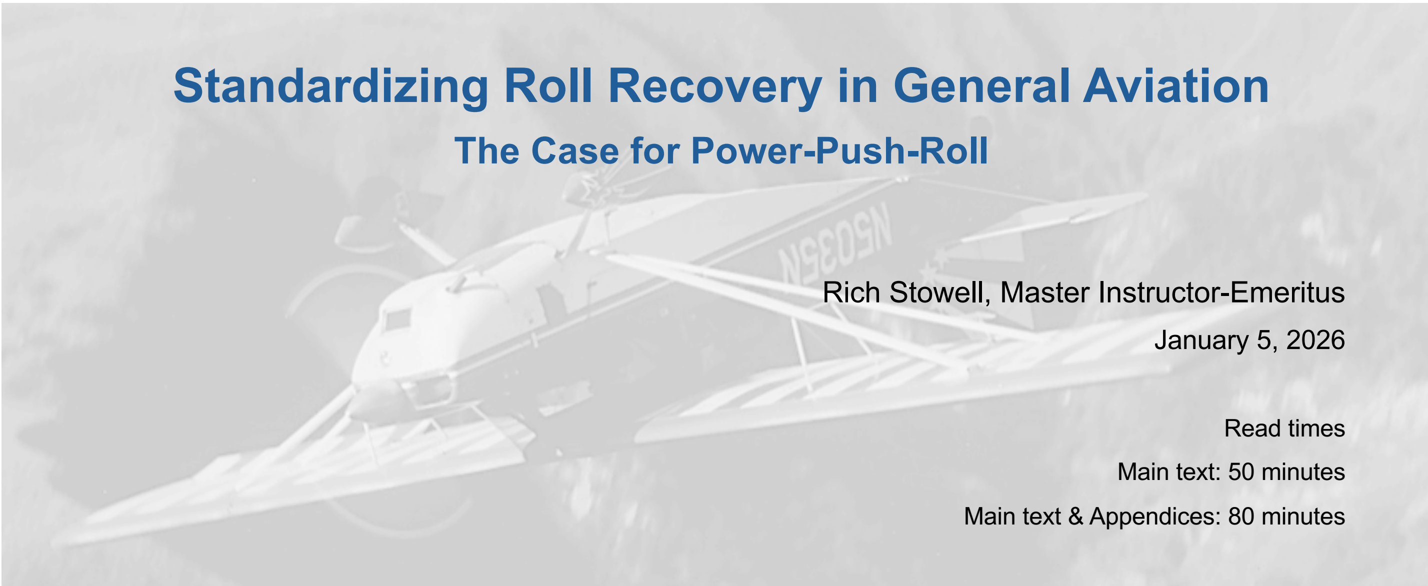

Standardizing Roll Recovery in General Aviation

The Case for Power-Push-Roll

Rich Stowell, Master Instructor-Emeritus

January 5, 2026

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Executive Summary

Problem: Lack of Standardization Undermines Safety

- Inflight loss of control (LOC-I) is the leading cause of fatal accidents in general aviation. Most end in a stall, spin, or spiral dive and are linked to deficiencies in manual flying skills. Known standards exist for stall and spin recovery, but no comparable standard exists for recovery from spiral dives and other roll upsets.
- Analysis of decades of guidance from aviation authorities, airplane manufacturers, and training providers reveals the extent of incomplete, conflicting, and inconsistent procedures. Further, the line between preventive and recovery actions is often blurred. These issues create confusion and unnecessary complexity for pilots, undermining safety.

Solution: Power-Push-Roll as the Standard

- This paper reviews the evolution of roll upset guidance and highlights key human factors. It clarifies the line separating developing upsets from developed upsets. It shows how startle, the instinct to pull, and weak mental models can delay or distort the pilot's response to a roll upset. It then proposes Power–Push–Roll as the standard roll upset recovery strategy for general aviation.
- Power–Push–Roll is consistent with the FAA principle that higher learning "starts with the broadest form of a procedure." The sequence is also consistent with "elegant conciseness," offering simple, memorable cues that optimize aerodynamic, airplane structural, and human performance realities.
- Power–Push–Roll builds on nearly four decades of successful use in *Emergency Maneuver Training* across diverse GA pilots and airplane types.

Actions: Proactive Stakeholder Involvement

Acting on these findings requires coordinated changes across policy, curriculum, and training. Stakeholders are encouraged to incorporate Power-Push-Roll into general aviation training materials, syllabi, and safety programs (see also Legal Notices).

Appendices A, E, and F are designed as ready-to-use material for improved guidance and lesson planning. Appendices A–D provide summarized roll recovery recommendations and historical source analysis.

The paper recommends that regulators, curriculum designers, and training organizations:

- Apply elegant conciseness principles when developing upset recovery guidance.
- Standardize roll upset recovery actions around Power–Push–Roll.
- Emphasize:
    - Manual flying skills and G-cueing throughout training;
    - Awareness and avoidance as the primary LOC-I mitigation strategies; and,
    - Initial and recurrent in-airplane training that develops the counterintuitive skills needed to recover from an upset.
- Align handbooks, training syllabi, and UPRT programs accordingly, including clearly differentiating between upset prevention and upset recovery.
- Teach pilots to abort substandard maneuvers before they become developed upsets.

Preface

The need to push to recover from a stall has been known since 1905. The NASA Standard spin recovery procedure has been around since 1936; the associated PARE mnemonic, since 1988. Yet no comparable standard exists for recovering from spiral dives and other unusual, banked attitudes. Some say general aviation should simply follow the airlines' lead.

My discomfort with applying airline roll upset procedures to general aviation is twofold. First, based on recommendations from the FAA, ICAO, and IATA, even the airline industry has not quite figured this out yet. Current recommendations lack standardization and are often overcomplicated. Second, the differences between airline and general aviation pilots, equipment, and operating environments are striking. Airlines focus on stall and roll upsets. Pilot error drives loss of control in general aviation, which usually ends in a stall, spin, or spiral dive.

Proper roll recovery boils down to three manual control actions: power, push, and roll. Guidance often overlooks the need to push. Most providers of upset prevention and recovery training understand why the push is needed, but they teach four different sequences. Such lack of standardization has always bothered me.

Hence, this paper takes an overdue deeper dive into recovery from roll upsets. The goal is to standardize and optimize recovery actions. I'm advocating for Power–Push–Roll as the standard mnemonic for roll recovery in general aviation.

Rich Stowell

Abstract

Eighty percent of inflight loss of control events involve pilot error. Most cases reflect inadequate training and delayed or incorrect pilot responses. Fear, fixation, and distraction often interfere with timely actions to avoid or recover from an upset. Thus, loss of control in general aviation often ends as a stall, spin, or spiral dive. Prevention and recovery skills are complex, perishable, and counterintuitive, requiring a commitment to recurrent upset training.

The FAA emphasizes teaching the broadest form of a procedure to reach higher levels of learning. Current practice conflicts with that principle by giving pilots several templates for the same type of upset. Multiple roll upset recovery templates create confusion and increase cognitive load. They also interfere with consistency during recurrency efforts with different training providers.

Recovery procedures for spiral dives and other roll upsets have evolved in a piecemeal way. Published guidance has gaps and contradictions and often fails to address human factors. Recommendations blur the line between awareness and avoidance of a developing upset and recovery from a developed one. Upset prevention and recovery training programs reinforce this ambiguity through divergent roll recovery strategies.

This paper examines these shortcomings and four common roll recovery strategies. It then proposes Power-Push-Roll as a standardized roll recovery strategy that is easy to retain, practical to use, and unambiguous. Power-Push-Roll also has a nearly 40-year track record of successful implementation across a diverse group of general aviation pilots and airplane types. Adopting it as the standard would reduce inconsistency among training providers.

General aviation stakeholders are encouraged to adopt Power-Push-Roll as the standard recovery strategy for roll upsets. They should continue to emphasize the importance of awareness and avoidance to mitigate inflight loss of control. They should also apply concise design principles when developing procedures and templates. As part of upset prevention, flight instructors should teach pilots how to abort substandard maneuvers before they become developed upsets.

Keywords: Power-Push-Roll; Roll Upset Recovery; Spiral Dive; LOC-I; UPRT; Human Factors; General Aviation

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Abbreviations

AAURS	APS All-Attitude Upset Recovery Strategy
ABS	American Bonanza Society
AOA	Angle of Attack
AOPA	Aircraft Owners and Pilots Association
APS	Aviation Performance Solutions
AUPRTA	Airplane Upset Prevention & Recovery Training Aid
BPPP	Beechcraft Pilot Proficiency Program
CAA	Civil Aeronautics Administration
CAA-NZ	Civil Aviation Authority-New Zealand
CASA	Civil Aviation Safety Authority (Australia)
CFR	Code of Federal Regulations
EAA	Experimental Aircraft Association
EASA	European Union Aviation Safety Agency
EMT	Emergency Maneuver Training
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FCI	Fighter Combat International
G	G-load, the ratio of Lift-to-Weight
GA	General Aviation
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
INTL	International
LOC-I	Loss of Control in-Flight
NACA	National Advisory Committee for Aeronautics
NAFI	National Association of Flight Instructors
NASA	National Aeronautics and Space Administration
PARE	Power-Aileron-Rudder-Elevator
SAFE	Society of Aviation and Flight Educators
TC	Transport Canada
UAS	Undesired Aircraft State
UPRT	Upset Prevention and Recovery Training

Definitions

From FAA Advisory Circular 120-111:[1]

Airplane Upset. An airplane in flight unintentionally exceeding the parameters normally experienced in line operations or training:

- Pitch attitude greater than 25 degrees nose up;
- Pitch attitude greater than 10 degrees nose down;
- Bank angle greater than 45 degrees; or
- Within the above parameters, but flying at airspeeds inappropriate for the conditions.[2]

Loss of Control in Flight (LOC-I). A categorization of an accident or incident resulting from a deviation from the intended flightpath.

Startle. An uncontrollable, automatic muscle reflex, raised heart rate, blood pressure, etc., elicited by exposure to a sudden, intense event that violates a pilot's expectations.

Surprise. An unexpected event that violates a pilot's expectations and can affect the mental processes used to respond to the event.

Undesired Aircraft State (UAS): A position, velocity, or attitude of an aircraft that reduces or eliminates safety margins.

From ICAO Document 10011:[3]

Developing Upset: Any time the aeroplane begins to unintentionally diverge from the intended flight path or airspeed.

Developed Upset: A condition meeting the definition of an aeroplane upset. "The need for counter-intuitive behaviour" is the distinguishing feature.

Other:

Procedure vs. Technique. A *procedure* is the broad action needed to accomplish a task. A *technique* is a method of accomplishing the task. If procedure is the *what* (e.g., "Power – off"), technique is the *how* (e.g., "pull the throttle all the way aft").[4]

Roll-off (a.k.a. wing drop). The inherent tendency for a wing to drop at the stall, especially during a wings-level stall. Significant roll-off can signal a departure into a spin or a spiral dive.

Roll upset. An unstalled unusual attitude characterized, if not driven by angle of bank. Though the recovery procedure might involve other actions, rolling is the main one. Examples include spiral dives and wake turbulence-induced rolls.

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[1] FAA, *Upset Prevention and Recovery Training*, 2–3. See also ICAO, *Manual on Aeroplane Upset Prevention and Recovery Training*, x–xiv. Note: Revision 3 of the *Airplane Upset Prevention & Recovery Training Aid for Transport Category Airplanes* defines an airplane upset as "an undesired airplane state characterized by unintentional divergences from parameters normally experienced during operations." Gone are references to specific pitch attitudes and bank angles.

[2] "The reference to inappropriate airspeeds describes a number of undesired aircraft states, including stalls. However, stalls are directly related to angle of attack (AOA), not airspeed." FAA, *Airplane Flying Handbook*, 2021, 5-1.

[3] ICAO, *Manual on Aeroplane Upset Prevention and Recovery Training*, A-8 and A-9.

[4] For more about the difference between procedure and technique, see the article by Barry Schiff at https://www.aopa.org/news-and-media/all-news/2023/february/pilot/proficient-pilot-techniques-or-procedures.

Introduction

The FAA says that maintaining control is "[a] pilot's most fundamental and important responsibility."[5] Still, inflight loss of control (LOC-I) remains the top fatal accident category in general aviation. Deficiencies in manual flying skills are a major factor in these accidents, with most ending in a stall, spin, or spiral dive.[6]

Familiar standards exist for recovering from stalls and spins. For instance, Push to recover from a stall first, before resuming normal use of all controls. NASA Standard spin recovery actions guided by the PARE mnemonic are another example. Yet no comparable standard exists for recovering from spiral dives and other roll upset scenarios. In fact, recommendations on how to recover from spiral dives have been inconsistent for decades.

Manual flying skills have long been recognized as the foundation for other technical flying skills.[7] These skills need emphasis throughout flight training, but other aspects of learning to fly often overshadow them.[8] Improving manual flying skills also increases the pilot's capacity to maintain situational awareness and avoid a loss of control in the first place. These skills are vital should recovery actions be needed.

This paper looks at the evolution of recovery actions recommended for spiral dives and other roll upset scenarios in general aviation airplanes. I then propose the adoption of Power-Push-Roll as an optimized standard recovery strategy for these types of upsets. Like standard stall and spin recovery actions, Power-Push-Roll is consistent with the concept of *elegant conciseness*.

Sidebar

Elegant conciseness is the purposeful distillation of complex actions into simple, memorable prompts. Designed to be easy to recall in stressful situations, the prompts rest on a foundation of deep understanding coupled with proper training.

A perfect example of elegant conciseness is the familiar *Stop, Drop, and Roll* mnemonic taught to children as part of Fire and Life Safety education.[9] In aviation, stall recovery training offers a stark illustration:

> Convoluted advice: "reduce the angle of attack," "reattach the airflow," and "lower the nose."
> Elegantly concise cue: "Push."

"Push" describes the exact corrective action the pilot must take. Reducing the angle of attack and reattaching the airflow are the consequences of this action. "Push" is the actionable prompt; the rest is part of understanding the underlying aerodynamics.[10]

Power-Push-Roll offers elegant conciseness for recovering from roll upsets. These clear cues can be recalled easily with proper training, even when stressed.

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[5] FAA, *Airplane Flying Handbook*, 2021, 5-27.
[6] AOPA, *Maneuvering Flight*, 5. While the literature often labels these as stall/spins, research suggests that several of them might be spirals. For example, see the article by Ed Wischmeyer at https://planeandpilotmag.com/loss-of-control-spins-or-spirals/.
[7] FAA, *Flightpath Management*, 3-5.
[8] Ibid.
[9] For a refresher on *Stop, Drop, and Roll*, see https://www.nfpa.org/news-blogs-and-articles/blogs/2022/03/31/not-your-mothers-stop-drop-and-roll-evolution-of-a-key-fire-safety-message.
[10] For a related discussion on complexity bias, see my blog post, "Complexity" at https://blog.communityaviation.com/learning-to-aviate/complexity.

The next section reviews the link between upset prevention and recovery training and manual flying skills. I then review relevant human factors and discuss the difference between developing and developed upsets, prevention and recovery. I analyze roll upset recovery in the context of general aviation after that. (Appendix A summarizes the roll recovery strategies referenced in this paper. Appendices B and C provide more detailed information about the sources and their recommendations.)

