will fall is aft of neutral. Neutralizing the rudder assumes the ability to reach the pedals is not so easy if your harness is loose and you experience negative "G" forces. This step is more important than raising the gear or flaps. It is a simple, yet critical step. It should never be delayed!

2. PCL – Idle.

WARNING

> Lower power settings reduce torque effect, restrict onset of rapid airspeed buildup, and enhance controllability. However, departures from controlled flight in close proximity to the ground may require rapid power addition upon OCF recovery.

3. Determine aircraft altitude.

Scan the altimeter frequently, especially if the recovery is delayed. You should always be aware of the aircraft's altitude and know approximately what 5000 feet AGL is on the barometric altimeter.

NOTE

Altimeter lag has been known to be insignificant.

4. Determine AOA, airspeed and check turn needle.

Many refer to this step, combined with the previous step, to "analyze" without being fully aware of what is being analyzed. The philosophy of this step in simplest terms is:

Check to see that the aircraft is <u>NOT</u> in a Steady-State Spin. If the aircraft is in <u>anything</u> other than a Steady-State Spin, the correct recovery inputs have already been set (neutral), and all that is required is to wait until the aircraft regains controlled flight to begin the unusual attitude recovery. Only if all 3 instruments indicate a Steady-State Spin should any form of anti-spin input be applied. A Steady-State Spin can normally be ruled out after noting AOA and airspeed. Checking the turn needle is required primarily to determine the correct rudder to use if AOA and airspeed indicate a Steady-State Spin or if passing/below 5000 feet AGL, the correct side for bailout. Being upside down and rotating does not necessarily equate to an inverted spin. Tales of inverted spins without intelligent recollection of AOA, airspeed, and turn needle should be as well received as stories of fish that got away. For example, the possible AOA values for a Steady-State Spin in the T-34C are 30 units (pegged) or 2 - 3 units. Noting any other value immediately indicates the aircraft is NOT in Steady-State Spin and applying anti-spin controls are inappropriate. The same applies for any airspeed value other than zero or stabilized between the typical 80 - 100 knots.

The steps of checking altitude, AOA, airspeed, and turn needle should take at most 1 - 2 seconds and can be thought of in easier terms by memorizing the Scan Pattern in Figure 2-1.

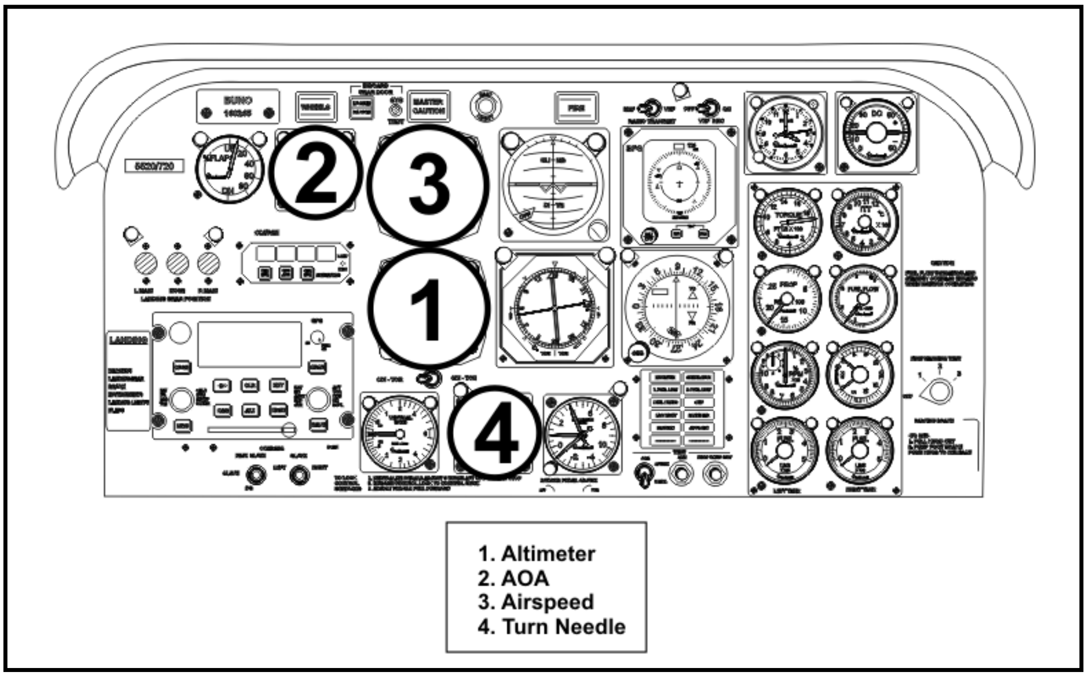


Figure 2-1 Scan Pattern

5. If in Steady-State Spin, execute appropriate spin recovery technique.

Assuming a Steady-State Spin, the controls at this point will be neutral. In order to execute the appropriate spin recovery technique, use full rudder opposite the turn needle deflection and moving the stick a bit more forward. Recovery may take up to two more full turns.

6. After the aircraft regains controlled flight, execute unusual attitude recovery as appropriate.

Barring complications or bailout, the aircraft will in all cases return to controlled flight, usually rather quickly. The unusual attitude that follows will, in most cases, be nose-low. While maintaining the nose-low attitude, check the position of the wings. If inverted, roll in the shortest direction to the upright position and then complete the recovery by leveling the wings and commencing a smooth pullout, not to exceed the aircraft "G" limits or 24 units AOA.

