

Pilot Induced Oscillations

We've had a number of propeller strike mishap events on the U.S. Federal Aviation Administration's preliminary reports page since the first of the year. "Prop strikes" are usually the result of loss of airplane control along its pitch axis during the on-runway phase of a landing. Because this is normally caused by improper control of pitch and speed by the pilot, we call this a ***pilot-induced oscillation***.

Pilot-induced oscillation (PIO) occurs when the airplane begins a departure from the desired flight path, and the pilot applies inappropriate, excessive or mis-timed corrections that result in ever-increasing excursions that threaten to force the airplane out of control. In short, the pilot is "behind the airplane" and his/her attempts at regaining control only make matters worse.

PIO can occur in any phase of flight, but it is usually associated with pitch excursions on landing. PIO can rapidly develop to catastrophic proportions, even in the hands of an experienced test pilot.

PIOs are usually the result of attempting to "force" the airplane onto the runway at too great a speed. The airplane bounces, not quite yet done flying, and glancing off the landing surface in a regime characterized by movement up and down in pitch. Aggravating the PIO is the pilot who "gives up," i.e., relaxes and stops actively managing the controls when the airplane touches down, as if the job is done when the tires touch the ground and not when the boarding doors are closed after the last person exits the airplane on the ramp. If the pilot relaxes and a PIO begins, this out-of-touch pilot will probably instinctively grab the controls and apply "corrective" inputs, but reactively, from a position of being mentally and physically "behind the airplane."

PIO-induced airframe stresses can rapidly damage landing gear and other airplane structures. It can force the airplane off the runway, out of control in roll or bouncing up into a stall. Landing gear overload and collapse frequently occurs, in fixed gear as well as retractable types. Whether the airframe itself is or isn't damaged, propeller strikes are common in propeller-driven aircraft.

Although in a very minor PIO you may be able to hold aft pressure on the elevator controls and dampen out the pitch excursions, once a PIO begins your best option is to power up and go around.

Master the PIO by adding go-arounds after the main gear touches the ground to your recurrent training regimen. Be well-practiced in establishing the right pitch and angle of attack, while firmly holding the proper attitude to ***prevent PIO from happening in the first place***.

Instructors, there are two kinds of go-around, and after the Private checkride most only teach one. It's comparatively easy to power up, pitch up and clean up from a point a couple hundred feet above the runway lights. It's quite another task to go around once the mains have touched, the speed is low and the angle of attack is very near a stall.

I spoke with a pilot in California last week who said he mistakenly thought he was fully current in go-arounds because he flies instrument procedures under the hood with an instructor every two months, and practices a lot of missed approaches from minimums. After hearing my presentation about stalls during go-arounds from the landing configuration, however, he realized he has not practiced a *real* go-around—from short final, with full flaps, at just above stall speed—since taking his Private Pilot checkride decades ago.

My first instructors presented touch-and-goes as pseudo go-arounds; in US Air Force training it wasn't considered a touch-and-go if the nosewheel of the Cessna T-41A touched the ground. We were learning the skill of aerodynamic braking, because some of us would go on to fly Air Force fighters. But we were also learning the art of the on-runway go-around, with a liftoff in a condition that necessitated a firm push forward on the controls with power application, then finesse as flaps were retracted and flying speed restored. In short, we learned how to recover from PIO.

If the propeller strikes it's another story. Prop strikes can cause immediate, catastrophic engine damage or propeller damage that makes a go-around incredibly risky. They can also cause internal overstresses that will become a catastrophic failure at some point dozens or hundreds of hours in the future, usually without warning. If the prop hits—you hear that awful tick-tick-tick of blades chewing into pavement—all bets are off. Hold back pressure, dampen the PIO and bring the airplane to a stop. Although every now and then we hear about a "hero" (I use that word derisively) who has a prop strike on landing (usually because he/she forgot to extend retractable landing gear) and powers up to go around and land the next time. The danger of engine failure is real, however, making the prop strike pilot much wiser (and likely to live to fly again) if he or she accepts the terrible mistake and continues the landing.

Most engine manufacturers recommend engine tear-down inspections after a propeller strike. One manufacturer considers a tear-down mandatory if the propeller speed is seen to drop any at all when the strike occurs, and even if a prop strike occurs when the propeller isn't turning (for example, a towing accident) if the damage is substantial enough the propeller must be removed from the airplane for repairs. I've not seen definitive research, but unofficial word from engine manufacturers is that investigation of crankshaft failures and other "bottom end" catastrophic engine failures in flight often reveals a propeller strike in that engine's past, frequently many years before the total engine failure occurs.