Upsetting

By John Morris

Some articles are worth repeating and some require updating. This one falls into a little of both types of previous articles written by myself and other contributors to POPA. It is a subject that should be constantly reviewed for the continuous safe operations of the PC12 and for all aircraft operators.

Past accidents involving Air Carrier Operations have caused Federal agencies to (again) require upset training due to apparent pilot inability to recognize and recover from an upset event -Loss of Control-Inflight (LOC-I). To be fair, airlines (US) to be specific, are operating with a near perfect safety record. But this issue is just part of a growing concern regarding systems automation and how it may be affecting the pilot's ability to actually fly the airplane. Reliance on instrument and crew redundancy may also be causing pilots to not think about basic fundamentals of aerodynamics and the causal effects during an upset event requiring the pilot(s), to interpret ALL the instruments, in a timely manner, to make corrective actions.

This is not just an airline industry problem. The general aviation (GA) community has experienced LOC-I events at a much greater frequency, including the PC12. And under very similar circumstances.

The FAA earlier this year issued drafts of (updated) Advisory Circular (AC) 120-109A, Stall Prevention and Recovery and Advisory Circular (AC) 120-UPRT, Upset Prevention and Recovery Training. The titles of these ACs explain their purpose and both are primarily intended for Part 121 Air Carriers but with the acknowledgement of its value for all aircraft instructors and operators. Already in circulation for GA is AC 61-67C change 1 (2007), Stall and Spin Awareness training, which addresses basically the same topics.

It could be assumed that GA pilots would be more attuned to the basic aerodynamic fundamentals than airline pilots. Why? Probably because GA aircraft are more often flown single-pilot with experience in lighter, slower, lower flying aircraft, requiring them to think more about basic flight fundamentals than when flying the big machines as part of a crew. This is also when kinesthesia (the sensing of changes in direction or speed of motion) is developed and assumed to be retained.

That may be have been true in the past but more and more GA aircraft are being equipped with digital instruments and avionics that rival the airlines, are going faster and can operate in the Flight Levels.

Simulator upset and in- aircraft upset (acrobatic) training is of course going to help with reviewing and refreshing recovery techniques but for how long? Unless the pilot maintains (acrobatic) proficiency concurrent with his or hers normal flight activities the "learned upset response curve" drops quickly after the upset training refresher.

What I believe needs to be accomplished by the pilot before, after or if never doing an "official" upset training course, is to maintain a mental proficiency regarding the basic fundamentals of aerodynamics

and what that relationship is related to the aircraft being flown. I really believe that the vast majority of pilots, once out of a formal flight training environment, forget or are very slow to remember the basics due to the inherent safety built into the aircraft being flown. From time to time LOC-I accidents happen during airline operations but more frequently during GA operations. And for lack of a better explanation, when this type of event occurs it often points to basic airmanship skills not being applied.

What are the basic aerodynamic fundamentals? Referring to AC 61-67C (condensing only for purposes of brevity), here are the following commonly used terms:

A. Stall/Spin terms and effects

1. Angle of Attack
2. Airspeed
3. Vso
4. Vs1
5. Va
6. Load Factor
7. Center of Gravity
8. Weight
9. Altitude and Temperature
10. Snow, Ice, Frost
11. Turbulence

B. Distractions

C. Wing contamination effect on Stall Warning, Stall Speed and Stall recovery

1. Autopilot masking effect

How many times have we heard the term “AoA”? It is THE key. Where I believe AoA begins to lose focus is with published Airspeeds. Some pilots incorrectly assume that maintaining at or above a published airspeed will keep the critical AoA from being reached. The same assumption of not reaching critical AoA is given based on pitch attitude with sufficient indicated airspeed. The fact is that critical AoA will always be based on relative wind to the reference line of the wing, along with relative wind being a function of airspeed and (pitch) attitude. In climbing, descending or straight/level flight, if the wind flow changes direction and the AoA does not follow, then the wing can/will stall. A sudden wind shift due to turbulence, wind shear, wing contamination (which can all occur inside weather systems) can cause part or all of the wing(s) to stall. Even light, uneven ice

accumulation that was not immediately shed with DeIce equipment can have a detrimental effect at low to mid altitudes.