205. STALLS AND DEPARTURE

Stalls can be categorized as either normal or accelerated. A normal stall will occur when the aircraft is in an unaccelerated flight condition. The primary warnings of an approaching unaccelerated stall in the T-34C are the rudder shakers, decreasing airspeed, and increasing AOA. Other indications may include airframe buffet (although somewhat more subtle) and decreasing control effectiveness. An accelerated stall will occur in an accelerated flight condition (increased "G's"), such as a Pullup or a Level Turn maneuver. Accelerated stalls always exhibit more severe characteristics than normal stalls. Normally, a "secondary stall" which may be experienced while recovering from a normal stall, such as that which is experienced periodically during the approach turn stall recovery, is actually an accelerated stall. Such a stall can be caused by the rapid addition of power, increasing the aircraft AOA, inducing a stall at a higher than normal airspeed, and "G" loading.

If the pilot has no intention of stalling the aircraft and stall warning such as rudder shakers or airframe buffet are experienced, he must take immediate action to avoid the stall. Actions reducing AOA, such as relaxing back stick pressure, leveling the wings, centering the ball, and advancing power smoothly are all appropriate. If such warnings are ignored, subsequent departure and PSG are inevitable. Misapplication of stall recovery controls may result in PSG or Incipient Spin. Stall recovery is accomplished in the conventional manner as follows:

1. Lower nose immediately by reducing back stick pressure.

2. Use aileron and rudder, as required, to regain straight and level balanced flight.

3. At the same time, advance power smoothly.

Stall departure is normally recognized by rapid yawing and a nosedown pitching movement, usually toward the direction of principal rudder input. The departure will be followed by PSG if the controls are not neutralized promptly. Positively neutralizing the controls will cause the airplane to recover from the stall departure, but may result in an ensuing unusual attitude from which the pilot can ultimately recover.

206. POST-STALL GYRATIONS

If control inputs are held after the aircraft departs controlled flight, the aircraft will continue to oscillate randomly about any or all axes in increasingly nose-low attitudes, which may or may not develop into a spin. From a 1.0 "G" departure, these oscillations are comparatively mild with a roll in the direction of applied rudder. With ailerons applied opposite to rudder deflection, lower nose attitudes and faster roll rates will result. PSG resulting from accelerated departures are similar, except that initial roll rates will be higher (assuming the same amount of rudder deflection). In either case, neutralizing the controls will affect rapid recovery, normally in a nose-low attitude. AOA and airspeed should be checked prior to starting pullout.

207. SPIRALS

The spiral is characterized by a nose-low attitude, high roll rates, and rapidly increasing airspeed. A spiral may easily be confused with a spin if the pilot relies solely on the interpretation of outside references and fails to accomplish a proper analysis of the cockpit flight instruments. Should the pilot misinterpret a spiral as a spin, it is highly unlikely that anti-spin inputs will affect a successful recovery.

If performed to the left, the cockpit indications will initially look like those of a Steady-State Erect Spin, with AOA pegged, airspeed moving into the typical 80 - 100 knot range, and turn needle fully deflected left. However, the aircraft is <u>not</u> <u>stalled</u>. This becomes apparent if the spiral is performed to the right, which makes the AOA hover near 20 units. Even when performed to the left, the airspeed will soon accelerate through the typical 80 - 100 knot range and positively indicate the aircraft is not in a spin. Airspeed will continue to accelerate with a rapid rate of rotation until the only method of recovery is effected, NATOPS OCF Recovery Procedures. Once the controls have been neutralized and the absence of spiral indications is confirmed, the pilot must recover from a nose-low, unusual attitude. Having the power reduced to idle will help slow the rate of airspeed increase. Excessive airspeed creates a strong tendency for the nose to pitch upward. This tendency is exaggerated when the aircraft is trimmed for a slower airspeed (i.e., 150 KIAS). It is critical to emphasize, the pilot must stop the roll and level the wings prior to allowing the nose to pitch upward. This will prevent a rolling pullout, which imposes additional stress on the airframe. Failure to prevent a rolling pullout could result in structural failure of the aircraft due to asymmetrical "G" loading. Prior to attempting a pullout, ensure the wings are level by referencing the horizon and do not exceed 24 units AOA or 4.5 "G's" (altitude permitting).

The key to a safe recovery from an inadvertent spiral lies in the expeditious recognition of the aircraft's actual flight condition. The pilot must be able to accomplish a proper analysis of the cockpit flight instruments and not rely solely on outside references.

208. T-34C ERECT SPIN CHARACTERISTICS

If pro-spin controls are maintained through the PSG phase, a spin will develop. Spin is characterized by stable pitch attitudes, AOA, vertical velocity, airspeed, and yaw rates. Cockpit indications of an erect spin are: Airspeed - <u>stabilized</u> between the typical 80 - 100 KIAS, AOA -

30 units, turn needle - fully deflected in direction of spin. Other characteristics include approximately 45° nose down attitude, a spin rate of 110 - 170 degrees per second, and a 9000 - 12,000 fpm rate of descent. The Incipient Spin will precede the fully developed spin, with some oscillations in all parameters present.

Positive recovery controls should be utilized for fully developed spins. If the controls are simply released, aerodynamic loads will hold the elevator full aft for several turns; the ailerons and rudder may "float" to near neutral. To neutralize the elevator, a moderate but definite forward force (approximately 40 lbs. for the T-34C) will be required to overcome the aerodynamic load. Positive control neutralization may occasionally result in a recovery, but in most cases, the recovery is slow and may not occur. With anti-spin controls maintained, recovery will occur in 1 - 2 1/2 turns.

209. DEFENSIVE POSITIONING

It is essential to teach unusual attitudes and OCF in order to more adequately prepare fleet aviators for the rigorous flight regimes with which they will constantly be dealing with as primary flight instructors. Additionally, it is as equally important to teach instructors the preventative measures concept of "defensive positioning".

The following is a discussion of maneuvers Student Aviator's commonly perform and sometimes perform incorrectly. This section is an amplification of common student errors found in P-330 (Contact FTI) and is intended to provide the new instructor with some knowledge gained by others through experience.