I finish with conclusions and next steps. Those steps include adopting Power-Push-Roll as the standard roll recovery strategy in general aviation. Continuing to emphasize the importance of awareness and avoidance to mitigate LOC-I. And encouraging instructors to teach pilots how to abort substandard maneuvers before they become developed upsets that require recovery actions.

The following is assumed unless otherwise noted:

- Positive G flight in a typical, single-engine, general aviation airplane;
- "Spiral" by itself refers to spiral dive;
- An understanding of basic aerodynamics and human factors;
- Awareness of *The Nine Principles of Light Airplane Flying*;
- Prevention strategies have failed—the situation is now a developed upset, requiring recovery from an unusual, banked attitude; and,
- The upset is recoverable.

I have also preserved source terminology in quoted material.

Section 1: UPRT & Manual Flying Skills

Key Takeaways: The table below summarizes the main issue, solution, and recommended actions for this section.

Issue	Solution	Actions
Skill-based errors drive most GA accidents.	Strengthen manual flying skills to increase safety and reduce LOC-I accidents.	Emphasize manual flying skills throughout training. Use standardized recovery strategies for stalls, spins, and spiral dives in GA training.

Effective upset prevention and recovery training (UPRT) rests on three linked layers: awareness, prevention, and recovery.[11] Preventing and especially recovering from upsets hinge on the pilot's manual flying skills (a.k.a. stick and rudder skills). These skills demand a solid working grasp of roll, yaw, pitch, and power.[12]

A detailed study of general aviation accidents found that "skill-based errors were the most common type."[13] These errors were present in nearly 80 percent of the accidents. They were also the first human link in the chain in about half the cases.[14] Decision errors, in contrast, "were present in roughly one-third of all accidents."[15]

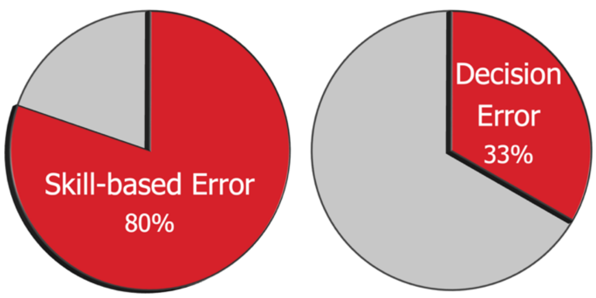

Figure 1-1: Breakdown of Skill-Based and Decision Errors in GA Accidents

Aerodynamic realities mean airplanes can stall, spin, and spiral dive.[16] Those are the most common outcomes when general aviation pilots lose control. Moreover, 93 percent of fatal stall/spin accidents in certificated, single-engine airplanes occur at or below traffic pattern altitude.[17] That alone argues for better training to improve awareness and to avoid breakdowns in manual flying skills. NTSB data shows loss of control in-flight (LOC-I) dominating other fatal accident categories in general aviation.[18]

[11] Brooks, et al., *Forging Pilot Resilience Against Loss of Control In-flight*, 5.
[12] ICAO, *Manual on Upset Prevention and Recovery Training*, 3-6.
[13] Wiegmann, et al., *Human Error and General Aviation Accidents*, 13.
[14] Ibid.
[15] Ibid., 14.
[16] A notable exception is the Ercoupe, certified as "characteristically incapable of spinning."
[17] Foster, *Stall/Spin Accident*, slides 6–7. As mentioned in Footnote 6, a number of these stall/spins might have been spirals.
[18] NTSB, *General Aviation Accident Dashboard*, online.

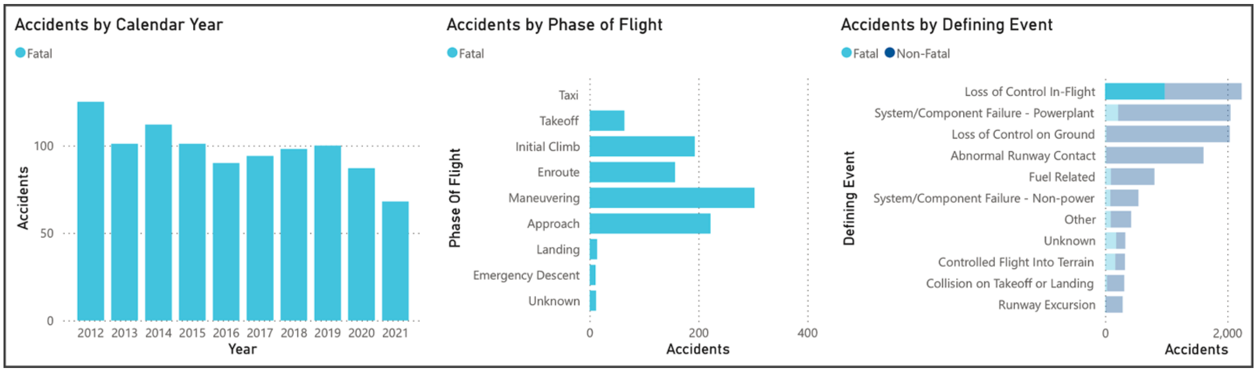

Figure 1-2: Fatal LOC-I – NTSB General Aviation Accident Dashboard

Training Considerations

Stall, spin, and spiral dive recovery processes have multiple steps, yet the main action differs for each case:

- Pushing forward on the elevator during stall recovery
- Applying full opposite rudder during spin recovery
- Rolling using ailerons during spiral dive recovery

Stalls can also transition into spins or spiral dives, and spins can transition into spiral dives. Even so, the pilot must focus on the key recovery input for the condition at the moment. Let's take a closer look.

Stall Recovery: Push

The central recovery action is the same no matter what adjective precedes the word "stall." Push, even when the nose of the airplane is already below the horizon.

The order of inputs matters as well. In a stall with roll-off, apply forward elevator first to break the stall, then deal with the bank angle. Push to reduce the angle of attack, then correct roll-off: elevator before ailerons, Push before Roll.

Many fatal accidents have resulted from "mis-prioritizing altitude loss as 'the' most important consideration" during stall recovery.[19] Thankfully, stall training is slowly returning to its core concept: "the most important action…is to reduce the AOA."[20]

An inadvertent stall is a developed upset, though it might not be an unusual attitude per se. A stall certainly can progress to an unusual attitude, a spin, or a spiral dive and loss of control. Even so, scenarios exist where pilots are advised to accept stalling as a more desirable possibility than damaging the airplane. Hence, the recommendation to slow to a speed at or below the design maneuvering speed when flying in rough air. This is another reason to require competency in stalls and stall recovery.

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[19] Ransbury, *Unloading in a Spiral Dive: Pushing, Rolling or Both?*

[20] FAA, *Stall and Stick Pusher Training*, ii; FAA, 2016 *Airplane Flying Handbook*, 4-7.

Spin Recovery: Power-Aileron-Rudder-Elevator (PARE)

Standard spin recovery actions are the same no matter what adjective precedes the word "spin." The order of recovery inputs matters as well, especially the critical sequencing of rudder-followed-by-elevator.

The order of recovery inputs is known by names like *NASA Standard*, *normal recovery controls*, and *conventional spin recovery*. Type certification spin test procedures have referenced the NASA Standard since 1962.[21] The PARE mnemonic is a convenient way of recalling NASA's optimal sequence of spin recovery actions.[22]

Spiral Dive Recovery: no clear standard (yet)

Intentional spiral descents have been part of flight training for more than a century. Spiral dives, in contrast, are inadvertent.[23] They are developed upsets that typically result from:[24]

- Roll-off during stalls and stall recoveries
- Botched spin entries or spins that spontaneously transition into spirals
- Poorly executed turning maneuvers
- Inattention to or misinterpretation of flight instruments

Figure 1-3: Instrument Indications in a Spiral Dive, FAA *Instrument Flying Handbook*

A spiral dive is also a "nose low upset."[25] Instinctively trying to pull the nose up to the horizon will often aggravate the situation. Pulling, especially when at steep angles of bank, can lead to high airspeeds and G-loads. Trying to pull and roll at the same time cuts the published structural design limit by two-thirds.[26] The normal category design limit of +3.8G, for example, shrinks to +2.5G during a rolling

[21] FAA, *Type Certification Spin Test Procedures*, 3. Later 23-8 series Advisory Circulars (*Flight Test Guide for Certification of Part 23 Airplanes*) no longer mention NASA spin recovery by name, but the recovery actions are NASA Standard. The guides also include caveats such as "unless the manufacturer determines the need for another procedure" or for acrobatic category spins, "the manufacturer may establish additional recovery procedures, provided they show compliance." Although the FAA uses the word "procedure," differences that might appear in manufacturer information are typically related to technique.

[22] For a detailed treatment of spins and PARE, see my book, *The Light Airplane Pilot's Guide to Stall/Spin Awareness*.

[23] Barber, *Aerobatics*, 23; FAA, *Airplane Flying Handbook*, 2021, 10-3–10-4.

[24] Stowell, *Emergency Maneuver Training*, 69; FCI, *Emergency Maneuver Training Manual*, 42; CASA, *Flight Instructor Manual*, 52.

[25] FAA, *Airplane Flying Handbook*, 2016, 4-23.

[26] FAA, *14 CFR 23.349(b)*, 171.

pullout.[27] As shown in Appendix C, though, pushing the elevator forward is often absent in advice on spiral dive recovery.

At least UPRT providers agree on the need to push as part of recovering from a spiral dive. They also agree that *push-before-roll* is a critical sequence, though they differ on the order of other actions.

Comprehensive UPRT programs pair academics and simulation with in-airplane training in stalls, spins, spirals, and other unusual attitudes.[28] Training built on clear standards gives pilots confidence that in a developed upset, they can reliably:

1. Regain cognitive control (that is, recover from "brain stall");[29]
2. Apply the correct recovery strategy; and,
3. Return to controlled flight without overstressing the airplane.

Upset recovery strategies must reflect how pilots behave under duress, especially when startled. They must also respect human factors if they are to be easy to learn in training and effective in practice. The next section explores these human factors issues in more detail.

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[27] General aviation airplanes usually don't have G-meters. Hence, incorporating G-cueing into flight training can help pilots manage G-loads when pulling out after recovering from stalls, spins, and spiral dives. For more information on G-load and G-cueing, access my free *Learn to Turn* booklet and other free *Learn to Turn* assets at https://www.richstowell.com.

[28] Effective UPRT programs have three integrated parts: academics, simulation, and in-airplane training. ICAO, *Manual on Upset Prevention and Recovery Training*, 2-1.

[29] For more about "brain stall," see my March 2, 2025, blog post, *The Human Factor* at https://blog.communityaviation.com/learning-to-aviate/the-human-factor.

Section 2: Human Factors

Key Takeaways: The table below summarizes the main issue, solution, and recommended actions for this section.

Issue	Solution	Actions
The pull instinct and inadequate training often impede proper recovery from upsets.	Use UPRT to teach pilots to override startle and pull responses.	Train deliberate and sequential upset recovery actions. Normalize recurrent proficiency training.

The last section showed the need to emphasize manual flying skills and use standardized recovery strategies for stalls, spins, and spiral dives. Here the focus is on human factors that affect a pilot's ability to prevent or recover from an upset.

Maintaining awareness is essential to upset prevention. Awareness can break down due to:

- Novel situations
- Distraction
- Lack of confidence/competence
- Miseducation/misunderstanding about the effect and use of the controls

A survey of pilots who had experienced a potential or inadvertent LOC-I found:[30]

- 80% of the LOC-I events involved pilot error;
- Most of the pilot errors (e.g., improper maneuvering; improper remedial action) were the direct result of inadequate training;
- 25% of the pilots said their instructor had not prepared them well, or did not teach them how to recover from LOC-I; and,
- Fear, fixation, and distraction interfered with taking corrective actions.

The FAA explains a core concept behind UPRT: [31]

> *Airplane upsets are by nature time-critical events; they can also place pilots in unusual and unfamiliar attitudes that sometimes require counterintuitive control movements. Upsets have the potential to put a pilot into a life-threatening situation compounded by panic, diminished mental capacity, and potentially incapacitating spatial disorientation.*

Also, "[a] very important point to remember is that the instinctive reaction to a nose-down attitude is to pull back on the elevator control."[32] Despite this, many spiral dive recovery procedures do not include Push to offset this reaction.

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[30] Majumdar, *Analysis of General Aviation Loss of Control Accidents*, 152.
[31] FAA, *Airplane Flying Handbook*, 2021, 5-5.
[32] FAA, *Instrument Flying Handbook*, 7-28.

Eric Müller observes:[33]

> *A confused pilot in a difficult situation has three nearly irresistible urges: one is to leave the throttle setting where it is…; another is to carry on and finish whatever it is he has begun, even if it has gone wrong; and the third is to pull instinctively on the stick. All three are very wrong and very dangerous.*

Sidebar

Regarding Müller's point about leaving the throttle setting where it is, author Robert T. Smith recounts a telling experience. The FAA once hypothesized that "a private pilot would reduce power to idle within one turn in an accidental spin."[34] Smith disagreed. To prove his point, Smith had new flight instructors encounter spins from power-on stalls in a Cessna 150. None of these instructors reduced the power. In fact, they didn't do anything. Smith had to take the controls and recover every time. He reasoned, "if a flight instructor wouldn't take corrective action…a private pilot wouldn't either."[35]

The Instinct to Pull

When startled, we pull as a self-preservation reflex. We might also pull because we don't understand the priorities during an undesired aircraft state (UAS) or upset. When stalled, we cannot return the airplane to level flight by pulling until we first push enough to reattach the airflow.

Unconscious pulling increases the angle of attack and G-load. "Pulling long enough, hard enough, far enough" can exceed aerodynamic or structural design limits.[36] The instinct to pull and hold the elevator control aft is strongest:

- at the stall break
- during spins
- in spiral dives and other unusual, banked attitudes
- after an engine failure on takeoff/initial climb
- when trying to stretch a glide

Figure 2-1: An Unusual, Banked Attitude where Pulling will Only Aggravate the Situation

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[33] Müller and Carson, *Flight Unlimited*, 56. Eric Müller was a seven-time Swiss Aerobatic champion, flight instructor, and accident investigator for the Swiss Civil Aviation Authority.
[34] Smith, *Advanced Flight Maneuvers*, 122.
[35] Ibid.
[36] This is a common phrase I use in presentations on loss of control and stall-spin awareness.

Appendices B and C show that roll upset recovery historically has either overlooked the benefit of pushing or overly confounded it. Ignoring the need to push ignores human factors and our propensity to pull when stressed, especially when the airplane is banked and heading downhill.

> **Sidebar**
> The so-called graveyard spiral is a spiral dive/nose-low upset. It is driven by the pilot's incapacity or unwillingness to stop pulling back on the stick or yoke.

The sequencing and extent of the push needed during recovery depend on the situation. Overriding the instinct to pull is a learned response that requires training the brain to command forward elevator, even when startled.[37] Learning how and when to push is critical to preventing and recovering from upsets that could lead to LOC-I.

