Tango Whiskey
AEROBATICS

UPRT TRAINING

2024 REV 2

FLIGHT TRAINING

Welcome to Tango Whiskey UPRT,

Our Ops team has spent significant time in setting up a world class syllabus that will allow you to experience first hand recovery techniques in an actual aircraft outside of the flight simulator world.

Our Upset Prevention and Recovery Training (UPRT) provides physiological exposure geared toward upset prevention and recovery which creates a frame of reference that can be transferred to your flight operation environment.

The practical and application of skills acquired during our in-airplane **UPRT** provides experience and confidence that cannot be fully acquired in the simulated environment alone.

This is course can be used by transport category, corporate jet and GA pilots alike. Multi-crew fundamentals will be discussed if you operate in that arena.

While there are 4 flight lessons scheduled in this program we can tailor specific packages and curriculum to you based on experience.

We have selected the Extra 300L for our program, the Extra offers a comfortable training environment that mimics high performance aircraft that many of our clients operate. The course is also available in our Pitts S2B.

We hope you enjoy our program as you gain a new skill set of tools for your professional or recreational flying.

Fly Safe,

Ruben Alconero

What is UPRT Training

UPRT is an abbreviated form of the terms Upset Prevention and Recovery Training. To achieve a better understanding of the subject, it is necessary to learn the phrases Upset Prevention and Upset Recovery.

Upset Recovery is the process of rescuing an aircraft from an unsafe situation, whereas Upset Prevention is the process of preventing the aircraft from an abnormal situation. In short, UPRT training refers to all of the theoretical and practical training that a flight crew obtains in order to provide them with the abilities they need to recover from situations in which the aircraft inadvertently exceeds safety parameters while in flight.

The Background for upset prevention and recovery training (UPRT)

Let us introduce a acronym. Loss of control in flight (LOC-I). LOC-I is the single largest cause of commercial aircraft accidents and fatalities.

Two accidents involving LOC-I that you may be familiar with are;

*Colgan Air Flight 3407 - Summary and discussion (appendix A)
*Air France 447 - Summary and discussion (appendix B)

An extensive ICAO/LATA report looked at 64 accidents involving LOC-I between 2009 and 2018. 94% of LOC-I involved fatalities to passengers and/ or flight crew. UPRT was established to be a mitigation tool against LOC-I.

Tango Whiskey UPRT Mission

The aim of our training program is to:

- Acquire the knowledge to recognize and avoid upset situations
- Learn to take appropriate and timely measures to prevent further divergence
- Understand basic airplane aerodynamics
- Learn airplane maneuvering techniques throughout the airplane operational flight envelope to perform recoveries from upsets.

What is an Upset

An airplane upset is an undesired airplane state characterized by unintentional divergences from parameters normally experienced during operations.

An airplane upset may involve pitch and/or bank angle divergences as well as inappropriate airspeeds for the conditions.

I. 7 Take Aways to UPRT

1. Reduce Angle of Attack (AOA):

• To recover from a stall, angle of attack must be reduced below the stalling angle—apply nose down pitch control and maintain it until stall recovery. If the angle of attack is greater than the stall angle, the surface will stall. Regardless

of the airspeed or pitch attitude of the airplane, the angle of attack determines whether the wing is stalled.
* A stall is an out-of control condition but is recoverable.
* A stall is characterized by any, or a combination of the following:
* Buffeting, which could be heavy at times.
* Decreased pitch authority.
* Decreased roll control.
* Inability to arrest descent rate.

2. Avoid Inappropriate Rudder Use

Transport pilots should be aware that certain prior experience or training in military, or GA, or other non-transport aircraft that emphasizes use of rudder as a means to maneuver in roll typically does not apply to transport aircraft or operations.

A rudder input is never the preferred initial response for events such as wake vortex encounter, or to reduce the bank angle preceding an imminent stall recovery.

The rudder can induce very rapid roll rates with significant time delay

The combination of rapid roll rates and time delay can startle, which can lead to rudder reversals. Large rudder reversals can lead to loads that exceed structural design limits.

3. Stall May Not Include an Un-commanded Nose Down Pitch

At extremely low airspeeds, with small aerodynamic forces acting on the airplane, and gravity still pulling towards the earth, the trajectory will be largely ballistic.

An un-commanded nose down pitch is not included as a stall characteristic for transport aircraft.

4. Avoid Flight Slower than L/D Max

At all times, pilots must ensure that flight slower than L/D Max (speed instability) is avoided in the high altitude environment.

