EMERGENCY MANEUVER TRAINING

Aviation Performance Solutions LLC presents …

EMERGENCY MANEUVER TRAINING

Pilot Training Manual

- Upset Recovery Training
- Stall/Spin Awareness and Recovery Training
- Instrument Recovery Training
- Integrated Workbook

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Third Edition 2007

APS Emergency Maneuver Training
A Division of Aviation Performance Solutions, LLC
www.apstraining.com
Mesa, Arizona USA

COURSE INTRODUCTION

As the President of Aviation Performance Solutions, I would like to thank you for your decision to participate in our specialized courses of training. In preparation for your APS program, we have provided this training manual as a reference to be used at your discretion. For your convenience and future reference, we have also included a Notes section in the back of this booklet for you to jot down your thoughts during your visit. Please enjoy your stay with us and take a moment to review the resources we have brought together to provide this training...

Our Commitment

Our team is committed to providing the highest quality upset recovery training, aerobatics instruction, spin recovery and instrument recovery training available in the industry at the best value for your training dollar.

APS Emergency Maneuver Training ensures our clients are in the hands of highly trained and experienced professional aviators. Our staff excels in quality customer service and, in addition to providing world-class training in leading-edge equipment, we put the customer second only to flight safety. Moreover, we ensure our training services are being delivered in strict adherence to the industry's highest performance standards. Our business philosophy integrates quality training amidst an easy-going and enjoyable atmosphere.

Instructors

Each one of our instructor pilot's professional flight experience spans a highly specialized spectrum of aviation that uniquely qualifies them as the ideal training providers. All have extensive experience in general aviation, aerobatic maneuvering, military flight instruction, and all have experience flying technologically advanced aircraft in commercial and/or transport category flight operations.

As a testament to our dedication to the quality of our instructor staff, the APS President and Chief Flight Instructor is one of only eleven NAFI Master CFIs in the United States to receive "aerobatic" accreditation out of a field of over 90,000 CFIs and nearly 500 Master CFIs nationwide.

Facilities

All APS training courses are headquartered in our modern corporate hangar/office facility centrally located at the Williams Gateway Airport in Mesa, Arizona. Arguably, Arizona boasts the nation's most consistently favorable VFR weather conditions supporting everyone's need for reliable course scheduling.

The Industry Standard

These key assets of personnel and infrastructure combined with our 10-years of business experience have helped us establish the industry standard. We've been constantly refining upset recovery training techniques common to all categories of fixed wing aircraft and this has helped to make APS an unparalleled training resource to the aviation community.

In addition to all training being in compliance with the FAA Upset Recovery Training Aid Revision 1, APS Emergency Maneuver Training (to our knowledge) is the only Part 141 Flight School certified upset recovery, spin and instrument recovery training course provider in the nation.

Training Aircraft
APS Training exclusively employs the German-built Extra 300L. In addition to being the world's highest performance certified aerobatic aircraft, the Extra 300L is one of the safest, most structurally sound aircraft available and is ideally suited for upset recovery and advanced aerobatics training. This aircraft is fully aerobatic, equipped with multiple-view digital video systems and certified by the FAA to a +/- 10 G envelope for your team's safety.

Despite the Extra's superior performance and capabilities, all maneuver-based and scenario-based training exercises are taught in a manner that ensures each student is trained to apply recovery techniques within the performance envelope of their specific aircraft.

Training Objectives
Our upset recovery and emergency maneuver training courses teach every participant to recover from any possible in-flight upset or flight envelope excursion. Most importantly, APS training programs are focused on promoting "Recognition and Avoidance" through flight training integrated with a thorough theoretical understanding of the aerodynamics involved with each potential flight condition. To accomplish this, we do immerse pilots into the world of unusual attitude and uncommon flight envelope conditions while instilling participants with effective recognition, avoidance and recovery capabilities.

Graduates can expect the development of:

- Increased awareness of all upset scenarios
- Early recognition and avoidance skills through practical experience and understanding
- Decisive recovery techniques
- Leadership skills and judgment in high pressure, time critical flight environments
- Enhanced multi-crew cockpit management skills during an upset
- Improved safety of flight

A Final Word
Thank you for joining our team for the next few days. We look forward to sharing our training with you. We're confident you will learn skills and develop insights during your course that will last a lifetime.

With sincere appreciation,

Paul BJ Ransbury, President
Master Flight Instructor
APS Emergency Maneuver Training

EMERGENCY MANEUVER TRAINING

TABLE OF CONTENTS

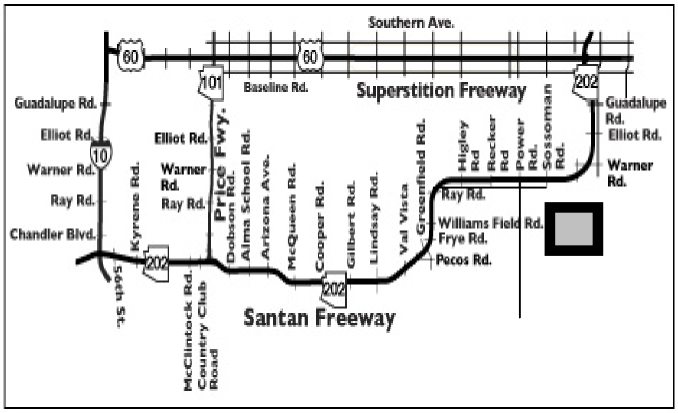
HANDOUTS and INSERTS:

On arrival at APS Emergency Maneuver Training, you will receive:

- Mission Exercise Summaries
- Instrument Recovery Training Supplement
- Various Articles Applicable to Your Selected Course of Training as Determined by Your Course Instructor(s)

CHAPTER 1: GENERAL INFORMATION

101 FACILITY LOCATION



Please visit our website for more detailed maps:
http://www.apstraining.com/fci_directions.htm

Williams Gateway Airport, home and headquarters for APS Emergency Maneuver Training, is located in the Phoenix metropolitan area in southeast Mesa, Arizona.

From US Highway 60: exit at Power Road – Exit 188 (DO NOT TAKE THE SOSSAMAN ROAD EXIT FROM US 60). Merge onto and proceed south on Power Road approximately 4.5 miles to the intersection of Power Road and E Ray Road. Turn left on E Ray Road. Ray Road will veer sharply to the right after approximately ¼ mile and the road becomes South Sossaman Road.

From the San Tan Freeway Loop 202 – exit onto Power Road – Exit 36. Proceed south on Power Road for ½ mile to the intersection of Power Road and E. Ray Road. Turn left on E Ray Road. Ray Road will veer sharply to the right after approximately ¼ mile and the road becomes South Sossaman Road.

Once on Sossaman Road you will have a reasonable view of the runways on the left and a golf course on the right as you proceed toward the main section of the airport. APS Emergency Maneuver Training facility is the 5th building on the left side of the road – bldg #5865, a brand new 25,000 square foot 2-story complex, located just beyond the Williams Gateway Airport Administration office. The building facade features a frontal view of two aircraft in formation.

APS Emergency Maneuver Training
5865 S. Sossaman Road.
Mesa, Arizona 85212
Toll-free: 866-359-4273
Tel: 480-279-1881

102 INSTRUCTOR PILOTS

Paul "BJ" Ransbury, President
Aerobatic, Upset Recovery & Spin Training Instructor
Instructor Qualifications:
NAFI Master CFI-Aerobatic
Part 141 Chief Flight Instructor
Certified Flight Instructor (CFI) | Multi-Engine Instructor (MEI)
Instrument Instructor Airplane (CFII) | Advanced Ground Instructor (AGI)
FITS: Cirrus Standardized Instructor (CSI) SR22/20
Military - Bombardier Flying Instruction Techniques Course Graduate
Military - Fighter Weapons Instructor Course Graduate
Professional Pilot Experience and Certifications:
Airline Transport Pilots License, Single/Multi-Engine IFR (US & CAN)
Airlines: A320 Airbus
Tailwheel / Complex / High-Performance Certified
2500+ hours Extra 300L Experience
Memberships: NBAA, AOPA, TBMOPA, MMOPA, EAA, IAC, NAFI, ICAS
Military Fighter Pilot Experience:
12 Yrs CAF: F/A-18 Hornet Fighter Pilot
Fighter Electronic Warfare and Advanced Radar Graduate
416 Tactical Fighter Squadron | 425 Tactical Fighter Squadron
Air Show Qualifications:
ICAS Certified Air Show Performer - Solo/Formation Aerobatics
Education:
BSc Honors Mathematics & Physics Degree | Royal Military College of Canada
Pursuing MBA - University of Phoenix

Clarke “Otter” McNeace
Aerobatic, Upset Recovery & Spin Training Instructor
Director of Flight Training / Check Pilot
Part 141 Assistant Chief Flight Instructor
Certified Flight Instructor (CFI) / Advanced Ground Instructor (AGI)
Multi-Engine Instructor (MEI) / Instrument Instructor Airplane (CFII/MEII)
11,000+ Flight Hours
U.S. Navy: 8 yrs active duty
F/A-18 Hornet Instructor | Fighter Weapons Instructor
Strike Phase Instructor | Landing Signal Officer (LSO) with Training Qual
36 combat missions: Desert Storm/ Southern Watch
300 carrier-arrested landings:
USS Midway, USS Independence, USS Nimitz,
USS America, USS Lexington
Airline Transport Pilot - 10 years | Airline Captain, B-737 - 5 years
Tailwheel, Complex, Sailplane endorsements
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Instructor Course Graduate - F16, A10, AT37
28 Combat Missions DESERT SHIELD / STORM | 1990-1991 (F-16)
356th Tactical Fighter Squadron (A-10)
24th Comp/Tac Air Support Squadron (A/OA-37)
4th Fighter Squadron, Hill AFB, UT (F-16)
421st Fighter Squadron, Hill AFB, UT (F-16)
310th Fighter Squadron (F-16 Ops Officer)
309th Fighter Squadron (F-16 Commander)
Airline Transport Pilots License, BE-400, MU-300
USDA Interagency USDI | Single Engine Air Tanker Firefighting Pilot
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"Stormin' " Norman Rennspies
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USAF Fighter Weapons School Graduate
Combat Vet DESERT SHIELD / STORM / SOUTHERN WATCH
1990-1998 (A-10,F-16)
25th Tactical Fighter Squadron (A-10) Suwon Korea
92nd Tactical Fighter Squadron (A-10) RAF Bentwaters
356th Fighter Squadron (A-10) Myrtle Beach, SC.
94 Training Squadron (TG-7A) USAF Academy, Co.
68th Fighter Squadron (F-16) Moody, GA.
61st Fighter Squadron (F-16) Luke AFB, AZ.
56th Training Squadron (F16 Chief Academic Instructor) Luke AFB, AZ
Peace Vector IV (F16 Commander) Gianaclis AB, Egypt
Airline Transport Pilots License
Airlines: Boeing 737, Airbus A320/319/321
B.S. General Engineering, USAF Academy, Co.
M.S. Management, Troy State University, European Region

Bill 'Muff' Moffat
Aerobatic, Upset Recovery & Spin Training Instructor
Canadian Air Force: 15 yrs active duty - F/A-18 Hornet Instructor
Fighter Electronic Warfare and Advanced Radar Instructor
Wing Tactical Evaluation Pilot
Canadian Air Force F/A-18 Demonstration Pilot
United States Navy F/A-18 Instructor Pilot | Carrier Qualified
Theatre of Duty: Kosovo
Airline Transport Pilot | Airlines:B-737, K&S Aviation 737 Instructor Pilot
Tailwheel, Complex, Sailplane endorsements
B. Comm, Dalhousie University

103 TRAINING AIRCRAFT

Your safety is our top priority. The APS fleet of German-built Extra 300Ls are a perfect fit to our training programs. Although we teach our course to the performance and capabilities of your specific aircraft, the Extra is certified to +/- 10Gs, has no prohibited maneuvers and boasts a max gross climb rate in excess of 3200 fpm, making it one of the safest and most capable aircraft in the sky.

As an added benefit, each aircraft is equipped with a multi-view digital video and audio system that records the entire flight for use as a teaching tool after the flight and as a keepsake to review or to show your family and friends.

As the world's most successful unlimited category aerobatic aircraft, the two-seat Extra 300L remains unrivalled in its class. Its proven performance in international aerobatic competition, combined with its docile handling and dependable stability, translate into a comfortable cross-country touring machine. For pure power, handling and performance, nothing matches this aircraft.

Specifications

Length..22.83'
Height..8.6'
Span..25.25'
Engine.. Textron Lycoming AEIO540L1B5, 300 HP fuel injected
Propeller..MT Constant Speed Propeller, 3 blade standard
Inverted Oil System.. Christen Industries
Fuel
Total Fuel Capacity..45.1 gallons
Useable Fuel - Standard Tanks..44.6 gallons
Total Fuel Capacity - Long Range Tanks..55.1 gallons
Useable Fuel - Long Range Tanks..54.5 gallons
Airspeeds
Never Exceed Speed (Vne)..220 kts
Maneuvering Speed (Va)..158 kts
Stall Speed @ 1800 lbs..55 kts
Stall Speed @ 2095 lbs..60 kts

Take-Off Performance: Standard Day @ Sea Level @ Gross Weight
Ground Run..653'
Total: Clear 50 foot obstacle..1789'
Performance
Maximum demonstrated @ 90° crosswind component..15 kts
Maximum Rate of Climb at Sea Level.. 3200 fpm
Service Ceiling..16,000 feet
Max Range Standard Tanks @ 8000 and 170 kts TAS415 nm plus 45 minute reserve @ 45% power
Long Range Tanks @ 8000 feet and 170 kts TAS ... 510 nm plus 45 minute reserve @ 45% power
Weight and Balance
Standard Empty Weight..1440 lbs
Gross Weight..2095 lbs
Maximum Useful Load..655 lbs

EMERGENCY MANEUVER TRAINING

CHAPTER 2: REGULATIONS & SAFTEY

201 REGULATIONS

1) In the FARs, aerobatic flight is described as "maneuvers intentionally performed by an aircraft, involving an abrupt change in its altitude, an abnormal attitude, or an abnormal variation in speed."
2) Part 91 of the Federal Aviation Regulations outlines specific items pertaining to aerobatic and formation flight. APS Emergency Maneuver Training operates in accordance with its FAA Certificate of Waiver or Authorization (FAA Form 7711-1) to ensure compliance with FARs 91.111, 91.303 and 91.307

FAR 91.303 - Aerobatic Flight

No person may operate an aircraft in aerobatic flight -

(a) Over any congested area of a city, town, or settlement;

(b) Over an open air assembly of persons;

(c) Within the lateral boundaries of Class B, Class C, Class D, or Class E airspace designated for an airport;

(d) Within 4 nautical miles of the centerline of any Federal airway;

(e) Below an altitude of 1,500 feet above the surface; or

(f) When flight visibility is less than 3 statute miles.

FAR 91.307 – Parachutes and Parachuting

(c) Unless each occupant of the aircraft is wearing an approved parachute, no pilot of a civil aircraft carrying any person (other than a crewmember) may execute any intentional maneuver that exceeds –

(1) A bank of 60 degrees relative to the horizon; or
(2) A nose-up or nose-down attitude of 30 degrees relative to the horizon.

202 FLIGHT PREPARATION

PREFLIGHT

1) Preflight inspection and control of ALL LOOSE ARTICLES cannot be over-emphasized.
2) Personal Preparation in the Cockpit
   a) Straps tight
   b) Headset secure
   c) Full rudder deflection easily achieved – even under negative G
      (knees should be bent at no more than a 120 degree angle with full rudder deflection sitting on the ground after strap-in)
   d) Confirm full-range of control column and rudder deflection available

INFLIGHT

1) Prior to every aerobatic maneuver, or sequence of maneuvers, the pilot in command will ensure that the airspace is clear of traffic and that a Pre-Stall-Spin-Aerobatic (PSSA) check is carried out. This check will consist of:
   a) **PSSA (Pre-Stall-Spin-Aerobatic) Check**
      i) Altitude
      ii) Area
      iii) Loose Articles
      iv) Temperatures and Pressures
      v) Fuel & Engine Parameters
      vi) Clearing turns appropriate to the maneuver (in order of preference):
         (1) 2 X 90 degree level turns or wing-over (Lazy Eight-like) maneuvers in opposite directions
         (2) 180 degree turn

2) It is the instructor's responsibility to ensure that each student is aware of all safety factors related to aerobatic flight. Although this document covers the key elements of each maneuver, every pilot must be ready to "centralize the controls and analyze" any peculiar situation whenever the maneuver or sequence of maneuvers becomes unfamiliar. Botched maneuver recovery techniques will be taught throughout the course.

