"Standardized Flight Profiles for Precision Flying"

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Ask an experienced pilot to describe what makes them a "professional" over their years of experience and see what they say. You may not get one answer, but you will find a few answers that keep repeating over and over. To understand what experienced pilots view as the techniques that make them professional should be what we teach our flight training cadets early in their training experience so they too will become precise, and thus, safe pilots.

Flight cadets typically start at the same place; knowing little to nothing about aviation. They also end up at the same place. That is, being a graduate of a program and expecting to step right from an aircraft weighing less than an automobile to an aircraft weighing a thousand times that. This may or may not be realistic expectation, but that is another topic. The focus of this piece is to address the techniques that educator's can use to help cadets learn to fly with grace and precision to make the transition with as little difficulty as possible.

NFTI is one of nine (9) Flight Training Operation (FTO) Centers run by CAE Oxford Aviation Academy. It has the challenge of taking pilot 'wannabes' straight out of 10+2 (high school) and turning them into tomorrow's airline pilots. This mission is complicated by having such programs distributed around the world and being administered under different National Aviation Authorities (NAA). There are a number of obstacles to learning that will always be present in an ab initio training program. A program like CAE's overcomes learning obstacles by creating an NAA compliant syllabus and having the instructors standardized across that syllabus to ensure that each is taught the same way, regardless of what country they are in. To this end, we should recognize that the same skills that make a professional pilot in one country should be universal in another. The certification requirements may be

different, but the techniques that lead to mastery of the skills are not. What may not be consistent are the techniques taught at the instructor level. This may be because our instructors were taught inconsistently; a disparity that has been observed for many years and complicates the process of standardization. If we search for the common denominator, perhaps we can define a common technique to teach cadets to achieve the smooth and safe flying skills the airlines seek. This can be described as "precision flying". So for arguments sake, lets discuss the techniques to achieve precision. This involves using "standardized flight profiles" and training cadets to repeatedly practice them to achieve the state of precision flying required to qualify for CPL/ATPL proficiency exams whether it be FAA, EASA, CASA, or DGCA.

So what is precision flying and what should we be teaching our cadets about it? Precision flying is the art of flying a set of procedures so consistently that the outcome of any maneuver or procedure is predictable and within specified limits without any unusual or unpredictable control inputs or maneuvering. Many pilots believe that this is just good judgment and yes, judgment sure plays a role, but there is more to it then that. Judgment is very difficult to teach. It is all based upon the common perception of the teacher and the student. An instructor could suggest a judgment technique of aligning ones eyes on a fixed spot on the glare shield in order to perform steep turns without gaining or losing altitude, but that spot will not work if the pilots have different heights or even from the right side to the left side of the cockpit. It is a technique that is too perception dependent. The instructor must find a way to communicate techniques that will work in any cockpit and with any pilot. They need to come up with a playbook that leads to consistency in maneuver and procedure execution that will allow pilot judgment to develop. This occurs because of repeated predictable maneuver outcomes as a result of constraints on technique variability. In flying, there are many variables that lead to the outcome of any maneuver. Pitch, power, and airspeed are the basic three, but aircraft configuration of flaps, gear, trim, winds, runway gradient, weather, and varying airport procedures simply makes forming judgment

difficult when they change rapidly and at varying times without the cadet understanding the relationships of each on procedure outcome.

So practice and developed judgment plus the constraint of changing variables and several other good flying habits leads to precision flying. Lets look at a couple of examples.

Judgment when trying to learn to flare the aircraft on landing is something that only results from practice. An instructor can teach tricks to aid the judgment process like looking toward the end of the runway during the flare, but only the person practicing can perfect the process after enough practice that their judgment is fine-tuned. So while judgment is crucial, it is not in itself the same as precision flying. Once the pilot practices enough and they are taught a few key techniques for minimizing variability in the procedure will performance become more consistent. Consistency practicing a learned repeatable procedure leads to understanding which leads to precision over time.

Precision flying, when talking about landings, is having the wheels touch down on a predetermined point on the runway with the longitudinal axis of the aircraft centered over the runway centerline. Judgment is important here, but there must be a process that eliminates variables that leads to consistent performance. This is especially true since the touchdown point may be defined from downwind or from a straight-in position. Only a properly defined procedure practiced over and over again will lead to precision.

Precision flying, when talking about instrument approaches, is arriving at the DH or DA on the procedure with the needles centered and with airspeed and power set appropriately without performing any large power or pitch changes along the way. Using a standardized flight profile for the aircraft at various segments along the approach will lead to precision execution of the maneuver if other changing variables are minimized. Again, judgment is important in executing a good approach, but it is going to be the flawless execution of a standardized procedure that will result in an approach demonstrating precision.

Precision flying, when talking about steep turns, is completing the maneuver at the proper altitude and heading after turning in both directions without using any rough or rushed control inputs. The steep turn is a tell-tail maneuver because it is difficult to bluff precision. You either completely understand it or you don't. If a cadet performs it mechanically, then the result will be a series of deviations from the standards and the instructor will be able to tell right away there is work to do.