When operating slower than L/D Max and where total drag exceeds total thrust, the airplane will be unable to maintain altitude and the only remaining option to exit the slow flight regime is to initiate a descent.

5. Aircraft are More Control Sensitive at Higher Altitudes and True Airspeeds

During high altitude maneuvering, it is imperative to not overreact with large and drastic inputs. It will take less force to generate the same load factor as altitude increases.

6. Thrust Available is Reduced as Altitude is Increased

In the high altitude environment, available thrust is significantly less that at lower altitudes. Conversely, a nose down pitch attitude contributes to the thrust on a magnitude of 3 times the available thrust due to gravity.

Pilots need to be careful of large pitch attitude changes during recovery.

The elevator is the primary pitch control in all flight conditions, not thrust in reducing angle of attack.

7. Timely and Correct Recognition is Vital to the Recovery from an Upset

*Recognize and confirm the situation.
*If the airplane is stalled it is first necessary to recover from the stall.
*Disconnect autopilot and auto-throttle. **if aircraft equipped*
*Gain control of the airplane.
*Determine and eliminate the cause of the upset.

II. Monitoring- One of a Pilots Best Countermeasures

Industry experts believe that flight crew engagement combats complacency through active monitoring. Therefore, active monitoring is the critical element to ensure awareness and avoidance of undesired airplane states and provides the strongest countermeasure against startle. An engaged crew is in the best position to cope with undesired airplane states.

Human Factors experts have defined active monitoring as follows:

"Active monitoring is a proactive knowledge-driven process of encountering and keeping track of how things are in relation to the perceiver and his expectations to enable the perceiver to take meaningful action. Active monitoring involves proactively seeking relevant information, making important information available, filtering information that is meaningless, creating new information, and off-loading cognitive processing onto the interface or adapting the interface to support monitoring".

Each pilot should:

- Know and understand the expected airplane state for the situation
- Communicate expectations. (Multi-Crew)
- Keep track of current airplane state
- Detect and communicate deviations from expectations (Multi-Crew)
- Assess risk and decide on a response
- Update and communicate understanding
- Take timely corrective actions

III. Causes Of Airplane Upsets

An airplane upset is not a common occurrence. There are a variety of reasons why upsets occur, including:

- Environmentally-induced- Turbulence, Mountain waves, Windshear, Microbursts, Icing, CAT, Thunderstorms
- Systems-induced - flight instruments, auto flight systems, flight controls
- Pilot-induced- Inattention, complacency, distractions, fatigue, spatial disorientation, vertigo, incapacitation, misuse of automation PIOs

IV. Flight Fundamentals

CONTROLS

Control inputs appropriate at one point in the flight envelope might not be appropriate in another part of the flight envelope.
Pilots must have a fundamental understanding of flight dynamics in order to correctly determine the control input(s) necessary.

ENERGY STATES

A pilot has three sources of energy available to manage or manipulate the flight path of an airplane.

The term "energy state" describes how much of each kind of energy the airplane has available at any given time.

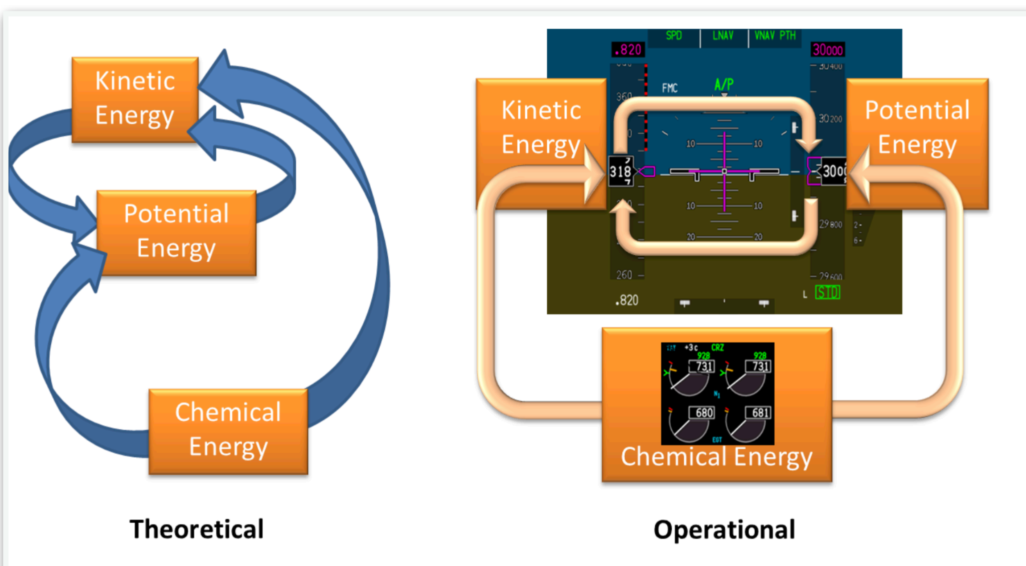
Pilots who understand the airplane energy state will be in a position to know instantly what options they may have to maneuver their airplane and therefore manage the trajectory.

