



# What the Examiner Sees – Aircraft Systems

by Larry Bothe, 5/5/2013

When conducting a practical test, FAA Designated Pilot Examiners (DPE's) are required to test, in one way or another, everything in the PTS for that certificate or rating. We can't skip anything. However, the FAA gives us the latitude to combine things for testing when it is appropriate. Aircraft Systems and System Malfunctions are two areas that really lend themselves to combination for testing purposes. It is necessary to know how a system works and what it does in order to know what will be affected by a failure, and how to deal with it.

When I get to the Systems part of a Private Pilot checkride and the applicant isn't very well prepared, I sometimes get the distinct feeling that he thinks the whole idea of knowing how something works, and how to deal with it if it breaks, is completely unfair. Those types of applicants think that after the preflight inspection, and they don't see anything obviously wrong, the rest of how/why things work is somebody else's problem. They have automobile mentality; you turn the key and it runs, and if it doesn't work right you take it to the dealer. Expecting them to know what system affects which parts of the plane is unreasonable; that's what the maintenance shop is for. That attitude may work for cars, but it doesn't work for planes because you're up in the air. You can't pull over to the side and call Triple-A. If I ask an applicant what he will do if this or that fails I often get the canned answer of "I'll land as soon as practical and get it fixed." That's true, but depending on where you are it may be necessary to fly along for an hour or so. That's what the requirement for systems knowledge is all about, what to do until you can land. It's not necessary to know how to fix it, but it is necessary to know that something is wrong, what will be affected as a result, and how to deal with it.

DPE's must employ scenario-based testing to the extent possible. A simple systems question might be, "You're flying along and your alternator stops creating electricity. What will be the first indication that something is wrong?" If I get the answer that "electrical things will stop working" I immediately know they don't understand the electrical system, and they have no idea why they are checking/doing at least some of the items in the run-up checklist, or what they

mean. Newer Cessnas, built in 1996 or after (commonly called “restart” airplanes), have an enunciator panel, right in front of the pilot, essentially at eye level. It has VOLTS and VAC enunciators that light up if either a low voltage or low vacuum situation occurs. But many applicants don’t even consider that those enunciators may light up in flight, which is the first indication of those respective failures. All they know is that the enunciators are supposed to be out during run-up. That’s it. A similar question for an applicant with an older Cessna could be, “You’re flying along and a red light illuminates on the instrument panel. What does that mean?” It of course means an electrical problem, probably alternator failure, but many applicants can’t tell me that.

Restart Cessnas even have a digital voltmeter. If I ask what the voltmeter will indicate if the alternator is working properly, and what indication it will have if the alternator fails, I often hear 24 volts, and zero volts. I get the 24-volt answer because the applicant has heard that the airplane has a 24-volt battery, and the zero answer because they figure that if no electricity is being created the answer must be zero. The correct answer for a properly functioning system is at or near 28 volts, because the system voltage has to be above battery voltage for the battery to charge. If the alternator fails then the system voltage will be 24 volts (or a few tenths less) because now the voltmeter is indicating battery voltage. What will you do if you think you have an alternator failure? The right answer is try to reset it (turn off the Master switch, wait about a minute, then turn it back on again), but often I get “land and get it fixed”. I counter with “what if you’re in Montana and there’s no airport close by?” I want to hear “I’ll turn off any unnecessary electrical equipment to conserve the remaining electrical energy in the battery.” And what if the battery actually goes dead; what will happen with the engine? If they tell me it will quit (because that’s what will happen in their car) the test may be over very soon. If you turn off all the things you don’t need, how long will the battery last? The answer isn’t a fixed number, but I have never heard of one lasting less than half an hour, and most will go an hour or so. Those are good things to know so you don’t get all panicky up front. I have had applicants tell me they will make a very risky precautionary off-airport landing in the event of an alternator failure. They need more training.

The same sorts of questions can be asked about the vacuum system. The enunciator panel, if present, is the first indication. The vacuum gauge will also tell the tale. If the vacuum pump fails, which instruments will be affected? Usually it’s the artificial horizon and the directional gyro, but not always. My Champ (not an IFR airplane) has a vacuum turn coordinator. It is necessary to know which systems activate what instruments so the pilot knows which ones remain

functional when a system fails. If an applicant can't differentiate between gyro and pitot-static systems, and know the power sources for each, additional training will be required.

I even get the "land and get it fixed" answer for simple engine overheat problems. In 40 years and over 7000 hours I have had numerous engine-overheat occurrences, but never one I couldn't solve with some combination of increasing airspeed (usually just stop climbing), reducing power or enriching the mixture. Only in the rare instance when oil temperature is very high and oil pressure is below the minimum is it necessary to land immediately. I don't like the "faulty gauge" answer to systems problems. Gauges seldom go bad in flight. But applicants love the "faulty gauge" response because it means nothing is really wrong, so they don't have to know/do anything right now. I expect applicants to believe the gauge until they can *prove* it is faulty, and that generally requires a certified mechanic. I have a very difficult time accepting the notion that an applicant for a pilot certificate doesn't know how to deal with simple, common problems.

What should a pilot do if he can't remember how to deal with a problem or system failure during the practical test, or in the real world of flight? Same thing; consult the POH. But even though applicants always have a POH with them for the test, and looking things up is typically allowed by examiners, I rarely get asked for permission to look something up. Why? Because the applicant doesn't even know that systems and problem resolution are described in detail in the POH. Not owning a POH for the airplane in which a student is taking lessons is a big mistake. If students only see the POH for a few minutes at a time while standing at the airplane they never learn what's really in there, and they can't find things when they need them. I know, generic POH's can cost \$60 or more to buy, but you'd be surprised what you can find on the Internet. Do a little searching.

Another thing I have found helps students a lot to understand how airplanes work is for them to actually see the parts. Take your student to the maintenance hangar and show him or her a plane that is opened up for inspection. Please don't do this as a 2-minute quickie. Take the time to point out all the major parts. Show the student the magnetos, with a wire going from one magneto to one spark plug in each of the four cylinders, and the other magneto the same. Explain the redundancy. Show them the vacuum pump, and explain how it pulls air through the air motors in the vacuum-driven instruments. The starter motor, alternator, carburetor and air box, and cabin heat source are all important and present a golden teaching opportunity. The lesson is very cheap for the student (he doesn't

have to rent the plane), but you get paid for the ground school. It's a great thing to do on a day you get weathered out of flying.

Aircraft systems knowledge is important from the standpoint of knowing what to do to cure a problem, or at least maintain safe flight until such time as the pilot can land and get it fixed. There are actually very few problems that can't be fixed, offset or minimized in flight, but it takes systems knowledge to get it right. Help your students to obtain their own copy of the POH so they can read the Aircraft Systems section in detail. Show them the important parts of the plane and explain how they work. Take extra time with female students because many of them have no frame of reference for mechanical things. Then your students will have adequate knowledge when they meet with the pilot examiner, and they will be safer when they're out flying.

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