"Even a little stress can make the easy hard."[38] So "[i]n critical situations, pilots need clear, actionable guidance."[39] Several sources in Appendices B and C recommend simultaneous recovery inputs. Well-defined, sequential actions tend to be easier to manage when our single-channel brains are surprised by a dramatic event.

Recovery actions from unusual attitudes and developed upsets are counterintuitive. They are learned responses. These skills are perishable and require a commitment to recurrent training. Bruce Landsberg says, "[i]t's impossible to completely shield yourself from all hazards, but…continuous improvement and recurrent training throughout your flying career is remarkably effective."[40] Flight training must also be rooted in first principles and guided by standardized strategies. Especially when it comes to upset prevention and recovery training for general aviation pilots.

Preventing LOC-I and recovering from it are two sides of the same UPRT coin. Defining the differences between prevention and recovery is the subject of the next section.

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[37] According to Airbus Training Standards Captain Savio Schmitz, "control is lost in the mind," *UPRTA 2080*, PowerPoint slide 11. Pilots must first learn how to regain control in their mind. Recovering from upsets and other emergencies requires conscious, deliberate actions.
[38] Stowell, *The Human Factor*.
[39] Grok 3 (xAI), personal communication with AI, July 18, 2025.
[40] Landsberg, *Learning from Icarus*, 4.

Section 3: Prevention vs. Recovery

Key Takeaways: The table below summarizes the main issue, solution, and recommended actions for this section.

Issue	Solution	Actions
The difference between prevention and recovery is not well understood.	Clearly differentiate between the upset prevention phase and upset recovery phase in training and procedure design.	Strengthen prevention skills with better awareness and avoidance training. Use in-airplane training to build precise, counterintuitive recovery actions for stalls, spins, and spirals.

I've discussed the need to emphasize manual flying skills and use standardized recovery strategies for developed upsets. I've also highlighted human factors that affect a pilot's ability to prevent or recover from an upset. The difference between the prevention and recovery phases of an upset is not well understood. This section provides that clarification.

Helping "trainees to recognize developing and developed upset conditions" is an essential feature of UPRT.[41] Training providers also "should focus their mitigations on…developing upsets instead of developed upsets."[42] Even so, "any risk mitigation effort would be incomplete without including recovery training."[43] Hence, Upset Prevention and Recovery Training.

"*Prevention* training focuses on awareness and avoidance of upsets."[44] Prevention occurs as the airplane "begins to unintentionally diverge from the intended flight path or airspeed."[45] Prevention is proactive.

In contrast, "*[r]ecovery* exercises assume that…upset conditions exist."[46] An upset has developed, dictating the need for the appropriate recovery procedure.[47] Recovery is reactive.

> a) **heightened awareness** — of the potential threats from events, condition, or situations;
> b) **effective avoidance** — at early indication of a potential upset-causing condition; and,
> } **Prevention**
> c) **effective and timely recovery** — from an upset to restore the aeroplane to safe flight parameters.
> ICAO Manual on UPRT, 2014

Figure 3-1: Three Objectives in the Design of UPRT Programs per ICAO

This distinction matters because it changes how the pilot must act.

[41] ICAO, *Manual on Aeroplane Upset Prevention and Recovery Training*, 3-7.
[42] IATA, *Guidance and Best Practices*, 46.
[43] ICAO, *Manual on Aeroplane Upset Prevention and Recovery Training*, 1-3.
[44] IATA, *Guidance and Best Practices*, 13.
[45] ICAO, *Manual on Aeroplane Upset Prevention and Recovery Training*, A-8 and A-9.
[46] IATA, *Guidance and Best Practices*, 13.
[47] Don't confuse "developed upset" with "developed spin." See the Definitions section: a developed upset is any "condition meeting the definition of an aeroplane upset." In an accidental spin, the pilot should not wait for the spin to fully develop before taking spin recovery actions. The accidental spin departure itself is a developed upset that demands immediate and proper spin recovery.

The Key Differentiator

Developed upsets have been defined several ways over the years. These include using specific pitch attitudes and bank angles, and generic phrases like "unintentional divergences from parameters normally experienced during operations."[48] Regardless, developed upsets possess one distinguishing feature: "The need for counter-intuitive behaviour" by the pilot.[49] This is what separates *recovery* from *prevention*.

Unintentional stalls, spins, and spiral dives are developed upsets. The airplane isn't approaching one of these states. The airplane is stalling; it is spinning; it is spiraling. The pilot must now make counterintuitive inputs to recover. The *Manual on Aeroplane Upset Prevention and Recovery Training* describes stall recovery:[50]

> *it may be counter-intuitive to use greater unloading control forces when recovering from a high AOA, especially at low altitude. If the aeroplane is stalled while already in a nose-down attitude, the pilot still needs to push the nose down (unload) in order to reduce the AOA. Altitude cannot be maintained in a stall and should be of secondary importance.*

Consider spin recovery actions. Those are not just counterintuitive but have also been described as "*mechanical control movements*."[51] As for spiral dives, rolling to recover goes against our instinct to try to pull up instead.

Preventing an upset relies on awareness and avoidance skills. Several actions taken here, even if not ideal, might still stop a developing upset (e.g., letting go of the controls). But ICAO rightly warns, "[c]ontrol deflections at one point in the flight envelope might not be appropriate in another part of the flight envelope."[52] This is especially true once you cross the line from prevention to recovery.

Actions taken when recovering from an upset cannot be random or instinctual. They must be precise, deliberate, and directed by the applicable procedure. Attempting stall or spiral recovery during a spin, for example, would be inappropriate. Or even dangerous.

The time between being able to prevent an upset and having to recover from it can vary as well. Surprise and startle become more likely as a situation devolves from developing upset to developed upset. In some cases, surprise and startle can occur together, making them hard to tell apart.[53]

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[48] ICAO, et al., *Airplane Upset Prevention & Recovery Training Aid*, 10.
[49] ICAO, *Manual on Aeroplane Upset Prevention and Recovery Training*, A-8. The manual describes this alternatively as "counter-intuitive behavior" and "non-intuitive factors." This terminology appears under headings like "Manual handling skills," "Human Factors," and "Developed Upsets." See pages 3-6, 3-18, 3-30, A-8, and A-9.
[50] ICAO, *Manual on Aeroplane Upset Prevention and Recovery Training*, 3-6–3-7, 3-18, and 3-30.
[51] Kershner, *The Basic Aerobatic Manual*, 24.
[52] ICAO, *Manual on Aeroplane Upset Prevention and Recovery Training*, 3-7.
[53] Vlaskamp, et al., *Recovery from startle and surprise*, 2.

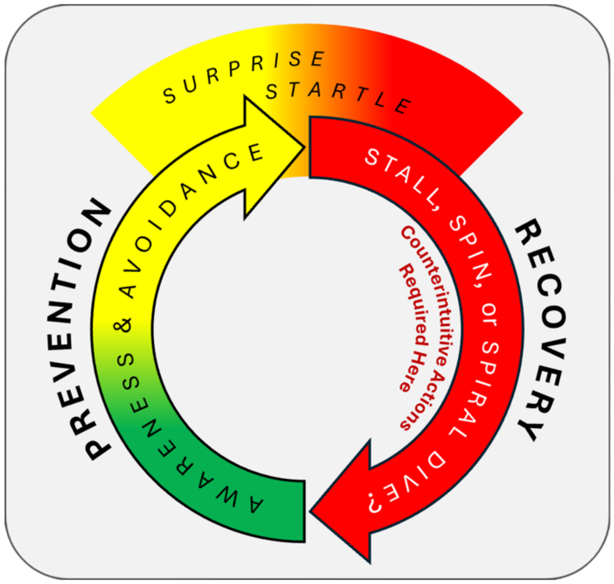

Figure 3-2: Distinguishing between Prevention and Recovery

Startle and Upset Recovery

Expanding on the previous section on human factors, "[s]tartle is a ubiquitous human response to surprising stimuli."[54] Startle cannot be trained out of us. Positive training experiences, though, can lessen its detrimental effect on our ability to perform under stress. Well-trained pilots are less likely to allow a developing upset to become a developed one. If they inadvertently do encounter a developed upset, they will be more likely to:

- recover quickly from startle-induced brain stall;
- identify the type of upset; and,
- perform the exacting and counterintuitive actions required to recover.

Poorly-trained pilots, by comparison, are more likely to go from a developing to a developed upset. If that happens, they will also be more likely to:

- be incapacitated by startle-induced brain stall;
- freeze or flail on the controls; and,
- be unable to follow upset recovery procedure.

[54] Martin, et al., *Fear-Potentiated Startle*, 104.

Example of Prevention vs. Recovery: Unintended Increase in AOA

Figure 3-3 shows a developing upset involving an unintended increase in angle of attack (AOA). Awareness: the pilot recognizes the increase in AOA based on multiple cues. Avoidance: the pilot intervenes by pushing on the elevator control.

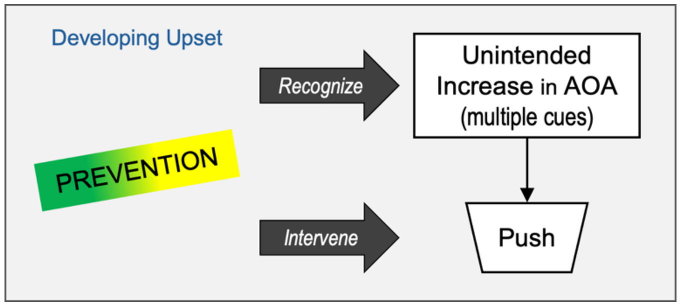

Figure 3-3: Example of Addressing a Developing Upset

What if preventing the unintended increase in angle of attack has failed? Figure 3-4 shows a developed upset where the airplane has stalled with rapid roll-off. The airplane is departing into a spiral dive or a spin. Despite momentary startle, the pilot uses available cues to identify the upset and follows the correct procedure to recover.

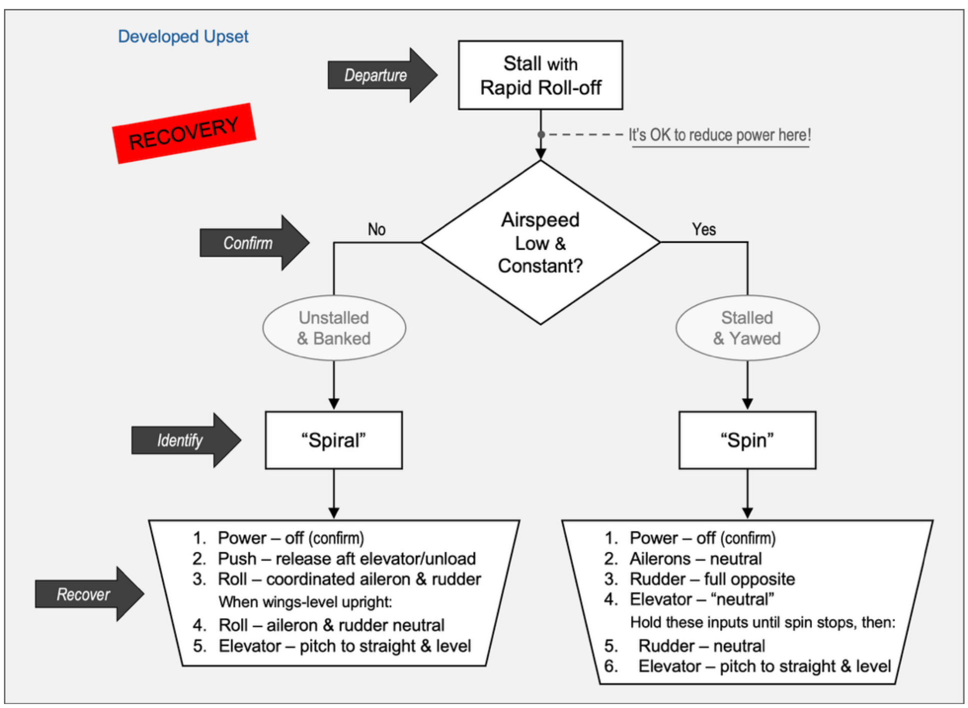

Figure 3-4: Addressing a Developed Upset when Prevention has Failed

- I'm spiraling. Which way do I roll when the time comes?
- I'm spinning. Which pedal is opposite rudder? How much forward elevator do I need once I've applied full opposite rudder?

All this while in the midst of an unplanned, time- and often altitude-critical event. This is what makes recovering from an upset exponentially more difficult than preventing it. It is also why in-depth training is necessary.

Most discussions about how to handle an upset might seem to be about the *recovery* phase but are really about the *prevention* phase. "Push" is usually an effective first step to thwart a developing upset. Things get more complicated once the line between developing and developed has been crossed. Stall recovery is not spin recovery is not spiral recovery. Counterintuitive actions choreographed for the specific type of upset are called for. Split-second decisions must be made as well.

So far, I've shown why better manual flying skills and standardized recovery strategies for developed upsets are needed. I've reviewed human factors that affect pilot performance when stressed by a developed upset. I've also drawn a clear distinction between upset prevention and recovery. The next section analyzes different roll upset recovery strategies. I then lobby for Power-Push-Roll as a sound standard for spiral dives and other roll upsets.

Section 4: Spotlight on General Aviation

Key Takeaways: The table below summarizes the main issue, solution, and recommended actions for this section.

Issues	Solution	Actions
No standard exists for recovery from roll upsets in general aviation. Conflicting guidance leads to confusion.	Guided by evidence and elegant conciseness, distill complex recovery actions into simple, memorable prompts.	Standardize and promote Power-Push-Roll for recovery from roll upsets in general aviation. Align training curricula accordingly.

Obvious ways to reduce LOC-I include emphasizing manual flying skills and adopting standardized recovery strategies. Effective UPRT strategies must take human factors into account. The need for counterintuitive inputs differentiates the upset recovery phase from the upset prevention phase. This section shines a light on general aviation roll upset recovery guidance.

General aviation (GA) is fundamentally different from transport category and military operations. GA airplanes usually have narrower speed ranges and more varied powerplant characteristics. The demographics of GA pilots also vary significantly. While airline pilots achieve the highest FAA certification and military pilots are rigorously selected, general aviation is accessible to nearly anyone. The result is a diverse community of over half a million general aviation pilots in the US alone.

In contrast to the highly standardized operations of the airlines and the military, GA is often less structured. It often involves single-pilot operations. Regular training is integral for airline and military pilots. GA pilots are only required to complete an hour each of ground and flight review once every two years. This variability extends to the quality and depth of flight training. As a result, a significant gap in knowledge, skills, and incentives to teach exists among general aviation instructors.

Despite these differences, some principles translate across sectors. For instance, the imperative to gain and maintain proficiency in manual flying skills applies to all pilots. Cockpit resource management concepts from the airlines have been adapted to general aviation. But applying airline methods for upset recovery may not be suitable for general aviation.

Decades of Imperfect Guidance

General aviation has lacked a consistent and universally accepted standard for recovering from spiral dives and other roll upsets. Without a clear standard, pilots are left with the preponderance of confusing, conflicting, and incomplete guidance summarized in Appendix A.

