TECH NOTE

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Smoking Rivets Can Be Detrimental To Your 210

For those of us who either own or work on the canti lever winged 210s, the issue of 'smoking rivets' on the lower inboard spar is becoming an ever more prevalent problem. While the first signs of dark streamers do not pose an immediate danger, the longer one waits to take action the greater potential exists for a more expensive repair.

The smoking is caused by the metals working against each other eventually causing the rivet to move. This wearing generates a fine aluminum powder that is black in color giving the appearance of smoking as it streams away. Frequently, the first sign of smoking is noticed shortly after treatment with a corrosion inhibitor like Corrosion X. These penetrants work into the wear areas and flush the powder out causing unsightly streaking on the most visible portion of the airplane. One certain way to avoid this problem is to stop flying your plane. Keep reading if you would like a better option.

"Smoking Rivets"

The remedy most certainly must include replacing the smoking rivets. FAA FAR 43 appendix-A, paragraph-(b)(1)(iv), categorizes this as a major repair which must be performed by a certified airframe mechanic and subsequently signed off by an A&P with FAA Inspector Authorization. Also, the required FAA Form 337 must refer to approved data to support the repair method. Approved data can be in the form of an Airworthiness Directive, an FAA approved Service bulletin, Manufacturers Service manual, FAA Designated Engineering Representative report, and in certain situations FAA AC 43.13-1B.

210 Universal Spar Rivets

After a good bit of trial and error, we found a method to replace these rivets that is relatively easy, effective, and approvable. Before we get into the details of how to replace the smoking rivets, a little history might help explain how we came to this final solution.

During our first attempts to remedy the problem, we tried removing the offending rivets and installing the same AN470AD5 rivets in the existing holes. Unfortunately, the holes were always just slightly enlarged from the wear of the old rivets causing the new rivets to not properly fill the now enlarged hole. The newly installed rivets would themselves start smoking in about a year or 200 flight hours. Additionally, we thought about installing the rivets wet with PRC (fuel tank sealant) as a stabilizer, but this would just mask the fact that the new rivets could not properly fill the hole.

Some research into the structures section of 210 service manuals revealed that Cessna generally allows for going to the next larger diameter rivet provided sufficient minimum edge distance is maintained. In this particular situation, the edge distance is already at the minimum for #5 rivets. FAA AC 43.13-1B provides no help because chapter 4 section 4 paragraph 4-52a(2) discourages enlarging holes in spar caps. A phone call to Cessna engineering was followed up by a good size check to pay them for written approval to

install #6 rivets in the spar cap. The first time we drilled the holes for the newer sized #6 rivets the horror of the finality of our actions overtook me. If these rivets ever started smoking there would be no opportunity to oversize them again. The lower spar cap, leading edge skin and lower aft inboard skin would have to be replaced causing a huge drain on anyone's wallet.

A third option surfaced courtesy of a customer whose specialized machine shop has the capability of manufacturing custom made rivets to fit each original hole. That option seemed great until we considered trying to convince the FAA to approve home made rivets.

Subsequently, I had a conversation with a friend who is a retired DER FedEx Structural Engineer. He told me about a problem that they had many years ago with 727 flap spars and stringers. It turns out that because the original AD rivets set in a hardened state, they were putting stress on the spar. Their solution was to replace the AD rivets with DD rivets. The DD rivets must be heat treated just before installation making them substantially softer and easier to set than AD rivets. An added benefit is that after the DD rivets cure a few days, they are about 30% stronger that the original AD rivets. This turned out to be the solution I had been looking for.

The 1985-86 Cessna 210 series service manual structures section paragraph 18-65 specifies acceptable replacement rivets. The substitute rivets listed are of the blind type, which we do not want to use. The DD rivets are not specifically listed as acceptable but are also not

Rivet Heads

prohibited, therefore FAA AC 43.13-1B can be used as 'approved' data for replacement of standard hardware. Section 4, chapter 4, paragraph 4-57b and 4-57d of the same advisory allows the use of any standard solid rivet of equal or greater strength whose material has no dissimilar metal concerns. More information on DD rivets can be found in several other books, including aircraft structural textbooks and Military Handbook 5.