CHAPTER 3: RELEVANT THEORY OF FLIGHT

Unlike the Wright brothers and pilots of early days, the modern pilot has the burden of dealing with a complex web of structured airspace, burdening regulations, and sophisticated equipment. Much of a pilot's training today is committed to managing these complex areas that can be a tremendous distraction. As a student pilot (we are all "students" of aviation, no matter your experience) we must give due consideration to developing skills to safely handle our aircraft in any adverse flight condition. *With Loss-of-Control in flight being one of the leading causes of fatal aviation accidents worldwide*, it is important that we not dismiss stall-awareness and upset recovery training as trivial.

Statistics demonstrate that the scenarios presented in the APS courses of training can threaten your safety, if not your very life, and could happen on any given day. Let's start the preparation through academic study. We will be applying each of the concepts presented in this chapter in a manner that clearly explains their application to recovering an aircraft. Understanding pertinent principles of flight pertaining to emergency maneuver training enables us to appreciate the effect of airflow on stability and control at varying speeds, angles of attack and flight attitudes.

301 GENERAL TERMINOLOGY [1]

1) An airplane is in *upright flight* whenever the pitch or bank angle is within 90° of its upright, wings-level attitude relative to the horizon.
2) An airplane is in *inverted flight* whenever the pitch or bank angle is exceeds 90° from an upright, wings-level attitude relative to the horizon. NOTE: Just because an aircraft is inverted, does not mean it is experiencing negative G's or a negative angle of attack.
3) *Coordinated flight* occurs whenever the pilot is proactively canceling the adverse yaw effects associated with power (engine / propeller effects), aileron inputs, and airplane rigging. We would experience *uncoordinated flight* otherwise.
4) *Relative wind* is the net wind presented to a lifting surface such as the main wing of an airplane. For our purposes, relative wind could be made up of several components: the wind resulting from the forward progress of the airplane through the air, the wind resulting from yawing or side-slipping.
5) *Angle of Attack (AOA)* refers to the angle formed between the chordline of a given wing, airfoil, or any other lifting surface, and the net relative wind. In positive G flight, the wing has a positive angle of attack and the Lift vector points through the top surface of the wing. In negative G flight, the wing has a *negative angle of attack* and the Lift vector points through the bottom surface of the wing.
6) *Adverse Yaw* is the yaw associated with deflected aileron inputs. A downward deflected aileron in normal flight produces more lift; hence, it also produces more drag. This added drag attempts to yaw the airplane's nose in the direction of the raised wing.

7) *Critical Angle of Attack* refers to the AOA representing the maximum coefficient of lift of a wing, airfoil, or other lifting surface. Every wing has at least two critical angles of attack: one positive, one negative. The positive critical angle of attack in a light airplane typically occurs in the range of ten to twenty degrees AOA. Critical values can be in excess of +35 AOA in modern fighter aircraft.
8) *A spiral* is nothing more than a turn during which the altimeter changes. An airplane in a spiral is not stalled.
9) *A graveyard spiral* usually occurs during IMC or marginal VMC flight. The resulting accident is often fatal and is typically driven by false or conflicting information from the visual and vestibular systems.
10) *G-load* or *Load factor* is the ratio of the total air load acting on the airplane to the gross weight of the airplane. For example, a load factor of 3 means that the total load on an airplane's structure is three times its gross weight. Load factor is usually expressed in terms of "G's" – that is, a load factor of 3 may be spoken of as 3 G's.
11) *Torque Components* (left turning tendency of aircraft with right-turning propellers) is made up of four elements that cause or produce a twisting or rotating motion around at least one of the airplane's three axes. These four elements are:
    a) *P-factor* (Asymmetric loading of the propeller)
    b) *Gyroscopic Effect* from gyroscopic precession of the propeller
    c) *Slipstream* (corkscrew effect of the slipstream)
    d) *Torque* from engine turning the propeller
12) *Induced Drag* is the drag created as a direct result of the lift created. Unlike parasite drag, induced drag is a direct function of angle of attack. As angle of attack is increased, induced drag increases exponentially.
13) *Parasite Drag or Form Drag* is the drag created from the skin friction and disruption of the streamline flow over the aircraft. It is a function of airspeed. As airspeed increases, parasite drag increases exponentially.
14) *Mush* can occur during low speed/high drag flight, with the airplane operating well on the back side of the power curve. The airplane is not stalled here; however, it is descending at a high sink rate toward the ground in spite of the application of additional power. A low, slow, dragged-in approach to landing often precipitates a mush accident. In swept wing aircraft, a similar aerodynamic condition can occur in the region referred to as Speed Divergence.
15) *Departure,* in the context of stalls and spins, means that the airplane has crossed the line from unstalled flight into stalled flight. Sometimes called a "departure from controlled flight."
16) *Stall* describes the turbulent separation of otherwise smooth airflow over the main wing, the horizontal stabilizer, the propeller blade, or any other lifting surface on the airplane. Unless otherwise specified, *stall* here normally refers to airflow separation from the main wing. Furthermore, the *Stall* - the intentional maneuver that pilots practice - is assumed to occur while maintaining coordinated flight throughout unless indicated otherwise.

17) *Upright Stall* refers to a stall encountered while under positive G loading, wherein the wing is stalled at its positive critical angle of attack, regardless of the airplane's attitude
18) An *Accelerated Stall* occurs anytime critical angle of attack is exceeded while experiencing G-loads greater than +1.0 in upright flight, or greater than –1.0 in inverted flight. Stalls encountered while turning, for example, are accelerated stalls. Thus, an aircraft can stall at any airspeed provided that sufficient G (or acceleration) is applied up to Va without overstressing the aircraft. To determine the airspeed that this will occur, simply multiply the square root of the load factor (or G) by the basic stalling speed of the aircraft. NOTE: Increased G-load equals and increase in stall speed. Conversely, decreased G-loading means a decrease in stall speed.
19) *Stall strips, stall fences, vortex generators, washout, wing twist, leading edge cuff, leading edge droop, modified outboard leading edge (MOLE), slots, slats,* et al., are design elements used to elicit specific slow flight and stall behavior in an airplane.
20) *Stall Buffet* occurs as turbulent airflow separates from the main wing and impinges on the empennage and tail surfaces. Keep in mind that there are several wing designs, such as the swept wing, where boundary layer separation typically occurs at or near the wing tips precluding impingement on the aircraft's empennage and tail surfaces.
21) *Stall Break* typically refers to the sudden change in pitch attitude as an airplane enters stalled flight. A properly loaded light airplane is designed to pitch to a lower angle of attack at the stall break. For swept wing aircraft, this does not necessarily hold true because of the effect a wing tip stall can have on the movement of the center of pressure. In a swept wing aircraft (for example), the aircraft can exhibit a nose-up moment to a higher AOA at the stall necessitating the integration of stall safety devices such as stall shakers and stick pushers to force intentional flight operations away from the region of stalled flight.
22) *Roll-off* (a.k.a. *wing drop)* describes an airplane's inherent tendency to roll at the stall. Roll-off often signals the transition to a spin.
23) *Positive roll damping* is the roll-stabilizing effect of an aircraft in normal flight. During normal flight, as an airplane rolls, the combination of forward motion *and* rolling motion results in the net relative wind meeting the down-going wing at a slightly higher angle of attack. Similarly, the net relative wind on the up-going wing strikes it at a slightly lower angle of attack. In normal flight, this results in the down-going wing having a slightly higher coefficient of lift and the up-going wing a slightly lower coefficient of lift, which tends to roll the aircraft back to level flight.
24) *Negative roll damping* is the roll de-stabilizing effect of an aircraft in stalled flight. During stalled flight, as an airplane rolls, the combination of forward motion *and* rolling motion results in the net relative wind meeting the down-going wing at a slightly higher angle of attack. Similarly, the net relative wind on the up-going wing strikes it at a slightly lower angle of attack. In stalled flight, this results in the down-going wing having a slightly lower coefficient of lift and the up-going wing a slightly higher coefficient of lift that tends to

contribute to the roll of the aircraft in the same direction. The down-going wing also produces higher drag than the up-going wing, which contributes to yaw in the same direction as the roll and can eventually contribute to the perpetuation of a spin yaw is prolonged.

25) *Post-stall gyration (PSG)* is usually used in the context of jet aircraft. PSG describes the uncontrolled motion about any or all of the flight axes immediately following a departure from controlled flight, but prior to the incipient spin phase. The uncontrolled motion of an aircraft experiencing PSG can be violent and disorienting; moreover, PSG might not follow a recognizable pattern.
26) *Deep stall* is a stabilized flight mode occurring at angle of attack on the order of 30 degrees or greater – well above the wing's critical angle of attack. Swept wing aircraft, T-tail aircraft, and aircraft loaded beyond their aft centers of gravity limits can be prone to deep stalls.
27) *A Falling Leaf (*a.k.a. *oscillation stall* or *rudder stall)* is a spin prevention exercise designed to improve a pilot's yaw awareness and footwork. The maneuver is typically entered from an intentional wings-level stall with idle power or low power. Once in stall buffet, the pilot quickly works the rudder pedals to prevent the stalled airplane from departing into a spin.
28) *Spin* aptly describes the maneuver, during which the airplane descends vertically along a tight, helical flight path while at stalled angles of attack. Smoke trailing behind a spinning airplane would etch a corkscrew in the sky. An airplane must be stalled and yawed in order to spin. Although rotation occurs around all three flight axes simultaneously, it's the combined yawing and rolling motion that give the spin its classic look.
29) *Tailspin* is a colloquial term for a spin and was used in the early years of powered flight.
30) *Autorotation* describes the self-propelling nature of a fully developed spin. The aerodynamics of stalled flight fuel autorotation through a process called "negative roll damping". Normal Flight, on the other hand, favors positive damping in roll and adverse yaw, both of which oppose the rotary motion of a spin. These different characteristics explain why spins are associated with stalled angles of attack, even though the stall itself does not generate the spin.
31) *Coupling* refers to a disturbance along one flight axis that induces a change along another axis. Yawing an airplane, for example, not only rotates the airplane about the yaw axis, but it also generates a secondary roll about the roll axis. Yaw / roll coupling is the aerodynamic factor that drives a spin.
32) *Inertia* refers to the resistance of various components of an airplane to changes in its flight path.
33) A spinning airplane rotates around its *spin axis.* The inclination of this axis and its location depend on the spin phase and on the type of spin encountered. As a typical light airplane falls into a normal spin, the spin axis rotates from horizontal to vertical (or nearly so). *Spin radius* is the distance between the airplane's spin axis and its center of gravity. The spin radius typically shrinks as the airplane progresses from the incipient spin departure into a developed spin.

34) *Upright spin* refers to a spin encountered while under a positive G loading, wherein the wing is stalled beyond its positive critical angle of attack, regardless of the airplane's attitude.
35) *Inverted spin* refers to a spin encountered while under a negative G loading, wherein the wing is stalled beyond its negative critical angle of attack, regardless of the airplane's attitude.
36) *Spin direction* is the direction the airplane is yawing relative to the pilot during a spin. Also referred to as "direction of rotation."
37) *Normal spin* refers to a spin entered with the controls applied and maintained in the following manner: power idle; ailerons neutral; rudder fully applied in the direction of rotation; elevator fully against the aft stop at or near the airplane's wings-level, +1.0 G stall speed, or against the forward stop at or near the airplane's wings-level, -1.0 G stall speed.
38) *Aggravated spin* and *abnormal spin* refer to spins wherein the controls are not positioned and/or maintained as described for the normal spin.
39) *Pro-spin* refers to airplane design elements and control inputs that contribute to spinning.
40) *Anti-spin* refers to design elements and control inputs that resist or counter spinning.
41) *Unrecoverable spin* and *inertially locked-in spin* refer to spins where the pro-spin forces and moments exceed the ability of anti-spin controls to stop the rotation. An airplane in an unrecoverable spin will continue to spin regardless of the recovery actions taken by the pilot- even if correct spin recovery actions are applied and held. Most airplanes, including a number of aerobatic/spin-approved airplanes, may have unrecoverable spin potential under certain circumstances.
42) The *incipient spin phase* is a transitional phase during which the airplane progresses from an uncoordinated (i.e. yawed) stall to pure autorotation. Incipient spins are typically pilot-driven, as pro-spin forces alone are weak and unable to sustain the rotation. Many intentional spins and competition aerobatic spins are performed in the incipient phase.
43) The *developed spin phase* represents a state of equilibrium between aerodynamic and inertial force moments acting upon the airplane. The spin is driven aerodynamically; hence the term a*utorotation.* If the controls are released, they will tend to float in spin configuration of their own accord as rotation continues.
44) The *recovery phase* is a transitional phase during which anti-spin forces and moments are at work to overcome pro-spin aerodynamics. Here, the nose attitude typically steepens. The rate of rotation may very well increase momentarily during the recovery phase.
45) In aircraft with a right turning propeller, the pilot can induce a *flat accelerated spin* by adding power and by applying aileron opposite to the direction of roll and by moving the elevator off its control stop (e.g., add power, right aileron, forward elevator during a normal upright spin to the left; add power, right aileron, aft elevator during a normal inverted spin to the right).
46) *Graveyard spin* typically refers to a fatal spin accident sequence wherein the pilot successfully recovers from the primary spin, but then reenters a secondary spin. The graveyard spin is typically driven by false or conflicting vestibulo-ocular (ear-eye) information.

47) *NASA Standard, normal recovery controls, standard spin recovery and normal spin recovery* all refer to the following specific recovery actions:

a) Power – off
b) Ailerons –neutral
c) Rudder – full opposite to the direction of yaw
d) Elevator – positive movement through neutral

Hold these inputs until rotation stops, then;

e) Rudder –neutral
f) Elevator –recover to straight and level

48) *Beggs method or Beggs/Muller* refer to the following spin recovery actions prescribed by aerobatic pilot and instructor Gene Beggs:

a) Power off.
b) Remove your hand from the stick.
c) Apply full opposite rudder until rotation stops.
d) Neutralize rudder and recover to level flight.

NOTE: This emergency spin recovery method may be effective and may be appropriate ONLY in a limited number of high performance aerobatic airplanes.

<u>Reference:</u>

[1]Portions excerpted with permission from: Rich Stowell, *The Light Airplane Pilot's Guide to Stall/Spin Awareness*; Rich Stowell Consulting, Ventura, CA, 2007.

CHAPTER 4: FACTORS AFFECTING DISORIENTATION

401 EFFECTS OF ACCELERATION FORCES (G-FORCES)

Positive-G

If an aircraft is accelerated in the pitching plane by increasing the angle of attack of the wings, it will move in a curved path and be subject to increased loading. This increased loading is measured in factors of "G" and is felt by the pilot as an apparent increase in weight. In straight-and-level flight a pilot experiences 1G but when he/she moves the stick back to enter a climb, loop, or banks the aircraft into a level steep turn, the pilot will experience a force greater than 1G. For example, in a 60-degree bank turn at a constant altitude, the pilot will experience 2G's and feel twice as heavy (G-factor, or load factor, of 2). If a pilot pulls 4G's in a maneuver, he will feel four times heavier (G-factor of 4).

High positive G has the following effects:

a) The blood becomes 'heavier' and tends to drain from the head and eyes to the abdomen and lower parts of the body.
b) The heart is displaced downwards by its 'increased weight,' thus increasing the distance it has to pump the 'heavier' blood to the brain and eyes.
c) Greater muscular effort is required to raise the limbs and hold the head upright.

As a result of (a) and (b), the eyes and brain could become starved for oxygen resulting in 'grey-out' followed quickly by 'black-out', and then, if the g-loading is sustained, g-induced loss of consciousness (G-LOC).

Your instructor will give you special training on how to combat these forces and show you how to work effectively in this environment. Awareness is the key to G-force management. Blackout and loss of consciousness are extremely rare and will be actively avoided during your flight training. Your instructor has thousands of hours of training in the high-G environment and will always be in the aircraft to ensure your complete safety.

NOTE: Your training will emphasize the flight envelope (i.e. limit load or G-limit) of the aircraft you typically fly. Depending upon your specific aircraft, the range of g-loading targeted for your training at APS will vary from between 2.5 G to 3.8 G. In some cases, utility and aerobatic category pilots may be requested to implement recoveries utilizing up to 4.4 G and 6.0 G respectively. To be clear: we will not be going out and pulling 8 G's just because we can. This serves no practical purpose and is of no value whatsoever in being competent in emergency maneuver training.

Grey-out is blurred vision under positive g-load accelerations; blackout is a dulling of the senses and seemingly blackish loss of vision under sustained positive g-load accelerations; loss of consciousness is characterized by a total lack of awareness or physical capability and can take up to several tens of seconds to regain sufficient awareness to effectively recover after the g-load situation is returned normal.

Due to the latent period before the symptoms of g-affects occur, it is possible to tolerate high 'G' for short periods. Illness, hunger, fatigue, lack of oxygen and the common 'hang-over' decreases tolerance. Tolerance varies with individuals, but the average pilot will black-out between 3.5 and 6G's after five seconds, 'graying-out' at about 1G less, and losing consciousness at about 1G over. During periods of grey-out or blackout, normal vision will return as soon as the high G-forces are reduced.