Precision flying, when talking about power-off accuracy landings, is skillfully guiding the aircraft from the point of power reduction to a predetermined touchdown point on the runway without adding power. There is an enormous amount of judgment required to perform this maneuver accurately and it takes a lot of practice. In the end, it is the graceful execution of the maneuver that will result in a precise performance. Only until the cadet can flawlessly execute the defined profile will judgment be developed and it is through this judgment that precision is demonstrated.

So let's look at the components of precision flying and explore how we can put it to work for us when teaching our students. From a professional pilot's standpoint, the components involved are using defined, standardized flight profiles, deliberate flight control and power movements, judicious use of trim, planning ahead to minimize changing variables, and a continual scan pattern to keep track of it all.

Lets look at each.

Standardized flight profiles –The school must define them, the training manual must depict them, the instructors must be standardized to teach them, and the cadet must memorize and practice them. The CAE training manual does a great job of defining dozens of maneuvers and details most

parameters from power settings to airspeeds at various points in executing the procedure. This is how airlines do it. No pilot flying for an airline would be allowed to define their own procedures in an Airbus, so neither should our cadets when we teach them to fly. If the procedure calls for an entry at a particular airspeed, then the cadet must be held to this standard every time. The important part for the cadet to understand is that there are key aspects of the procedure that must be memorized and applied at the right moment without having to take the time to stare at an instrument. A great example is the knowledge that in a given weight configuration, reducing power to a certain manifold pressure and RPM combination at a given airspeed, will yield a consistent rate of decent, which will produce a predictable decent angle. The cadet has to be taught to believe this and always follow this pattern exactly. At first there is the temptation to keep staring at the airspeed indicator after the power reduction waiting for the speed to lock in. The student must understand that it takes the aircraft 4-8 seconds to stabilize after any power, pitch, gear, or flap change. The instructor must teach the student that knowing this gives them 4-8 seconds to do something else waiting for the aircraft to do what it was designed to do. Why give up that time staring at an instrument waiting for something to happen if it always does? This is the belief in the profile, the practice that convinces the cadet that it works nearly perfectly every time, and the gained extra time to stay ahead of the aircraft to watch for more important things that are about to happen. This develops confidence, allows the cadet to develop a smoother, more adept mastery over the procedure and finally, achieve a more precisely executed procedure.

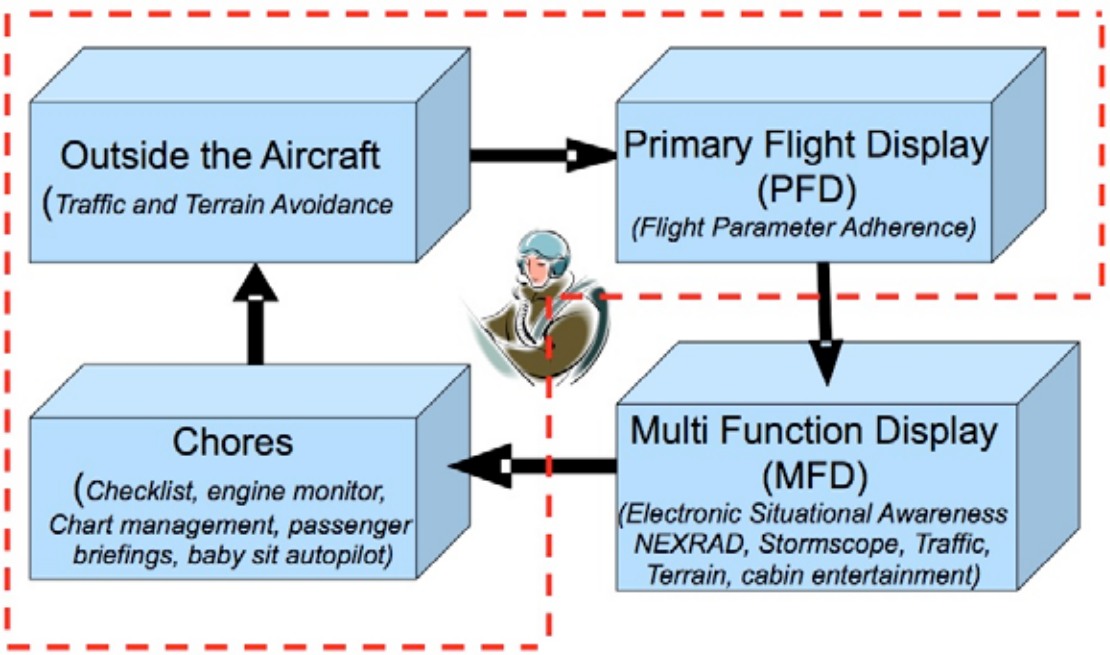
Discrete, Delicate Flight Control and Power Movements – The next component of precision flying involves the human machine interface. One of the things that an instructor will tell you about the first flight of a cadet is the large, jerky control movements they will make. The cadet must be taught early on to relax at the controls and make small, smooth control inputs to avoid over-controlling. This certainly is one causal factor of pilot Induced Oscillations (PIO) during landing skill development. Once the cadet learns to make small, fingertip control changes, then PIO and other related maladies tend to disappear. Just as mentioned in the previous section, the aircraft takes 4 – 8 seconds to assume a new equilibrium after a power, gear, or flap configuration change. It stands to reason that a deft touch on the controls will minimize over-controlling and yield a much more precise result. As instructors, we have witnessed cadets over time that apply the “death grip” on the controls; you know the “white knuckles” we sometimes see on new students. Sometimes this is because cadets do not know any better and sometimes it is due to nervousness. The brain tends to transmit nervousness or stress to the extremities. Some people stiffen their legs on the rudder pedals and some exhibit their stress on the yoke or control

stick. The instructor should get the student to relax their grip on the controls at the earliest stages of training so it is not engrained as a habit. Once they relax, they can gain more confident, finite control of the yoke, rudders, and power lever.