1. **Spin Defensive Positioning**

The spin is a terrific confidence builder for a new aviator and is a relatively simple maneuver to perform, but if not entered correctly or if the student is slow to put in the proper inputs, you as the instructor may end up in a flight regime you did not intend to enter. Some of the defensive techniques are:

a. As the student rolls out after completing the clearing turn, look at his head to see if he is looking out the opposite direction of the last 90° of the clearing turn. This may be an early indication they are going to spin the wrong way. You could either confirm the direction verbally or wait to see they are leading the rudder in the correct direction. If they are leading with the wrong rudder, confirm verbally. Look for the early signs.

b. As the instructor, you must constantly be vigilant of other traffic; try to look and make sure it is clear around your aircraft in both directions. If at the stall the student puts in the wrong full rudder, either let him continue if you have cleared the area and debrief it after you have recovered, or recover immediately by taking the controls and performing OCF Procedures. You do not want confusion in the cockpit at the stall and subsequent cycling of the rudder pedals.

c. As the nose of the aircraft comes up, you, as the instructor, should be done looking outside. You should be shadowing the controls and beginning your scan looking for stalled AOA (altitude, AOA, airspeed, and turn needle). If you do not see the correct control inputs going in, go ahead, put them in, and debrief it later. This does not mean you are flying the maneuver, but you are going to make sure it is executed correctly. Silence the horn.

d. The spin entry should be very methodical and deliberate; it should not be a slow "milked" entry with not enough back stick to increase AOA to stall. If you see the proper control inputs are not put in, apply them in a timely manner to avoid a spiral or just entering an unusual attitude.

e. After you are in the spin, confirmed by stalled AOA and stable airspeed (80 - 100 knots), shadow the controls, block the aileron input, and hover your boot over the rudder input. Now we are looking for a correct recovery, ensure that as you are shadowing, you do not block the rudder as the student is trying to put in the correct recovery rudder and ensure the stick is put in the proper position.

f. Upon spin recovery, the student may leave the recovery rudder in too long; emphasize that the controls go to neutral once rotation stops.

2. Approach Turn Stall Defensive Positioning

The ATS is a relatively benign maneuver and as an instructor, you will do many of them; however, due to this maneuver's normally benign nature, it can catch you by surprise. You may end up in an OCF scenario you did not intend to be in if the student does something unexpected.

The purpose of this instruction is not to reiterate what is already covered in the Contact FTI, but to prepare the instructor for the unexpected. With that said, this excerpt from the Contact FTI bears reiteration with regard to the ATS.

NOTE

> Stalls should be practiced to the maximum extent to build confidence and proficiency. In all cases, however, departure from controlled flight shall be avoided. Instructional time should be used to practice successful recovery techniques rather than test the student's ability to recover from uncontrolled flight.

As an instructor, you will have the opportunity to recover from the "botched" ATS under an approved OCF syllabus; however, the SNA is being taught to recover from an ATS that may save their life should this occur in the Landing Pattern. We are not teaching them to recover this maneuver from OCF. Therefore, here is what to expect when you least expect it. Some of the defense techniques are:

a. During the clearing turn, tell the student you are going hot mic and turn it on. This is a small item, but may become very important to you if your student departs the aircraft unexpectedly and you are trying to reach the ICS switch to tell him you have controls, while at the same time trying to raise the flaps.

b. During the descent after the clearing turn, check the student's trim. This can be done a couple of different ways. Have the student show his hands or put your left hand on the trim wheels after power reduction to feel the trim inputs. This helps the student learn the correct trim inputs for the pattern, and it will affect your departure from controlled flight if they are incorrectly trimmed and enter a secondary stall or input incorrect rudder.

c. As the student enters the stall you should shadow them on the controls. It is not uncommon for the student to raise the nose after beginning the recovery and enter a secondary stall. If this occurs at the point when the power is spooling up, you could depart to the left due to torque effect. You can solve this early by verbally telling them to relax some back stick.

d. It is also not uncommon for the student to use the left rudder when recovering from an approach turn stall to the left. Point out that the student may enter the left rudder incorrectly on recovery from an approach turn stall to the right also; in either case, the left rudder is always incorrect to counter the torque. You can prevent this by shadowing the controls with your right foot over, not on, the right rudder pedal; you can prevent the SNA inadvertent left rudder input with an artificial stop. Additionally, note that it does not require full rudder to depart the aircraft. With full rudder input at a stalled or near stalled condition, you need to be concerned about an approach turn spin with the gear and flaps down.

3. **Slip Defensive Positioning**

The slip is a terrific way to lose excessive altitude while maintaining airspeed and ground track; however, with a misapplied rudder or inattention to airspeed, the student could depart or stall the aircraft. Some of the defense techniques are:

a. Pre-brief the student to say, "Wing down, top rudder" as they are lowering the wing to enter the slip. You should shadow them on the controls as they enter.

b. Make sure the rudder (slip) is taken out before the student tries to change directions and lower the other wing and swap rudders. The rudder should be taken out smoothly and entered smoothly. If the student is not taking out the rudder before making turns, they may inadvertently enter a skid. Again, shadow the controls.

c. If a student is changing rudders and changing the wing in a rapid or rough manner, they could depart the aircraft due to a rapid increase in yaw rate (Figure 1-10). Due to the out-of-balanced flight condition, the stall speed will be higher. In either case, shadow the controls.