***Important note**: Tests have shown that under rapid G-increases of 1G/sec or greater, or when applying positive-G immediately after a maneuver involving negative-G, a pilot may lose consciousness without experiencing blackout, and that recovery may take up to thirty seconds. A lot can happen in that time. This is called the *"Push – Pull Effect"* and your instructor will be monitoring the flight to ensure that rapid G-onset is minimized. Smooth, positive control of the aircraft is the key reducing exposure to the "push-pull effect".

To help reduce the effects of positive-G, the "Anti-G Straining Maneuver" should be practiced and used whenever you are under g-loading above normal levels. It involves tightening the legs and abdominal muscles and 'bearing down' which is accomplished by trying to exhale but not allowing air to escape. This creates extra tension on the abdominal muscles and constricts the veins and arteries to minimize the amount of blood that pools in the lower body. The pilot should inhale … wait three seconds … exhale approximately 20% of lung capacity over a 1 second interval and then immediately inhale to repeat the sequence. The muscle contraction of the extremities and abdomen should be sustained throughout the G exposure.

Negative-G

When the pilot feels the G-forces acting in the reverse direction to normal (as in sustained inverted flight, an outside loop or an inverted spin), this is known as negative-G. Excess blood is forced into the head and 'red-out' occurs at about –4G to –5G. Unlike positive G's, there is no known straining maneuver that can be accomplished to counter the effects of negative G. You will be spending very little time in negative G flight. It is not the purpose of this training to teach you how to fly at negative G (or even zero G).

402 SPATIAL DISORIENTATION

The body uses three integrated sensory systems working together to determine orientation and movement in space. First, the eye is by far the largest source of information. Second, the Somatosensory System refers to the sensation of position, movement, and tension perceived through the nerves, muscles, and tendons. This is the "Seat of the pants" part of our flying. The third sensory system is the Vestibular System that is a very sensitive motion sensing system located in the inner ears. It reports head position, orientation, and movement in three-dimensional space.

During your training, getting back to the basics of flying the attitude and envelope of the aircraft will be of primary importance. Using your eyes to avoid extreme flight conditions and, if encountered, using them to regain control is also an important skill that must be learned and practiced. Statistically, ninety percent of the Loss of Control In Flight (LCIF) accidents happen in visual meteorological conditions (VMC). It's no accident that much of your training will be in VMC. Flying can sometimes cause your three sensory systems to supply conflicting information to the brain, which can lead to disorientation. During flight in VMC, the eyes are the major orientation source and usually prevail over false sensations from other sensory systems. When these visual cues are taken away, as they are in instrument meteorological conditions (IMC), false sensations can cause a pilot to quickly become disoriented.

Your training will focus on teaching you where to look, scan, and focus your eyes through the varied phases of flight in VMC. Those of you staying for the Instrument Recovery Training (IRT) will learn how to use your instruments in IMC for recognition, avoidance and recovery from extreme flight attitudes.

The vestibular system's primary purpose is to enhance vision. The second purpose, in the absence of vision, is to provide perception of position and motion. On the ground, the vestibular system provides reasonably accurate perception of position and motion. In flight, however, the vestibular system may not provide accurate assessment of orientation. In both the left and right inner ear, three semicircular canals are positioned at approximate right angles to each other. Each canal is filled with fluid and has a section full of fine hairs. Acceleration of the inner ear in any direction causes the tiny hairs to deflect, which in turn stimulates nerve impulses, sending messages to the brain. The vestibular nerve transmits the impulses from the utricle, saccule, and semicircular canals (Figure 2) to the brain to interpret motion.

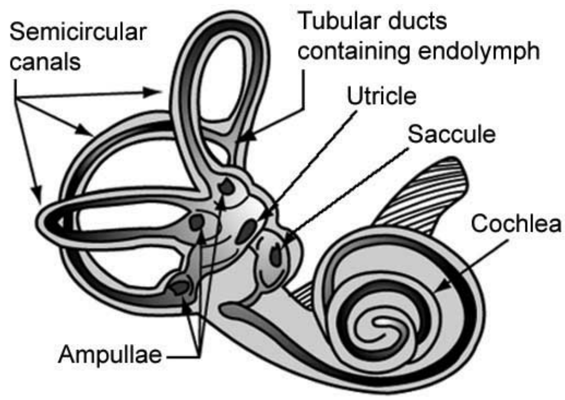


Figure 2: The Vestibular System - semicircular canals and otolith organs

Your training will concentrate on learning "when" and "if" to trust your vestibular system in order to detect an unsafe safe flight condition and effect a safe recovery, if needed.

The somatosensory system sends signals from the skin, joints, and muscles to the brain that are interpreted in relation to the earth's gravitational pull. These signals determine posture. Inputs from each movement update the body's position to the brain on a constant basis. "Seat-of-the-pants" flying is largely dependent upon these signals. The body cannot distinguish between acceleration forces due to gravity and those resulting from maneuvering the aircraft, which can lead to sensory illusions and false impressions of the airplane's orientation and movement.

As we know, some early pilots believed they could determine which way was up or down by analyzing which portions of their bodies were subject to the greatest amount of pressure. We now understand that the seat-of-the-pants "sense" is completely unreliable as an attitude indicator. However, when used in conjunction with visual references, "seat of the pants", is critically important as we learn how to use it effectively to determine angle of attack and g-loading- but not flight attitude. This will be clearly explained during the course of your training and you will apply this knowledge in several practical situations.

403 CAUSES OF SPATIAL DISORIENTATION (SD)

There are a number of conditions and factors that will increase the potential for SD. Some of these are physiological in nature (human factors) while others are external factors related to the environment in which the pilot must fly. Awareness by the pilot is required to reduce the risks associated with these factors.

Personal Factors. Mental stress, fatigue, hypoxia, various medicines, G-stress, temperature stresses, and emotional problems can reduce a pilot's ability to resist SD. A pilot who is proficient at accomplishing and prioritizing tasks with an efficient visual and instrument crosscheck and is mentally alert as well as physically and emotionally qualified to fly, will have significantly less difficulty maintaining orientation.

Workload. A pilot's proficiency is decreased when he/she is busy manipulating cockpit controls, anxious, mentally stressed, or fatigued. This leads to increased susceptibility to SD.

Inexperience. Inexperienced pilots are particularly susceptible to SD. A pilot who must still search for switches, knobs, and controls in the cockpit has less time to concentrate on visual references and instruments and may be distracted during a critical phase of flight. It is essential for an effective crosscheck to be developed early and established for all phases of flight to help reduce susceptibility to SD.

As we all know, every pilot is susceptible to SD. One would hope that the difference between an inexperienced pilot and experienced pilot is that the experienced pilot would recognize SD sooner and immediately establish priorities to reduce its affects. Denying the existence of SD by inexperienced pilots has been a major contributing factor to countless LCIF accidents.

Proficiency. Total flying time does not protect an experienced pilot from SD. More important is current proficiency and the amount of flying time in the last 30 days. Aircraft mishaps due to SD generally involve a pilot who has had limited flying experience in the past one month period. Vulnerability to SD is high for the first few flights following a significant break in flying.

Instrument Time. Pilots with less instrument time are more susceptible to SD than more instrument experienced pilots.

Phases of Flight. Although distraction, channelized attention, and task saturation are not the same as SD, they contribute to it by keeping the pilot from maintaining an effective visual or instrument crosscheck. SD incidents have occurred in all phases of flight, in all kinds of weather but are particularly prevalent during the takeoff and landing phases of flight. Aircraft acceleration, speed, trim requirements, rates of climb or descent, and rates of turns are all undergoing frequent changes. The pilot flying on instruments may pass into and out of VMC and IMC. At night, ground lights can add to the confusion. Radio channel changes and transponder changes may be directed during critical phases of flight close to the ground. Unexpected changes in climb out or approach clearances may increase workload and interrupt an efficient crosscheck. An unexpected requirement to make a missed approach or a circling approach at night in IMC at a strange field is particularly demanding. All of these factors and more can significantly increase the potential for SD.

402 PREVENTION OF SPATIAL DISORIENTATION MISHAPS

Recognize the Problem. If a pilot begins to feel disoriented, the key is to recognize the problem early and take immediate corrective actions before aircraft control is compromised.

Reestablish Visual Dominance. The pilot must reestablish accurate visual dominance. To do this, either *look outside if visual references* are adequate or keep the head in the cockpit, defer all nonessential cockpit chores and concentrate solely on *flying basic instruments*.

Resolve Sensory Conflict. If action is not taken early, the pilot may not be able to resolve sensory conflict.

Transfer Aircraft Control. If the pilot experiences SD to a degree that interferes with maintaining aircraft control, then consider relinquishing control to a second crewmember (if qualified) or, if available and capable, consideration should be given to using the autopilot to control the aircraft if the flight attitude is not severe.

403 MINIMIZING MOTION SICKNESS

During your training at APS, it's possible for the student to experience motion sickness. Besides being uncomfortable, it limits your ability to learn. At APS we have tailored our courses in consideration of the fact that some students will experience some form of motion sickness during the course. Syllabus rides are organized so that all objectives can be easily accomplished within the five-ride program, even with an average occurrence of motion sickness.

CAUSES OF MOTION SICKNESS

Apart from physical disorientation, a feeling of nausea may be brought on by:

a) Apprehension of the unknown
b) Apprehension of the sensation of feeling nauseous
c) Apprehension of making an error

WHAT TO DO ABOUT IT

First of all, do not worry about getting airsick. Even very experienced pilots can become nauseous in an unusual flight environment. Our instructors have been trained in alleviating factors that can contribute to motion sickness and will take action to help relieve any symptoms.

A positive, can-do attitude goes a long way toward ensuring your ability to obtain maximum training benefits during your training flights. Focusing on the objectives and procedures prior to and during each flight will help you prevent apprehension and motion sickness. Climb into the aircraft eager to tackle the fun-filled challenge ahead. With your understanding instructor behind you, just make the firm decision to overcome any perceived barriers and focus your mind on the task at hand.

The following is a list of things to consider before the flight to help prevent motion sickness:

a) Ensure you are well rested and hydrated.
b) Eat a light meal an hour or two before the flight.
c) With a doctor's permission, consider taking Dramamine about an hour prior to the flight if you have serious concerns related to nausea.
d) With a doctor's permission, consider obtaining a motion sickness "patch".

The following is a list of things to consider airborne to prevent and alleviate motion sickness:

e) Ensure your air vents are wide open and directed toward your face.
f) Take slow, deep breaths.
g) Keep your eyes outside the cockpit focusing on the horizon.
h) Ask your instructor for a break.
i) Ask to take control of the aircraft and just fly an easy, smooth flight path.
j) Focus on the task at hand. Force your mind to think of something else besides your stomach.
k) Ask questions. Make comments. Be pro-active in your training; *do not allow yourself to become passive.*

l) If sickness becomes inevitable, do not be afraid to use the provided airsick bag. This is rare but it does happen on occasion. You will feel much better once you have released that menacing feeling.

CHAPTER 5: EMERGENCY MANEUVER EXERCISE GUIDE

THE "SAY & DO" TECHNIQUE

During your training, you will be required to memorize and recite the recovery procedure appropriate to the flight condition you are faced with (there are only two procedures). You will be expected to say the recovery step (i.e. "Push") and then consciously make the appropriate control input for that step. Before further control inputs are made, you will say the next step in the recovery (i.e. "Power") and then consciously make the appropriate control input. You should not give us a running narrative of what you are doing on the recovery (i.e. "I am now relaxing the backpressure…" or "Okay, here I go…hmmm...I'm pushing the throttle forward"). Giving us a running narrative only serves to slow you down during the recovery. Nor should you remain silent while performing the recovery procedure.

Please do not accept the attitude that you cannot talk and fly at the same time. If you fly airplanes and talk to ATC, then you already have the necessary cognitive abilities needed to successfully accomplish this aspect of training.

The speed of your recovery is NOT the primary concern while learning these procedures. ACCURACY of each step and the SEQUENTIAL application of the recovery steps are the top priorities. Blending of control inputs or allowing your control inputs to get ahead of your mouth will be discouraged. Once you can successfully "Say & Do" each of the recovery steps, then and only then will the speed or efficiency of the recovery be emphasized. The accuracy of the recovery will always take precedence over the speed of the recovery.

WHY IS THIS IMPORTANT?

Recovering from stalls and spins requires the pilot to make control inputs that are contrary to the normal reflexes. A few common reflexive actions observed during stall and spin training include the following:

- Freezing on the controls
- Holding the breath
- Involuntary swearing and sweating
- Continuing to hold the elevator control aft because of a dramatic, nose-down flight attitude
- Inadvertently applying opposite aileron as a wing dips at the stall break, or as the airplane starts to roll into an incipient spin
- Wildly shoving the elevator control forward
- Leaning the body away from the spin direction
- Pressing both legs against the rudder pedals, making it difficult to fully apply the opposite rudder
- Once applied, allowing recovery inputs to drift to other positions before the airplane stops rotating

Interestingly, several of these reflex actions are responsible for causing inadvertent stall and spin departures in the first place. These are not just the reactions of low-time pilots during their first encounters with stalls and spins, but also of experienced pilots - even highly trained test pilots - who have become confused or excited during exposure to stall/spin scenarios.

Simply put; stall and spin recovery actions are counterintuitive. Hence, they must be learned well enough to supplant reflexive actions. In the early stages of stall/spin training, the mind must consciously direct the body to make the appropriate inputs. Only repeated and structured practice, paying close attention to the physical details, can reduce the amount of mental effort needed to make the body react with the appropriate inputs in a crisis. This is no different from any other mechanical skill requiring a complex and precise set of body movements. In an airplane, though, the difference literally could be life or death.

Think of these procedures as red boldface emergency checklist procedures. If you had an engine fire, you would do the immediate action items first and in order. You would not start at step #10 then go to step #2 and so forth. That would potentially aggravate the situation or, at the least, not put out the fire completely. A checklist, by design, is to be done in sequence. This is the only way the pilot can ensure that a task is accomplished.

Not only is saying the step beneficial for directing proper control inputs but it is sound Crew Resource Management (CRM) procedure. Your fellow crewmember can be kept “in the loop” of what you are trying to accomplish during the recovery.

This may seem strict or “very picky” to some. No so, it is simply uncompromising and has demonstrated to yield the most effective results and to maximize skill retention. Not only is your life potentially at risk but also the lives of your passengers. We have many years and thousands of hours of instructing pilots with vast amounts of NASA/NTSB reports to back our teaching methods. It is simply a matter of attitude. If you come with a positive attitude and open mind, you will gain the maximum benefit from this course and have fun doing it. Remember, a true professional aviator knows aviation is about life-long learning.

PSSA✓ : PRE-STALL / SPIN AEROBATIC CHECK

1) Prior to every aerobatic maneuver or sequence of maneuvers, the pilot in command will ensure that the airspace is clear of traffic and that a Pre-Stall-Spin-Aerobatic (PSSA) check is carried out. This check will consist of:
   a) **PSSA (Pre-Stall-Spin-Aerobatic) Check**
      i) Altitude
      ii) Area
      iii) Loose Articles
      iv) Temperatures and Pressures
      v) Fuel & Engine Parameters
      vi) Clearing turns appropriate to the maneuver (in order of preference):
         (1) 2 X 90 degree level turns or 2 X 90 degree wing-over (Lazy Eight-like) maneuvers
         (2) 180 degree turn

2) It is the instructor's responsibility to ensure that each student is aware of all safety factors related to aerobatic flight. Although this document covers the key elements of each maneuver, every pilot must be ready to "centralize the controls and analyze" any peculiar situation whenever the maneuver or sequence of maneuvers becomes unfamiliar. Botched maneuver recovery techniques will be taught throughout the course.

EXERCISE #1: HANDLING / ATTITUDES / STEEP TURNS

OBJECTIVE: Familiarization with basic flight characteristics and control forces of the Extra 300L.

WHY? This is the first step in the building block approach of the EMT Syllabus. Becoming acquainted with the control stick (as opposed to a yoke) and its associated control forces will allow for more accurate control inputs during maneuvers.

NOTE: It must be understood that even though the control forces are considerably lighter than most aircraft, there will be no flight characteristics or procedures introduced that will be unique to the Extra 300L.

WHAT IS IT? You will fly level turns using 30/45/60° angle of bank (AOB). Climbs and descents using various power settings will also be flown.

KNOWLEDGE TEST Does a 60° AOB level turn at 100 kts require the same G-loading as a 500 kt level turn at 60° AOB?

From the perspective of the pilot sitting in the aircraft:

- What type of movement is roll?
- What type of movement is yaw?
- What type of movement is pitch?

