

## *Symptoms Versus Problems*

In forty plus years of aircraft maintenance there is one outstanding theme that still continues to bludgeon our psyche to this very day. The vast majority of maintenance related problems and accidents are not a cause of lack of information, wear, age, or poor design - but rather, by human error. The majority of aircraft maintenance related problems and accidents are actually caused by the owner/operators. Identifying, repairing and preventing maintenance related problems is one of the greatest challenges, but not for the reasons that you might think. One of the best insights that students from our maintenance classes receive is the recognition of the difference between symptom and problem. Identifying the difference between a symptom and a problem is critical when conducting maintenance on aircraft. In this article, we will use the term “problems” for the root cause of a problem or maintenance discrepancy. On the other hand, “symptoms” by definition means “something that indicates the existence of something else”.

To get us started we will use a recent example. The owner of a new SLSA airplane with a new continental O-200 engine arrives at the shop with a total of 49 hours on his new aircraft. Within the first 10 hours of operation of the aircraft, the owner had identified the symptom of oil leaking from the Garlock seal around the starter drive-shaft. (Symptom). The amount of oil that was leaking was significant and was covering the belly of the aircraft as well as the windshield. Solution: owner replaces the brand-new continental starter with another brand-new continental starter. Results: within hours of installing the new starter the oil was once again leaking profusely from the starter Garlock seal duplicating the original (symptoms). Solution: owner replaces the second brand-new continental starter with an after-market Sky-tech starter. Results: oil continues to leak at a slightly slower rate, (symptom). Solution: live with the problem. Ironically, we only became involved with this scenario as a result of the owner bringing the aircraft to us to solve an additional problem of radio noise. In the process of identifying the radio noise, we identified the Sky-tech starter as an anomaly on what should have been a stock SLSA airplane. A conversation ensued that uncovered this series of interactions between the aircraft owner and his aircraft. We explained that it is virtually impossible for the continental starter to fail the Garlock seal under normal conditions. After a brief lecture on the possible root causes of this particular symptom, we were able to explain to him that this symptom is normally a result of over pressurization of the crankcase. Over pressurization the crankcase is typically a result of low compressions and blow-by around the rings into the crankcase. A quick test by pulling the propeller through by hand confirmed this as at least a likely scenario. Unbelieving that this was even possible on a 49-hour new engine, the own-

er requested an official compression check which revealed that indeed, none of the four cylinders reaching even a pathetic 40/80. After explaining to the owner that this was probably a result of an improper engine break-in, he revealed that the aircraft manufacturer had told him that the engines come from the factory already broken in. And his explanation of his flight from the east coast to the west coast immediately upon receipt of the aircraft at a constant RPM, in cruise, was the confirmation that the improper break-in and subsequent glazing of the cylinders as the root cause of the problem. We can continue to change starters “until the cows come home” but it’s not going to improve the compression. Without the significant and costly intervention to repair the cylinders the engine remains in a state of significant compromise. Think of all of the dangers associated with fixing the symptoms rather than the problem. For example, we are flying around with significantly reduced power output - dangerous at best. We are going to have significant oil fouling of spark plugs, and the potential for loss of additional power should both spark plugs be fouled on a single cylinder.

Talking with the owner it was easy to identify the reason that he had chosen to fix symptoms rather than the problem. Having basically no understanding of the engine systems in particular, and maintenance in general, left him with no tools from which to even begin to approach solving the root cause of the problem. This is the primary reason that everyone is reluctant to address root cause problems. In order to address a root cause problem, you have to be able to identify all of the probable sources contributing to the problem. The amount of education necessary to become intimately familiar with the aircraft and engine systems can be quite intimidating. Taking the aircraft to a professional who is intimately familiar with the aircraft and engine systems can, often times, be quite expensive.