The three sources of energy are:

- Kinetic energy, which increases with increasing airspeed.
- Potential energy, which is proportional to altitude.
- Chemical energy, from the fuel in the tanks which can be converted to thrust.

These three types of energy can be traded, or exchanged:

- Airspeed can be traded for altitude (kinetic to potential energy)
- Altitude can be traded for airspeed (potential to kinetic energy)
- Thrust can be converted into airspeed and/or altitude (chemical to either kinetic or potential energy)



Kinetic energy needs to be replenished (from potential or chemical energy), as it is continuously expended in the process of generating the aerodynamic forces acting on the airplane which result in controlled flight (lift and drag).

This process of consciously controlling the energy state of the airplane is referred to as "energy management".

The trading of energy must be accomplished with a view toward the final required energy state.

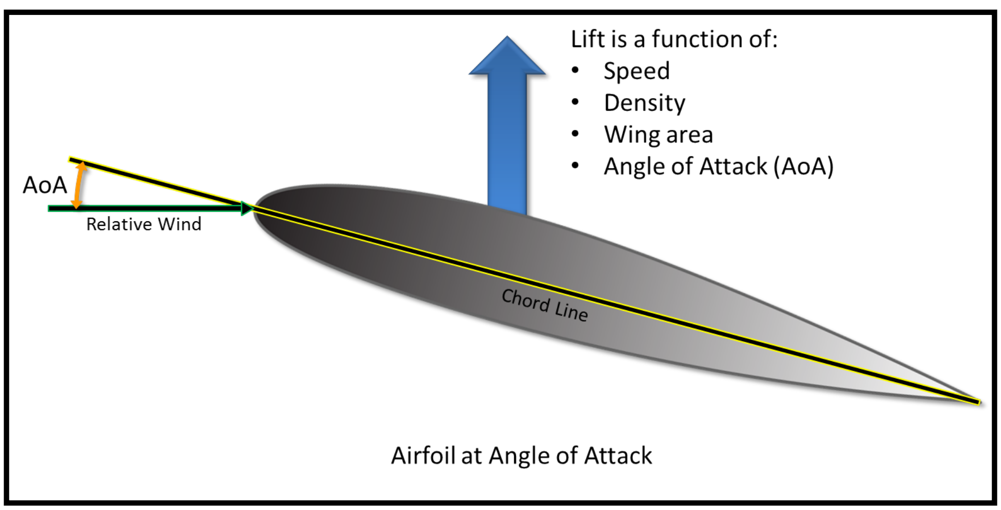
AERODYNAMICS

Aside from gravity and thrust forces, the other forces acting on an airplane are generated as a result of the changing pressures produced on the surfaces that result in turn from the air flowing over them.

Angle of Attack and Stall

Most force-generating surfaces on modern transport category airplanes are carefully tailored to generate lifting forces efficiently.

Wings and tail surfaces all produce lift forces in the same way. The figure below shows a cross section of a lifting surface and the familiar definition of angle of attack versus lift.