4. **Emergency Landing Pattern Defensive Positioning**

With regard to the Emergency Landing Pattern (ELP), the previous slip defensive techniques apply. In addition, here are other ELP considerations. Some of the defense techniques are:

a. When simulating a power loss emergency, once you say "Simulated" and pull the power, the student still has the controls (stick and PCL), but you are the only one who will move the PCL to a SIMULATED FTHR condition (205 ft-lbs). Leave your hand near the PCL while guarding the Condition Lever to ensure the student does not pull it.

b. If a student selects a bad, unprepared field (one that you really can not land in if you lost the engine), you may let him go to the bad field, but not to the point where you know you will not be able to make some other good field you have in sight. You do not want to be in a situation where you are out of altitude and options, have an actual emergency, and you have set yourself up to prove a point.

c. During waveoff from a High Altitude Power Loss (HAPL)/Low Altitude Power Loss (LAPL), there should never be a question about who is doing the waveoff. It will always be the instructor; therefore, you should take the controls with enough altitude so that you do not descend below the waveoff altitude. When taking the controls from the student, anticipate the aircraft being untrimmed, add power, level the wings, and center the ball. Use the same Waveoff Procedures that are in the Contact FTI. When climbing out, you should climb for a suitable low key in case of an actual emergency.

5. **Landing Pattern Defensive Positioning**

Landing Pattern errors are contained in the Contact FTI. However, as an instructor, it is important you maintain a vigilant scan and good situational awareness while in a high traffic environment where your attention will be divided between trying to teach a young aviator how to land and knowing where your interval is. Do not trust the student to do this. It is important to note that students will have bad landings (some more than others) and that is all right. Your task as an instructor is to know what a bad landing is and what an unsafe landing is; the first is part of the learning curve, the latter should be waved off. In this syllabus, you will see examples of both and learn where that line is so that you do not cross it.

a. **Typical errors include**:

i. Not trimming throughout pattern.

ii. Balloon-fast on final and over flare.

iii. Porpoise landing-correct by waveoff.

iv. Stall prior to touch down.

v. Overshoot/Undershoot final.

vi. Low/High.

vii. Slow/Fast.

viii. Poor crosswind correction/Crab landing.

ix. Late/Early transition at the 180 position.

x. Turning without interval.

xi. Missed calls/Using UHF vice ICS.

xii. Lowering right wing vice using right rudder on liftoff from touch-and-go.

b. **Defensive techniques**:

i. Shadow the student on the controls. Do not ride the controls all the time, the student needs an opportunity to make mistakes and learn to correct them on his own or waveoff.

ii. Do not overload the student to the point where they are task saturated on every pass and lose Situational Awareness (SA) because this may help keep them from doing something unexpected.

Only by teaching and developing defensive positioning techniques, can we expect our instructors to be able to prevent any situation from developing beyond their ability to correct it. Defensive positioning training will improve our reaction time by allowing us to "feel" an improper input and act correctly, or not allow the improper input to be accomplished at all if that is the suitable thing to do. It is just as important to recognize an unsafe situation developing and prevent it from happening, as it is to properly assess an OCF regime and recover from it correctly.

A good example of defensive positioning occurs during an ATS (especially to the left) when the student's tendency (read, "Common Errors") is to apply left rudder vice the correct input of right rudder. By placing your right foot over, not specifically on, the right rudder pedal, you can prevent the SNA inadvertent input with an artificial stop. This prevents the dreaded Approach Turn spin. Other examples include "guarding" the rudder pedals during HAPL/LAPL work to prevent a slip from becoming a skid or keeping your hand behind the stick during takeoffs and landings to prevent overrotation, overflare or pushover after ballooning.

Defensive positioning must be an integral part of the Instructor Training Syllabus to be instilled effectively in all of our flight instructors prior to "hitting the pits".

210. OUT-OF-CONTROL FLIGHT MANEUVERS

1. **Cross-Control Departure**

a. **Description**: The Cross-Control Departure is a basic flight departure maneuver designed to demonstrate how a combination of high AOA, Angle of Bank (AOB), and excessive yaw rate can lead to an inadvertent loss of control.

b. **General**: The maneuver will be entered by the Standardization Instructor and recovered by the IUT. Once established in straight-and-level flight, the aircraft will be rolled into a steep AOB. Back stick and top rudder pressure will be applied as power is retarded toward idle, ensuring entry airspeed is below 120 KIAS. Once a stalled AOA is realized, the aircraft will depart with a rapid, nose-low roll in the direction of applied rudder. Several more rapid rolls may result and a spin will develop if control inputs are maintained. Post-departure recovery will be accomplished quickly and easily by neutralizing the controls. Minimum entry altitude for cross-control departure is 8000 feet AGL.

c. **Procedures**

i. Establish the aircraft in 100 KIAS level flight, clean configuration.

ii. Perform stall checklist and clearing turn.

iii. Roll out of the clearing turn, reduce power to 200 ft-lbs. and set 100 KIAS best glide attitude.

(a). Roll 45° AOB in either direction.

(b). Simultaneously:

(1). Reduce power toward idle.

(2). Increase back stick pressure while applying slight aileron toward the lower wing.

(3). Input top rudder.

iv. Increase control inputs until the aircraft departs controlled flight.

CAUTION

The possibility of overstressing the aircraft at airspeeds less than V_A (135 KIAS at maximum gross weight) exists due to V_A decreasing as gross weight decreases. The combination of this lower V_A at lower gross weights and asymmetrical loading encountered during cross-control departures may overstress the aircraft. Cross-control departures SHALL NOT be executed at airspeeds in excess of 120 KIAS.

NOTE

Departure will be in the direction of applied rudder.

v. IUT will assume control of the aircraft and recover in accordance with OCF Recovery Procedures.

2. **Zero Airspeed Departure**

a. **Description**: The Zero Airspeed Departure demonstrates the departure from controlled flight associated with an unusually high pitch attitude.

b. **General**: The maneuver will be entered by the Standardization Instructor and recovered by the IUT. The aircraft will be positioned in a vertical attitude and power will be reduced to idle. Airspeed will decrease to zero and upon departure, the nose will fall forward or backward depending on the exact attitude at the top of the maneuver. Minimum entry altitude for the Zero Airspeed Departure is 8000 feet AGL.