HOW

- PSSA

- ✈ Establish level flight at 120 kts with power stabilized.
- ✈ **Coordinated Turns:** Roll into 30° AOB turns while maintaining altitude. Identify the role of ailerons, elevator and rudder during turns. Emphasize coordination of aileron and rudder when changing the bank angle. Crosscheck resulting performance with the instruments.
- ✈ **Steep Turns:** Use pitch, power and bank corrections to maintain altitude and constant airspeed with bank angle set at 45 - 60 degrees. Note the relationship between bank angle and rate of turn. Also note the G-loading required to maintain level flight with varied AOB.

RECOVERY

- ✈ As you return to level flight, note the decreased G-loading compared to turning in flight.

COMMON ERRORS

- Failing to add rudder when rolling the aircraft. (coordinated turn)
- Failing to release/coordinate rudder pressure when AOB is established.
- Failing to maintain the flight attitude relative to the horizon (backpressure) during the steep turns.
- Failing to add power during the steep turn to compensate for increased drag.
- Failing to coordinate rudder pressure in response to torque effects during slow flight.

EXERCISE #2: DUTCH ROLLS

OBJECTIVE: Demonstrate the importance of coordinated rudder and aileron inputs in common turning maneuvers.

WHY? Coordinated control inputs can help avoid many unusual flight situations that could progress to dangerous flight attitudes or loss-of-control flight conditions.

WHAT IS IT? The Dutch Roll is a two-part flight demonstration. The first part demonstrates the effect of aileron inputs on yaw *without* the use of rudder. The second part demonstrates the effect of aileron inputs *with* the use of coordinated rudder.

KNOWLEDGE TEST

- What is adverse yaw? In what common handling exercises, do you expect to have to correct for it?
- Is there adverse yaw once the angle of bank has been established and ailerons neutralized in medium bank turns (20 – 45° AOB)?
- Why is a rudder correction required as the airspeed reduces on prop aircraft?
- Does rudder correct for each of; gyroscopic effect, slip stream, and P-factor on prop aircraft?

HOW PERFORMED:

- PSSA
- **Dutch Roll**: from a cruise attitude and about 80 kts, pick a visual reference point straight over the nose of the aircraft on the horizon (the instructor will discuss this point of reference during the briefing).
  - Part 1: While holding (locking) the rudders in the neutral position, using only aileron input, roll aircraft from side to side (approximately +/- 30 degrees of bank) at a moderate rate. Note the side-to-side movement of the nose as the roll is generated. Note when the aircraft rolls right, the nose yaws left and vice versa. Also note the substantial swings of the ball. This adverse yaw is generated by induced drag differential between the ailerons.
  - Part 2: Once again, roll the aircraft using aileron from side-to-side at a moderate rate but use rudder inputs to now keep the nose pointed

straight ahead at the ground reference point. If rudder is coordinated properly, the nose will only rotate about the longitudinal axis of the aircraft. Yaw will be nonexistent. Note the lagging effect of the ball.

COMMON ERRORS:

- Rolling too quickly
- Part 2: Failing to apply coordinating rudder effectively as aileron is applied

EXERCISE #3: ZOOM MANEUVER

OBJECTIVE; Demonstrate controllability at airspeeds less than the 1G stall speed.

WHY? Although there is a specified 1G stall speed for every aircraft (~60 knots in the Extra 300L), any aircraft is capable of flying controllably below the 1G stall speed without exceeding critical angle of attack (AOA).

Stall speed is a function of AOA and an aircraft can stall at any speed if critical AOA is exceeded. A critical action step in Stall Recovery involves immediately reducing the angle of attack. If we carry this to a logical conclusion, we should be able to fly below the 1G stall speed without stalling if we are constantly commanding less than critical AOA at any airspeed or flight attitude.

WHAT IS IT? The zoom maneuver is an altitude-gaining maneuver where the nose of the aircraft is pitched very nose-high and then gently unloaded to demonstrate controllability at airspeeds less than the 1-G stall speed.

KNOWLEDGE TEST

- Is the Coefficient of Lift a function of airspeed or angle of attack?
- Does Coefficient of Drag increase or decrease with increasing angle of attack?
- Is pulling G's (example, 60° AOB level turn at 2 G's) while sustaining level flight an indication of increased angle of attack?

HOW

- PSSA
- **Zoom Maneuver**: start at approximately 120 kts and full power.
- Pitch the nose 70 degrees nose-high.
- At 70 kts, gently relax back pressure to a attain a light positive G and nose the aircraft over. Continue to feed forward pressure on the control stick to feel light in the seat which equates to approximately + ¼ to ½ G's. Note the airspeed will continue to drop well below the 1 G stall speed of 60 kts (40 kts or less is not unusual).
- Be careful not to push too hard or you will go to zero or negative G and be pushed out of your seat.

- ✈ While continuing the unload the nose of the aircraft back to the horizon, gently roll the aircraft back and forth using aileron to about 15° AOB each direction to demonstrate the positive stability of aircraft control. As the nose of the aircraft pitches down below the horizon, allow the airspeed to increase above the 1G stall speed (60+ knots) and gently effect recovery to level flight.

COMMON ERRORS:

- ✈ Not maintaining a positive push on the elevator to hold light "G" until the nose is below the horizon and airspeed is increasing above 60 kts.

EXERCISE #4: SLOW SPEED MANEUVERING

OBJECTIVE: Gain awareness of the characteristics of slow flight and how to effectively control altitude, airspeed and yaw in this regime.

WHY? Many portions of normal flight in the traffic pattern or recoveries from an emergency or unusual attitude may involve slow flight.

WHAT IS IT? Slow flight is defined as "flight in the speed range from just below 1-G maximum endurance speed to just above the 1-G stall speed." It can be encountered in all flight attitudes. Planned or inadvertent entry into 'slow flight' is one indication of an imminent stall.

KNOWLEDGE TEST

- When can slow flight be encountered?
- Are we close to critical angle of attack during slow flight?

HOW

- PSSA

- Pull the power to idle and allow the aircraft to decelerate to 70 kts while holding altitude.
- Approaching 70 kts, set power to stabilize at 70 kts. Keep in mind the aircraft is in the region of reverse command and will require higher power settings to sustain slower airspeeds while holding a constant altitude.
- Use pitch to control airspeed and vary power as necessary to hold altitude.
- Scan outside to focus on flying the aircraft attitude while referencing the airspeed indicator and altimeter.
- Note the diminishing response of flight controls, increased sustained angle of attack and change of aircraft noise. Also, note the increased right rudder pressure needed to center the ball due to P-factor and slipstream.
- After straight and level flight, practice gentle turns, climbs and descents by adding or subtracting power while using pitch to control airspeed.

RECOVERY

- Increase power while reducing angle of attack to re-establish cruise.

COMMON ERRORS

- Failing to scan outside and not using the aircraft attitude/pitch for airspeed control.
- Failing to add right rudder pressure due to increased torque effects.

EMERGENCY MANEUVER TRAINING

EXERCISE #5: UNACCELERATED STALLS

OBJECTIVE: Recognize an imminent unaccelerated (1G) stall, the stall itself and then use the correct recovery to regain aircraft control and minimize altitude loss.

WHY? Effective recognition and expeditious recovery from a stall reduces the chances of the aircraft entering a spin, developing an adverse flight attitude or generating an aggravated stall.

WHAT IS IT? An aircraft is in a stall when flown at an angle of attack greater than the critical angle of attack. This flight condition results in a loss of effective lift, roll stability, and an increase in drag.

KNOWLEDGE TEST

- Which flight control directly influences angle of attack?
- What are the stall characteristics of the following wing designs? Consider; stall progression, aileron effectiveness and handling characteristics.
    a. Rectangular Wing
    b. Moderately Tapered Wing
    c. Swept Wing
- When does an aircraft experience negative roll damping?
- Should ailerons be used in a Stall Recovery? If so, when?

HOW PSSA

Power Off Stall

- With power at idle, allow the airspeed to decelerate while maintaining altitude.
- Simulating we are distracted, focus your eyes outside the cockpit on the developing flight attitude while continuing to feed back pressure until the aircraft stalls.
- Execute a Stall Recovery (below) when directed by the instructor.

Power On Stall

- The instructor will set about 20” MP on the engine.
- Bring the nose up to about 20° in a climbing turn (feet on the horizon). While simulating being distracted, the airspeed will begin

to decay. At a constant 20° nose up flight attitude with airspeed decreasing, the AOA will be increasing.

- Hold this attitude and bank angle until the stall. Note, the aircraft may roll one direction or the other at the stall.
- Execute a Stall Recovery (below) when directed by the instructor.

STALL RECOVERY

- Stall recovery is a Say & Do technique. You will first say the step (ie. **PUSH**) and then move the flight controls as appropriate for the step before moving on to the next step. Here is the recovery:
- **PUSH**: Say, **"Push":** Release back pressure on the elevator to allow the aircraft to unload and seek a lower angle of attack.
- **POWER**: Then say, **"Power":** Smoothly but aggressively add full power (usually). Increased power will help drive the aircraft away from the stall and preserve altitude irrespective of nose position. Exceptions exist where power should be set to idle and these will be discussed in ground training.
- **RUDDER**: Then say, **"Rudder":** While referencing outside the cockpit VMC or the attitude indicator IMC, use rudder to coordinate the aircraft. Do NOT reference the ball as it is completely unreliable. Use your senses to determine the existence of yaw. If the aircraft is still rolling then "pop" opposite rudder to stop the roll. You are not to attempt to roll the aircraft using the rudder. The primary purpose of rudder is to cancel yaw. Rudder will be used to cancel yaw during all recoveries.
- **ROLL**: Then say, **"Roll":** Now is the time to use coordinated ailerons and rudder to expeditiously roll the aircraft to a level flight attitude. You should not pull back on the elevator until the wings are within 30° of level flight.
- **CLIMB**: Then say, **"Climb":** If the airspeed is still below $V_{A,}$ you should smoothly but aggressively pull just short of stall (in and out of the horn, shaker, or stall light) to maximize lift thus minimize altitude loss in the dive recovery. If the airspeed is greater than $V_{A,}$ smoothly but aggressively pull to the limit load of the aircraft and consider a power reduction to idle. You should initially set a Vy pitch attitude (~10° nose up in the Extra 300) and then confirm positive rate on the altimeter or VSI.

COMMON ERRORS

- Using ailerons at the stall break to attempt to correct generated roll.
- Adding too much forward pressure (dumping the nose) at the stall break.
- At the stall break, releasing the backpressure but immediately reapplying backpressure resulting in possible secondary stall (pumping the stick).
- Failing to apply full power.
- Looking at the ball and chasing it with rudder application.
- Trying to level the wings with rudder vice ailerons.
- On the “Climb” step, failing to set the Vy attitude and confirming a positive rate of climb.

EXERCISE #6: FALLING LEAF (RUDDER STALL EXERCISE)

OBJECTIVE: To demonstrate the dynamic instability of an aircraft in stalled flight and the proper use of rudder to cancel yaw.

WHY? Demonstrating the unstable nature of stalled flight due to negative roll damping will emphasize the critical importance of avoiding stalled flight and expediting a thorough recovery should a stall be encountered.

WHAT IS IT? The Falling Leaf is a very dynamic exercise where the aircraft is held in a full stall with idle power. The rudder is used correct any developed yaw. The aircraft will be losing altitude during this maneuver.

KNOWLEDGE TEST

- What aerodynamic factor causes negative roll damping?
- Is the aircraft positively or negatively roll damped in a stall?
- Are ailerons effective in a stall? If so, when? Why or why not?
- What is the most effective flight control for reducing angle of attack?
- Can an aircraft be stalled in any flight attitude? How about inverted?

HOW - PSSA

- From level flight, set idle power and allow the aircraft to decelerate to a normal wings-level power-off stall. Approaching the stall, begin "running" on the pedals to get your feet moving. Your goal will be to aggressively cancel any yaw/roll that is developed in the exercise. Essentially, you will be acting as a manual yaw damper.
- At the stall, pull and hold the control stick full aft with neutral ailerons and keep the ailerons neutral throughout the maneuver until recovery. The Instructor will help hold the stick back. This will ensure the aircraft remains in a stalled condition throughout the exercise.
- Now, use all available rudder to cancel yaw. If the aircraft rolls right then full left rudder will be needed to stop the roll. Because of negative roll damping, once the roll begins, opposite rudder is needed to stop the roll. Note the marked instability of the aircraft in this stalled condition. This is due to *negative roll damping*. Also, take note of

- the pitch oscillations. Continue this "rudder dance" until the Instructor terminates the exercise by stating, "recover".

- When instructed, aggressively (but not excessively) reduce angle of attack with forward elevator movement. This will reduce the angle of attack and recover the aircraft from the stall.
  Note the immediate stability of the aircraft as it regains normal AOA (i.e. $<AOA_{critical}$)
- The result will be a nose down attitude, possible over-banked, but in normal (unstalled) flight. Notice the immediate roll stability due to positive roll damping in normal flight. Continue with the remainder of the Stall Recovery.

COMMON ERRORS

- While in stalled flight, holding the rudder in one direction too long.
- Not using sufficient rudder to stop the rolling moment.
- Applying the rudder in the wrong direction

EXERCISE #7: THE AILERON ROLL

AEROBATICS: All aerobatics taught during APS Emergency Maneuver Training courses (URT/EMT/IRT) are used as tools to develop skills to recover an aircraft from adverse flight conditions. In these specialized courses of training, we are not attempting to teach how to fly perfect aerobatic maneuvers, give significant emphasis to the ideal shape of the maneuver nor do we express measurable concern to maintaining specific lines. The instructor will state the correlation to emergency maneuver training for each aerobatic maneuver exercise. Certain aerobatic maneuvers give pilots exposure, awareness and skill-development opportunities that cannot be efficiently developed in any other way. Note: If you are participating in an aerobatics-specific course at APS, we will provide exact detailing of the "how to" of competition-standard aerobatic maneuvering during your ground training complemented by other published references.

OBJECTIVE: To learn to roll an aircraft in an effective manner to re-orient the lift vector while minimizing altitude loss.

WHY? The aileron roll exposes the pilot to all possible angle of bank attitudes in a single maneuver. Over-banked situations, such as those caused by wake turbulence, can lead to tremendous altitude loss if the aircraft is not rolled upright effectively.

WHAT IS IT? An aileron roll is an aerobatic maneuver in which the aircraft is rolled 360 degrees around its longitudinal axis as illustrated below. This maneuver is accomplished by use of coordinated ailerons and rudder while keeping AOA low and positive.

KNOWLEDGE TEST What is the most effective flight control to roll an aircraft in normal flight?

Why do we need to reduce angle of attack before rolling when over-banked?

How do you know if you have pushed (unloaded) enough before rolling?

How long do you hold the push?

HOW

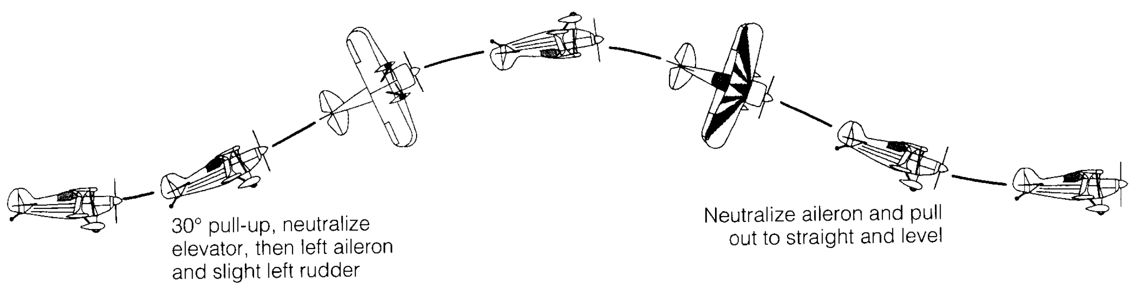
- PSSA
- ✈ Establish cruise speed of 120 kts with power stabilized.
- ✈ Pull nose up about 20°(feet on the horizon).
- ✈ Say "Push", then push slightly until you feel light in the seat. This ensures a decreased AOA.
- ✈ Say "Roll", then use coordinated aileron and rudder to roll the aircraft in one direction while holding the slight push. Look straight ahead at distant horizon.
- ✈ Watch the world go around.
- ✈ When the wings are back to level flight, stop the roll.
- ✈ Now apply backpressure to return the nose to level flight.

COMMON ERRORS

- ✈ Failing to push slightly before beginning the roll.
- ✈ Failing to hold the slight push throughout the roll.

- Over-pushing through the inverted flight attitude
- Pulling when approaching the inverted flight attitude

Fig. A-11 The Aileron Roll.



20-degree pull-up, then slight push of elevator, then left aileron and slight left rudder

Neutralize aileron when wings are level and pull out

EXERCISE #8: THE INSIDE LOOP

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OBJECTIVE To learn proper G-loading and angle of attack control through changing speed conditions.

