



# Secondary Indications

by Matthew McDaniel

The concept of secondary indications is one that, ideally, should be planted into the minds of pilots in the earliest phases of training. It is often overlooked during primary instruction and consequently, it fails to ever become standard procedure for many pilots. As a result, the most basic cockpit procedures can become opportunities for errors dozens of times per flight. Certainly the ideas presented here are applicable beyond Cirrus aircraft. They pertain to piston-powered, turboprop, and jet aircraft alike. This is especially true in today's growing fleet of glass-cockpit, technically-advanced general aviation aircraft. That fleet began with Cirrus, expanded with similar designs like the Columbia/Corvalis and Diamond Stars, and encompasses all manner of general aviation aircraft through after-market conversions and enhancements. The speed and complexity of today's most popular piston production aircraft can expose poor procedures and techniques very quickly, causing rapid breakdowns in situational awareness, CRM, and even aircraft control.

What is a secondary indication? In the simplest terms, it is anything that can be used to confirm that an action taken has resulted in the desired effect. More specifically, anytime a pilot manipulates any cockpit control (whether it is a primary or secondary flight control, a switch, button, lever, or knob), it is to induce a specific result. Observing and understanding whether the desired result was actually achieved, via the action taken, is the trick. Sometimes, in low-stress situations, pilots get complacent and simply assume that their actions have affected desired results. Other times, in high-workload situations, actions are taken in haste and quickly forgotten as other pressing matters are subsequently addressed. In either case, the result can be the same: An action which does *not* create the desired result is missed, creating the first link in an error chain, leading to compromised flight safety, violations, incidents, or even accidents.

As an instructor, check airman, and mentor, I have seen literally thousands of examples of missed secondary indications. A pilot flips a switch, assuming it did what it was intended to. Later, that assumption bites the unsuspecting airman. The most classic example is manipulation of the landing gear lever. It is selected down and the landing gear

is assumed to be down and locked. Secondary indications such as gear lights, circuit breakers, motor/pump sounds, and/or gear warning horns are overlooked, ignored, or misinterpreted; the final result is totally predictable. If you need further proof of this, look no further than YouTube, where a quick search for "Gear Up Landing" will generate a variety of embarrassing clips of pilots unknowingly landing gear-up while the gear horn blares away inside the cockpit. While improper landing gear usage might be the most classic (and dramatic) example of missed secondary indications, it is, obviously, not one we would encounter in Cirrus aircraft, but, neither is it the most common example of missed secondary indications, regardless of aircraft type.

The most frequent examples of missed secondary indications I see involve improper programming of modern navigation units, autopilots, and flight directors. For example, ATC instructions are issued, the pilot programs the GPS or FMS accordingly, and then selects the desired autopilot mode(s). Secondary indications such as CDI deflections, heading bug position, flight mode annunciations, etc., are not referenced. Subsequently, the aircraft ends up off course and/or altitude by some margin before the problem becomes obvious to the pilot and/or ATC, and a correction is initiated (if it's not too late).

Often, it's the most basic tasks that trip pilots up when they don't utilize secondary indications. How many times have you been flying on an assigned heading, utilizing the autopilot, when ATC issues a clearance direct to a fix? You deftly program the GPS/FMS to comply with the clearance, the magenta line obediently connects said fix to your present position, the CDI auto-slews to the new course and centers up. You are happy to be on your way! Then, the secondary indications slip through your fingers unnoticed. The CDI slowly begins to drift towards the edge of its scale. The aircraft on the moving map begins to separate from the magenta line. Why? Because you forgot to change the autopilot mode from Heading to Nav, and in spite of your skilled GPS programming, the autopilot continued doing exactly as it had been set to do; flying the heading, as designated by the position of the heading bug. What secondary indications did you miss? Well, aside

from those longer term indications mentioned above, there are undoubtedly some immediate or short-term indicators, as well. The first would have been that the aircraft did not turn from its present heading to the heading necessary to track the new course. Second would be the annunciations indicating the active modes of the autopilot (HDG versus NAV). Be honest...you know you've done it! I certainly have, and I've seen it countless times while instructing in both aircraft and simulators.

