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# The Pitot-Static System: What you don't know, may kill you.

*By Richard Bertoli, CSIP*

As student pilots, we were all introduced to the airplane pitot-static system. During our instrument training, we should have been taught the pitot-static system to a correlation level of learning[1]. That's CFI speak for knowing something inside, out, and upside down (pun intended). Unfortunately, this level of knowledge doesn't stick around for long. The "out of sight – out of mind" principle applies here. This article will hopefully refresh memories and provide a few "sticking" points to keep in mind when your PFD suddenly looks like this ⟹


## Review

The pitot-static system instruments use measurement of pressure differential to obtain: airspeed, altitude, and rate of climb or descent. The airspeed indicator compares the difference between static pressure and ram-air pressure at the pitot-tube. The altimeter compares the difference between static pressure and the pressure inside the instrument's sealed aneroid capsule, which is 29.92" Hg, mechanically adjusted when altimeter setting is entered in the Kollsman window. The vertical speed indicator compares the static pressure of the airplane's present position to the static pressure of where the airplane was a few seconds ago, using a calibrated leak to gauge rate of change. Informative graphics of the innards of the traditional instruments can be found in any decent text book or on the internet. The Avidyne PFD uses solid-state electronic sensors instead of the needles, gears and diaphragms found in the "steam-gauge" instrument mechanisms, but still relies on the static system for the required pressure information.

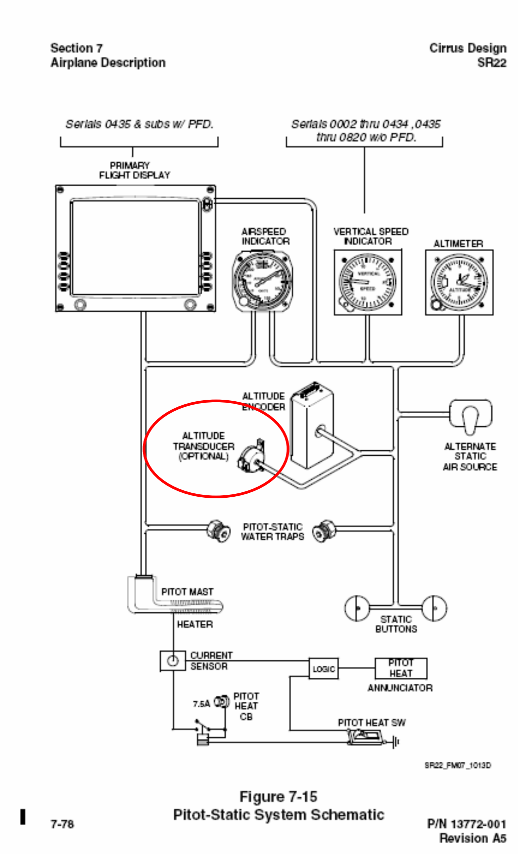



Figure 7-15
Pitot-Static System Schematic

## The Cirrus System

Study the diagram on the left (or in the POH) and take note of the equipment connected to the static line plumbing. The PFD, the back-up instruments, the altitude encoder (for transponder use), and the altitude transducer all use static pressure from the same system. The autopilot derives its altitude (or pitch control) information from the altitude transducer. I'm going to repeat this: The autopilot derives its altitude (or pitch control) information from the altitude transducer. In the event of some sort of static line blockage indicated by the PFD displaying red X's over the air-data instruments, it is extremely likely that the autopilot will be

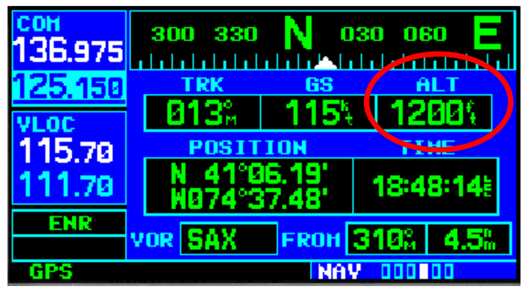
[1]Levels of learning as described in the Aviation Instructor's Handbook: Rote, Understanding, Application, Correlation.

rendered useless for altitude or vertical speed control. The scary part is that there are no failure warnings or red flags to indicate this loss of utility. A recent fatal accident *may* have been the result of this scenario, where an aircraft took off into IMC, encountered instrument trouble (the pilot reported in a radio transmission) and inexplicably crashed into the ocean, killing all three souls on board. It is still under NTSB investigation.

Also keep in mind that the back up instruments will not be reliable either. Let's review traditional instrument failure modes with static line blockage: the ASI may indicate a false drop in airspeed in a climb above the altitude where the blockage occurred; the altimeter will be frozen at the altitude where blockage occurred; and the VSI will indicate nothing but zero. Obviously, all these miscues can add up to a recipe for disaster in a low-altitude climb.

## Performance, Attitude, Configuration

The proficient pilot should know the P.A.C. profile for every phase of flight in his/her aircraft. This applies not only to instrument approaches, but also to take-off and climb. The pilot who takes off and knows that full power and 10° nose up pitch will establish a climb rate of 800-1200 feet per minute around 110 KIAS, will not be affected by the static port blockage. This pilot will use the attitude indicator for pitch and bank control, while maintaining full power with throttle assuring a safe altitude above the ground is reached before troubleshooting the malfunction. The really sharp pilot may use the position page in the NAV group of the Garmin 430 to get a GPS derived altitude (*see graphic*).




One of the published limitations of the autopilot prohibits engaging it below 400 ft. AGL. Do you think 400 ft. is enough of a margin to wrestle with an autopilot malfunction in IMC on a partial panel? Why not increase that height to something closer to 1000 ft. AGL? For the pilots who can't wait to be relieved of their rusty instrument scan, has hand flying the airplane on departure become that much of a chore? Maybe it's time for an appointment with a CFII.

## When to expect this problem

A windy, heavy rain, a careless wash, or condensation may introduce moisture into the static lines, where it collects in low points. Sometimes, moisture alone may not be enough to cause a problem, but if it freezes during the climb, then a blockage may occur. There are static line drains, used during routine maintenance, but they are inaccessible to the pilot in the current Cirrus design.

## The Solution

When the airplane has reached a safe altitude and the pilot feels that everything is under control, it is time to manipulate that little blue lever labeled: **Alternate Static Source**. The location of this lever may be my only gripe with the design of this otherwise very ergonomic cockpit. Why they would place this at the foot of the pilot, requiring tremendous head movement, possible seat belt removal and yoga contortions for the short armed (or big bellied) is beyond me, especially considering the situation where it's required may be critical to flight safety. Regardless, one should know where this lever is and how to use it. Maintenance personnel recommend exercising the lever periodically, as the plastic valve can get sticky.

With the alternate static source engaged, static pressure is now measured from inside the cabin and a large part of the problematic plumbing has been bypassed (see schematic). The PFD air data instruments should return to the display and normal functionality should be restored to all affected equipment. There are performance charts in the POH that denote airspeed and altitude corrections when alternate static is in use. The difference is negligible, though I wouldn't consider flying an ILS to minimums without an independent verification of altitude, e.g. precision approach radar.