Much of the guidance, for instance, ignores the critical need to push to reduce angle of attack and G-load. Recovery advice often jumps straight to "roll the wings level and raise the nose." It's unclear if the push is assumed, or if the adverse effect of a rolling pullout on the structural design limit has been considered. Further, the FAA makes needless distinctions between spiral dive, nose high, nose low, and "upset" scenarios.

Analyzing Roll Upset Recovery Strategies

UPRT providers agree on pushing before rolling, but they differ on when to address the other recovery actions. The graphic shows four commonly taught sequences.[55]

Strategy	Push-Roll-Power	Push-Power-Roll	Push-Power-Rudder-Roll	Power-Push-Roll
a.k.a.	All-Attitude Upset Recovery Strategy		All-Attitude Upset Recovery Checklist	—

Figure 4-1: Four Common Roll Recovery Strategies

Let's look at each in more detail.

Push-Roll-Power and Push-Power-Roll

These two sequences are part of the APS *All-Attitude Upset Recovery Strategy* (AAURS), also promoted in the air carrier industry. Push-Roll-Power is the Baseline AAURS; Push-Power-Roll is the Variant.[56] Appendix D describes the evolution of the AAURS, a.k.a. single or universal recovery strategy.

The FAA's recovery templates stem from recommended practices developed by air carrier industry stakeholders.[57] Even so, the FAA templates shown below deviate from both the Baseline and Variant AAURS. The essence of nose high recovery is Push-Power with no mention of Roll.[58] Nose low recovery is this clunky version of Push-Roll-Power:[59]

> Push *if required to recover from stall*
> Roll *<u>but</u> it may also be necessary to Push to reduce G-load and improve roll effectiveness*
> Power *adjust if required*

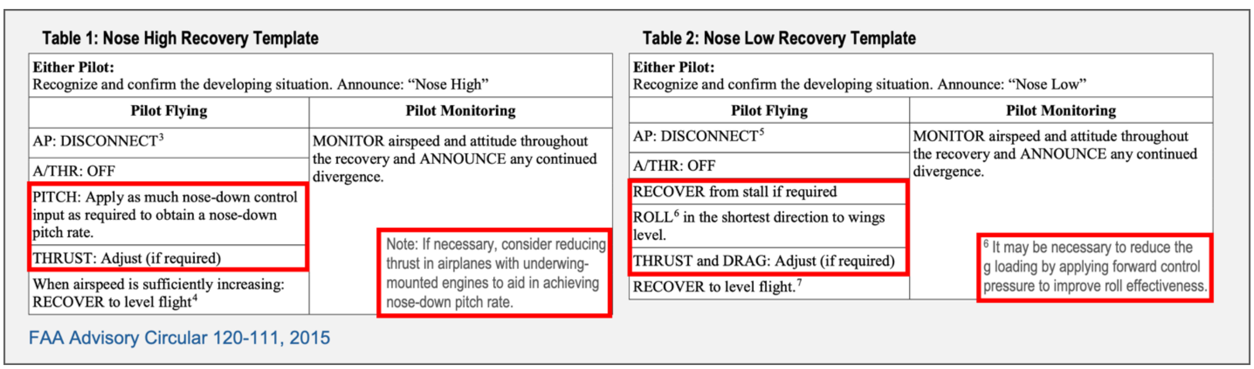

Table 1: Nose High Recovery Template

Either Pilot: Recognize and confirm the developing situation. Announce: "Nose High"	
Pilot Flying	**Pilot Monitoring**
AP: DISCONNECT[3]	MONITOR airspeed and attitude throughout the recovery and ANNOUNCE any continued divergence.
A/THR: OFF	
PITCH: Apply as much nose-down control input as required to obtain a nose-down pitch rate.	
THRUST: Adjust (if required)	Note: If necessary, consider reducing thrust in airplanes with underwing-mounted engines to aid in achieving nose-down pitch rate.
When airspeed is sufficiently increasing: RECOVER to level flight[4]	

Table 2: Nose Low Recovery Template

Either Pilot: Recognize and confirm the developing situation. Announce: "Nose Low"	
Pilot Flying	**Pilot Monitoring**
AP: DISCONNECT[5]	MONITOR airspeed and attitude throughout the recovery and ANNOUNCE any continued divergence.
A/THR: OFF	
RECOVER from stall if required	
ROLL[6] in the shortest direction to wings level.	[6] It may be necessary to reduce the g loading by applying forward control pressure to improve roll effectiveness.
THRUST and DRAG: Adjust (if required)	
RECOVER to level flight.[7]	

FAA Advisory Circular 120-111, 2015

Figure 4-2: FAA's Recommendations for Nose High and Nose Low Attitudes

Similar inconsistencies appear in the *Manual on Aeroplane Upset Prevention and Recovery Training* and in the *Airplane Upset Prevention & Recovery Training Aid*. Nose high recovery reduces to Push-Power-Roll in both

[55] Some use the term "thrust" instead of "power."
[56] Personal email correspondence from Paul "BJ" Ransbury, CEO, Aviation Performance Solutions, May 19, 2024.
[57] FAA, *Upset Prevention and Recovery Training*, ii.
[58] Ibid., 16.
[59] Ibid., 17.

documents.[60] Like the FAA's template, recovery actions for the nose low case follow the same clunky form of Push-Roll-Power:[61]

> Push *if required to recover from stall*
> Roll *<u>and/but</u> it <u>is/may be</u> important to Push to reduce G-load and improve roll effectiveness*
> Power *adjust if required*

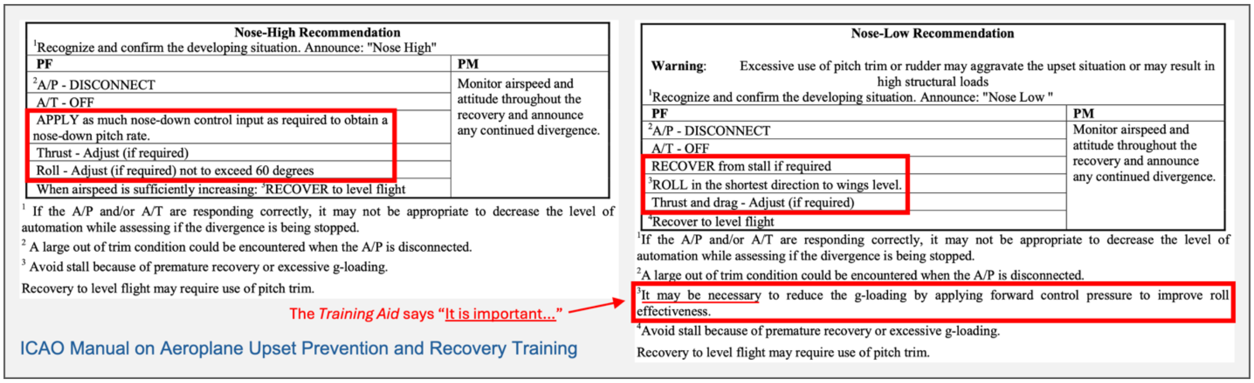

Figure 4-3: ICAO's Recommendations for Nose High and Nose Low Attitudes

The International Air Transport Association (IATA) gives three possible roll recovery strategies that can be recommended by manufacturers:[62]

1. Push-Roll-Stabilize. This version implies that Power (and drag) can be addressed any time during, and simultaneously with, Push-Roll-Stabilize actions.
2. Push-Roll-Power-Stabilize. The order of actions in this version is clear.
3. Push-Roll-Stabilize. This version implies that Power (and drag) can be addressed any time during, and simultaneously with, Roll-Stabilize actions.

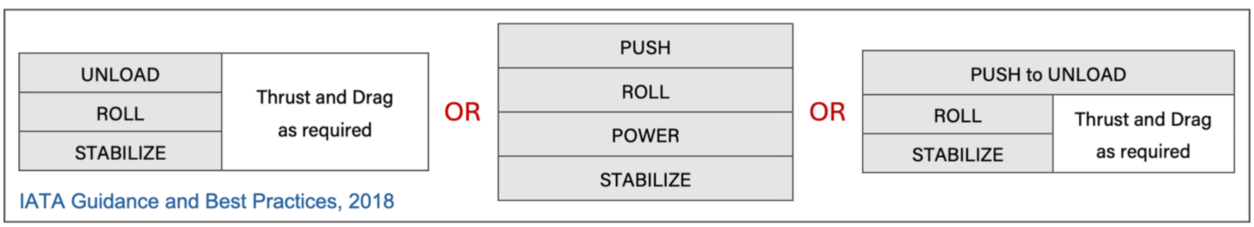

Figure 4-4: Possible Roll Recovery Strategies per IATA

Push-Power-Rudder-Roll

This sequence is part of the *All-Attitude Upset Recovery* technique that APS developed before the AAURS (see Appendix D). It evolved as a recovery checklist for a "wide variety of stalls, upsets, wake turbulence encounters and unusual attitudes" other than developed spins.[63]

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[60] ICAO, *Manual on Aeroplane Upset Prevention and Recovery Training*, 3-44; ICAO, et al., *Airplane Upset Prevention & Recovery Training Aid*, 81–83.
[61] ICAO, *Manual on Aeroplane Upset Prevention and Recovery Training*, 3-44; ICAO, et al., *Airplane Upset Prevention & Recovery Training Aid*, 84–85.
[62] IATA, *Guidance and Best Practices*, 26.
[63] Ransbury and McNeace, *Caution, Wake Turbulence!* 32.

Other recovery templates for stalls and unusual banked attitudes assume the rudder is being used to cancel yaw throughout. In this sequence, canceling yaw is a distinct action performed at a specific point in the checklist. This extra step seems unnecessary for several reasons.

A proper Push input has already reduced angle of attack and G-load and increased the margins to both aerodynamic and structural limits. The airplane is neither stalled nor spinning, though it might be skidding or slipping. Appropriate Roll inputs include applying enough rudder to cancel yaw. Thus, any skid or slip is removed automatically while the roll rate improves at the same time.

Sidebar

I was asked to evaluate the stall behavior of a high-performance airplane that had a reputation for rapid roll-off at the stall. The airplane was a technically advanced, state-of-the-art, single-engine turboprop. It consistently exhibited hard roll-off to the left, which was usually worse in the landing configuration (i.e., power idle, ailerons neutral).

Roll-offs sometimes resulted in bank angles of 120–150 degrees with nose-down pitch attitudes of 40–60 degrees. Recovery was a mashup of spin and spiral dive inputs. Namely, applying full opposite rudder followed by pushing forward elevator, then rolling to wings level, then pitching to level flight. The *All-Attitude Upset Recovery* checklist would have called for neutralizing the rudder before rolling, then reapplying that same rudder during the roll. An inefficient added step under the circumstances.

Power-Push-Roll

As revealed in Appendices B and C, addressing Power early when recovering from a roll upset in general aviation airplanes is consistent with:

- Guidance from the FAA in the U.S., CASA in Australia, and the Civil Aviation Authority in New Zealand.
- Nearly 70 years of advice found in aviation publications around the world.
- Recommendations from airplane manufacturers like Cessna and Cirrus.
- Training guidance for popular amateur-built airplanes like the RV series by Vans Aircraft.
- Addressing the potential for propeller overspeed, more rapid airspeed build up, and torque roll.

Addressing power early is also important if a stall departs into a spin or spiral dive. Especially if the early cues are ambiguous. Moreover, Eric Müller advises that "[i]n any kind of anxious situation the first thing to do is cut the motor."[64] This applies even during a departure stall if reducing power will help the pilot maintain or regain control.[65]

Power-Push-Roll has been a staple of the *Emergency Maneuver Training* (EMT) program since 1987. It has been taught to thousands of GA pilots, including student pilots, instructors, and pilots employed by numerous state and federal agencies. It has been used in general aviation airplanes ranging from low performance to high performance types.

Standardizing Roll Upset Recovery Actions

Advice on how to recover from a spiral dive should be straightforward, yet general aviation continues to struggle with it. Published guidance remains confusing and incomplete.

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[64] Müller and Carson, *Flight Unlimited*, 56.

[65] For example, "reduction of power on the operating engine(s)…would be considered normal use of the controls" when recovering from critical-engine-inoperative stalls in multiengine airplanes, FAA, *Flight Test Guide for Certification of Part 23 Airplanes*, 78–79.

According to the FAA, attaining the highest levels of learning "starts with the broadest form of a given procedure."[66] The FAA contradicts this advice by giving pilots separate recovery procedures for spiral dive, nose high, nose low, and "upset" scenarios.

The *Airplane Upset Prevention and Recovery Training Aid* states, "[c]onsolidation of recovery techniques…is done for simplification and ease of retention."[67] It then lists two techniques, one for nose high and another for nose low. As noted earlier, we find discrepancies between versions in the *Training Aid*, the *All-Attitude Upset Recovery Strategy*, and FAA material. It seems even the air carrier industry has work to do to simplify and standardize roll upset recovery information.

Teaching Points[68]

Despite the mess, the common features are visible and lead to the following teaching points:

1. "Roll upset" is a family of unusual attitudes characterized, if not driven by angle of bank.[69]
2. The power setting must be addressed.
3. Pushing forward, whether to "reduce angle of attack," "reduce G-load," "unload the wing," or "improve roll effectiveness," is an important precursor to rolling.
4. Rolling to wings level is the main event in the recovery process. Emphasis is on the aileron input coupled with enough rudder to cancel yaw.

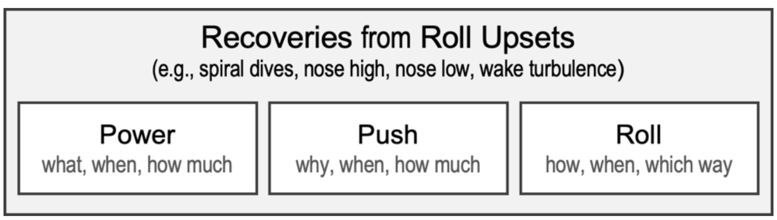

Figure 4-5: Teaching Points for Recoveries from Roll Upsets

Other names attached to a roll upset scenario are irrelevant. Whether the airplane is nose high or nose low relative to the horizon is irrelevant. Also irrelevant: whether the pilot is flying by outside visual references or reference to flight instruments.

Remember, I've assumed that upset prevention has failed, that is, awareness and avoidance have broken down. We are in the recovery phase of the upset. We are now focusing on counterintuitive, manual control inputs. The teaching points are clear: Power, Push, and Roll. These points are broad, simplified, and easy to retain—the very definition of elegant conciseness (see Appendix E). These teaching points must also inform roll upset recovery training.

[66] FAA, *Airplane Flying Handbook*, 2016, 4-24.
[67] ICAO, et al., *Airplane Upset Prevention & Recovery Training Aid*, 78.
[68] A teaching point is the smallest unit of information that can be taught as a self-contained fact or step in a process for performing a task.
[69] For example, spiral dive, graveyard spiral, nose high, nose low, and wake turbulence-induced roll.

Look at the FAA's upset recovery templates again (see Appendix C–Convoluted Guidance for further analysis).