The result is a tendency to focus in on symptoms rather than root cause problems. Symptoms, are easy to identify, simple, and usually are much easier to make disappear. The problem with fixing a symptom is two-fold. The first issue is that by treating the symptom you are not actually curing the problem. The second issue is that by making the symptom disappear you are covering up the one, and often only, telltale sign that there actually is a problem. Symptoms can be inexpensive to identify, repair, and make disappear. However, it is the equivalent to solving the problem of the blinking check engine light, flashing away, as a result of lack of oil in your car engine, by unplugging the check engine light. Recognize that symptoms are one of the most valuable resources that you have in troubleshooting the root cause of any problem. By eliminating symptoms, you are eliminating all of the information that you need in order to be able to troubleshoot what is really going on.

Aircraft owners are often shocked by our explanation of how we troubleshoot an aircraft/engine problem. It’s really quite simple. And even though it’s simple, it can sometimes be rather expensive and time-consuming. The process involves bringing the aircraft into the shop, taking all of the owner’s observations and experiences with

the aircraft into account, and then identifying all of the subsystems that may have any correlation with symptoms. Once we have identified all of the subsystems that may have some correlation with the root cause of the problem, we do an inspection on each one of those subsystems. Then the process of repairing discrepancies found within each of those subsystems begins. All we are essentially doing is returning the aircraft and engine back to its original stock configuration. When we are done, we simply run the engine to verify that everything is working correctly. It works every single time without many exceptions. How is it possible that this would not work? Especially with the consumer engines like Lycoming, Continental, and Rotax that have been proven and in service for many decades. If you put the engine back into the configuration as it was when it came out of the factory, it's going to work correctly. If it does not work correctly, this is simply an indication that something was missed on your initial inspection and the engine is not in the stock configuration.

Now even though we have identified how simple it is to troubleshoot a problem, this is where the system breaks down. In order to be able to troubleshoot the root cause of a problem you have to have a complete and comprehensive knowledge of all systems. Having a partial understanding of the system generally leads to assumptions that are not only wrong, but can actually cause additional problems. Customers are often frustrated about our unwillingness to troubleshoot problems over the phone. The reason for this, is that what they are really asking, is for us to troubleshoot symptoms. "Fixing Symptoms Causes Problems". We are often horrified at what we see on Internet chat rooms. It seems that the vast majority of the forum discussions are based on the premise of dealing with symptoms rather than problems. On occasion, we see the valiant heroes attempting a twenty paragraph dissertation on the subject trying, in vain, to sort out the misinformation that is so prevalent.

You don't have to wait for symptoms to show up to start solving the problems. When you find something that is broken, worn, out of adjustment, corroded, or just improperly installed, it is time to fix that "problem". It is all too common that we have a customer with an airplane who believes that maintenance is part of the annual inspection. Nothing could be further from the truth. A proper annual inspection should be nothing more than a verification that the maintenance which has been accomplished during the year has been done correctly and that there are no anomalies which should be addressed. Those customers who maintain their aircraft on a regular basis and fix everything immediately upon identification, find that the overall cost of maintenance on their aircraft is reduced and their reliability increased. Waiting for a symptom, "that scares the hell out of us", before bringing the aircraft into the shop for repairs is not a very efficient way to approach maintenance. An airplane that is maintained in top-notch condition becomes very easy to troubleshoot should a problem arise. An airplane that has a plethora of deferred maintenance becomes very difficult to troubleshoot primarily because of the numerous deficiencies that may be contributing to the problem. It's not uncommon we find one problem causing several other

problems, which are in turn causing several other problems. These can be very difficult customers to work with because properly solving all of the contributing problems can sometimes be time-consuming and costly. They don't necessarily want to spend the money, they simply want the airplane to stop scaring them. It simply doesn't work that way. The mechanics willing to fix only the symptoms that have been scaring the aircraft owner often find themselves in trouble when months later the root cause of the problem rears its ugly head.

If there's one bit of practical advice that we can give to any aircraft owner - it is to become intimately familiar with all of your aircraft and engine subsystems. Actually, being in aircraft builder is one of the best ways to become familiar with aircraft and engine sub-systems. If you're not there yet, find yourself a resource who can support you while you are learning. If you were to ask us advice about how to become a better pilot, we would put becoming better informed about your aircraft and engine right at the top of the list.