Airfoil at Angle of Attack

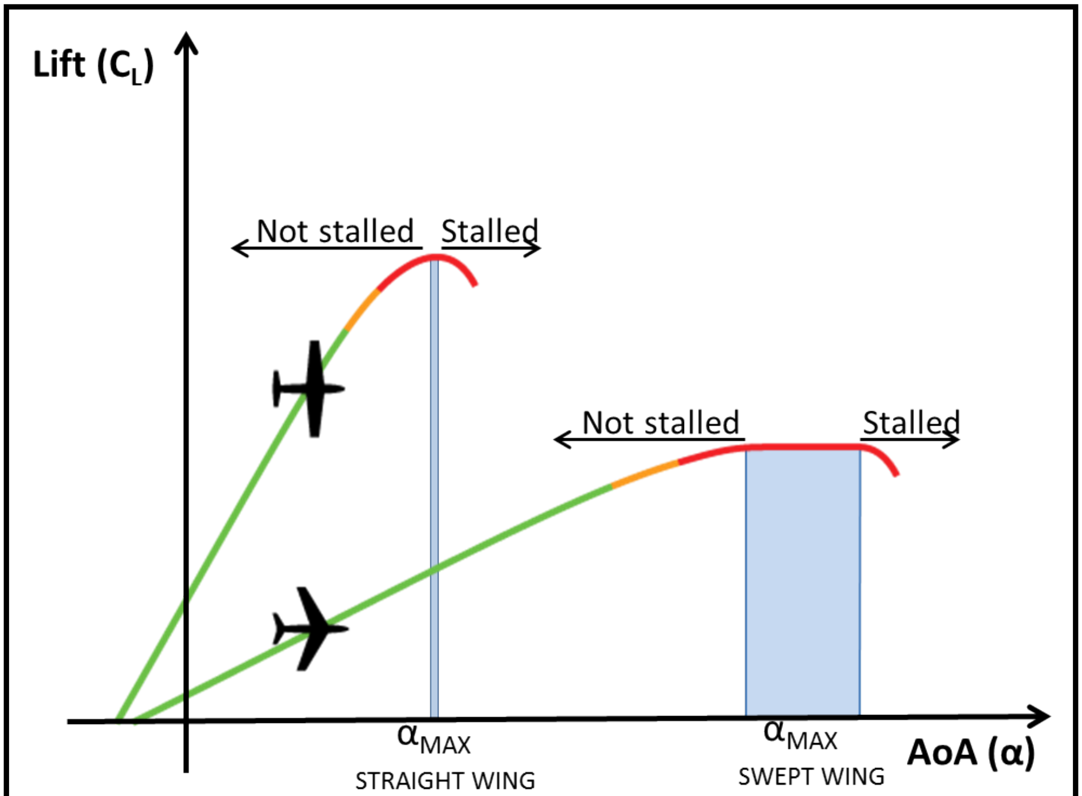
As angle of attack is increased, lift increases proportionally and this increase in lift is generally linear up to a point.

At the critical angle of attack, the air moving over the upper surface can no longer remain attached to the surface, the flow breaks down and the surface is considered stalled.

Wing shape influences the lift curve slope as illustrated in the figure below by the coefficient of lift C_L. The steepness of the slope affects the rate at which lift changes due to angle of attack. Straight wing and swept wings behave differently at higher angles of attack in turn affecting stall behavior.

For a straight wing, small differences in angle of attack produce notable changes in lift and potentially a quicker stall recovery when the angle of attack is reduced.

Swept wings stall at higher angles of attack and the stall (g break) may not be so well defined.



Straight / Swept Wing

V. RECOVERY FROM AIRPLANE UPSETS

There is an infinite number of situations that pilots can experience while flying an airplane.

The techniques that are presented in this section are applicable for most situations.

It must be emphasized that the degree of upset will define how prompt or aggressive the required control inputs will be to recover from the event.

In all cases the pilot response to an upset must be appropriate to arrest and recover the condition.

Up to full-scale control deflections may be necessary. However, initiating recovery with arbitrary full-scale control deflections could actually aggravate the situation.

An excessive or inappropriate control input that overshoots the desired response can startle the pilot and cause one upset to lead to another.

An overview of actions to recover from an upset would encompass three basic activities:

1. **Assess the energy (become situationally aware)**
2. **Arrest the flight path divergence**
3. **Recover to a stabilized flight path**

These three activities must be part of every recovery from an upset.

SITUATIONAL AWARENESS OF AN AIRPLANE UPSET

A pilot actively monitoring is an engaged pilot who has a wealth of information available to them in modern cockpits. Consequently, they are more situationally aware than all previous generations of pilots.

An engaged pilot will be ready to intercept an unintentional airplane divergence which is the overwhelming goal: avoid an upset from developing in the first place.

The first actions for recovering from an airplane upset must be correct and timely.

It is very important for the crew to realize the differences in airplane handling at high altitude, versus low altitude (less thrust/power available and more sensitive flight controls).

Managing startle is imperative all the time, but particularly in high altitude conditions where the pilot has the least amount of hands on experience to manipulate the airplane.

The key point is to use gentle control inputs and not arbitrary open loop inputs.

Exaggerated control inputs through reflex responses must be avoided.

An excessive or inappropriate control input that overshoots the desired response can startle the pilot and cause one upset to lead to another.

Startle Factor

It has already been stated that airplane upsets do not occur very often and that there are multiple causes for these unpredictable events.