WHY? This maneuver exposes the pilot to all possible pitch attitudes and teaches the pilot how to recognize the maximum structural load-loading of their aircraft. The pilot will continue to develop 3-dimensional awareness while practicing dive recovery techniques during the last ½ of the maneuver.

WHAT IS IT? From an upright level flight condition, the Inside Loop is a 360 degree turn in the vertical plane of motion with the elevator being the primary flight control.

KNOWLEDGE TEST

- If you increase the G-loading of an aircraft, does the angle of attack increase?
- Can you pull as many G's as you want at any speed?
- How many G's are available at maneuvering speed (V_a)?
- What is your aircraft's maneuvering speed (V_a)?
- What is the limit load of your aircraft? Why?
- Can you stall the aircraft when operating above maneuvering speed?

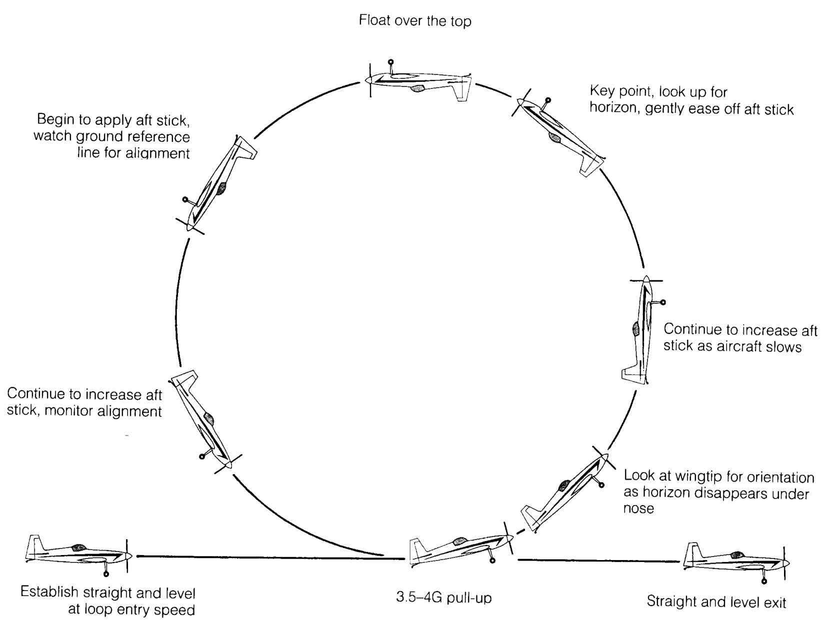
HOW

- PSSA

- Set full power and 160 kts in level flight.
- Smoothly apply backpressure until you feel the G-loading your instructor has requested (typically this will be the limit load of your aircraft). From his G-meter, the instructor will announce the G-loading throughout the maneuver.

- Continue adjusting backpressure to hold the target G-loading until the horizon goes out of sight. Now look right or left at the wing in relation to the horizon in order to keep situational awareness throughout the loop.

- As airspeed bleeds off and your available G-loading decreases, adjust your pull to maintain a constant pitch rate over the top of the loop. Additional right rudder pressure will be necessary due to increased torque effects.
- Approximately 30-45° prior to reaching the wings-level inverted flight attitude begin looking forward over the nose to find the horizon.
- Continue adjusting backpressure to maintain a constant pitch rate.
- On the backside of the loop (i.e. nose pointing at the ground), airspeed will begin to increase rapidly. Adjust backpressure to once again pull the requested G's as the maneuver is completed and the aircraft is returned to level flight.



COMMON ERRORS

- Failing to reference the horizon throughout the maneuver to maintain orientation.
- Failing to keep backpressure on the elevator as the aircraft becomes inverted (over the top of the loop).
- Failing to adjust the back pressure (pull) to the simulated limit load of the client's aircraft as airspeed accelerates above Va on the backside of the loop (dive recovery)

EMERGENCY MANEUVER TRAINING

EXERCISE #9: INVERTED FLIGHT

AEROBATICS: All aerobatics taught during APS Emergency Maneuver Training courses (URT/EMT/IRT) are used as tools to develop skills to recover an aircraft from adverse flight conditions. In these specialized courses of training, we are NOT attempting to teach how to fly perfect aerobatic maneuvers, give significant emphasis to the ideal shape of the maneuver nor do we express measurable concern to maintaining specific lines. The instructor will state the correlation to emergency maneuver training for each aerobatic maneuver exercise. Certain aerobatic maneuvers give pilots exposure, awareness and skill-development opportunities that cannot be efficiently developed in any other way. Note: If you are participating in an aerobatics-specific course at APS, we will provide exact detailing of the "how to" of competition-standard aerobatic maneuvering during your ground training complemented by other published references.

OBJECTIVE: Used as a practical method of "de-programming" a pilot's common reaction of "pulling to bring the nose up" when presented with an over-bank or inverted flight condition.

WHY? Situations such as wake turbulence encounters or cross-controlled stalls can quickly lead to inverted flight situations with little or no warning. It is vitally important to have awareness of how to maintain aircraft control and situational awareness while recovering to level flight.
NOTE: It is not our intention to teach you how to maintain negative G's while in inverted flight in your aircraft. This is only an exercise in *eliminating* a common instinctual reaction (ie. pulling) that could have disastrous results.

WHAT IS IT? Sustained flight upside down, while holding altitude and keeping the aircraft under complete control.

KNOWLEDGE TEST

- If you pull back on the elevator while inverted, what will that action do to the dive angle?
- If you push on the elevator such that you rise out of your seat against your harness, what have you done to the angle of attack?
- Are most aircraft designed to fly with sustained zero or negative G's?

HOW

- PSSA
- Establish cruise speed of 120 kts with power stabilized.
- Pull nose up about 20°(feet on the horizon).

- Then push slightly until you feel light in the seat.
- Then use coordinated aileron and rudder to roll the aircraft in one direction while holding the slight push.
- As the aircraft approaches 90° AOB, begin pushing even harder to <u>hold</u> the nose above the horizon. Stop your roll when you have achieved wings-level inverted flight. You will be in your straps hanging from your hips under negative 1-G.
- After stabilizing and holding altitude, use aileron to roll upright while continuing to hold forward pressure. When the aircraft passes through 90° AOB, begin to apply back pressure to resume positive G's in upright level flight.

COMMON ERRORS

- Failing to push slightly before beginning the roll.
- Failing to hold the slight push throughout the roll.
- Failing to push even harder (feeling of coming out of your seat) as the angle of bank passes 90° on its way to inverted.
- Failing to hold the push once inverted. The nose should remain above the horizon.

EXERCISE #10: NEGATIVE ROLL DAMPING EXERCISE

OBJECTIVE: Introduce the stability differences of positive roll damping verses negative roll damping in their respective flight conditions.

WHY? It is important to understand that normal flight (unstalled) provides positive (good) stability in the roll axis. However, stalled flight (AOA > Critical) provides a negative (deteriorating) stability in the roll axis that can lead to extreme flight attitudes or conditions.

WHAT IS IT? This is a two-part demonstration. The first part demonstrates positive roll damping while in normal flight (unstalled). The second part demonstrates negative roll damping while in continuous stalled flight.

KNOWLEDGE TEST

- If a yawing moment is applied to an aircraft, which wing (up-going or down-going) has the greater angle of attack local angle of attack?
- If a wing has a greater angle of attack than the other wing, does it have a corresponding increase in lift in normal flight? In stalled flight?
- While in normal flight, if an aircraft begins to roll because of aileron input or yaw, will the aircraft continue to roll if the aileron input or yaw is removed?
- While in stalled flight, if an aircraft begins to roll because of aileron input or yaw, will the aircraft continue to roll if the aileron input or yaw is removed?
- Is aileron effect reversed in stalled flight?
- Should we use ailerons to control roll in a stalled flight condition?

HOW - PSSA

- <u>Part One</u>: Establish stabilized normal flight. Any speed above the stall is acceptable.
- Apply momentary aileron input (a hit-and-release on the stick in either direction) to begin an aircraft roll.
- Once the roll has started, quickly release the aileron input allowing the ailerons to neutralize on their own. Note the aircraft ceases to roll. This is due to *positive roll damping*.
- Repeat the exercise using a short and brisk application of rudder and note the results.

- Part Two: At idle power, decelerate the aircraft for a level power-off stall.
- At stall, pull and hold the control stick full aft which keeps the aircraft in a continuous stalled flight condition.
- Press and hold full rudder in either direction. The aircraft will begin to roll due to the generated yaw.
- After aircraft starts to roll, neutralize the rudders.
  NOTE: the aircraft continues to roll due to negative roll damping.
- After another 90 - 180° of roll, completely relax the backpressure on the stick allowing the aircraft to break the stall. NOTE: the aircraft immediately stops rolling due to positive roll damping in normal (unstalled) flight regardless of flight attitude.
- Now use ailerons to level the wings (if not already) and pull out of the dive.

COMMON ERRORS

- Failing to hold the elevator fully aft.
- Giving up while in the maneuver.

EXERCISE #11: SKIDDED TURN STALLS

OBJECTIVE: Perform proper recognition, avoidance and recovery techniques from skidded turn stalls. Observe characteristics of skidded turn stalls and their effects.

WHY? It is important to understand that there is no practical benefit to doing a skidded turn. The potential altitude loss could be disastrous if an aircraft is stalled during the skid. The key ingredients for spin entry are contained in a skidded turn stall.

WHAT IS IT? An uncoordinated maneuver where there is excess yaw in the direction of the turn. This is normally pilot-induced. The most common phase of flight for this error is when turning base to final and a runway overshoot is developing. If the pilot refuses to increase his angle of bank or decides against initiating a go-around, he will typically try to increase his turn rate by adding inside rudder. (See discussion of uncoordinated turns.) NOTE: *A skidding turn can always be recognized by the movement of the ball drifting off center toward the high wing in a steady-state unstalled turn*.

KNOWLEDGE TEST

- ✈ What is the primary purpose of the rudder?
- ✈ Does a skidded turn help us to turn quicker?
- ✈ Is there any aerodynamic benefit to a skidding turn?
- ✈ How do you know if you are in a skidded flight condition?
- ✈ Is there much warning of a stall in a skidded turn?
- ✈ Will the aircraft roll in a skidded turn stall? If yes, which way?
- ✈ If the aircraft rolls in this stalled condition, will it keep rolling? Why?
- ✈ Will there be much altitude lost in a skidded turn stall?

HOW - PSSA

- ✈ Starting at 80 kts and idle power, establish a 30° AOB coordinated turn while holding altitude.

- Simulate letting the aircraft overshoot the runway centerline and feed additional rudder in the direction of the turn to tighten the turn while keeping bank and pitch angle constant.
- Rudder input will tend to slice the nose even lower and we will respond with a stick back input to keep the nose up, putting the aircraft closer to critical AOA.
- Rudder input will also induce the outer wing to travel faster, generating more lift, and therefore, rolling the aircraft further into the turn. We will compensate by feeding in opposite aileron to maintain bank angle.
- In compensation for the applied rudder, we have entered a cross-controlled flight condition and increased angle of attack.
- The resulting lack of turn performance will cause the aircraft to continue to overshoot the runway. Typically, the normal pilot reaction is to do more of everything by increasing all control inputs, starting with more inside rudder and associated cross-control inputs (inappropriate), to attempt to make the final turn work.
- As backpressure is increased further, a sudden stall will ultimately induce a rolling moment causing the aircraft to roll toward the inside (low) wing. When the roll is detected, immediately initiate a Stall Recovery as outlined below.

RECOVERY

- Normal Stall Recovery (See Exercise #5)
  - Push
  - Power
  - Rudder
  - Roll
  - Climb

<u>NOTE</u>: Altitude loss during a skidded turn Stall Recovery can be greater than 600’ depending on the type of aircraft and the amount of uncoordinated rudder used in generating the stall.

COMMON ERRORS

- At the stall, using ailerons to try to stop the roll during the “Push” step.

- During the "Push" step, applying too much forward pressure resulting in a "dump" of the nose and excessive loss of altitude.
- During the "Rudder" step, looking at and chasing the ball.
- If the aircraft is inverted while doing the "Roll" step, rather than rolling first upright, the typical instinctual pull will result in tremendous altitude loss.

  See Exercise 14: Split-S

EXERCISE #12: SLIPPING TURN STALLS

OBJECTIVE Perform a proper entry into a slip. Practice proper recognition, avoidance, and recovery from slipping stalls. Observe characteristics of slipping turn stalls and forward slipping stalls and their effects.

WHY? The slipping turn is a useful maneuver for losing altitude quickly, particularly if high on the landing approach. Also, the slipping turn can be useful when coping with in-flight control failures such as split flaps, jammed ailerons or a jammed rudder. The potential altitude loss could be catastrophic if an aircraft is stalled during the slip. *The key ingredients for spin entry are potentially contained in a slipping turn stall despite that fact that, aerodynamically speaking, slipping flight is inherently stall resistant.*

WHAT IS IT? A slipping turn is an uncoordinated turn due to excess yaw opposite to the direction of the turn. The inside wing points toward the ground while the deflected rudder points skyward, opposite to the direction of the turn. NOTE*: A slipping condition is recognized by the ball drifting out of center toward the* ***LOW*** *wing in steady-state unstalled flight.*

KNOWLEDGE TEST

- Is a slip a valid piloting technique?
- In a forward slip, where do you expect the ball to be in relation to your wings?
- Why do we add airspeed on final approach to compensate for crosswinds and/or gust factor? (Think of control inputs for crosswind landings)
- If we stalled the aircraft in a slip, would the aircraft roll? If yes, which way? Are there exceptions?
- If the aircraft rolls in this condition, would it keep rolling? Why?

HOW - PSSA

Forward Slips

- We will simulate a crosswind landing approach with the aircraft being high on final. At idle power and about 80 kts, begin by lowering a wing about 10-20°. Then add opposite rudder. Now check that the ball has drifted to the low wing. The amount of rudder you apply will determine how much angle of bank you will need to keep the aircraft tracking straight ahead. Allow the nose to drop slightly in order to preserve airspeed.

- **Forward Slip to a Stall:** Now we will simulate getting distracted and losing track of airspeed / nose attitude. We will bring the nose up to the horizon and allow the airspeed to bleed off. As airspeed bleeds off, continue to feed in backpressure on the elevator. Airframe buffeting will begin as the critical angle of attack is approached. When the aircraft stalls, it will roll away from the ball and in the direction of the applied rudder. When the roll is detected, immediately initiate a Stall Recovery as outlined below.
  NOTE: During your training, notice how much more cross-control input is required in a slip to get the aircraft to stall as compared to a skidded stall.

Slipping Turns

- We will simulate an idle-power turn to final while being too high on the approach. At idle power and in a coordinated 30° AOB, apply opposite rudder (high rudder) from the direction of turn. The ball should now drift to the lower wing. Continue to apply aileron pressure to hold the 30° AOB. The nose will need to be lowered in order to preserve airspeed.
- **Slipping Turn to a stall:** Now we will simulate getting distracted and losing track of airspeed / nose attitude. We will bring the nose up to the horizon and allow the airspeed to bleed off. As the airspeed bleeds off, continue to feed in backpressure on the elevator. Airframe buffeting will begin as the critical angle of attack is approached. As backpressure is increased, a stall will finally induce a rolling moment causing the aircraft to roll toward the outside (high) wing. When the roll is detected, immediately initiate a Stall Recovery as outlined below.

RECOVERY - Normal Stall Recovery (See Exercise #5)

- Push
- Power
- Rudder
- Roll
- Climb

COMMON ERRORS

- ✈ Not holding assigned flight attitude or altitude resulting in prolonged entry.
- ✈ Allowing the flight attitude to vary dramatically.

EXERCISE #13: SPIRAL DIVES

OBJECTIVE Recognize conditions associated with a spiral dive and apply the correct recovery action.

WHY? A spiral dive can lead to severe altitude loss and if not recovered properly. An improper recovery can possibly lead to a steeper angle of bank and aircraft structural damage/ failure during the recovery. The ability to quickly identify the situation and recover properly is an important tool for all pilots.

WHAT IS IT? A spiral dive is a steep angle of bank turn with the aircraft in an excessive nose-low attitude resulting in increasing airspeed and possibly G-forces. They are normally entered as a result of a poorly executed turn, or through inattention to flight parameters while in steep turns or during Stall Recovery.

KNOWLEDGE TEST

- ✈ If in a level turn, must the G-loading be increased if the angle of bank is increased? Why?
- ✈ If in a steep turn (AOB > 45°), does the angle of bank tend to increase on its own? How does that affect the vertical component of the lift vector?
- ✈ In general, if we are increasing G-loading, are we increasing angle of attack?
- ✈ In a high speed descending turn, is it possible we will not have enough G availability to bring the nose up?
- ✈ To the pilot, can a spiral dive look similar to a spin?