So let's get to work. Do all the obligatory precautionary preparations, ground the airframe, chock the wheels and finally, support the wings with jacks just enough to relieve the compression on the soon to be replaced rivets. Now we are ready to start drilling the offending rivets.

To begin drilling, always use a high quality, sharp, 135 degree, split point bit. Even bits of the best quality cut a hole larger than the diameter of the bit, due to off center point. Therefore, never drill through the rivet head past the surface of the first skin. The holes are already too big, and we don't want to lose any more metal. Special bits can be had that won't 'walk,' but for this application it's not worth the price. After the rivet head is chipped off, use a tight fitting punch and a large ball peen hammer to drive the tail out. Since we are working inside the wing area where there are no light ribs or gussets, there is no need for the use of a backup bar.

After drilling out and removing the offending rivets, clean each hole with some kind of aluminum safe solvent such as Acetone or MEK while heeding the safety precautions for these products. Inspect each hole for evidence of cracks or corrosion. A light spray of zinc chromate from each end of the hole will be a nice gesture for the next owner of the plane so he/she won't have to deal with corrosion issues in the same area.

A special bucking bar must be fabricated to fit between the tail of the rivet and the wing attach forging. We made ours from a chunk of scrap tungsten alloy obtained from that custom machine shop that could make rivets. Tungsten has almost twice the mass as steel, which really helps set rivets in confined areas. The bar should be shaped to have a large body with a small lip that will just slide between the rivet tail and the wing attach forging. The overall dimensions ended up about one inch wide by two inches deep and three inches tall. Be sure and tape a thin strip of scrap aluminum to the wing attach forging so the bucking bar won't damage it.

At this point you will need a kiln capable of holding 870 degrees Fahrenheit, plus or minus 10 degrees for about an hour. The ideal temp is 930 but the slightest over temp causes the rivets to be too brittle to set, so 870 was chosen to give good cushion. We did a search on the Internet, and for less than five hundred dollars, purchased the smallest good quality kiln with a digital temperature control that we could find. The kiln can be small because we are only 'cooking' a hand full of rivets and the digital control is needed to accurately maintain the temperature within the limits. Place twice as many rivets as you need into the kiln basket because rivets are cheap in comparison to time spent firing the kiln up a second time for just one more rivet. Set the kiln to ramp up to the required 870 degrees slow enough to not over shoot the temp and melt the rivets. After they have been at 870 degrees for about one hour, quickly remove the basket and dip it in cool water to quench the rivets. With the first group of rivets that we heated and then quenched, we expected a lot of steam and boiling but it was very anticlimactic. You have approximately thirty minutes before the rivet begins to harden, but if you have a delay in your

work, the rivets can be reheated several times.

For the installation of the new rivets, a good 4X rivet gun set at 35 p.s.i. works well. The riveting is easiest when done by two people so a little practice might be in order. Best results for filling the hole and making a nice tail on the rivet happens when the rivet setting is accomplished in one proper length trigger pull on the gun. This is usually about three to four seconds. It may take the first three rivets to find the exact amount of time for your particular setup.

The whole process from start to finish only takes about five man-hours, including paperwork. And best of all, after all of the preparation time, the actual setting of the thirty-six

Rivet Kiln

rivets only takes about ten minutes. As with painting, it's the prep work that gets you. These new DD rivets attain one half

Flush Spar Rivets

their maximum strength in approximately one hour and full strength four days after setting. Be sure and wait the required four days or you will be doing it all again soon. A little touch up paint on the new rivet heads and you are ready to go.

Hopefully this article gives you enough information to get your 210 smoke free. If you need more details or just some encouragement, give me a call I'd be glad to help.

About The Author: *Paul New, owner and operator of Tennessee Aircraft Services, Inc., in Jackson, Tennessee, has been a CPA member for eight years and has been through CPA's Flight Control Rigging course as well as several of the CPA model System and Procedures courses. Paul is an A&P and has his IA license. His shop specializes in major airframe and structure repair, have their own wing jigs, and are experts in cantilever wing repair.*