An engaged pilot will be ready to intercept an unintentional airplane divergence which is the overwhelming goal to avoid an undesired airplane state from developing in the first place.

Unexpected low airspeed, stall warnings, buffeting and large changes in airplane attitude (design dependent) when the airplane is on autopilot can startle an un-engaged flight crew.

Pilots are usually surprised or startled when a dynamic upset does occur, even if they are engaged through actively monitoring, but they will be better situationally aware to adapt to the situation.

An un-engaged pilot will need to regain situational awareness in order to identify the situation. Only an engaged (and therefore situationally aware) pilot/crew can effectively recover from an upset.

The pilot must overcome the surprise and quickly shift into analysis of what the airplane is doing and then implement the proper recovery.

Pilots must avoid reacting before analyzing what is happening and avoid fixating on one indication instead of diagnosing the situation.

Effective training and crew engagement (active monitoring) during all cockpit activity is the best insurance to deal with startle factor.

TROUBLE SHOOTING THE CAUSE OF THE UPSET IS SECONDARY TO INITIATING RECOVERY AND REGAINING CONTROL OF THE AIRCRAFT.

NOSE HIGH RECOMMENDATION

PITCH
THRUST
ROLL
RECOVER TO LEVEL FLIGHT

NOSE LOW RECOMMENDATION

RECOVER FROM STALL (IF REQUIRED)
ROLL
THRUST and DRAG
RECOVER TO LEVEL FLIGHT

Stall Review

Regardless of attitude, a wing can be stalled at any airspeed and altitude, if the critical angle of attack is exceeded. It is important to understand that at high speeds, although it is possible to stall the wing, the structural design limits could be exceeded well before the stall actually occurs.

Previously, pilots were improperly trained and evaluated to recover from an approach to stall with emphasis on minimum loss of altitude while "powering" out of the near-stalled condition.

The only way to recover from a stall is to reduce the Angle of Attack.

Regardless of how close the airplane is to the ground, it is impossible to recover from a stalled condition without reducing the angle of attack and that will certainly result in a loss of altitude.

Although the thrust or power may supplement the recovery, it is not the primary control.

At stall angles of attack, the drag is very high and excess thrust available to overcome this drag may be marginal.

If the engines are at idle, the engine acceleration could be very slow, thus extending the recovery.

At high altitudes, available thrust is reduced.

The elevator is the primary control to recover from a stalled condition because, without reducing the angle of attack, the airplane will remain in a stalled condition until ground impact, regardless of the altitude at which it started.

Stall recovery requires a deliberate and smooth reduction in angle of attack.

Thrust/power can supplement the recovery only after the angle of attack has been reduced below the critical angle of attack.

Although stall angle of attack is normally constant for a given configuration, at high altitudes swept wing airplanes will stall at a reduced angle of attack due to Mach effects.

The pitch attitude for recovery will also be significantly lower than what is experienced at lower altitudes.

Buffet will likely precede an impending stall on swept wing airplanes and may even occur before the activation of stall warning devices.

Recovery from the stall is the primary objective, and altitude loss must be accepted. Flight crews must exchange altitude for energy.

Unlike low altitude recovery from stall, at high altitude, considerable altitude will be lost.

If altitude recovery is attempted prematurely, a secondary stall will likely occur.

If landing gear and/or slats and flaps are already extended, it is important to not change the airplane configuration until the airplane vertical flight path has been brought back under control.

While it is routine to reduce the flap setting on a standard go around as a means of reducing airplane drag, in a high angle of attack situation, the increase in angle of attack that occurs as the flap transitions may place the airplane deeper into the stalled condition resulting a delayed recovery and increased loss of altitude.

In a similar fashion, selection of landing gear up results in a substantial increase in airplane drag for the period the landing gear doors are open on many airplane types. In a critical recovery situation, the increase in drag would result in a further unanticipated loss of airspeed.

Follow your OEM specific procedures for a stall event with respect to changing airplane configuration during the recovery back to normal flight conditions.