Judicious Use of Trim – One of the most effective ways to maintain a stabilized configuration is through continual small trim changes to achieve the desired combination of airspeed and rate of climb or descent. Once you achieve a trimmed airspeed, then minute power changes will fine-tune the rate of climb or descent to a near exact amount. This will result in precise control over maintaining a glideslope or climb profile. It is also highly effective in steep turns, maintaining best glide while trying to make a chosen forced landing point, and maintaining altitude during minimum controllable airspeed and effects of configuration demonstrations. One thing we know for sure is that the human body's "muscle memory" is not very accurate at holding an aircraft configuration while we are distracted on something else. Instructors should teach their cadets early about the wonders of maintaining a stabilized configuration by frequent and judicious use of elevator trim.

Advanced Planning and the Elimination of Change Variables -
Another important aspect of a precision flying skillset is the application of advanced planning. We have been taught that Single Pilot Resource Management (SRM) is the precise and balanced use of situational awareness, aeronautical decision-making, and cockpit workload management. When a pilot is preparing to fly a procedure that has a defined flight profile, it is important to fly it the way they practiced it. That is, use the predetermined airspeed, power, gear, and flap configurations that have been set out for that maneuver unless conditions dictate otherwise. It is important to reduce the number of changing variables in any maneuver in order to allow planning for uncontrollable variables such as changing winds. If a maneuver is executed the way it was rehearsed with precise power, flap, gear, and other variables applied at the prescribed times, then the pilot has reduced the number of variables that can become contingencies to a manageable amount. In a landing or instrument approach scenario, if flaps power, airspeed, and gear are deployed exactly as rehearsed, the few remaining variables are crosswind and headwind components, right? Everything else should be as expected. The pilot can then use situational awareness to detect variances and then apply aeronautical decision making to determine what to do about it. If flaps, gear, power and pitch are all changing at haphazard times, then each change results in the 4 – 8 second reconfiguration delay and that means that situation awareness is delayed, the pilot is distracted and performance will vary from predicted.

Continual Moving Cockpit Scan Pattern – The final element that pilots must develop to demonstrate precision flying skills is a cockpit scan pattern that allows their attention to continue to refocus so situational awareness stays sharp and real time. Pilots who are struggling with precision probably have developed an erratic scan pattern and are allowing themselves to stare at areas too long which leads to loss of focus on more relevant areas of the procedure. A good scan pattern involves three (3) main areas in a non-glass cockpit and four (4) areas in a glass cockpit.



The problem with an erratic scan pattern is that the pilot is not looking at an area as it needs attention and it soon develops into a larger problem that requires more attention to correct. That typically means a larger correction that detracts from precision. In a flying minute in a glass cockpit, there are four areas that need the pilot's continual attention; that only allows 15 seconds per area per minute. If the pilot stares at an area too long or stares at an area that is not relevant for the procedure, the performance suffers. Divide this again with just the flight instruments and that means that in the 15 seconds allotted for the PFD area, the pilot needs to get everything they need from all the instrument portrayals in just 15 seconds or other important areas go unnoticed! In performing maneuvers, it is possible to purposely exclude an area of the scan during the maneuver. For instance, a pilot performing steep turns can ignore the MFD during the maneuver to focus more intently on the PFD and looking outside the aircraft to clear traffic. It really is a skill to learn to focus one's attention exactly where it is needed. That developed skill leads to precision.

The professional pilot learns from experience to approach each procedure with an element of predictability in order to assure that the result is what was practiced in both the aircraft and the simulator. This is done by using rehearsed flight profiles and applying smooth control inputs, frequent trim, maintaining constantly changing vigilance in a scan and these all lead to a stabilized flight configuration. They also learn that reducing the number of variables that are changing at the last moment increases safety margins. It results in precise maneuvers and procedures which leads to comfort for the passengers and mitigates the chances of mishap. They learn to make small corrections to the controls and power and to frequently trim the aircraft to achieve a perfect balance of flight equilibrium. They also develop a continually moving cockpit scan pattern in order to continually refresh situational awareness with real time data. These elements lead to precision flying and represent the best of what professional aviators demonstrate every day.

We should learn from the professional pilot and include precision flying techniques at the earliest possible stages of cadet training. The training community must also ensure that the instructors they hire are themselves precision flyers. They should be universally standardized in these techniques and use agreed to flight profiles spelled out in their training manuals. This will produce the professional, precision flying pilots that the world's air carriers are so desperately seeking.

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