Table 1: Nose High Recovery Template

Either Pilot: Recognize and confirm the developing situation. Announce: "Nose High"	
Pilot Flying	**Pilot Monitoring**
AP: DISCONNECT[3]	MONITOR airspeed and attitude throughout the recovery and ANNOUNCE any continued divergence.
A/THR: OFF	
PITCH: Apply as much nose-down control input as required to obtain a nose-down pitch rate.	
THRUST: Adjust (if required)	Note: If necessary, consider reducing thrust in airplanes with underwing-mounted engines to aid in achieving nose-down pitch rate.
When airspeed is sufficiently increasing: RECOVER to level flight[4]	

Table 2: Nose Low Recovery Template

Either Pilot: Recognize and confirm the developing situation. Announce: "Nose Low"	
Pilot Flying	**Pilot Monitoring**
AP: DISCONNECT[5]	MONITOR airspeed and attitude throughout the recovery and ANNOUNCE any continued divergence.
A/THR: OFF	
RECOVER from stall if required	
ROLL[6] in the shortest direction to wings level.	
THRUST and DRAG: Adjust (if required)	[6] It may be necessary to reduce the g loading by applying forward control pressure to improve roll effectiveness.
RECOVER to level flight.[7]	

FAA Advisory Circular 120-111, 2015

Spiral Dive Recovery Template
1. Reduce power (throttle) to idle
2. Apply some forward elevator
3. Roll wings level
4. Gently raise the nose to level flight
5. Increase power to climb power

Upset Recovery Template
1. Disconnect the wing leveler or autopilot
2. Apply forward column or stick pressure to unload the airplane
3. Aggressively roll the wings to the nearest horizon
4. Adjust power as necessary by monitoring airspeed
5. Return to level flight

FAA Airplane Flying Handbook, 2016

Figure 4-6: Four Recovery Strategies from the FAA

The FAA emphasizes teaching the broadest form of a procedure to reach higher levels of learning. Publishing four recovery strategies conflicts with that principle. Logic, the teaching points, and decades of experience suggest the four strategies can be consolidated and standardized into one. The benefits of standardization include:

- Providing a consistent, universal approach that can be applied to most general aviation airplanes.
- Creating a solid mental framework that works in high-stress situations.
- Ensuring consistent training across flight schools, instructors, and UPRT providers.

A good standard is the springboard for aeronautical knowledge and hands-on experience. Alternate strategies can be introduced from there if proper justification and context are given for deviating from the standard. Power, Push, and Roll form a solid standard to build on when examining roll upsets. It can also be optimized for general aviation.

Optimizing Roll Upset Recovery

If standardization is about consistency, optimization is about effectiveness.[70] Optimization can also be adaptive.[71]

Take Power, for example. The type and degree of power change depend on the airplane and the situation. Unsure if that roll-off at the stall is the start of a spin or a spiral dive? Power off.

[70] Standardization and optimization are not new concepts. NASA Standard spin recovery, for example, is the starting point for spin training in general aviation airplanes. The PARE mnemonic identifies the teaching points: Power-Aileron-Rudder-Elevator. PARE also optimizes the sequence of events to maximize the probability of recovering from recoverable spins.

[71] Adaptive means having the ability to change or adjust to suit different conditions or environments.

Nose low and airspeed increasing? Power off. Addressing this first will reduce the risk of propeller overspeed and slow the acceleration.

Nose high and decreasing airspeed? Increasing power might make sense in airplanes with lower horsepower-to-weight ratios. Addressing this first can slow deceleration and improve control effectiveness when in a low energy state. Reducing some power might make sense in airplanes with higher horsepower-to-weight ratios, especially if an uncontrollable torque roll is possible.[72]

The sequence Push-then-Roll is optimal, but the time between the two inputs can vary. Nose low with increasing airspeed? The delay between Push and Roll will usually be short. Nose high with decreasing airspeed? The delay might be longer if the goal is to push the nose to the horizon first.

Sequential inputs are also easier to manage from a human factors standpoint. Verbalizing the key words can help displace instinctive reactions with correct recovery inputs.[73]

In life-critical situations, pilots need to implement procedures that are simple and unambiguous. The procedure also must be adaptable to different airplanes and scenarios. All told, Power-Push-Roll is an appropriate standard optimized for recovering from roll upsets in general aviation airplanes. Learning the nuances of the procedure and developing the skill to apply it both require hands-on training. Additionally, "the pilot implementing the recovery is expected to have aircraft-specific knowledge related to their aircraft's performance and flight characteristics."[74]

The above discussion is summarized in the following graphic, which highlights the recovery chunk of the overall roll recovery process. The graphic is an example of roll recovery guided by the concept of elegant conciseness. Appendix E describes elegant conciseness in more detail and offers a broad framework for upset recovery templates.

Chunks	Mnemonics	Details & Nuance
	Pilot-facing Simplicity	Underlying Complexity for Academic Discussion and Deeper Understanding
Pre-Recovery (set up)	Think First Confirm	– Human factors (surprise & startle, brain stall, pull instinct) – Aerodynamic and other cues (VFR & IFR contexts)
Recovery	**1. Power 2. Push 3. Roll**	**– Nose-high, nose-low, torque roll, overspeed, control effectiveness – Unloading, reducing AOA & G-load, rolling pullouts, design limits – Ailerons to roll, rudder to cancel yaw, roll direction considerations**
Post-Recovery (clean up)	When upright 4. Roll 5. Elevator	– Neutralizing aileron and rudder inputs – Managing the pitch rate and G-load to return to straight & level

Figure 4-7: Example of Power-Push-Roll in a Framework Guided by Elegant Conciseness

Manual flying skills. Human factors. Preventive versus recovery actions. Historical guidance. Logic and elegant conciseness applied to confusing recommendations. Standardizing and optimizing. It leads back to the beginning for roll upset recovery in general aviation: Power-Push-Roll.

Conclusions and next steps follow.

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72 Even in the nose-high case, "Power – off" would not be an unreasonable default action. Gravity and a smooth Push will lower the nose to the horizon.
73 Trainees have been doing this in the EMT program for decades. Verbalizing recovery actions is also part of the "recognize, confirm, announce" strategy used by at least one major airline.
74 Ransbury and McNeace, *Caution, Wake Turbulence!* 31.

Conclusion

This paper examined the haphazard evolution of procedures for recovering from spiral dives and other roll upsets. Missing elements. Unnecessary distinctions. Clunky guidance. To be effective, recovery procedures must also "account for human factors, aircraft characteristics, and operational context."[75] The key takeaways from each of the previous sections are combined in the following table.

Issues	Solutions	Actions
• Skill-based errors drive most GA accidents. • The pull instinct and inadequate training often impede proper recovery from upsets. • The difference between prevention and recovery is not well understood. • No standard exists for recovery from roll upsets in general aviation. • Conflicting guidance leads to confusion.	• Strengthen manual flying skills to increase safety and reduce LOC-I accidents. • Use UPRT to teach pilots to override startle and pull responses. • Clearly differentiate between the upset prevention phase and upset recovery phase in training and procedure design. • Guided by evidence and elegant conciseness, distill complex recovery actions into simple, memorable prompts.	• Emphasize manual flying skills throughout training. • Use standardized recovery strategies for stalls, spins, and spiral dives in GA training. • Strengthen prevention skills with better awareness and avoidance training. • Use in-airplane training to build precise, counterintuitive recovery actions for stalls, spins, and spirals. • Standardize and promote Power-Push-Roll for recovery from roll upsets in general aviation. • Align training curricula accordingly.

LOC-I prevention and recovery skills are "complex and perishable."[76] The correct mental model needs to be planted from the start. Embedding a recovery procedure requires study and deep practice, and good initial and recurrent training to keep it accessible. While especially true of spin and roll recovery procedures, this training mindset applies to all our flying skills.

Pilot actions drive most fatal LOC-I accidents in general aviation. When GA airplanes depart controlled flight, they usually do so in a stall, spin, or spiral dive. Three possibilities, each requiring a different focus during recovery. Consequently, no single recovery strategy can adequately deal with all three types of developed upset.

Designing good recovery procedures is not easy, but the concept is simple. Guided by elegant conciseness:

1. Find the broadest form of the procedure for the type of upset.
2. Distill the teaching points.
3. Optimize for easy retention and practical use.

NASA Standard spin recovery guided by PARE is a good example. It gives pilots "clear, prioritized actions rather than simultaneous inputs that can lead to conflicting control movements or missed steps."[77] It is tailored to the behavior of typical general aviation airplanes.

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[75] Claude, response to author query, Anthropic, June 27, 2025, https://claude.ai.
[76] FAA, *Airplane Flying Handbook*, 2016, 4-24.
[77] Claude, response to author query, Anthropic, June 27, 2025, https://claude.ai.

Power-Push-Roll should be the NASA Standard spin recovery counterpart for roll upset recovery in general aviation. The sequence has simple, clear teaching points. It lists prioritized actions to help stressed pilots. It's adaptable to various types of roll upset. It's also tailored to the characteristics of many general aviation airplanes.

Power-Push-Roll is not new. It combines decades of instructional experience with guidance offered by airplane manufacturers and in pilot training materials. It provides a common starting point for roll upset recovery training. Deviations from the standard must be justified and put in the proper context, with the caveats explained.

Procedures and techniques will likely vary between aviation sectors. Pilots who move from one sector to another must appreciate the operational differences and adapt accordingly.

Appendix F has quick takeaways and training checklists for aviation educators and regulators.

Next Steps

Standardizing roll upset recovery in general aviation requires coordinated action by the aviation community. Stakeholders are encouraged to incorporate Power-Push-Roll into general aviation training materials, syllabi, and safety programs (see also Legal Notices). Further:

- UPRT providers should develop and teach to published syllabi aligned with industry standards.
- Regulatory bodies, aviation organizations, and training providers should:
    - Use elegant conciseness to guide the development of upset recovery templates. For example, only three templates are required in general aviation: one each for stall recovery, spin recovery, and roll upset recovery.
    - Standardize around the Power-Push-Roll sequence in training materials.
- Instructors should:
    - Encourage pilots to get hands-on emergency maneuver/upset prevention and recovery training only from qualified instructors. (See Appendix F for training checklists).
    - Emphasize the importance of awareness and avoidance to mitigate LOC-I.
    - Delineate "the need for counterintuitive actions by the pilot" as the line between developing and developed upsets, prevention and recovery.
    - Include G-cueing in flight training (i.e., develop a feel for the control pressure and seat-of-the-pants cues associated with G-load). In a level turn at 60 degrees of bank, for instance, the pilot is pulling and feeling +2.0G.
    - Teach pilots to abort substandard maneuvers sooner rather than later, and that like a go-around, it's okay to abort.[78] This includes possibly reducing power since power could aggravate a deteriorating situation.
- Aviation media and stakeholders like FAA, UPRT Network, UPRTA International, AOPA, EAA, SAFE, and NAFI should disseminate key findings from this paper.

We have tolerated the loss of controllable airplanes for too long. Upset training is becoming more widely accepted and available. It's time to stop confusing pilots about the straightforward actions to recover from roll upsets. **Power-Push-Roll.**

[78] When to abort a maneuver could be based on Airman Certification Standards, manufacturer limitations, personal minimums, or a combination of these.

Appendix A: Summary of Roll Upset Recovery Recommendations

Below is a summary of the roll upset recovery strategies referenced in this paper sorted by year. “Roll upset” includes unusual, banked attitudes like spiral dives, nose-high, nose-low, and wake turbulence. “Recovery” indicates a developed upset, which requires counterintuitive actions. The Appendices that follow provide more detailed information about the sources and their recommendations.

Source	Year	Country	Power	Push	Roll	Sequence	Notes
CAA	1941	USA	No	No	Yes	Roll	
Hillburn	1957	USA	Yes	No	Yes	Power-Roll	
Hillburn	1957	USA	Yes	Depends	Yes	Simultaneous	Push only in nose-high case
Cessna	1970	USA	Yes	No	Yes	Power-Roll	Cessna 150 and 152, 1970–1978
FAA	1980	USA	No	No	Yes	Roll	Using visual references
FAA	1980	USA	Yes	No	Yes	Power-Roll	Using instrument references
Cessna	1981	USA	Yes(?)	No	Yes	Power(?)-Roll	Power assumed idle
Mason	1982	USA	Yes	No	No	Power	
Cessna	1985	USA	Yes	No	Yes	Power-Roll	
Holmes	1987	USA	Yes	Yes	Yes	Power-Push-Roll	
Kershner	1987	USA	No	No	Yes	Roll	
DeLacerda	1989	USA	No	No	Yes	Roll	
Stowell	1990	USA	Yes	Yes	Yes	Power-Push-Roll	
Kershner	1993	USA	Yes	No	Yes	Power-Roll	Power action first, if necessary
Stowell	1996	USA	Yes	Yes	Yes	Power-Push-Roll	
Thom	1997	GBR	Yes	No	Yes	Power-Roll	
DeLacerda	2002	USA	Yes	No	Yes	Power-Roll	Patton and DeLacerda combined
TC	2003	CAN	No	No	No	No guidance	
CASA	2006	AUS	Yes	No	Yes	Power-Roll	
CASA	2006	AUS	Yes	Depends	Yes	Simultaneous	Push only in nose-high case
Stowell	2007	USA	Yes	Yes	Yes	Power-Push-Roll	
CAA-NZ	2008	NZL	Yes	No	Yes	Power-Roll	
Cirrus	2011	USA	Yes	No	Yes	Power-Roll	Cirrus SR20 and SR22
FAA	2012	USA	Yes	No	Yes	Power-Roll	Power action depends on airspeed
FAA	2012	USA	Yes	Depends	Yes	Power-Push(?)-Roll	Push only in nose-high case
ICAO	2014	INTL	Yes	Yes	Yes	Push-Power-Roll	Nose-high recovery
ICAO	2014	INTL	Yes	Depends	Yes	Push(?)-Roll-Power	Nose-low recovery
FAA	2015	USA	Yes	Yes	No	Push-Power	Nose-high recovery
FAA	2015	USA	Yes	Depends	Yes	Push(?)-Roll-Power	Nose-low recovery
Pope	2015	USA	Yes	No	Yes	Power-Roll	
FAA	2016	USA	Yes(?)	Yes	No	Power(?)-Push	Power assumed idle
FAA	2016	USA	Yes	Yes	Yes	Power-Push-Roll	Influenced by Stowell?
FAA	2016	USA	Yes	Yes	Yes	Push-Roll-Power	"Upset" recovery
Vaccaro	2016	USA	Yes	No	Yes	Power-Roll	
Vaccaro	2016	USA	Yes	Yes	Yes	Power-Push-Roll	
AUPRTA	2017	INTL	Yes	Yes	Yes	Push-Power-Roll	Nose-high recovery
AUPRTA	2017	INTL	Yes	Yes	Yes	Push-Roll-Power	Nose-low recovery
Kruse	2017	AUS	Yes	Yes	Yes	Power-Push-Roll	
Pilkington	2017	AUS	Yes	Yes	Yes	Power-Push-Roll	Influenced by Stowell?
IATA	2018	INTL	Yes	Yes	Yes	Push-Roll	Power action anytime as needed
IATA	2018	INTL	Yes	Yes	Yes	Push-Roll-Power	
IATA	2018	INTL	Yes	Yes	Yes	Push-Roll	Power action as needed after Push
BPPP	2020	USA	Yes	No	Yes	Simultaneous	
BPPP	2020	USA	Yes	Depends	Yes	Simultaneous	Push only in nose-high case
FAA	2021	USA	Yes	Yes	Yes	Power-Push-Roll	Influenced by Stowell?
CAA-NZ	2023	NZL	Yes	No	Yes	Simultaneous	
PilotWorkshops	2023	USA	Yes	Yes	Yes	Power-Push-Roll	
Hirschman	2025	USA	Yes	No	Yes	Power-Roll	

Appendix B: Historical Perspective on Nose-Low & Nose-High Attitudes

Nose-low and nose-high attitudes are developed upsets that might also include an angle of bank. The sources referenced below illustrate the lack of standardization. Appendix C focuses on the spiral dive.