CAUTION

It is preferred the nose fall forward at the departure point due to the aircraft going through fewer pitch oscillations (typically one) prior to recovery. If the nose falls backwards, the aircraft typically goes through 3 or more pitch oscillations before positive "G's" and recovery are established. These oscillations neutralize the inverted and upright pickups in the oil pump inlet, thereby causing a low spike in oil pressure.

c. **Procedures**

i. Perform the Stall Checklist and Clearing turn.

ii. Add maximum allowable power and accelerate to aerobatic cruise (approximately 180 - 190 KIAS).

iii. Smoothly raise the nose to the vertical (3 1/2 "G" pullup recommended).

iv. Reference the wingtip against the horizon.

v. Once vertical, reduce power to idle.

vi. Hold back stick pressure to maintain a vertical attitude until the aircraft departs controlled flight.

CAUTION

Reverse airflow over the control surfaces will cause significant feedback to the controls. Failure to maintain neutral controls can result in damaged controls and control stops.

NOTE

Ensure the rudder remains at neutral so as not to input pro-spin controls.

vii. IUT will assume control of the aircraft and recover in accordance with OCF Recovery Procedures.

3. **Aggravated Approach Turn Stall**

a. **Description**: This maneuver demonstrates the rapid and disorienting divergence to departed flight that may occur following a rough application of stall recovery control inputs while practicing approach turn stalls at altitude.

b. **General**: The maneuver will be flown by the Standardization Instructor and recovered by the IUT. The aircraft will be flown through a normal approach turn stall and during the recovery, control inputs will be initiated to induce a secondary stall. The aircraft will depart by rolling in the direction of the applied rudder. Minimum entry altitude for the aggravated approach turn stall is 8000 feet AGL.

c. **Procedures**

i. Perform the Stall Checklist and Clearing turn.

ii. Establish the aircraft in a right-hand descending 90 KIAS approach turn (300 ft-lbs., gear and flaps down, 30° AOB).

iii. Simultaneously set 12 - 15 degrees noseup and reduce power to 200 ft-lbs.

iv. Hold this attitude until the aircraft stalls, characterized by the nose pitching down.

v. Simultaneously:

(a). Level wings.

(b). Add maximum power.

(c). Raise the nose 12 - 15 degrees above the horizon.

(d). Input a slight amount of left rudder.

CAUTION

Do not apply excessive or full rudder because a spin may develop.

vi. Hold this attitude until the aircraft departs controlled flight, characterized by a rapid roll to the left.

vii. IUT will assume control of the aircraft and recover in accordance with OCF Recovery Procedures.

NOTE

The Standardization Instructor will raise the flap handle as the aircraft departs.

CAUTION

Care must be taken not to overspeed the flaps and/or landing gear.

4. **Spiral Demo**

a. **Discussion**: This maneuver is demonstrated by the Standardization Instructor to familiarize the IUT with the cockpit indications and flight characteristics of a spiral in the T-34C. During the maneuver, the Standardization Instructor will execute Normal Spin Entry Procedures up to the point of stall. Immediately after the stall, full rudder and full back stick shall be applied. As the aircraft enters the post-stall gyration 3/4 (and up to full) aileron will be applied in the direction of spiral with stick slightly forward of neutral. The aircraft will do a "Barrel Roll" type entry and initially "feel" like a spin. Altitude, AOA, airspeed, and turn needle are scanned to differentiate between a spin and a spiral and are called out by the IUT. Airspeed will continue to build unless OCF Recovery Procedures are initiated. The Standardization Instructor should maintain pro-spiral control inputs until the airspeed reaches at least 120 knots (no greater than 150 knots) to allow the IUT ample opportunity to recognize the aircraft is not in a Steady-State Spin. If the maneuver is performed to the left, the AOA will be fully pegged (if performed to the right, AOA will indicate approximately 20 units) and the turn needle pegged in the direction of rotation, strongly resembling a Steady-State Spin. However, the airspeed will accelerate rapidly through 80 - 100 knots. Minimum entry altitude for the Spiral Demo is 13,500 feet AGL and OCF recovery will be initiated by 150 knots. Test pilots have found that rates of descent associated with a spiral can be as high as 27,000 fpm. The aircraft will typically recover within 1/4 turn, once OCF recovery inputs are initiated.

b. **Procedures**

i. Perform procedures to enter a normal erect spin.

ii. As the aircraft begins the "Barrel Roll" departure, feed in 3/4 aileron and position stick slightly forward of neutral while maintaining full rudder deflection.

iii. IUT shall report altitude, AOA, airspeed, and turn needle following spiral entry.

iv. OCF IP will maintain pro spiral control inputs until airspeed has reached 120 knots, but no greater than 150 knots.

v. Initiate OCF Recovery Procedures upon IUT recognition of spiral or no later than airspeed reaching 150 knots. This maneuver is a demonstration only and will not be performed by the IUT.

vi. Recover from ensuing unusual altitude.

NOTE

Recovery airspeeds will be in excess of 200 knots with recovery initiated at 150 knots.

CAUTION

Failure to initiate recovery by 150 knots will result in extremely rapid airspeed buildup and high rates of descent. The possibility of asymmetrical "G" loading during the pullout exists due to the extremely disorienting effects felt during a spiral recovery.

5. **The Slip/Skid Departure Demo**

a. **Description**: This maneuver demonstrates the characteristics of the stall and departure of the aircraft in a slip and skid.

b. **General**: The maneuver lets the IUT analyze the AOA and departure airspeeds under different flight conditions (i.e., slip versus skid and accelerated versus unaccelerated). The maneuver emphasizes the reason we fly the aircraft in a slip vice skid and how acceleration will affect the airspeed at departure. Fly the slip demo first, climb back to altitude, and repeat for skid.