HOW **-** PSSA

- ✈ Establish a 60° AOB level turn (2 G's) at 120 kts with the power stabilized.
- ✈ We will now simulate getting distracted and being unaware of an increasing the bank angle beyond 60°. Without applying more backpressure, the nose will begin to fall.
- ✈ After the bank angle has increased to as much as 75° and the airspeed has increased, we will simulate that we now recognize the descending turn and will apply more backpressure increasing the

load to 3 G's. This will be ineffective for bringing the nose back to the horizon and tremendous altitude loss will ensue.

- Recover as outlined below.

RECOVERY (Follow Say & Do Technique)

- **"Push"** - Push the elevator so that you reduce the G-loading (light in the seat). This also reduces the angle of attack.
- **"Power"** - Reduce (close throttle). With the nose below the horizon, airspeed is probably increasing and therefore, power is not needed, as it will only serve to increase our altitude lost.
- **"Rudder"** – Ensure yaw is canceled and the aircraft in coordinated flight
- **"Roll"** – Using coordinated aileron and rudder; roll the aircraft to level flight.
- **"Climb"** Recover out of the dive by pulling to the load limit of the aircraft if above Va.

COMMON ERRORS

- Failing to push enough to reduce the G-load (light in your seat) before rolling wings level.
- Failing to reduce the power to idle.
- Premature backpressure on the elevator before achieving wings level.

EMERGENCY MANEUVER TRAINING

EXERCISE #14: SPLIT-S (½ ROLL & PULL-THROUGH)

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OBJECTIVE

To recognize the effect and consequences of pulling back on the elevator when presented with an inverted or extreme over-bank flight condition.

WHAT IS IT?

The Split S is a maneuver in which the aircraft is rolled to the inverted position and then pulled through as in the last half of a loop. The result is a loss of altitude, a gain in airspeed, and a 180-degree change of direction.

WHY?

Performing the Split-S is an excellent demonstration of how ***not*** to recover from an over-banked aggravated stall or nose-low unusual attitude situation. Excessive altitude loss occurs if a Split-S recovery is used as instead of the recommended recovery techniques taught at APS

KNOWLEDGE TEST

- If presented with inverted flight, does applying backpressure on the elevator increase the dive angle?
- Will power increase or decrease your altitude lost during a Split-S? Why?

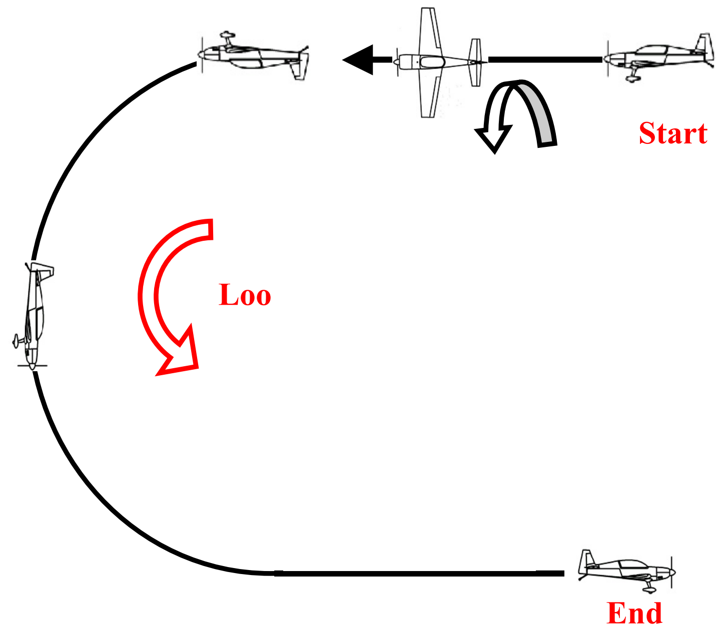
HOW

- PSSA
- Maximum Entry speed - 100 kts
- Attitude - 20 degrees nose up; power – midrange.
- Roll aircraft to the wings level inverted position and then immediately apply smooth but aggressive backpressure. As the aircraft begins a downward trajectory, the airspeed will increase rapidly. When speed has increased above Va, the elevator pressure should be applied to ensure the aircraft is turning at a g-loading equal the limit load of the simulated aircraft.
- Continue the backpressure until the aircraft has achieved level flight in the opposite direction.

COMMON ERRORS

- Applying too much backpressure too early and pulling the aircraft into an accelerated stall.
- Applying too much backpressure and pulling more G's than briefed.

The Split 'S' Maneuver



EMERGENCY MANEUVER TRAINING

EXERCISE #15: THE CUBAN 8

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OBJECTIVE

To get exposed to extreme aircraft attitudes and practice components of the techniques used in unusual attitude recoveries.

WHY?

Aerobatics help to develop a pilot's situational awareness. Performing the Cuban 8 is a great exercise to practice maintaining orientation in various attitudes in addition to continuing to develop both g-awareness and dive recovery techniques. Particular to this maneuver, we focus attention on the nose-low (45 degrees) inverted flight attitude and the application of properly coordinated control inputs to recover the aircraft. The skills developed in this aerobatic maneuver are directly applicable to both stall recovery and unusual attitude recovery proficiencies.

WHAT IS IT?

The Cuban 8 is a combination of two partial loops with an aileron roll to the upright flight attitude from the inverted 45-degree nose-low position. The ½ rolls (2 in the maneuver) occur after passing the inverted wings level position over the top of each looping maneuver. The resulting flight path essentially traces a sideways 8 through the air. Thus the name "Cuban Eight".

KNOWLEDGE TEST

- When faced with an extreme nose high attitude (only blue sky is visible out forward windscreen), where should the pilot look to regain situational awareness?
- When faced with an extreme nose low attitude (only ground is visible out forward windscreen), where should the pilot look to determine the direction of the nearest horizon?

HOW

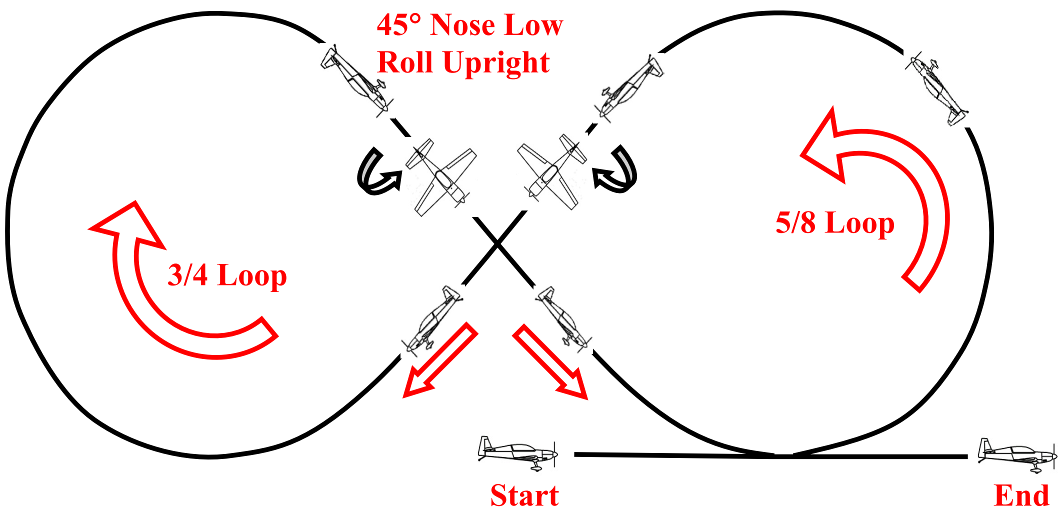
- PSSA
- Establish 160 kts level flight with full power.

- Smoothly apply backpressure until the pre-briefed G-load is achieved. Strive to keep a wings-level pull. As the horizon disappears well below the nose, shift your scan to the right or left to view the wings in relation to the horizon and take note of the pitch rate. As airspeed decreases, continue to apply backpressure while striving to hold the same pitch rate. G-load will decrease over the top of the loop and control inputs will be varied by the pilot to continue to sustain a constant pitch rate.
- Reference the wing in relation to the horizon. When the nose is approximately 45° nose-low in an inverted flight attitude, apply just enough forward stick pressure, while stating and applying "Push – Power – Rudder", to feel light in the seat and then, state "Roll" while you roll the aircraft upright using coordinate aileron and rudder while holding the slight forward pressure.
- Allow the aircraft to accelerate to approximately 140 kts while 45° nose down in preparation for an immediate entry into another cuban eight exercise.
- Once 140 kts is achieved, state "Climb" and begin applying backpressure to establish the prebriefed G-load.
- THIS IS EXCELLENT RECOVERY PRACTICE: SAY & DO
- Continue as described above to accomplish another cuban eight exercise without delay.
- Recover to level flight after completing the second 45° nose-down roll to upright or as directed by the instructor.

COMMON ERRORS

- Faulty pull up: too many G's or not enough.
- Failing to shift your view to the right or left wingtips prior to reaching the vertical nose-up attitude during the first ¼ turn of the cuban eight entry.
- Failing to maintain the backpressure to hold a constant pitch rate once the G-load is established.
- Failing to push to feel light in the seat before rolling upright from the inverted 45° nose down position.
- Over pushing in the recovery to a zero or negative-g flight condition

Fig. A-1: Cuban 8



EMERGENCY MANEUVER TRAINING

EXERCISE #16: POWER OFF APPROACH TO LANDING

OBJECTIVE To effectively fly a forced engine-out approach.

WHY? It is a constant requirement to maintain proficiency in power off approach situations. Most aircraft POHs do not present recommended flight profiles for engine-out situations for multi-engine aircraft yet complete power loss on both single-engine and multi-engine aircraft is still prevalent today.

WHAT IS IT? An emergency procedure in which the aircraft is flown at the proper glide speed, an appropriate landing spot is chosen and, using situational awareness and appropriate aircraft control, the aircraft is landed safely.

KNOWLEDGE TEST

- What are some possible scenarios that could result in losing your engine(s)?
- Do you know what your V_{bg} (Best Glide Speed) is for your aircraft?
- At V_{bg}, will your glide ratio remain the same irrespective of your weight?
- What is the power-off approach profile recommended by the FAA?
- If engine failure occurs after takeoff, how much altitude is needed to glide back to the departure runway?
- With enough altitude on departure, will you then always have the option of returning to the airport if presented with a complete loss of power?

HOW **-** PSSA

- Engine failure will be simulated by setting idle power.
- V_{bg} is 85-90 kts.
- An overhead 360° pattern will be emphasized.

RECOVERY

Speed

- Adjust pitch attitude to obtain and maintain V_{bg} (Best Glide Speed)
- If slower than best glide speed at any point in the profile, the pilot must be willing to sacrifice some of the remaining altitude to achieve best glide speed…this is the top priority!

Look for a Spot

- Pick a landing site that is well within glide range.
- If on approach or departure, view the airport as **one** landing site, but not necessarily **the only** landing site.
- Altitude permitting, fly directly to the landing sight for an overhead approach or fly to directly intercept some point on the overhead approach profile.

Set-up

- There may not be ample time to configure the aircraft totally for a forced landing. However, by performing additional tasks as time permits, we enhance the probability of post-crash survival or possibly restarting the engine. Do not do these additional tasks at the expense of aircraft control. *Maintain aircraft control first*, ensure the aircraft is adhering to the proper forced landing profile then, and only then, perform additional tasks situation-permitting.

COMMON ERRORS

- Stalling the aircraft
- Making turns too steep (i.e. greater than 45° AOB).
- Failing to obtain and maintain V_{bg} after engine(s) failure.
- Failing to perform coordinated turns.
- Attempting to stretch the glide (i.e. slow below V_{bg}) on final approach.
- Failing to know the minimum altitude required to perform an overhead 360° power-off pattern at best glide speed in the pilot's specific aircraft type.
- Failing to know the minimum altitude required to complete a turn back to the departure airfield during an engine failure after takeoff.

EMERGENCY MANEUVER TRAINING

EXERCISE #17: UNUSUAL ATTITUDE RECOVERIES

OBJECTIVE Recognize and safely recover from a wide variety of unusual attitudes.

WHY? Unusual attitudes can happen in any flight regime. Time and altitude available for recovery can be critical. Situational awareness, recognition of unusual attitudes and the proper execution of the recovery techniques are key to safely recovering the aircraft.

WHAT IS IT? An unusual attitude is any flight attitude that occurs inadvertently. It may result from turbulence, inattention, disorientation, aborted aerobatics, uncoordinated stalls or a host of other possible scenarios that could result in an unfamiliar flight attitude.

KNOWLEDGE TEST

- What is the relationship between bank angle and the lift vector?
- Irrespective of the aircraft's attitude, if the pilot feels positive G's (pressed into his seat), does he have a positive angle of attack on the aircraft?
- If a pilot applies backpressure while in an over-banked or inverted flight attitude, what effect is there on the dive angle of the aircraft?
- If a pilot applies a slight forward pressure while in an over-banked or inverted flight attitude, what effect is there on the dive angle?
- What is the most effective flight control to roll an aircraft while in unstalled flight?
- What are the dangers of uncoordinated (particularly rudder) control inputs if used to recover from unusual attitudes nose-high or nose-low in high or low speed flight?

HOW - PSSA

- The instructor (with you riding the controls) will place the aircraft in various unusual attitudes nose high and nose low with various bank angles, speeds, and power settings. When appropriate, the instructor will tell you to recover.
- Wake Turbulence Encounters: Although we think of wake turbulence encounters typically happening in the vicinity of airports, wake turbulence encounters can happen anywhere, whether from a

passing heavy aircraft at 17,000 feet or from mountain wave turbulence and so on. During the course, the instructor will present you with simulated wake turbulence encounters and ask you to recover. The recovery is Push-Power-Rudder-Roll-Climb.

RECOVERY

- In all recoveries, if the flight attitude is not immediately recognized, centralize the controls and analyze the situation. The combined observation of airspeed and altitude can reliably determine whether the aircraft is in a nose-high or nose-low flight attitude.
- Disconnect the Auto-Pilot (if equipped)

Nose Low

- If airspeed is increasing and altitude is decreasing, the aircraft is in a nose-low attitude.
- To prevent an excessive airspeed build-up and a corresponding excessive loss of altitude:
  - **"Push"** – Add slight forward pressure to the elevator to effectively unload (light in your seat) the aircraft. This will minimize dive angle (especially when over-banked), increase aileron effectiveness, and prevent asymmetrical G-loads that can damage the aircraft.
  - **"Power"** – Pull the throttle to idle. Power will only contribute to increased airspeed, which dramatically increases our altitude loss especially if accelerating above maneuver speed. NOTE: This is not a Stall Recovery that demands increased power to minimize altitude loss.
  - **"Rudder"** – Confirm yaw has been canceled and in coordinated flight
  - **"Roll"** – Using full ailerons and *coordinated* rudder while maintaining the above push, aggressively roll the wings level (orients lift vector skyward). The Roll should be towards the nearest horizon (shortest distance). If the horizon is not visible (i.e. inverted and nose-low with a "face full of dirt"), scan left and right out the windscreen to look for blue sky or, if IMC, reference the attitude indicator. If blue sky is seen out the right side then roll right and vice versa. If blue sky is not seen then aggressively roll any direction and the sky will come into view. Do not apply backpressure while rolling; you must maintain the forward pressure until the wings are within 30° of level.

- **"Climb"** – Once the wings are level, recover out of the dive by smoothly, but aggressively, applying backpressure to bring the nose back to the horizon. If above maneuvering speed, pull to the limit load of the aircraft at idle power. If below maneuvering speed, pull to an angle of attack just short of the stall warning to maximize lift resulting in a minimization of altitude loss in the dive.
- When the aircraft is established in the climb, return to the desired configuration and power setting.

Nose High

- A nose-high attitude can be recognized by a lack of horizon reference, a decreasing airspeed with the altitude increasing.

To recover:

- **"Push"** – Add slight forward pressure to the elevator to effectively unload (light in your seat) the aircraft. This reduces AOA that in turn lowers the stall speed effectively increasing the normal flight envelope of the aircraft. The unload also allows the nose to more quickly fall toward the horizon. Do not push to zero or negative G-load.
- **"Power"** – Apply full power. Power preserves airspeed and assists in retaining more controllability of the aircraft.
- **"Rudder"** – Confirm yaw has been canceled and in coordinated flight
- **"Roll"** – Using ailerons and *coordinated* rudder, roll towards the nearest horizon to a maximum of 45-60° AOB. Rolling towards the nearest horizon reduces the vertical component of lift and allows the nose to slice more rapidly toward the horizon which preserves both airspeed and controllability. In nose-high unusual attitudes with bank angles less than 90 degrees, roll the aircraft as required to obtain 45-60° AOB. For nose-high unusual attitudes with greater than 90 degrees of bank (over-banked), bank angle should be <u>reduced</u> to again achieve 45-60° AOB.
- **"Climb"** – As the nose crosses the horizon, roll wings level while maintaining your push and check that your airspeed is above 1-G stall speed. If slow (below the 1-G stall speed), allow the airspeed to build by letting the nose of the aircraft fall slightly below the horizon while sustaining the unload prior to recovering the aircraft to level or climbing flight.