Modern Airmanship

According to Hillburn in 1957, "[t]he following rules are followed by the pilot to recover from unusual attitudes" during instrument flying:[79]

1. *Look at the airspeed indicator…*
2. *If the airspeed is too high, simultaneously reduce the power and correct the bank, and then correct the pitch attitude.*
3. *If the airspeed is too low, simultaneously increase the power and correct the pitch, and then correct the bank attitude.*

Pushing before rolling is not mentioned in the "airspeed too high" case. In the "airspeed too low" case, "correct the pitch" suggests pushing before rolling.

Flight Instructor Manual - Aeroplane

According to CASA in 2006, standard nose high and nose low recovery inputs are to be applied simultaneously.

Nose high[80]

- *Airspeed rapidly approaching or below maximum angle climb speed – APPLY FULL POWER (Otherwise leave power as is.)*
- *ROLL WINGS LEVEL*
- *EASE FORWARD ON CONTROL COLUMN TO LEVEL ATTITUDE*

Apply power, roll, and push inputs at the same time to recover from a nose high attitude.

Nose low[81]

- *Airspeed rapidly approaching or exceeding maximum maneuvering speed – CLOSE THROTTLE (Otherwise leave power as is.)*
- *ROLL WINGS LEVEL Then*
- *EASE OUT OF DIVE*

Pushing is not mentioned in the nose low case.

Instrument Flying Handbook

According to the FAA in 2012, this is how pilots should recover from unusual attitudes when flying on instruments.

[79] Hillburn, *Modern Airmanship*, 500.
[80] CASA, *Flight Instructor Manual*, 81.
[81] Ibid., 82.

Nose high[82]

> *If the airspeed is decreasing, or below the desired airspeed, increase power (as necessary in proportion to the observed deceleration), apply forward elevator pressure to lower the nose and prevent a stall, and correct the bank by applying coordinated aileron and rudder pressure to level the miniature aircraft and center the ball of the turn coordinator. The corrective control applications are made almost simultaneously, but in the sequence given above.*

Power, push, roll to recover from the nose high attitude. It's unclear what "almost simultaneously, but in the sequence given" means.

Nose low[83]

> *If the airspeed is increasing, or is above the desired airspeed, reduce power to prevent excessive airspeed and loss of altitude. Correct the bank attitude with coordinated aileron and rudder pressure to straight flight by referring to the turn coordinator. Raise the nose to level flight attitude by applying smooth back elevator pressure. All components of control should be changed simultaneously for a smooth, proficient recovery. However, during initial training a positive, confident recovery should be made by the numbers, in the sequence given above.*

Pushing is not mentioned in the nose low case. Inputs should be made "simultaneously" except during initial training. There, inputs should be applied in sequence.

RV-Type Training Guide

According to Vaccaro in 2016, this is how pilots flying RV-type airplanes should recover from unusual attitudes.

Nose high[84]

> *If the nose is high and airspeed is decaying, select wide-open throttle if engine and propeller effects are not a factor, neutralize ailerons and apply only enough rudder to maintain coordinated flight while establishing a low G condition…. Then adjust bank, pitch and power to attain the desired flight attitude.*

"Establishing a low G condition" suggests pushing before "adjusting bank" (i.e., rolling).

Nose low[85]

> *Select idle power. With the velocity vector below the horizon and the nose low, RV-types will accelerate very rapidly, and are capable of reaching dangerous airspeed quickly. For airplanes equipped with fixed pitch propellers, if power is not adjusted to idle, an engine over-speed is very likely. Idle power will also help control airspeed build-up regardless of propeller type fitted, however proper, smooth application of G (drag created by lift) will be critical to maintain airspeed within limits. To recover, unload momentarily, crisply roll wings level and apply back pressure to pull the nose up to establish level flight.*

"Unload momentarily" means to push before "crisply" rolling to wings level.

BPPP Instructor Standards Manual

According to the American Bonanza Society in 2020, this is how pilots should recover from unusual attitudes when flying on instruments.

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[82] FAA, *Instrument Flying Handbook*, 7-27.

[83] Ibid., 7-28.

[84] Vaccaro, *RV-Type Training Guide*, 354.

[85] Ibid., 355.

Nose high[86]

- *Recognize decreasing airspeed and increasing altitude.*
- *Simultaneously, add power, lower the nose to the horizon and roll the wings to level.*
- *Reset power.*

Power, push, roll at the same time to recover from the nose high attitude.

Nose low[87]

- *Recognize increasing airspeed and decreasing altitude.*
- *Set the throttle to idle.*
- *Roll to wings level.*
- *Use elevator control force only as necessary to trend the nose toward the horizon.*
- *Reset power.*

No mention of a push when recovering from a nose low attitude.

Convoluted Guidance

The FAA published the advisory circular, *Upset Prevention and Recovery Training* in April 2015. The following year, its *Airplane Flying Handbook* included the new chapter, "Maintaining Aircraft Control: Upset Prevention and Recovery Training."

The advisory circular states:[88]

> *Although this AC is directed to air carriers to implement part 121 regulations,* ***the FAA encourages all airplane operators, pilot schools, and training centers to implement UPRT and to use this guidance, as applicable to the type of airplane in which training is conducted*** [emphasis added].

The *Airplane Flying Handbook* states:[89]

> *The context in which UPRT procedures are introduced and implemented is also an important consideration.... To attain the highest levels of learning possible, the best approach starts with the broadest form of a given procedure, then narrows it down to type-specific requirements.*

These publications present a total of four upset recovery templates. One for nose high attitudes. One for nose low attitudes. Another for spiral dives. And yet another for generic upsets. The templates appear together in the graphic that follows.

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[86] ABS Air Safety Foundation, *BPPP Instructor Standards Manual*, 44.

[87] Ibid.

[88] FAA, *Upset Prevention and Recovery Training*, i.

[89] FAA, *Airplane Flying Handbook*, 2016, 4-24.

Table 1: Nose High Recovery Template

Pilot Flying	Pilot Monitoring
Either Pilot: Recognize and confirm the developing situation. Announce: "Nose High"	
AP: DISCONNECT[3]	MONITOR airspeed and attitude throughout the recovery and ANNOUNCE any continued divergence.
A/THR: OFF	
PITCH: Apply as much nose-down control input as required to obtain a nose-down pitch rate.	
THRUST: Adjust (if required)	Note: If necessary, consider reducing thrust in airplanes with underwing-mounted engines to aid in achieving nose-down pitch rate.
When airspeed is sufficiently increasing: RECOVER to level flight[4]	

Table 2: Nose Low Recovery Template

Pilot Flying	Pilot Monitoring
Either Pilot: Recognize and confirm the developing situation. Announce: "Nose Low"	
AP: DISCONNECT[5]	MONITOR airspeed and attitude throughout the recovery and ANNOUNCE any continued divergence.
A/THR: OFF	
RECOVER from stall if required	
ROLL[6] in the shortest direction to wings level.	
THRUST and DRAG: Adjust (if required)	[6] It may be necessary to reduce the g loading by applying forward control pressure to improve roll effectiveness.
RECOVER to level flight.[7]	

FAA Advisory Circular 120-111, 2015

Spiral Dive Recovery Template
1. Reduce power (throttle) to idle
2. Apply some forward elevator
3. Roll wings level
4. Gently raise the nose to level flight
5. Increase power to climb power

Upset Recovery Template
1. Disconnect the wing leveler or autopilot
2. Apply forward column or stick pressure to unload the airplane
3. Aggressively roll the wings to the nearest horizon
4. Adjust power as necessary by monitoring airspeed
5. Return to level flight

FAA Airplane Flying Handbook, 2016

Figure B-1: Composite of Roll Recovery Procedures from FAA Sources

Look at the manual recovery actions. The spiral dive, upset, and nose low templates assume a banked attitude. The nose high template assumes the wings are level. What if the wings are not level in the nose high case?

Power

The templates tackle power (or thrust) several ways. It's reduced to idle first when recovering from spiral dives. It's to be adjusted later in the recovery scheme in the nose high, nose low, and so-called upset scenarios.

Why is power reduced to idle early in spiral dive recovery, but later in the nose low scenario? Or "as necessary by monitoring airspeed" in the upset template? Spiral dives are nose low upsets and vice versa.[90] Yet we are given three templates offering three slightly different solutions to the same fundamental problem.

The nose high template includes the note, "[i]f necessary, consider reducing thrust in airplanes with underwing-mounted engines to aid in achieving nose-down pitch rate." Getting the nose down is critical in a nose high upset. Why not reduce thrust in airplanes with underwing-mounted engines early instead of having to determine if it's necessary? And why is this a secondary note?

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[90] Thom, *Flying Training*, 274; FAA, *Airplane Flying Handbook*, 2016, 4-23; ABS Air Safety Foundation, *BPPP Instructor Standards Manual*, 20.

Push

Notice how the templates treat the elevator action:

- *Apply as much nose-down control input as required to obtain a nose-down pitch rate*
- *RECOVER from stall if required*
- *It may be necessary to reduce the g loading by applying forward control pressure*
- *Apply some forward elevator*
- *Apply forward column or stick to unload the airplane*

The nose low template requires the pilot to decide if the airplane is stalled or experiencing Gs. More likely than not, nose low upsets will involve one or the other. Why have the pilot evaluate "stall or G-load" when pushing will take care of both issues?

Further, nose low upsets and spiral dives are synonymous. Why have conflicting advice between these two templates? The same question applies to the nose low and upset recovery templates.

Roll

Three templates describe the roll step as follows:

- *ROLL in the shortest direction to wings level*
- *Roll wings level*
- *Aggressively roll the wings to the nearest horizon*

As mentioned earlier, the nose high template does not address the possibility of a banked attitude. Yet the generic upset template, which could apply to nose high or nose low upsets, does.

Assumed in all the templates is the need to coordinate aileron and rudder inputs while rolling. The appropriate amount of rudder with the aileron will improve roll performance. Even so, the basic piloting technique of coordinating aileron and rudder inputs suddenly becomes muddled when it comes to recovery from overbanked attitudes.

The *Airplane Flying Handbook*, for example, says to use "coordinated aileron and rudder inputs" when recovering from spiral dives.[91] The advisory circular says "[c]areful use of rudder to aid roll control should be considered **only if roll control is ineffective** [emphasis added]."[92] This requires more evaluation by the pilot during the most critical phase of the recovery. It's unclear what "if roll control is ineffective" means.

Again, "the best approach [to attain the highest levels of learning] starts with the broadest form of a given procedure."[93] Having four recovery templates for the same family of upset (i.e., unusual, banked attitudes) is anathema to this approach.

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[91] FAA, 2016 *Airplane Flying Handbook*, 4-23; FAA, 2021 *Airplane Flying Handbook*, 5-26.
[92] FAA, *Upset Prevention and Recovery Training*, 15.
[93] FAA, 2016 *Airplane Flying Handbook*, 4-24.

Appendix C: Historical Perspective on Spiral Dives

Appendix B focused on nose-high and nose-low upsets. This Appendix looks at spiral dives.

Confusing, contradictory, and often incomplete spiral dive recovery information has been provided to pilots for decades. The sources referenced below illustrate the lack of standardization.

Guidance from Around the World

1997 – United Kingdom

In *Flying Training*, author Trevor Thom writes:[94]

> *A **nose-low/increasing speed** attitude, if not corrected, can develop into a spiral dive, which can be recognised by:*
>
> - ***a high g-loading****;*
> - ***a rapidly increasing airspeed****…; and*
> - ***a rapid loss of height****…*

Here are the first three steps to recover:[95]

> - ***reduce power*** *(close the throttle);*
> - ***roll the wings level*** *with aileron and rudder;*
> - ***ease out of the ensuing dive****…*

Despite mentioning high G-load, the recovery procedure does not include a push to reduce the G.

2003 – Canada

Transport Canada says, "[a]ircraft that are difficult to spin can quickly build up speed during a failed spin entry. It is important for students to recognize this entry to a spiral dive and immediately apply the correct spiral dive recovery procedure."[96] No guidance is provided on how to recover from the spiral dive despite the heading, "Inadvertent Spiral."

> **Sidebar**
>
> Under "Spin Recovery," Transport Canada claims that once spinning stops, the airplane will "most likely be in a spiral dive condition."[97] This might be the case if recovery actions are taken as the airplane departs into a spin. After about a half turn in a spin, the airplane will most likely recover in a wings-level dive.

2006 – Australia

When teaching recovery from spiral dives, instructors are advised to "stress the necessity of first ensuring the throttle is closed then levelling the wings."[98] No mention of pushing to reduce G-load.

2008 – New Zealand

To recover from a spiral dive, "close the throttle, use the ailerons to reduce bank angle, and ease…out of the ensuing dive."[99] No mention of pushing to reduce G-load.

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94 Thom, *Flying Training*, 274.
95 Ibid.
96 Transport Canada, *Stall/Spin Awareness*, 18.
97 Ibid., 10.
98 CASA, *Flight Instructor Manual*, 53.
99 Civil Aviation Authority of New Zealand, *Spin Avoidance and Recovery*, 8.

2016 – United States

Under "Spiral Mode Recovery," the FAA advises, "[r]elease the back pressure on the stick (yoke), neutralize the rudder and recover from the steep dive."[100]

The context is an intentional spin that has transitioned to a spiral. While the FAA assumes idle power, the recovery procedure fails to address the angle of bank associated with the spiral.

2023 – New Zealand

To recover from a spiral dive recovery during instrument flying, "[c]lose the throttle and simultaneously level the wings."[101] No mention of pushing before rolling the wings level.

CAA/FAA Training Handbooks

1941

The *Civil Pilot Training Manual* hints at spiral dives and recoveries. Botching a steep turn, for example, will result in:[102]

> *a diving turn, with too much speed and an inordinately steep bank…… The practical remedy…is first to reduce the angle of bank with aileron pressure, coordinating the rudder as usual.*

Power is not addressed and no mention of pushing to reduce the G-load.

1980

The FAA *Flight Training Handbook* states:[103]

> *To recover from an unintentional nose-low attitude during a steep turn, the pilot should first reduce the angle of bank with coordinated aileron and rudder pressure.... Attempting to raise the nose first by increasing back elevator pressure will usually cause a tight descending spiral, and could lead to overstressing the airplane.*

Contrast this with spiral recovery when flying by reference to instruments:[104]

> *During initial training, students should be required to make the recovery from a nose-low spiral attitude by taking actions in the following sequence: (1) reduce power; (2) level the wings; (3) raise the nose. After proficiency is attained, all recovery actions may be taken simultaneously.*

The FAA treats spiral recovery as a function of where the pilot is looking. Reducing power is not mentioned when using visual references but reduced to idle first when using instrument references. Pushing to reduce G-load is not mentioned in either case.