NOTE

> This maneuver is demonstration only and will not be performed by the IUT. The IUT will focus on various AOAs and airspeeds throughout the maneuver.

The maneuver will be flown and recovered by the Standardization Instructor. In the power off glide configuration, aircraft will be clean. Maneuver may be performed in either direction. Minimum entry altitude for the maneuver will be 8000 feet AGL.

c. **Procedures**

i. Configuration: Position the aircraft at a minimum of 8000 feet AGL in slow cruise and clean configuration.

ii. Perform Checklist and Clearing turn.

iii. Roll wings level, then reduce the PCL to 205 ft-lbs. and slow to 100-knot glide and retrim.

iv. Establish the aircraft in a slip.

v. Once established, momentarily roll the aircraft toward 60° AOB while maintaining 100-knot glide (note the aircraft still flies normally in the slip). IUT should be watching AOA and airspeed.

vi. Once reestablished in a normal slip, slowly (unaccelerated stall) decelerate the aircraft while holding the slip. Note, that the aircraft stalls between 50 - 60 knots indicated and towards wings level. Execute OCF Recovery Procedures and go back to 100-knot glide.

vii. Once reestablished at 100-knot glide, put the aircraft back into a slip in direction of Clearing turn.

viii. Once reestablished in a slip, smoothly pull 1 1/2 - 2 "G's". Note, the stall speed is higher than the unaccelerated stall (85 - 90 knots indicated). Aircraft still stalls towards wings level. Execute OCF Recovery Procedures.

ix. Climb back to altitude (minimum 8000 feet AGL), review checklist, and Clearing turn.

x. Repeat procedures for skid without the roll toward 60° AOB. IUT should note that stall speeds are about the same for both the skid and slip. The departure in the skid though will be toward inverted (low-wing will stall first). OCF Recovery Procedures will enable a recovery from each condition with minimal loss of altitude.

6. **The Rudder Swap Departure**

a. **Description**: This maneuver demonstrates the departure characteristics of the aircraft with a rapid increase in yaw rate.

b. **General**: This maneuver will emphasize to the IUT the need for shadowing the controls and ensuring the student enters and removes rudder in a smooth manner while executing HAPL, LAPL, or Precautionary Emergency Landing (PEL) procedures. The aircraft will depart controlled flight due to a rapid increase in yaw rate. Figure 1-4 illustrates this departure is not due to yaw angle, but the rate at which yaw is achieved. Remember, this departure is only demonstrated in one manner, but could occur under varying circumstance, (i.e., the student changing directions while completing S-turns or bow-ties and changing or removing rudders too quickly.

NOTE

This maneuver is demonstration only and will not be performed by the IUT.

The maneuver will be flown and recovered by the Standardization Instructor. In the power off glide configuration, aircraft will be clean. The maneuver may be performed in either direction. Minimum entry altitude for the maneuver will be 8000 feet AGL.

c. **Procedures**

i. Configuration: Position the aircraft at a minimum of 8000 feet AGL in slow cruise and clean configuration.

ii. Perform Checklist and Clearing turn.

iii. Roll wings level, then reduce the PCL to 205 ft-lbs. and slow to 100-knot glide and retrim.

iv. Enter skid (simulating an accidental misapplication of rudder by a student).

v. Once established in the skid, swap to the other rudder quickly with little or no back stick to emphasize depart due to yaw rate.

vi. Recover using OCF Procedures.

211. SUMMARY

The procedures outlined in this FTI have been gleaned from the experiences and misfortunes of others. Training methods listed herein have been thoroughly tested through years of flight experience with the T-34C aircraft and have proven the ability to expand the skill envelope of each new IUT. Every T-34C IUT is encouraged to read and live by the procedures outlined in NATOPS and this FTI. Your first experience in the aircraft will demonstrate it is a very docile aircraft in the OCF scenario. This is very true, but in the hands of an unprepared pilot, it is very unforgiving.

APPENDIX A
GLOSSARY

A

Angle Of Attack (AOA): The instantaneous angle between a reference line on the airplane (usually the wing chord line) and the relative wind direction. AOA is depicted in Figure A-1.

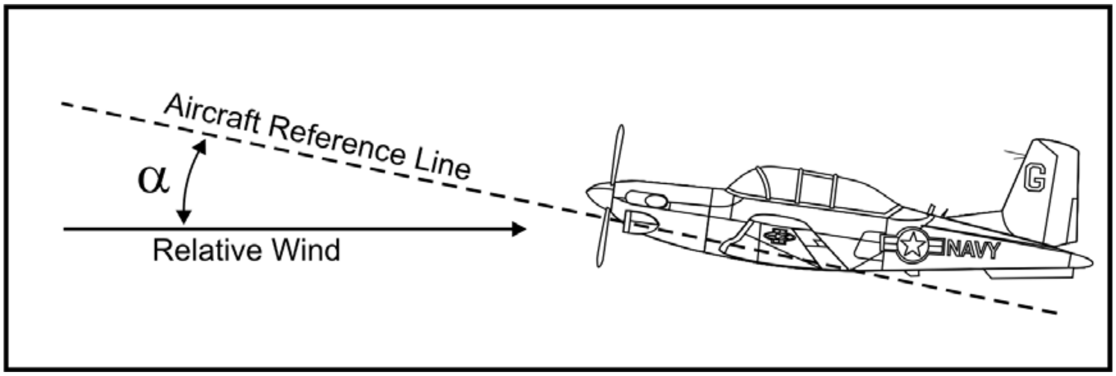


Figure A-1 Angle of Attack

Aerodynamic Coupling: An aerodynamic characteristic affecting dynamic stability, which results when a disturbance about one axis causes a disturbance about another axis (e.g., a combination of yawing and rolling motion resulting from rudder deflection).