- When the aircraft is in level flight, reduce power to maintain normal cruise airspeed.

WAKE TURBULENCE RECOVERY

- **“Push”** – Irrespective of a nose high or nose low flight attitude, apply slight forward pressure to unload (light in the seat) the aircraft.
- **“Power” -** As Required. Increasing or decreasing power depends on altitude, attitude, configuration and airspeed trend. At altitude with nose low, power would probably come back. Near the ground and slow, e.g. low and slow (even with the nose down) – full power may be required.
- **“Rudder”** – Confirm yaw has been canceled and in coordinated flight
- **“Roll”** – Using full ailerons and coordinated rudder while maintaining the above push, aggressively roll the wings to continue with either the nose-high or nose-low unusual attitude recoveries explained above.
- **“Climb”** – When the aircraft is in level flight or climbing, return to desired configuration and power setting.

COMMON ERRORS

- Adding power when nose low and airspeed building.
- Failing to add full power with nose high and airspeed decreasing.
- Failing to apply forward pressure for a “light in the seat” feeling.
- Pushing too much causing zero or negative G.
- During a nose-low recovery, failing to hold the push until the wings are level.
- During a nose-high recovery, failing to hold the push until the nose is below the horizon with the airspeed accelerating above 1-G

EXERCISE #18: THE HAMMERHEAD

AEROBATICS: All aerobatics taught during APS Emergency Maneuver Training courses (URT/EMT/IRT) are used as tools to develop skills to recover an aircraft from adverse flight conditions. In these specialized courses of training, we are NOT attempting to teach how to fly perfect aerobatic maneuvers, give significant emphasis to the ideal shape of the maneuver nor do we express measurable concern to maintaining specific lines. The instructor will state the correlation to emergency maneuver training for each aerobatic maneuver exercise. Certain aerobatic maneuvers give pilots exposure, awareness and skill-development opportunities that cannot be efficiently developed in any other way. Note: If you are participating in an aerobatics-specific course at APS, we will provide exact detailing of the "how to" of competition-standard aerobatic maneuvering during your ground training complemented by other published references.

OBJECTIVE

To get exposed to extreme aircraft attitudes and practice the techniques used in upset recovery and spin recovery.

WHY?

Develops confidence in aircraft control at airspeeds well below the 1-G stall speed. It demonstrates that even though there is continuous yaw below stall speed, the aircraft will not enter a spin as angle of attack will be maintained below critical at all times during the maneuver. It also allows practice in the use of rudder control to cancel yaw in preparation for spin recovery as well as affording the opportunity practice dive recovery techniques.

WHAT IS IT?

From straight-and-level flight, the aircraft is brought into a vertical climb and held in that position until almost zero airspeed. Full left rudder is then applied and the aircraft yaws, or cartwheels, 180 degrees until pointed vertically downwards and enters a vertical dive. On recovery, the aircraft will be heading in the opposite direction of entry heading

.

KNOWLEDGE TEST

- What is the AOA when the aircraft is in the vertical (i.e. going straight up)?
- Where should you be looking during the hammerhead (i.e. left, right, or forward) to hold yourself in the vertical?
- Is slight forward pressure required to hold the aircraft in the vertical?
- When well below stall speed and full rudder is applied, why does the aircraft not enter a spin?

HOW

- PSSA

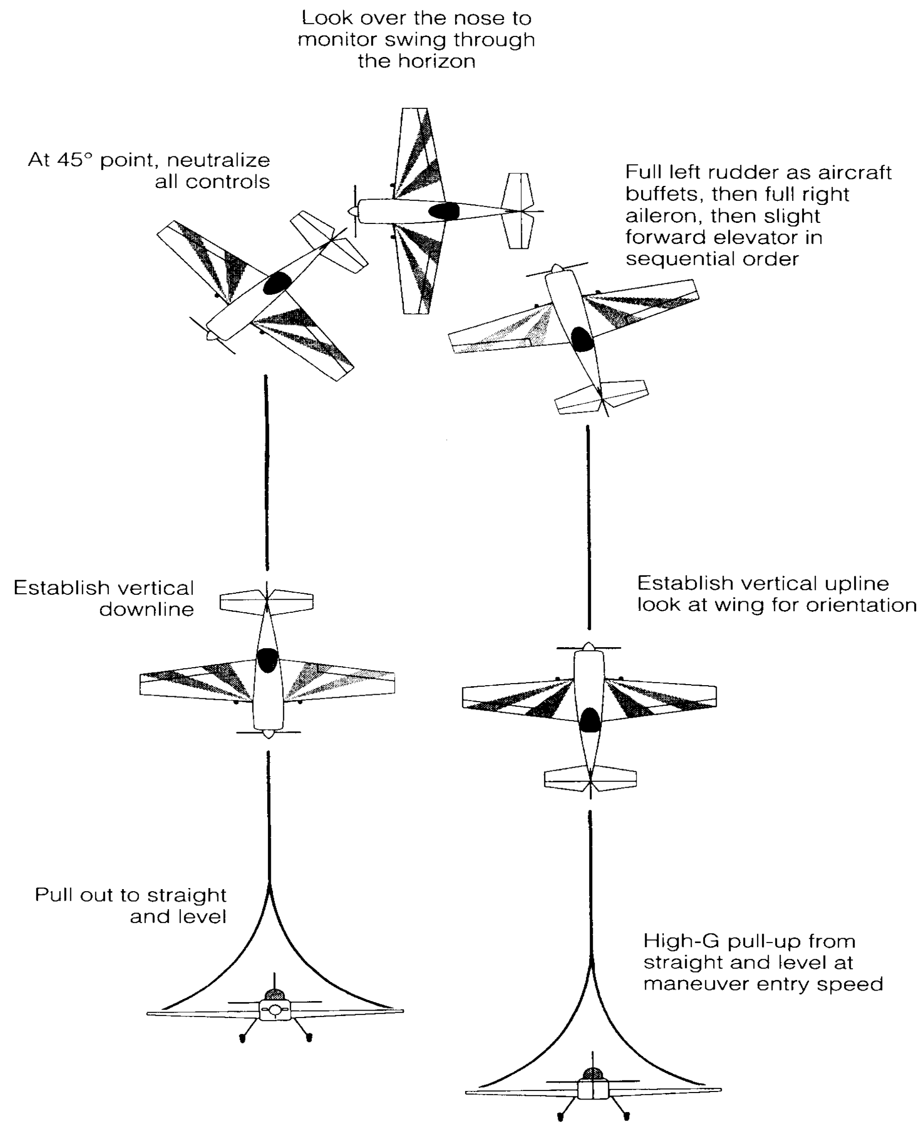
- Establish 160 kts level flight with full power.
- Smoothly apply backpressure until the prebriefed G-load is achieved. Strive to keep a wings-level pull. As the horizon disappears well below the nose, shift your scan to the left to view the wings in relation to the horizon.
- Continue your pull until the fuselage of the aircraft is perpendicular to the horizon. Apply elevator pressure as required to

- freeze the vertical attitude of the aircraft while continuously referencing the horizon off the left wing of the aircraft. Using peripheral vision, continue to scan the wing orientation in relation to the horizon and adjusting elevator and rudder pressure to hold the attitude within parameters defined by your instructor.
- Just after the aircraft begins to buffet (and before it starts to torque roll), apply full left rudder and hold. The nose will slice downward toward earth. Immediately following the kick of the rudder pedal, slight right aileron and forward elevator movement may be required to maintain the proper flight attitude as the aircraft rotates from straight up, to straight down.
- When the nose of the aircraft is approaching the straight down position, apply full opposite rudder to cancel yaw to stop the nose in the vertical. When established in the vertical down attitude, neutralize the rudder.
- When the airspeed accelerates to approximately 1.5 Vs (90 kts), apply smooth but aggressive backpressure to bring the nose back to the horizon (level flight). Be careful not to over-pull the aircraft into a secondary stall. When above your simulated maneuvering speed, be careful not to pull the aircraft beyond the prebriefed G-load. Use the seat of your pants to determine the proper G-load.

COMMON ERRORS

- Failing to shift your scan to the wing as you pull to the vertical up position.
- Holding the backpressure too long as the aircraft approaches the vertical up position.
- Applying too much forward pressure after achieving vertical.
- Failing to apply FULL rudder to initiate the kick over the top.
- Failing to neutralize the rudder when the nose is pointing straight down.

The Hammerhead Maneuver



EXERCISE #19: IMMELMAN (THE ROLL-OFF-THE-TOP)

AEROBATICS: All aerobatics taught during APS Emergency Maneuver Training courses (URT/EMT/IRT) are used as tools to develop skills to recover an aircraft from adverse flight conditions. In these specialized courses of training, we are NOT attempting to teach how to fly perfect aerobatic maneuvers, give significant emphasis to the ideal shape of the maneuver nor do we express measurable concern to maintaining specific lines. The instructor will state the correlation to emergency maneuver training for each aerobatic maneuver exercise. Certain aerobatic maneuvers give pilots exposure, awareness and skill-development opportunities that cannot be efficiently developed in any other way. Note: If you are participating in an aerobatics-specific course at APS, we will provide exact detailing of the "how to" of competition-standard aerobatic maneuvering during your ground training complemented by other published references.

OBJECTIVE

To learn proper G-loading and angle of attack control through changing speed conditions. Skills for stall and unusual attitude recovery are also enhanced.

WHY?

This maneuver continues to develop the unloaded roll technique, which is fundamental to effective unusual attitude recoveries, especially in slow-speed flight conditions. Additional skill development continues in the recognition and application of the limit-load of your specific aircraft as well as 3-dimensional flight attitude awareness.

WHAT IS IT?

An Immelman consists of the first half of a loop, followed by a half-roll back to level flight. The result is a significant gain in altitude (approximately 1000' – varies with airspeed and g-loading at entry) with a 180-degree change of direction, as shown in Fig. I.

KNOWLEDGE TEST

- Is it possible to stall an aircraft while inverted?
- Does pulling back on the elevator while inverted increase your dive angle?
- What is the most efficient flight control to roll an aircraft in unstalled flight while at very slow airspeed?

HOW

- PSSA

- Establish full power and 160 kts in level flight.
- Smoothly apply backpressure until you feel the G-loading your instructor has requested. From his G-meter, he will relay the G-loading as you pull into the ½ loop entry.
- Execute the ½ loop following the same techniques as described in Exercise 8: The Inside Loop.
- Continue adjusting your backpressure to hold the assigned G-loading until the horizon goes out of sight. Now look right or left at the wing in relation to the horizon in order to keep situational awareness throughout the initial pull. Take note of, and maintain, the pitch rate throughout the ½ loop portion of the maneuver.
- As the airspeed decreases, your G-loading will decrease as you continue to feed in backpressure to hold a constant pitch rate.
- Approximately 45 degrees prior to achieving inverted flight over the top of the ½ loop, shift your scan forward to the approaching horizon over the nose. When the cowling touches the horizon, apply slight

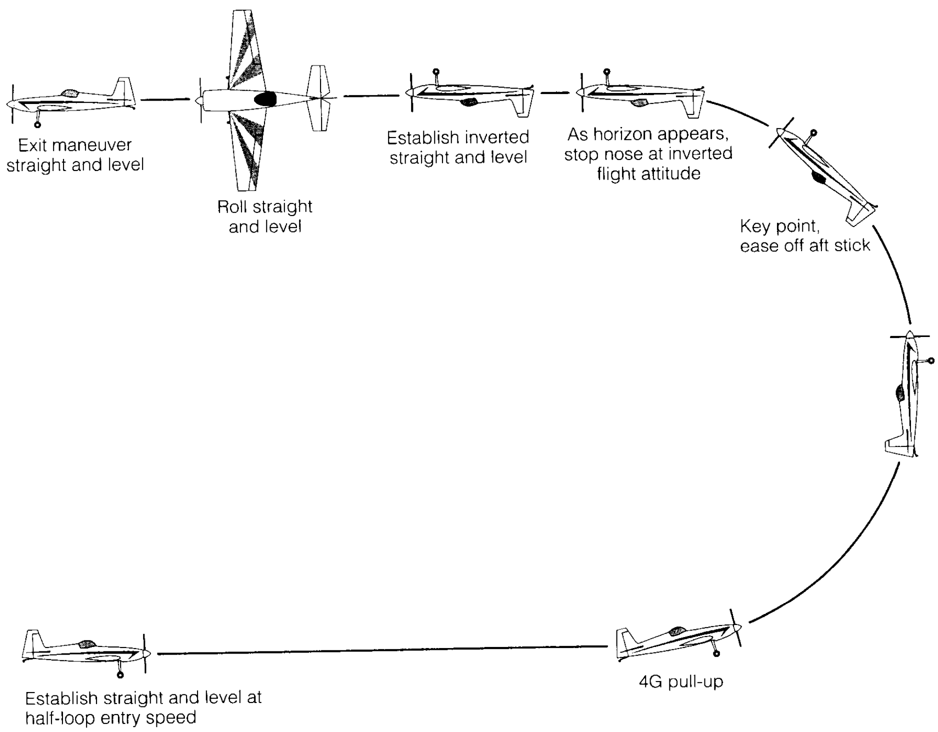
forward pressure (light in the seat) and then using coordinated aileron and rudder, roll upright.

- Unlike a competition-standard immelman, you are not trying to maintain level flight on the recovery nor are you trying to fly a constant radius loop. The technique being developed is the proper unloaded roll technique critical to effective slow-speed unusual attitude recovery and skill development.

COMMON ERRORS

- Not achieving the assigned G-load on the initial pull.
- Not shifting your scan left or right to view the wing in relation to the horizon to maintain orientation.
- Not maintaining backpressure as the aircraft passes through the vertical.
- Applying too much forward pressure causing zero or negative G's on the roll to upright.
- Rolling and pulling during the roll to upright causing an over-banked stall while attempting to recovery the aircraft.

The Immelman



EMERGENCY MANEUVER TRAINING

EXERCISE #20: SIMULATED CONTROL LOSS

(AILERON / ELEVATOR / RUDDER / FLAP FAILURE)

OBJECTIVE

Recognize and apply safe recovery techniques to retain aircraft control during from various control failures and/or structural damage scenarios.

WHY?

Control failures are very rare but are often manageable if corrective action is taken before the aircraft enters an unusual attitude. In addition to control failures, structural integrity issues can arise due to such occurrences as; bird strikes, icing, hail damage and so on. Pilots should understand various techniques for safe recovery of the aircraft when confronted with unexpected adverse handling characteristics and/or aircraft structural integrity issues.

WHAT IS IT?

A control failure is the inability of a particular surface to perform normal operation. This can be manifested through conditions such as simple control jams or become more complex when a bird strike breaches the structural integrity of the aircraft and various flight controls. Ground instruction and in-flight scenario-based exercises will revolve around maintaining aircraft control, analyzing the situation, and taking appropriate actions to safely return the aircraft to an airport. Appropriate actions include developing a strategy for *performing a controllability check* whenever aircraft control or structural integrity is in question. In addition to analyzing the runway environment for best landing runway and direction of landing, the pilot will also determine a minimum controllable airspeed at a safe altitude prior to attempting to land. These considerations are usually not included in aircraft POH.

KNOWLEDGE TEST

- With a jammed rudder, what flight control can be used to control the track of the aircraft?
- With a jammed rudder or aileron, what type of flight condition will likely occur when maintaining track? (Slip or Skid)
- How do you tell the difference between a Slip and a Skid in steady-state (constant pitch and bank) unstalled flight?
- With a jammed rudder or aileron, which way (toward or away from the ball) should you turn the aircraft?

- With a free-floating elevator, what pitch controls are available?

- Can the **Push-Power-Rudder-Roll-Climb** Strategy for unusual attitude recoveries help in the control failure and/or structural damage scenario?
- Why Is flying the ATTITUDE of the aircraft very important in these control failure scenarios?

HOW -PSSA

- The following control failures will be investigated:
  - Aileron
  - Split-flap
  - Rudder
  - Elevator

RECOVERY

Aileron Failure

- **PUSH –** Apply forward pressure (light in the seat) to decrease AOA and increase airspeed (if desired).
- **POWER** – Increasing or decreasing power may be wise to achieve greater rudder effectiveness (aircraft dependent). If in a high torque prop aircraft and the aileron is jammed in a left roll (assuming a right-turn prop), consideration should be given to decreasing power to reduce aggravating torque effects.
- **RUDDER –** If aircraft is rolling, use available opposite rudder to counter the roll and level the aircraft to a manageable flight attitude to maintain track. If aircraft is not rolling, use rudder to initiate turns when needed.
  - Power can be used in twin-engine aircraft to help control bank
  - Aircraft will be in controlled slip when safely turning or maintaining track. All turns should be made in the direction of the ball (low wing).
- **ROLL** – Ailerons not functional. Secondary roll through rudder application must be used.
- **CLIMB** – attempt to get the aircraft climbing until complete control has been confirmed.
- Do a controllability check at altitude.
- For landing, use a normal flight attitude. If a crosswind exists on approach, the crosswind component should be on the ball side (low wing side) during approach.