2012

The FAA *Instrument Flying Handbook* states:[105]

> *If a rapid downward movement of the altimeter needle or vertical speed needle, together with an increase in airspeed, is observed despite application of back elevator pressure, the airplane is in a diving spiral.*

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[100] FAA, *Stall and Spin Awareness Training*, 7.
[101] Civil Aviation Authority of New Zealand, *Flight Instructor Guide–Unusual attitudes*.
[102] CAA, *Civil Pilot Training Manual*, 196.
[103] FAA, *Flight Training Handbook*, 65.
[104] Ibid., 187–188.
[105] FAA, *Instrument Flying Handbook*, 7-23.

The fix:[106]

> *Immediately shallow the bank with smooth and coordinated aileron and rudder pressures, hold or slightly relax elevator pressure, and increase the cross-check of the attitude indicator, altimeter, and VSI. Reduce power if the airspeed increase is rapid.*

No mention of pushing before rolling, though the pilot could "hold or slightly relax elevator pressure."

2016

This edition of the FAA *Airplane Flying Handbook* has a new Chapter 4 entitled, "Maintaining Aircraft Control: Upset Prevention and Recovery Training."

Regarding spins that could transition to spirals:[107]

> *It is important to note that some training airplanes will not enter into the developed phase but could transition unexpectedly from the incipient phase into a spiral dive. In a spiral dive the airplane will not be in equilibrium but instead will be accelerating and G load can rapidly increase as a result.*

Regarding spiral dives:[108]

> *A spiral dive, a nose low upset, is a descending turn during which airspeed and G-load can increase rapidly and often results from a botched turn.... Pilots typically get into a spiral dive during an inadvertent IMC encounter, most often when the pilot relies on kinesthetic sensations rather than on the flight instruments.*

The chapter also includes the first spiral dive recovery template. Recovery actions follow the Power-Push-Roll sequence.[109]

Spiral Dive Recovery Template
1. Reduce power (throttle) to idle
2. Apply some forward elevator
3. Roll wings level
4. Gently raise the nose to level flight
5. Increase power to climb power

Figure C-1: Spiral Dive Recovery Template in the FAA *Airplane Flying Handbook*

2021

"Maintaining Aircraft Control" and its spiral recovery template are moved to Chapter 5 in this edition of the FAA *Airplane Flying Handbook*.

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[106] FAA, *Instrument Flying Handbook*, 7-23.

[107] FAA, *Airplane Flying Handbook*, 2016, 4-15.

[108] Ibid., 4-23.

[109] Ibid., 4-24. Full disclosure: I was given the opportunity to review and comment on the draft of Chapter 4. Several of my comments were incorporated verbatim and most likely influenced the spiral dive recovery template.

Other Training Material

1957

To recover from a nose-low attitude during instrument flying, Major John E. Hillburn offers the following:[110]

> *If the airspeed is too high, the power must be reduced to prevent excessive airspeed and loss of altitude; then the banking attitude is leveled to maintain straight flight and back pressure is applied to bring the nose of the aircraft up…*

No mention of a push to reduce the G-load.

1982

In *Stalls, Spins, and Safety*, Sammy Mason points out the difference between a spin and a spiral when flying in instrument conditions:[111]

> *If the vertical-speed indicator reveals a rapid rate of descent, and the airspeed indicator shows a speed near or slightly over the stall, the airplane is spinning. If the airspeed is increasing rapidly, the airplane is in a spiral.*

"In either case," Mason says, "the throttle should be closed."[112]

1987

In *The Basic Aerobatic Manual*, William Kershner gives a general review of spirals and spins:[113]

> *A spiral is a steep, diving turn with a low angle of attack and high (usually increasing) airspeed. The average 2-hour student should be able to recover easily from a spiral because the controls are used normally; the wings are leveled with coordinated aileron and rudder pressures and the nose brought up by back pressure.*

No mention of a push or what, if anything, to do with power.

1989

In *Surviving Spins*, Fred DeLacerda writes:[114]

> *Recovery from a spiral requires coordinated control pressures. The wings are levelled by coordinated ailerons and rudder pressures followed by back pressure to bring the nose up.*

No mention of pushing or what, if anything, to do with power.

1990

In the *Emergency Maneuver Training* video, I use the following graphic to summarize when a pilot should take Power-Push-Roll recovery actions.[115]

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[110] Hillburn, *Modern Airmanship*, 499.
[111] Mason, *Stalls, Spins, and Safety*, 104.
[112] Ibid.
[113] Kershner, *The Basic Aerobatic Manual*, 24.
[114] DeLacerda, *Surviving Spins*, 51.
[115] Stowell, *Emergency Maneuver Training* video, 01:02:34.

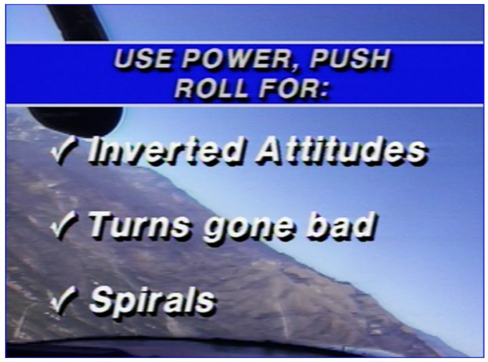

Figure C-2: Screenshot from the 1990 *Emergency Maneuver Training* Video

1993

In the "Spins" chapter in *The Flight Instructor's Manual*, Kershner writes the following for spiral recovery:[116]

> *[The pilot] levels the wings with coordinated aileron and rudder pressures and brings the nose up by back pressure…*

Kershner provides more detail in the chapter, "Teaching Emergency Flying by Reference to Instruments":[117]

> *You may decide that closing the throttle is always a good first step in a spiral recovery....*

He then lists these recovery steps:[118]

1. *Adjust power if necessary. (Usually a good reduction is required to avoid fixed-pitch prop overspeeding.)*
2. *Level the wings using the attitude indicator.*
3. *Bring the nose up to the level-flight attitude by reference to the attitude indicator.*

No mention of a push.

1996

In the book, *Emergency Maneuver Training*, I introduce Power-Push-Roll at the end of Chapter 4, "Curved Flight."[119] Chapter 8, "Overbanked" expands on the procedure with ten paragraphs on the how and why behind these steps.[120]

2002

In *Facts About Spins*, DeLacerda cites the spin recovery procedure used by test pilot Jim Patton, retired NASA Chief of Flight Operations. Here are the first three steps in Patton's eight-step procedure:[121]

1. *Close the throttle.*
2. *Neutralize the ailerons.*
3. *Check airspeed and confirm low constant airspeed (this confirmation differentiates between a spin and a spiral).*

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[116] Kershner, *The Flight Instructor's Manual*, 227.
[117] Ibid., 144.
[118] Ibid.
[119] Stowell, *Emergency Maneuver Training*, 70.
[120] Ibid., 126–128.
[121] DeLacerda, *Facts About Spins*, 50.

With a spin confirmed, the remaining steps follow NASA Standard spin recovery actions.

DeLacerda warns, "an airplane can transition from a spin to a spiral, a transition that even experienced pilots have difficulty determining."[122] Hence, the importance of Patton's airspeed check in step three before continuing with spin recovery actions.

DeLacerda himself describes spiral recovery thus:[123]

> *The wings are leveled by coordinated aileron and rudder pressures followed by back pressure to bring the nose up.*

Again, no mention of a push.

2007

In *Stall/Spin Awareness*, I describe recovery from a spiral thus:[124]

> *Now deliberately and sequentially apply the spiral recovery actions: Power–reduce it to idle; Push–release the back elevator pressure; Roll–apply lots of aileron and some coordinating rudder to roll back to wings-level.*

2017

In *Aerobatics Down Under*, David Pilkington writes:[125]

> *The correct recovery action is to close the throttle completely, unload the elevator with forward stick pressure and positively roll the wings level.*

In *Fly Better*, Noel Kruse lists four steps to recover from the so-called steep phase of a spiral dive:[126]

1. *Reduce power to idle (to control airspeed).*
2. *Relax elevator control to neutral (to control "G force" build up)*
3. *Roll the aeroplane to "wings level" with the ailerons.*
4. *Smoothly pull out of the dive.*

2023

PilotWorkshops describes recovery from a so-called graveyard spiral as follows:[127]

> *The primary cue for adjusting power is airspeed. It's high and increasing, so immediately reduce throttle to idle.... If there's any question about what to do with the throttle, bring it swiftly to idle....*
>
> *[T]he next step is counterintuitive in a steep dive: You need to push. Neutralize the ailerons and give a slight push on the yoke—just enough to reduce load factor to about 1 g. Neutralizing and pushing also protects against inducing "rolling g-forces" that would occur if you pulled and rolled simultaneously....*
>
> *After pushing to reduce load factor, roll the wings level to the horizon with coordinated aileron and rudder.*

122 DeLacerda, *Facts About Spins*, 50.
123 Ibid., 46.
124 Stowell, *Stall/Spin Awareness*, 344.
125 Pilkington, *Aerobatics Down Under*, 106. I reviewed a draft of this book. The author took my advice on spiral recovery.
126 Kruse, *Fly Better*, 205.
127 PilotWorkshops, *Emergency Strategies*, 53–54.

Aviation Media

1987

Harold Holmes details spiral recovery in his article, "Spin or Spiral Dive?":[128]

1. *Close throttle.*
2. *Identify spiral dive by verifying increase in airspeed.*
3. *Release back pressure on yoke.*
4. *Stop the roll with ailerons.*
5. *Recover from the dive smoothly but firmly.*
6. *Return to normal cruise power in straight and level flight.*

2015

Stephen Pope addresses recovering from a spiral dive in an online article for *Flying*:[129]

> *First, immediately reduce power to flight idle. Then bring the airplane to wings level with coordinated use of aileron and rudder. Finally, use elevator inputs to bring the airplane to straight and level flight, keeping in mind that at the high airspeed you risk structural failure, and you may eventually need to start applying forward elevator to keep the nose from rising too much.*

No mention of the need to push until pitching to straight and level.

2025

Dave Hirschman demonstrates spiral recovery in an AOPA video. He advocates the three steps, idle power, wings level, and pull out of the dive as shown in the following screenshot.[130]

Figure C-3: Screenshot from the 2025 AOPA Video

Hirschman says that "a G-meter will show…two or even more Gs in a spiral."[131] Yet he doesn't say where this G-load comes from or whether (or how) it should be addressed during recovery.

[128] Holmes, *Cockpit Classroom*, 89.
[129] Pope, *Flying*, online.
[130] Hirschman, *Airplane Spins vs. Spirals* video, 01:06.
[131] Ibid., 01:25–01:33.

Airplane Manufacturers

Cessna and Cirrus manufacture some of the most popular general aviation airplanes in the world.

1970–1978

The Cessna 150 is introduced in 1959–60. The first recovery procedure for a spiral dive appears in owner's manuals a decade later under "Disorientation in Clouds." The first three steps:[132]

> *(1) Close the throttle.*
> *(2) Stop the turn by using coordinated aileron and rudder control to align the symbolic airplane in the turn coordinator with the horizon reference line.*
> *(3) Cautiously apply elevator back pressure to slowly reduce the indicated airspeed…*

The *Pilot's Operating Handbook* for the 1978 Cessna 152 lists the same first three steps as above.[133]

No mention of a push in any of these procedures.

1981

Many spins-approved Cessna models tend to spontaneously transition from spins to spirals despite pro-spin control inputs. Cessna provides this general guidance:[134]

> *If a spiral is encountered as evidenced by a steady increase in airspeed and "G" loads on the airplane, recovery should be accomplished quickly by leveling the wings and recovering from the resulting dive.*

These spins are intentional, and power is assumed to be idle already. Pushing during spiral recovery is not mentioned despite noting a steady increase in G-load.

1985

Cessna publishes the *Pilot Safety and Warning Supplements*. The first three steps for spiral dives encountered while in the clouds:[135]

> *1. Retard the throttle(s) to idle.*
> *2. Stop the turn by using coordinated aileron and rudder control to align the symbolic airplane in the turn coordinator with the horizontal reference line or center the turn needle and ball of the turn and bank indicator.*
> *3. Cautiously apply control wheel back pressure to slowly reduce the airspeed.*

Again, no mention of a push.

2011

The first three steps for "Inadvertent Spiral Dive During IMC Flight" in Cirrus models SR20 and SR22 are:[136]

> *1. Power Lever…IDLE*
> *2. Stop the spiral dive by using coordinated aileron and rudder control while referring to the attitude indicator and turn coordinator to level the wings.*
> *3. Cautiously apply elevator back pressure to bring airplane to level flight attitude.*

Like Cessna, Cirrus does not address the need to push.

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[132] National Flightshops, *All Those Cessna 150's*, 1970 Section 3-2.
[133] Cessna, *Pilot's Operating Handbook – 1978 Model 152*, 3-12.
[134] Cessna, *Spin Characteristics of Cessna Models*, 5–6.
[135] Cessna, "Pilot Proficiency," *Pilot Safety and Warning Supplements*, 4–5.
[136] Cirrus, *SR20 Pilot's Operating Handbook*, 3-19; Cirrus, *SR22 Pilot's Operating Handbook*, 3-19.

Under "Spins," Cirrus notes:[137]

> *If, at the stall, the controls are misapplied and abused accelerated inputs are made to the elevator, rudder and/or ailerons, an abrupt wing drop may be felt and a spiral or spin may be entered. In some cases it may be difficult to determine if the aircraft has entered a spiral or the beginning of a spin.*

The pilot must identify the type of upset and apply the correct recovery procedure.

Type-Specific Training

RV-Type Airplanes

The RV series by Vans Aircraft dominates the amateur/homebuilt airplane market. Michael Vaccaro offers the "Unload for Control Concept" as an intro to upset recoveries in these airplanes.[138]

Yet when it comes to recovering from a spiral dive, Vaccaro does not mention unloading. Instead, he says to recover these airplanes "by reducing power, rolling the wings parallel to the horizon and smoothly applying G."[139]

Beechcraft Pilot Proficiency Program

The Beechcraft Pilot Proficiency Program offers standardized training to owners of various Beechcraft models. The program includes a demonstration of spiral recovery with power change.

The *Instructor Standards Manual* notes that the "technique is identical to recovery from a nose low, increasing airspeed unusual attitude."[140] The first two points in the technique are:[141]

- *Simultaneously, level the wings and reduce power to idle.*
- *Note pitch behavior. In most cases pitch up occurs without pilot input as the airplane seeks trim airspeed.*

Again, the significance of pushing is not addressed.

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137 Cirrus, *SR20 Pilot's Operating Handbook*, 3-20; Cirrus, *SR22 Pilot's Operating Handbook*, 3-20.
138 Vaccaro, *RV-Type Training Guide*, 353.
139 Ibid., 290.
140 ABS Air Safety Foundation, *BPPP Instructor Standards Manual*, 20.
141 Ibid.