B

Body Axis System: The system by which the axis of flight or aircraft movement are determined. The airplane body axis system is shown in Figure A-2.

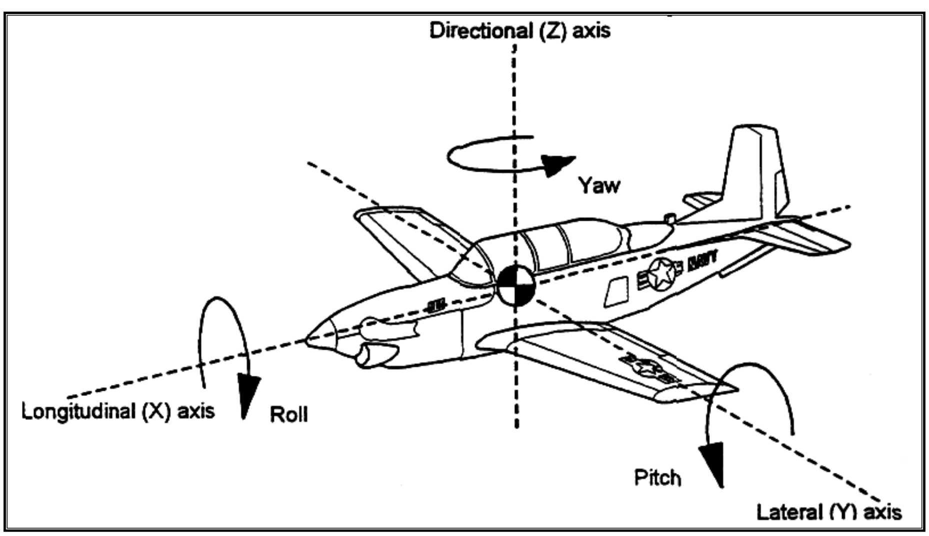


Figure A-2 Axis

D

Departure: The phase of flight during which the airplane goes from controlled to uncontrolled flight. The departure boundary is depicted in Figure A-3.

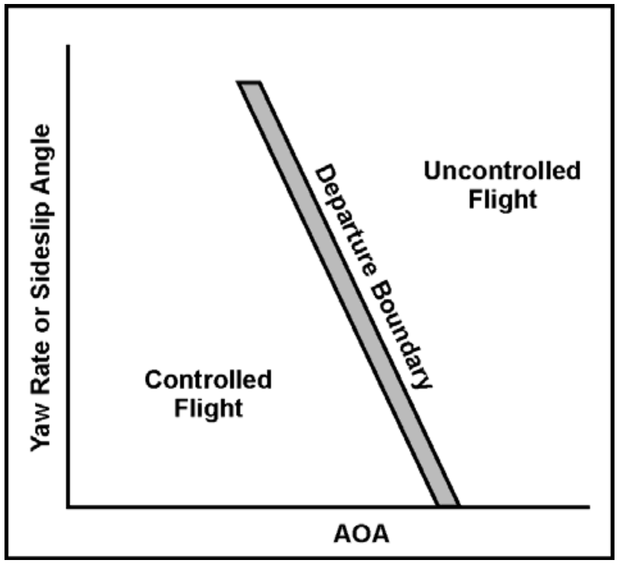


Figure A-3 Departure Boundary

M

Moment Of Inertia (I): With respect to any given axis, the moment of inertia is a measure of the resistance of a body to angular acceleration. I_x, I_y, and I_z are moments of inertia about respective body axes.

<u>**S**</u>

Sideslip Angle: Relationship between the displacement of the airplane centerline from the relative wind rather than from a reference axis (Figure A-4).

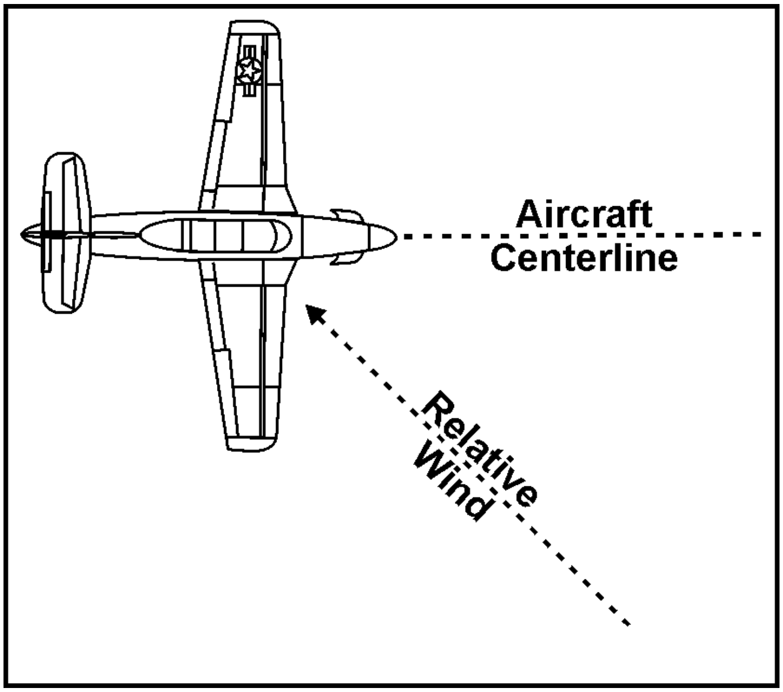


Figure A-4 Sideslip Angle

Stall: (Not an all-inclusive definition) The AOA beyond which a further increase in AOA will not produce a corresponding increase in lift.