FLIGHT TRAINING COURSE OBJECTIVE

The objective of this course is to reduce the pilot-in-training's risk of a Loss of Control - Inflight. This course accomplishes the objective with one ground school and 4 flight lessons. The first three flight lessons focus on pilot physiological and psychological response, upset avoidance, and advanced aircraft control. This approach is designed to minimize motion sickness, reduce startle factor, and maximize the pilot-in- training's aircraft control and confidence. The last two lessons give the pilot-in-training the opportunity apply their skills and recover from the prior two lessons. ***While not a aerobatic course we will perform aerobatic maneuvers and you will find three of the most basic aerobatic maneuvers- the ROLL, LOOP, and IMMELMANN all demonstrate and incorporate recovery techniques in their design.***

Initial Discussion-

Aircraft limitations

Regulations

Training Areas

Airsickness mitigation Emergency / Safety Procedures

1. Empty pocket rule

2. Emergency upset recovery

3. Emergency release of controls

4. Aircraft emergency procedures (Engine out, fire, NORDO)

5. Parachute inspection, fit and use

6. Bail out procedures

7. G – LOC (AGSM) Anti-G Straining Maneuver

8. Positive exchange of control

FLIGHT LESSON 1

Skill building: G-awareness and Aircraft Control

OBJECTIVE: This lesson has two objectives:

A. Prepare the pilot-in-training for UPRT flight in the Extra 300L and provide aircraft familiarization including normal and emergency procedures.

B. Instruct the pilot in training to understand the relationship between g-loading and aircraft control. This lesson uses level and vertical turns (loops and barrel rolls) to introduce the concept of stalled and near stalled flight at varying airspeeds and reinforces the first step of upset recovery, reducing g-load (AOA).

-Level Turns

1. A-GSM (Anti-G Straining Maneuver)

2. Steep turns ≥ 65° angle of bank, ≥ 2.5g

3. Accelerated Stalls ≥ 3.5g

4. (Loop and Barrel Roll)

5.. Energy management

6. Inverted positive g-loading

7. Inverted positive AOA vs negative and 0° AOA

8. Wings level, upright and inverted, near stalled flight

FLIGHT LESSON 2

Skill Building: High Bank and Inverted Flight

I. OBJECTIVE: After reducing the AOA / g loading, rolling the aircraft about the lateral axis is the second step to upset recovery. The objective of this lesson is to:

Provide the pilot-in-training the opportunity roll the aircraft about the longitudinal axis to upright flight from high bank angles including inverted and vertical flight.

Experience repetitive inverted flight scenarios with varying energy states allowing the pilot-in-training to gain a higher level of comfort with high bank angles and inverted flight. The pilot-in-training will control the aircraft while inverted with positive, negative, and neutral g-loading and learn how to transition from one to the other. The pilot-in-training will assess the attitude and energy state of the aircraft prior to making the appropriate and timely control inputs required to roll the aircraft upright.

Content- Loop / Aileron Roll / Hammerhead

-Skidding Stalls

* Incipient Spin Recovery

* Intentional Spin Recovery

- Wing unloading

1. Aileron Roll (0g roll)

2. Aileron Roll High Speed

3. Aileron Roll Low Speed

4. 2 Point roll hold in inverted

5. Loop

6. Hammer Head

FLIGHT LESSON 3

Skill Building: Combined g-awareness, roll control, and vertical line

OBJECTIVE: The objective of this lesson is for the pilot in training practice the skills attained in prior lessons and perform advanced maneuvers that require precise load, roll, pitch, and yaw control. These maneuvers are the final preparation for upset training. During these maneuvers the pilot in training will have to understand the energy state of the aircraft in all attitudes and make proper inputs in all axes to complete the maneuvers without departing controlled flight.

CONTENT – Immelmann / Cuban 8/ Split S

-Immelmann

-Half Cuban Eight

-Split-S

-Stall and Incipient Spin Recovery

-Other maneuvers that have been performed in the prior lessons that would like be repeated

FLIGHT LESSON 4

Upset recovery: Visual reference

OBJECTIVE: During this flight lesson, the instructor will place the aircraft into upset attitudes from which recovery is necessary. The pilot will be required to immediately recognize and recover from any upset attitude using control techniques introduced in previous lessons.

1. Recognition of pending upset and upset

• Airplane – specific examples of instrumentation/ visual cues during developing and developed upset.

• Effective scanning (effective monitoring) **Discussion** for Jets, GA, EFIS, Non-EFIS

2. Upset prevention and recovery techniques

• Timely and appropriate intervention

• Nose high/ wings level recovery

• Nose low/ wings level recovery

• High bank angle recovery (including inverted)

• Nose high/ high speed

• Nose high/ low speed

• Nose low/ high speed

Course and Document References -

*A practical guide for improving flight path monitoring

https://flightsafety.org/files/flightpath/EPMG.pdf

*Airplane Upset Prevention and Recovery Training Aid (3rd Edition)

https://www.icao.int/safety/loci/auprta/index.html

* FAA AC 120-111, April 14,2015 - Upset Prevention and Recovery Training

https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentid/1027328