Besides weather, what other factors can accelerate reaching critical AoA? Weight and aft Center of Gravity can have an effect due to the aircraft's natural critical AoA having been achieved at an earlier stage. Finally, reliance on autopilot's masking an approaching upset, and/or pilot induced distraction has been proven to cause LOC-I.

All of what has been currently discussed is about recognition and prevention, which of course is the optimal solution to not having a LOC-I.

But what about recovery from an upset? This is the area where, understandably, officials do not wish dwell. Everyone wants a positive outcome by prevention. But that is not the real world. I would like to think that no pilot intentionally wants to have an upset event but stuff happens!

This is part of the mental training that I am writing about. It has to do with aerodynamics and how, by understanding the basics, a pilot can make the correct decisions in a timely manner to correct the unanticipated upset. The remainder of this article will be focusing on PC12 operations.

I have been asking my clients for almost two years, through test questions with multiple choice answers, about how they would react to becoming inverted while in their PC12. The answers were to be in order of importance and have been somewhat consistent but not definitive. Almost all first responded that they needed to have more information. I thought being inverted was all the information needed! But that showed to me, even while in a ground school, there is hesitation to react, which is a major problem towards recovery from an LOC-I.

I choose inverted because of the engine torque and the likelihood of becoming inverted, or near inverted, as a result of an inadvertent stall while operating the engine at cruise power or greater. Almost all responded to power reduced to Idle as the first step. Absolutely critical since the engine torque, in this scenario, is the reason for turning inverted rapidly.

After reducing power to idle, the next two steps are where we all need as much understanding about aerodynamic forces as possible.

Pushing on the yoke, AKA reducing AoA was almost the unanimous answer, with the debate centering generally on which is first, Power or Push? Part of this particular discussion falls into the "what if I am not fully inverted" and that more information question.

I have had some clients make the comment "un-load the aircraft", specifically the wings regarding the first step. Load factor (definition): Ratio maximum load aircraft can sustain to the gross weight of the aircraft – measured as "G". Putting "G"' loads on a normal category aircraft is not what anyone wants to do but in an upset event that is probably what is going to happen, and rapidly, unless un-loaded. Va (re-emphasized in the current AC) has been long determined to be the maximum airspeed (based on aircraft gross weight) that full or abrupt control movements can be

applied to an aircraft without sustaining structural damage. Maintaining at or below Va when attempting to recover from inverted flight will be a tall order but hopefully we can be close.

Which is then the third step? Roll the aircraft (shortest direction) back towards the horizon. The question mark is because I have read several articles and have had discussions with acrobatic pilots who regard using Rudder as the third step. I believe it should be Aileron first due to the aileron/rudder interconnect already incorporating the rudder [zero flaps configuration /47 and /47E] and for the non- /47 aircraft due the already built in stability of the PC12. Rolling the aircraft back towards level with the horizon will reduce the G forces that will be induced while in a steep bank and simultaneously attempting to maintain altitude.

Put it all together and it appears to not be that difficult to recover, if inadvertently upset. Just pull Power to Idle, Push the yoke forward (initially) to reduce AoA and roll the aircraft towards horizon. Piece of cake!

Problem – startle effect causes a different reaction without thinking. Almost universally the first reaction is to Pull on the yoke. I have done it myself and I am supposed to know better! Startled because the AoA indication (if observing it) did not indicate an imminent stall, the Stick Pusher did not activate to protect. The AoA's are reference tools primarily used for prevention by indication. The Stick Pusher is designed not to react until both AoA's indicate together, for 3 seconds, that a stall exists from both AoA's. However the Stick Shaker may activate during the upset and then possibly the Stick Pusher, both as a result of the upset and possibly the initial pilot reaction of pulling back on the yoke.

The initial reaction, as difficult as it may seem, is to look at the situation first. A lot of action can happen in 3 seconds. Absolutely reduce Power to Idle, then whatever degree of inversion we should be initially pushing (at least lightly) while rolling the wings back towards the horizon [one of the best inventions for the attitude indicator is the Sky Pointer – where the sky pointer is pointing, go there!]. Once wings approaching level, if our head is actually level as well, we can apply pulling yoke pressure as well as power.

The mental training is really thinking about the "what if" and applying known information to convince yourself to do it right. Obviously it is better to never get into the upset scenario but like all things training, preparation and a healthy dose of ego checking will make us all safer.

"A safe pilot is always learning"

John Morris - ACFT Services

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