Static Directional Stability: Essentially the weathercocking tendency of the airplane or the initial tendency of an airplane to return to Steady-State flight after a disturbance about an axis. Directional Stability can be positive, neutral, or negative (Figure A-5).

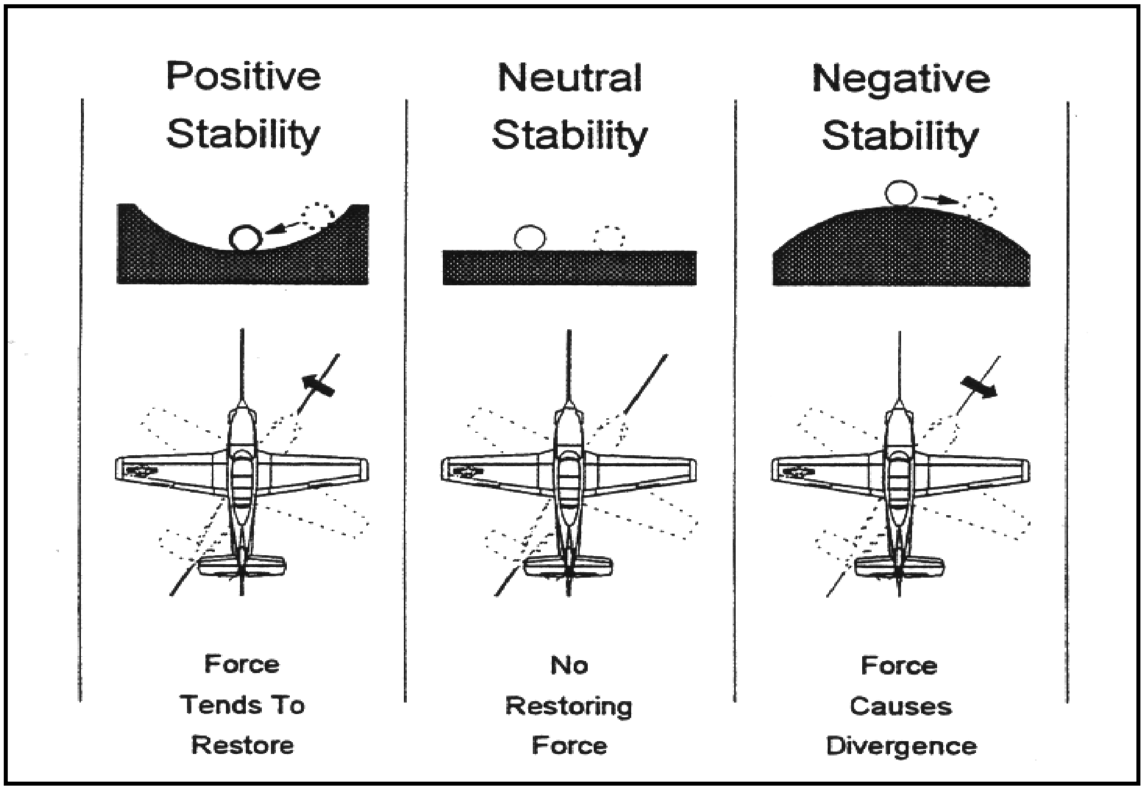


Figure A-5 Static Directional Stability

<u>Y</u>

Yaw Angle: Relates the displacement of the airplane centerline from some reference azimuth. This term is normally used in wind tunnel tests and is presented here only to eliminate or minimize the tendency to confuse it with angle of sideslip or yaw rate. Yaw angle is depicted in Figure A-6.

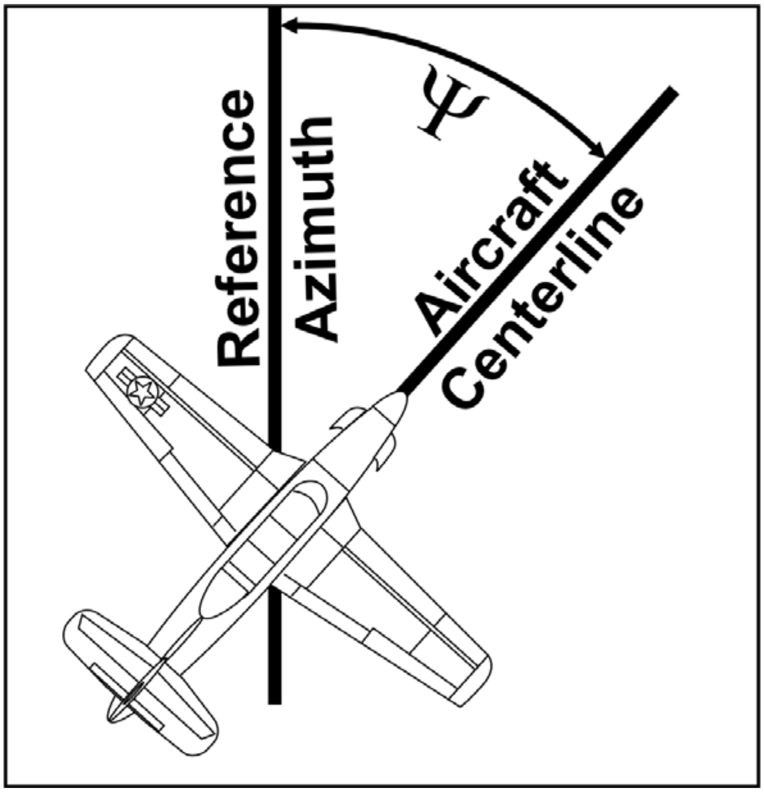


Figure A-6 Yaw Angle

Yaw Rate: Rate of change of yaw angle or how fast the nose of the airplane is moving across the horizon is measured in degrees per second (deg/sec).

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