A good working knowledge of your aircraft's systems is another critical element to using and understanding secondary indications. When a switch is flipped, what system is primarily affected and what are the indications that you can expect to confirm the desired results? Conversely, what are some indicators of a failure? Sometimes it's as simple as a light illuminating or extinguishing. Other times, the indicators are changes in electrical loads, instrument readings, pressure/temperature values, or even aircraft handling characteristics. While the primary indicator might be the actual position of the switch, it's the secondary indicators which confirm the switch is functioning correctly.

I was taught to look for and react to secondary indications early in my flying career. Those lessons were reinforced when I began teaching and imparted similar lessons to my own students. My first exposure to truly formalized procedures for secondary indications was in turbine aircraft. It was in operating that type of equipment where I began to be both formal and verbal regarding secondary indications.

How so? When I selected the first notch of flaps on a Learjet, for instance, I would move the flap handle to the first extension notch and leave my hand in that position while watching the flap position indicator move, and be perceptive to the aircraft's expected pitch changes, as well. When the indicator reached the position that coincided with the handle, I would announce, "Flaps set and indicating eight," and remove my hand from the flap lever only after that confirmation was verbalized. It seems like such a basic thing to do, but that's the point. Some very basic discipline in seeking and utilizing secondary indications can make you a better pilot and head off any number of abnormalities before they are allowed to escalate into emergencies. I find myself using similar verbalizations when ferrying Cirrus aircraft solo, or when flying them in a crew setting with one of my fellow CSIPs.

My "Top Five" list of the most frequently missed secondary indications that I see while teaching in Cirrus aircraft are:

5. Switching between HDG and NAV modes on the autopilot (or failure to switch, when necessary) and a total omission of the expected annunciations from the pilot's instrument scan.
4. When activating an approach (430s or CP). Did it really activate correctly or at all? Did the appropriate changes happen within the Flight Plan, and are the expected course and fix now active? All too often, the answer is no, but the problem isn't recognized until final course or glideslope interception doesn't happen as planned. Using

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appropriate secondary indications, the problem could have been recognized and corrected well in advance.

3. The flaps are not retracted during climb. Upon leveling for cruise flight, the pilot notices the cruise speed is slower than normal. In spite of the nose-low pitch attitude (a fairly obvious secondary indication of flap position), the pilot is befuddled by the unusual performance. Fortunately, the newest Cirrus autopilots with envelope protection provide visual or audible warnings of flap over speeds, but the thousands of Cirrus aircraft still flying with S-Tec autopilots don't have this safety feature.
2. Engine parameters: I so often see Cirrus pilots adjusting power and mixture to achieve what they believe is the optimum LOP fuel flows. Yet, they all but ignore the resulting secondary indications, such as EGT, TIT, CHT, and even IAS. They will happily drone along at a fuel flow they are happy with in spite of elevated engine temperatures and abnormal IAS readings for a given power/mixture/altitude combination. Some of these secondary indications take several seconds or minutes to stabilize, so coming back for a second or third look (and possible readjustments) should be standard procedure.
1. I would have to say the example I see most often is probably the most basic. That would be when a single button push is required on the GPS/FMS unit or autopilot. The pilot pushes said button, but fails

to push hard enough or physically misses the button slightly, so nothing happens. No changes are initiated and everything continues as previously programmed, yet the desired result from the button push is assumed. No attempt was made to check secondary indications such as annunciation changes, course/moving map updates, aircraft pitch/roll adjustments, etc. The end result is always a confused reaction as to why the airplane is not doing what the pilot just told it to. Make sure the airplane got your message!

In the end, it boils down to one thing: In an aircraft, assume anything is dangerous. Always take a second to prove to yourself that you and the machine are in sync. Assume nothing, confirm everything, and fly safely. **COPA**

About the Author: *Matthew McDaniel is a Master & Gold Seal CFI, ATP, MEI, AGI, & IGI and Platinum CSIP. In 22 years of flying, he has logged over 12,000 hours total, over 4,500 hours of instruction-given and over 3,500 hours in all models of the Cirrus. As owner of Progressive Aviation Services, LLC (www.progaviation.com), he has specialized in Technically Advanced Aircraft and Glass Cockpit instruction since 2001. Currently, he also flies the Airbus A-320 series for an international airline and holds six turbine aircraft type ratings. Matt is one of only 26 instructors in the world to have earned the Master CFI designation five consecutive times. He can be reached at matt@progaviation.com or (414) 339-4990.*



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