Appendix D: Historical Perspective on the All-Attitude Upset (a.k.a. Single) Recovery Strategy

This appendix traces how the single all-attitude upset recovery strategy evolved.

Providers of UPRT keep refining their training methods using research, new information, and practical experience. Aviation Performance Solutions (APS) is an exemplary UPRT provider that continues to innovate and make significant contributions to aviation safety.

The current *APS All-Attitude Upset Recovery Strategy* evolved over many years of instruction, testing, and refinement. APS traces its earliest approach to recovery to the Canadian military's primary flight training program at Portage la Prairie in the mid-1980s.[142] There, future APS CEO Paul "BJ" Ransbury learned Pressure-Power-Rudder-Level-Climb as the standard stall recovery sequence. APS adopted this as its stall recovery standard.[143]

Originally known as Fighter Combat International (FCI), APS also adopted the *Emergency Maneuver Training* name, reflecting the influence of my EMT methodology.[144] This included integrating the PARE spin recovery checklist into its spin training.[145] APS also adopted Power-Push-Roll for recoveries from spiral dives, unusual, banked attitudes, and simulated control failure scenarios.[146]

As APS began working with stall scenarios, trim-induced upsets, and higher-performance aircraft, the term "Pressure" often proved insufficient. "Pressure" evolved into "Push," not as a reflexive jab, but as a deliberate assessment and management of angle of attack.[147] This change aligned with recommendations in the *Airplane Upset Recovery Training Aid—Revision 2*.

APS then developed its integrated *All-Attitude Upset Recovery Technique Checklist*. This was promoted as "a single set of in-flight procedures to recover from virtually any uncontrolled flight attitude, outside of a fully developed spin."[148] The relevant part of this checklist is Push-Power-Rudder-Roll. Below is the APS matrix, divided into two types of recovery: All-Attitude Upset Recovery and NASA Standard Spin Recovery.[149]

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[142] Personal email correspondence from Paul "BJ" Ransbury, CEO, Aviation Performance Solutions, December 7, 2025.
[143] FCI, *Emergency Maneuver Training Guide*, 30.
[144] Personal email correspondence from Paul "BJ" Ransbury, CEO, Aviation Performance Solutions, December 7, 2025.
[145] FCI, *Emergency Maneuver Training Guide*, 60. Shown as "P.A.R.E."
[146] FCI, *Emergency Maneuver Training Guide*, 42, 50–52, 56–57; Ransbury and McNeace, *Caution, Wake Turbulence!* 36.
[147] Personal email correspondence from Paul "BJ" Ransbury, CEO, Aviation Performance Solutions, December 7, 2025.
[148] Editorial Staff, *"All-Attitude" Recovery Technique Promoted*, online; Ransbury and McNeace, *Caution, Wake Turbulence!* 38.
[149] Ransbury and McNeace, *Caution, Wake Turbulence!* 46.

All-Attitude Upset Recovery™ Technique		NASA Standard Spin Recovery
CENTRALIZE / ANALYSE		**POWER**
DISCONNECT AUTO-PILOT / AUTO-THROTTLE*		**AILERONS**
RECOVER		**RUDDER**
PUSH*		**ELEVATOR**
POWER*		
RUDDER		
ROLL		
CLIMB		
Flight Conditions		**Flight Conditions** (if recoverable)
Power off/on Stall	Spiral Dive	Spin
Accelerated Stall	Unusual Attitudes	Incipient Spin
Cross-controlled Stalls	Over-banks	Aggravated Spins
Slipping Stalls	Wake Turbulence	Flat Spin
Skidding Stalls	Rolling Upsets	Accelerated Spins
Incipient Spin		

Figure D-1: APS Matrix of Recovery Strategies, 2009

Both recoveries list "incipient spin" as an applicable condition. NASA Standard spin recovery actions, though, make no distinction between spin phases or spin types. An airplane spinning unintentionally (by definition, a developed upset) calls for spin recovery actions regardless of the status of the spin.

In the Push-Power-Rudder-Roll sequence, Rudder was intended only to cancel yaw and avoid aggravating a pre-spin condition. Overuse of rudder, especially negative transfer from improper general aviation training, was a known risk factor in larger, higher-inertia aircraft.[150]

ICAO, EASA, and FAA templates eventually removed Rudder as a separate recovery step. In 2015, APS fully aligned its training, updated its recovery sequence, and renamed it the *APS All-Attitude Upset Recovery Strategy* (AAURS).[151] For this discussion, the relevant part of the AAURS is Push-Roll-Power. This is promoted in the air carrier industry as the Baseline AAURS, while Push-Power-Roll is the Variant.[152]

Below are the four roll recovery strategies, their origins, and their stated applicability. The strategies are shown in order of their formal introduction.

Strategy	Power-Push-Roll	Push-Power-Rudder-Roll	Push-Roll-Power	Push-Power-Roll
Origin	Stowell	Aviation Performance Solutions		
Applicability	Spiral Dives, Overbanked Attitudes, Rolling Upsets, Wake Turbulence	Stalls, Spiral Dives, Overbanked Attitudes, Rolling Upsets, Wake Turbulence, and Incipient Spins* *WARNING: THE ABOVE STRATEGIES ARE CONTRARY TO NASA STANDARD SPIN RECOVERY		

Figure D-2: The Four Roll Upset Recovery Strategies

150 Personal email correspondence from Paul "BJ" Ransbury, CEO, Aviation Performance Solutions, December 7, 2025.
151 APS Training, *What Is the APS All-Attitude Upset Recovery Strategy?*, online.
152 Ibid. Like the EMT program, "Say-Do" is a core feature of the *APS All-Attitude Upset Recovery Strategy*. Calling out each step during recovery improves control sequencing and pilot performance even if startled. APS research has shown better recall, fewer execution errors, and more durable skill retention when pilots verbalize recovery actions as they perform them.

APS continues to teach NASA Standard Spin Recovery using PARE in piston aircraft programs and general-aviation-focused courses. In contrast, recovering from a spin in multi-engine turboprops and business jets is not a realistic option.[153] In those aircraft, strict stall awareness and prevention are essential to avoid a spin departure.

The current state of roll recovery procedures is convoluted, but the idea of a single recovery strategy makes sense for the air carrier industry. Spins are not an issue there. General aviation differs fundamentally from air carrier operations. Inadvertent stalls, spins, and spiral dives are common outcomes when general aviation pilots lose control. So, a single, all-attitude recovery strategy is impractical in general aviation.

Recall the difference between prevention and recovery. "Push" is usually an effective first step to stop a developing upset, but things are more complicated in a developed upset. This is why good UPRT programs emphasize prevention by design, while still exposing trainees to recoveries from developed upsets.

Stalls, spins, and spiral dives are developed upsets. Each demands a different and counterintuitive set of recovery actions. General aviation flight training should rest on established standards for stall recovery, spin recovery, and roll upset recovery. Such standards already exist for stalls and spins. Power-Push-Roll is recommended for spiral dives and other roll upsets.

[153] Personal email correspondence from Paul "BJ" Ransbury, CEO, Aviation Performance Solutions, December 7, 2025.

Appendix E: Applying Elegant Conciseness to Upset Recovery Templates

In aviation, procedures are often summarized in short phrases, acronyms, and mnemonics. It is easy to overlook the principle that makes these cues effective: *elegant conciseness*. Elegant conciseness is the purposeful distillation of complex actions into simple prompts. It has a dual characteristic: pilot-facing simplicity with underlying complexity.

Elegant conciseness is not about creating shortcuts. It is not about oversimplifying or memorizing. Elegant conciseness compresses best practices, human factors, and aerodynamic realities into easily recalled actions. These cues are memorable and robust, which can be especially useful in an emergency.

Durable learning comes from mastering the underlying complexity. This requires study, critical thinking, and hands-on training. Lots of training. Upset recovery templates designed with elegant conciseness can improve the transfer of knowledge and skill. They can also help pilots recall critical action items with confidence while appreciating the depth and discipline represented by the mnemonics.

A Broad Framework for Recovery Templates

This paper has exposed the muddled state of published roll recovery recommendations and templates. Yet the common themes suggest a framework for elegantly concise templates for the three most common upsets: stalling, spinning, and spiraling. The process of recovering from a developed upset has three chunks:[154]

- Pre-recovery
- Recovery
- Post-recovery

Pre-recovery (set up) actions might include:

- Regaining mental control—recover from brain stall and get your head back in the game
- Assessing the situation (for example, recognize, confirm, announce)
- Disconnecting the automation—revert to manual flying skills

Recovery actions will be specific to the upset. Consider the three most common types in general aviation:

- Stalling—Push
- Spinning—PARE: Power-Aileron-Rudder-Elevator
- Spiraling—Power-Push-Roll

Post-recovery (clean up) actions will usually include:

- Stabilizing the airplane (for example, neutralize recovery inputs)
- Managing the flightpath—return to the desired state (for example, straight and level flight)

[154] For clarity, I've separated the parts of the recovery process into "chunks"—self-contained units of action. This facilitates greater consistency and efficiency when teaching and learning the material. It also supports recall and execution, especially when the pilot is stressed.

Like mnemonics, these chunks are consistent with the concept of elegant conciseness. The extent of pre- and post-recovery actions will depend on the sophistication of the airplane. The time needed to complete the recovery process will vary as well. Recovering from a wings-level stall might be quick. In an aggravated spin, it could take an additional turn or more after completing PARE before reaching the post-recovery chunk. Pilot competency will also affect the time it takes to complete the recovery process.

Below is a framework for upset recovery templates informed by elegant conciseness. (Refer to the earlier example of this framework applied to the Power-Push-Roll strategy.)

Chunks	Mnemonics	Details & Nuance
	Pilot-facing Simplicity	Underlying Complexity for Academic Discussion and Deeper Understanding
Pre-Recovery (set up)		
Recovery		
Post-Recovery (clean up)		

Figure E-1: A Framework for Upset Recovery Templates

Appendix F: Quick Takeaways and Training Checklists

Stakeholders are encouraged to incorporate Power-Push-Roll into general aviation training materials, syllabi, and safety programs (see also Legal Notices).

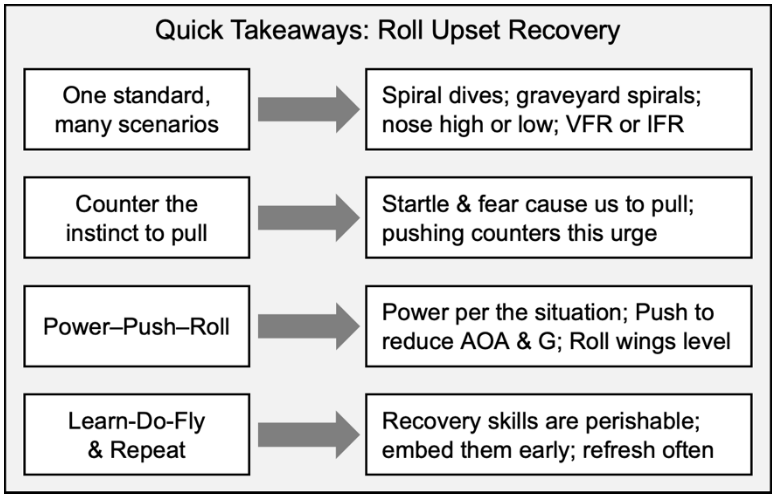

Figure F-1: Quick Takeaways for Aviation Educators and Regulators

Power-Push-Roll recovery checklist

1. Power – off/on (airplane- and situation-dependent)
2. Push – reduce AOA and G-load
3. Roll – apply ailerons to roll; apply rudder to cancel yaw

When upright

4. Roll – neutralize aileron and rudder inputs
5. Elevator – manage the pitch rate and G-load to the desired flightpath

Three broad roll upset scenarios to discuss (include VFR and IFR cues)

I. Nose low, airspeed high/increasing
II. Nose high, airspeed low/decreasing
III. Wake turbulence-induced roll (rolling with vs. rolling against the vortex)

Considerations for all-attitude roll upset flight training

- ☐ An airplane operated in the acrobatic category.[155]
- ☐ Parachutes per FAR 91.307.[156]
- ☐ Training airspace per FAR 91.303.[157]
- ☐ A flight instructor who specializes in UPRT techniques.[158]

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[155] See "Aeroplane & Equipment Considerations," Brooks, et al., *Forging Pilot Resilience Against Loss of Control In-flight*, 12–17.
[156] See https://www.ecfr.gov/current/title-14/chapter-I/subchapter-F/part-91.
[157] Ibid.
[158] "Upset prevention and recovery training is different from aerobatic training," FAA, *Airplane Flying Handbook*, 2021, 5-5. See also "Instructor Considerations," Brooks, et al., *Forging Pilot Resilience Against Loss of Control In-flight*, 17–21.

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About the Author

Rich Stowell began his career as a full-time flight instructor in 1987 specializing in spin, emergency maneuver, and aerobatic training. He is the author of the books *Emergency Maneuver Training* and *The Light Airplane Pilot's Guide to Stall/Spin Awareness*. He has also been called an architect/grandfather of modern upset prevention and recovery training.

Stowell is the 2014 National FAA Safety Team Representative of the Year and 2006 National Flight Instructor of the Year. He has delivered more than 500 safety presentations and is a recognized subject matter expert on loss of control in light airplanes. Stowell has been a panelist at two safety events hosted by the NTSB in Washington, DC. He has also worked as an expert witness for the Department of Justice Aviation, Space, and Admiralty Litigation Section.

Thanks to financial support from Avemco Insurance and Hartzell Propeller, Stowell released his free *Learn to Turn* program in 2021. He followed that with *The Nine Principles of Light Airplane Flying* in 2022 and the *Blueprint for an Optimal Aviation Learning Experience* in 2024. Collaborating with Community Aviation, he released the *Intro to Stalled Flight* course in 2025.

Stowell has logged 10,600 hours of flight time, with 9,500 hours of flight instruction given. His experience includes performing 35,600 spins in 260 spins-approved airplanes representing 50 types, and logging time in 540 single-engine airplanes representing 110 types.

A 20-year Master Flight Instructor (now Emeritus), Stowell is a Charter and Life Member of SAFE and a Founding Member of the Upset Prevention and Recovery Training Network. In 2025, Stowell served as the general aviation Individual Operator UPRT Working Group Team Lead for the Upset Prevention and Recovery Training Association-International.

Stowell is a 42-year member of AOPA, EAA, and IAC, and was a 20-year member of NAFI. He is one of fewer than 200 pilots to earn the *All Five* special achievement award from the IAC. He holds a bachelor's degree in mechanical engineering from Rensselaer Polytechnic Institute, Troy, NY.

Legal Notices

Per 14 CFR 91.3(a): ***The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft.***

Stakeholders are encouraged to incorporate Power-Push-Roll into general aviation training materials, syllabi, and safety programs. Permission is granted to use Stowell's marks provided they are:

- Used for educational purposes in general aviation training;
- Used in the same context as presented in this paper and as detailed in his books, *Emergency Maneuver Training* and *Stall/Spin Awareness*; and,
- Attributed as appropriate.

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