Rudder Failure

- **PUSH –** Apply forward pressure (light in the seat) to decrease AOA, increase airspeed and increase aileron effectiveness. The pilot must be willing to sacrifice altitude to regain control.
- **POWER** – Increasing power may be wise to gain airspeed for greater aileron effectiveness. If in a high torque prop aircraft and rudder is jammed in left roll, consider reducing power to minimize torque effects.
- **RUDDER** – not functional
- **ROLL** – If aircraft is rolling, use all available opposite aileron to counter the roll and level the aircraft. If aircraft is not rolling, use aileron to initiate turns when needed.
  - Power can be used in twin-engine aircraft to help control bank
  - Aircraft will be in controlled slip. All turns should be made using ailerons in the direction of the ball (the low wing).
- **CLIMB** – attempt to get the aircraft climbing until complete control has been confirmed
- Do controllability check at altitude.
- If rudder is jammed in a neutral position, avoid maximum performance climbs. Make smooth power changes and controlled aileron inputs. Restrict to your flight attitude to less than 30 degrees of bank and 10-15 degrees of pitch if at all possible.
- For landing, use a normal attitude. If a crosswind exists on approach, the crosswind component should be placed on the ball side (low wing side) for approach and landing.

Elevator Failure

- **POWER** – Control of the pitch attitude must be maintained through the use of; power, elevator trim and center of gravity positioning (ie. shifting baggage/passengers)
  - If in a Nose-Up attitude, reduce power to lower the nose and consider using gyroscopic properties to control the nose position (in a prop aircraft)
  - If in a Nose-Down attitude, add power and consider using gyroscopic properties to control the nose position (in a prop aircraft)

Flap Failure

- If flaps fail to deploy, use a no-flap landing technique
- If flaps fail to retract (i.e. during a go-around) then smoothly add power while pitching for airspeed. If no retraction, fly pattern below Vfe and carry out an approach and landing for that specific flap configuration.
- If a split flap occurs during extension then discontinue any further flap selection and consider retracting the flaps (refer to POH). If the split flap condition persists, the net effect is the same as depressing an aileron, which could lead to an over-banked attitude, aggravated stall or spin if uncorrected. The aircraft will roll away from low flap but yaw towards it. If the split flap leads to an uncontrollable roll, use the **Push-Power-Rudder-Roll-Climb** technique and counter the roll and yaw with aileron and rudder. The pilot must be willing to sacrifice altitude in order to gain airspeed for better aileron/rudder effectiveness. Once under control, climb and carry out a controllability check at a safe altitude. Consider increasing approach speed to the flapless approach speeds or even faster, if the uncoordinated flight condition is considerable.

COMMON ERRORS

- Failing to unload (push) the aircraft while trying to regain control because of an instinctual unwillingness to lose altitude.
- Failing to vary airspeed for greater flight control effectiveness.
- Failing to add power to maintain or increase airspeed.
- Failing to adjust nose attitude to stop altitude loss once aircraft is under control.

EXERCISE #21: INCIPIENT SPIN RECOVERIES

OBJECTIVE

Recognize aerodynamic factors developing in an incipient spin and take appropriate actions to effectively recover in a timely manner to avert a develop spin.

WHY?

Spins can be entered from any flight regime and any flight attitude. Being aware of and recognizing the control inputs required to enter a spin will help you avoid inadvertent spin entry parameters. It is important to understand the different phases of a stall leading to a spin in order to apply proper recovery control inputs. In this exercise, we concentrate on the ability to stop the spin in the incipient phase before it fully develops.

WHAT IS IT?

An incipient spin is the result of an uncoordinated (aggravated) stall, with each wing having a different amount of lift and drag yet both beyond the critical angle of attack. It is a maneuver in which the aircraft starts its departure from upright flight and seeks an ever-increasing decent angle along a tight, helical flight path while at stalled angles of attack. You will recover in the incipient phase (less than one rotation).

KNOWLEDGE TEST

- ✈ What are the stages of a spin?
- ✈ Is an incipient spin more like a stall or a spin? Why?
- ✈ What type of recovery (stall or spin recovery) do we use in the incipient spin phase?
- ✈ If we don't know what recovery to use but the stalled flight condition is generating significant yawing and rolling, which recovery should we select?
- ✈ What are the two aerodynamic factors required for an aircraft to spin?
- ✈ During an incipient spin, what is the "Rule of Thumb" for deciding which recovery procedure (stall or spin) to use?
- ✈ Will a NASA Standard Spin Recovery (P.A.R.E.) effectively work in an incipient spin?

HOW - PSSA

- Most entries will be from the slipping turn stalls or skidded turn stalls (see Exercise #11 & 12 for entry parameters).
  - Additional Spin Entries:
    - Power-off descent
    - Climbing maneuvers with and without turns
    - High ‘G’ flight conditions
    - Power-on entries
- When the aircraft stalls, the instructor will help you hold the pro-spin controls. This simulates “freezing” on the controls after the stall.
- After the aircraft rolls ½ to ¾ of a revolution (incipient spin), the instructor will have you initiate the recovery (see below).

RECOVERY **Stall Recovery** (See Exercise #5)

- **Push**
- **Power***
- **Rudder**
- **Roll**
- **Climb**

* Power selection considerations will be discussed during ground training

COMMON ERRORS

- Not moving the elevator far enough forward in the “Push” step.
- Failing to neutralize the ailerons during the “Push” step.
- Failing to properly apply opposite rudder if the aircraft is still rolling during the “Rudder” step.
- Doing “rolling pulls” during the “Roll” step.

EMERGENCY MANEUVER TRAINING

EXERCISE #22: FULLY-DEVELOPED SPIN RECOVERIES

OBJECTIVE

Build confidence by performing multiple rotation spins, spin recoveries procedures and safely recovering the aircraft. Practice procedural discipline and develop all-attitude awareness.

WHY?

Statistically, 28% of stall/spin accidents are fatal. Since the knowledge and skill of the pilot should always match the airplane, the ability to properly recognize and avoid a spin, while appreciating how a spin develops, will make any pilot a safer pilot. The ability to recover from a fully developed spin is a critically important awareness exercise to the overall stall/spin education process.

WHAT IS IT?

A spin is the result of a prolonged uncoordinated stall, with each stalled wing having a different amount of lift and drag (negative roll damping) while being subjected to continuous yaw. It is a maneuver in which the aircraft descends vertically along a tight, helical flight path while at stalled angles of attack.

KNOWLEDGE TEST

- What are the stages of a spin?
- What are the two aerodynamic factors required for an aircraft to spin?
- What are three methods to determine which recovery rudder to use?
- How should you hold your head and where should you look during a spin recovery?
- Is negative roll damping a driving force in an aircraft spin?
- Should we ever push the elevator BEFORE applying opposite rudder?
- Canceling yaw is top priority in a spin recovery. (True or False)
- Will the aircraft be pointing close to straight down (vertical) after the spin rotation has been stopped from a 3-turn spin?

HOW

- PSSA

- Most upright spin entries will be from a power-off stall (see exercise #5). Just prior to the stall (65-70 kts), push and hold full left or right rudder immediately followed by full aft stick.
- Hold these full control deflection inputs for the entire duration of desired number of turns until recovery is initiated by the instructor stating “Recover”.

- Typical altitude loss is about 350 - 500 feet per turn in the Extra 300L and most small general aviation aircraft.
- Note instrument indications.
- At the direction of the instructor, recover using the NASA Standard Spin Recovery procedure below (P.A.R.E.)

Additional Spin Entries:

- Skidded turn
- Slipping turn or straight ahead slipping stalls
- Power-off descent
- Climbing maneuvers with and without turns
- High 'G' flight conditions
- Power-on entries

RECOVERY **<u>NASA Standard Spin Recovery: P.A.R.E. Recovery</u>**

- **"Power" –** Reduce power to idle.
- **"Ailerons" –** Neutralize the ailerons (select flaps up). Do not allow ailerons to be deflected in either direction.
- **"Rudder" –** Determine the direction of the spin and then push <u>full</u> rudder opposite the rotation of the spin and hold until rotation stops.
- **"Elevator" –** Immediately following the completion of pushing full opposite rudder to full control deflection, push the elevator through neutral. Some aircraft may required full-forward elevator to effectively reduce angle of attack sufficiently to recover from an upright spin.

Hold these inputs until rotation stops, then immediately:

- **"Rudder"** – Neutralize the rudder (very important, holding opposite rudder deflected during recovery increases the risk of entering a spin in the opposite direction.
- **"Elevator" –** Since the nose is now pointing straight down, airspeed will build rapidly. Smoothly but aggressively pull right to the prebriefed G-load to effectively bring the nose back to the horizon.

Note: While recovering from the dive, any disorientation and sensation of continued spinning can be reduced by fixing your eyes on an external reference point (i.e. horizon). Ensure you establish visual dominance in the recovery while suppressing vestibular illusions.

COMMON ERRORS

- Not holding full rudder and elevator deflection until recovery is initiated.
- Moving the elevator inappropriately while neutralizing the ailerons.
- Failing to push enough forward elevator during the first "Elevator" step.
- Failing to apply *full* opposite rudder during the first "Rudder" step.
- Failing to neutralize the rudder after spin rotation stops.

EMERGENCY MANEUVER TRAINING

EXERCISE #23: AGGRAVATED & INVERTED SPIN MODES

(FLAT / STEEP / ACCELERATED / INVERTED)

OBJECTIVE Introduce aggravated spin modes and understand the associated control inputs affecting them.

WHY? Otherwise recoverable aircraft can quickly become unrecoverable if inappropriate power and/or flight control inputs are applied during spin recovery. You will experience how various *inappropriate* control inputs will aggravate a spin. Maximizing the probability of recovery certainly hinges on applying *appropriate* recovery inputs in the proper sequence.

WHAT IS IT? An aggravated spin is a spin that deepens or becomes more difficult to recover due to inappropriate power and/or flight control inputs contrary to the NASA Standard Spin Recovery procedure.

KNOWLEDGE TEST

- ✈ In general, will increased power help or hinder spin recovery?
- ✈ Can inappropriate aileron input cause an increased spin rotation? How about premature elevator application?
- ✈ Should we ever push the elevator BEFORE applying opposite rudder?
- ✈ If we apply the incorrect recovery rudder for the P.A.R.E., what should we do?
- ✈ Is an inverted spin much more disorienting than an upright spin?
- ✈ How should you hold your head and where should you look if in an inverted spin? What's different about the recovery, if anything?

HOW - PSSA

- ✈ Most spin entries will be from a power-off stall (see exercise #5); however, the instructor will demonstrate numerous possible ways of entering an aggravated or inverted spin.
- ✈ Once in the spin, the instructor will demonstrate numerous control inputs that will aggravate the spin.
- ✈ Typical altitude loss is about 350 - 500 feet per turn in the Extra 300L.
- ✈ Note instrument indications.
- ✈ At the direction of the instructor, recover using the procedure below (P.A.R.E.)

Demonstrations

- Power Effect – Right Spin, add throttle – note the change as the spin becomes faster / steeper. In a left spin, add power and note how the spin flattens.
- Aileron Effect – add in-spin aileron – note the change as spin becomes faster, more nose low with more roll
- Add out-spin aileron – note the reduced roll component and accelerated yaw component
- Elevator Effect – add forward elevator with and without aileron – note changes as spin becomes faster, flatter or steeper

RECOVERY

NASA Standard Spin Recovery: P.A.R.E. Recovery

"Power" – Reduce power to idle.

"Ailerons" – Neutralize the ailerons (select flaps up). Do not allow ailerons to be deflected in either direction.

"Rudder" – Determine direction of the spin and then push full rudder opposite the rotation of the spin and hold until rotation stops.

"Elevator" – Immediately following the completion of pushing full opposite rudder to full control deflection, then:

UPRIGHT SPIN: Push elevator *forward* through neutral

INVERTED SPIN: Pull elevator *aft* through neutral

Some aircraft may required full elevator deflection to effectively reduce angle of attack sufficiently to recover (if recoverable).

Hold these inputs until rotation stops, then immediately:

"Rudder" – Neutralize the rudder (very important, holding opposite rudder deflected during recovery increases the risk of entering a spin in the opposite direction.

"Elevator" – Since the nose is now pointing straight down (true whether recovering from an upright or inverted spin), airspeed will build rapidly. Smoothly but aggressively pull to the prebriefed G-load to effectively bring the nose back to the horizon.

Note: While recovering from the dive, any disorientation and sensation of continued spinning can be reduced by fixing your eyes on an external reference point (i.e. horizon). Ensure you establish visual dominance in the recovery while suppressing vestibular illusions.

COMMON ERRORS

- Mental freezing on the controls. Pilot must force proper recovery action by mechanically implementing the recovery using the Say & Do technique.
- Failing to push enough forward elevator (upright spin) or pull enough aft elevator (inverted spin) during the first "Elevator" step.
- During an inverted spin, looking up. (This can be disorienting)

EMERGENCY MANEUVER TRAINING

EXERCISE #24: INADVERTENT SPIN RECOVERIES

OBJECTIVE Recognize and recover from spins entered from stalled unusual attitudes commonly referred to as "botched maneuvers".

WHY? The unusual attitude and stall recovery demands timely and appropriate control inputs in order to affect a safe and efficient recovery. If, however, late or inappropriate control inputs are made, an inadvertent spin is possible.

WHAT IS IT? A spin may be entered in many varied ways; all of which have common contributing factors. A spin entry requires continuous stall and continuous yaw. Any failed unusual attitude or stall recovery that results in the aircraft remaining in an aggravated (yaw) stall condition will drive the aircraft through the incipient spin phase and into the fully developed spin phase.

KNOWLEDGE TEST

- What are the two aerodynamic requirements to spin an aircraft?
- Is it possible to stall an aircraft from an unusual attitude?
- Is it possible to stall an aircraft while inverted?
- Is it possible to enter another spin while recovering from a spin?
- If a spin is entered from an unusual attitude stall, is it possible that the spin will be aggravated (i.e. flat, accelerated, inverted)

HOW **-** PSSA

- The instructor will place the aircraft into a spin from an extreme flight condition and call "Recover"
- The student will call out each input as he/she recovers the aircraft

Suggested Unusual Attitude Entries:

- Left climbing turn, right spin (over-the-top) at 70 kts.
- Loop, left spin as nose passes through horizon on the back
- Left turn at 80-90, right snap roll
- Immelman via left roll, into spin immediately

- ✈ Left hammerhead to upright flat spin
- ✈ Right hammerhead to inverted flat spin

RECOVERY **<u>NASA Standard Spin Recovery: P.A.R.E. Recovery</u>**

"Power" – Reduce power to idle.

"Ailerons" – Neutralize the ailerons (select flaps up). Do not allow ailerons to be deflected in either direction.

"Rudder" – Determine direction of the spin and then push <u>full</u> rudder opposite the rotation of the spin and hold until rotation stops.

"Elevator" – Immediately following the completion of pushing full opposite rudder to full control deflection, then:

UPRIGHT SPIN: Push elevator <u>*forward*</u> through neutral

INVERTED SPIN: Pull elevator <u>*aft*</u> through neutral

Some aircraft may required full elevator deflection to effectively reduce angle of attack sufficiently to recover.

Hold these inputs until rotation stops, then immediately:

"Rudder" – Neutralize the rudder (very important, holding opposite rudder deflected during recovery increases the risk of entering a spin in the opposite direction).

"Elevator" – Since the nose is now pointing straight down (whether recovering from a developed upright or inverted spin), airspeed will build rapidly. Smoothly but aggressively pull to the prebriefed G-load to effectively bring the nose back to the horizon.

<u>Note</u>: While recovering from the dive, any disorientation and sensation of continued spinning can be reduced by fixing your eyes on an external reference point (i.e. horizon). Ensure you establish visual dominance in the recovery while suppressing vestibular illusions.

COMMON ERRORS

- ✈ Rapid "flailing" of the controls in a panic attempt to maintain/regain control of the aircraft. Commonly this only aggravates spin entry and significantly delays recovery
- ✈ Mental freezing on the controls. Pilot must force proper recovery action by mechanically implementing the Say & Do technique.

CHAPTER 6: NOTES

Upset Recovery Training: Mission 1 (URT 1 or QUAL 1)

