

Comanche Cabin Door Hinge Pins and Bushings

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Any time you need to remove the cabin door of a Comanche, you must, of course, extract the door hinge pins. Rarely do you have to remove the serrated eccentric bushings. There are three circumstances, however, in which removing the bushings is necessary:

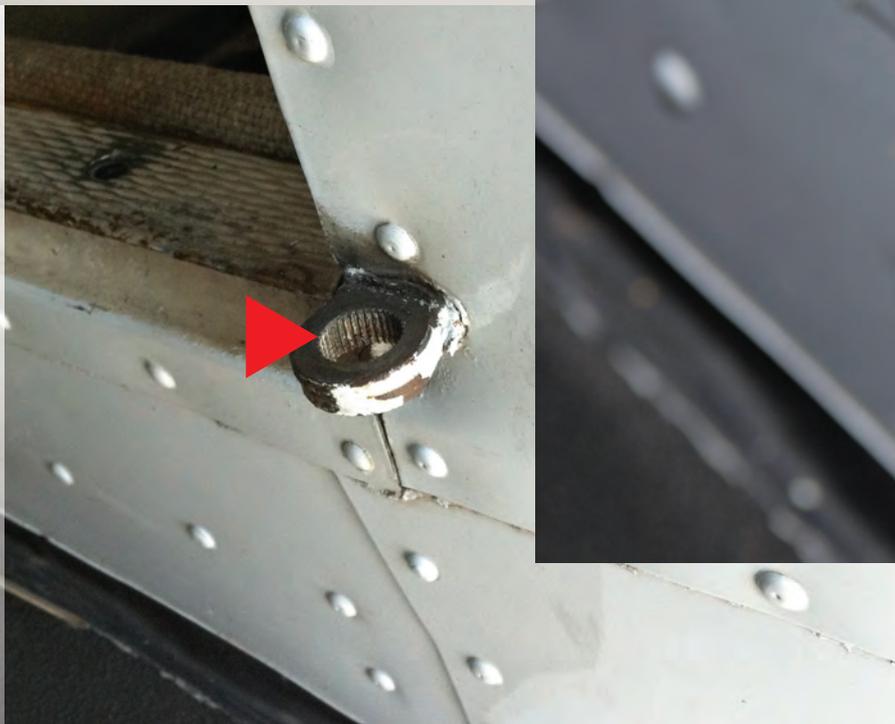


Figure 1: Eccentric bushing pushed out of hinge tongue. Note the serrated edges and the eccentric location of the opening (above).

Figure 2: Tongue part of the hinge.

1. You need to replace the bushings and hinge pins because their worn condition causes the door to sag and will lead to abnormal wear on the hinges themselves.
2. You want to reposition your present cabin door to try to achieve a better fit.
3. You are replacing the door, and the one you have located in a salvage yard does not fit in the doorframe like your old one. That situation would almost certainly require removing the bushings to reposition them.

is the hinge itself. Thus most of the wear in the hinge should take place on the inside surface of the bushing and the outside surface of a small section of the hinge pin. For the most part, the broader surfaces of the mortise and tenon portions of the hinges themselves should not be directly supporting the weight of the door, but they will start to do so if the contact surfaces of the bushing and hinge pin become sufficiently worn. This condition would cause the mortise portion of the hinge to spread apart and show wear in its inner surfaces because they would now

be making more contact with the outer surface of the tenon part of the hinge. This is a scenario seen in many mechanical devices; “wear begets wear” and as one part deteriorates, it accelerates wear on the part next to it.

The *eccentric bushings* have a serrated outer edge so that they can be mounted into a similarly serrated opening in the fuselage hinge tongue (see Figures 1 and 2). The opening in this bushing is placed eccentrically so that in fitting the door within the doorframe, you can position the hinge pin (and therefore the door) slightly fore or aft by rotating the bushing. And, to a small extent, you can also move the door inward or outward. The serrations on the bushing insure that once you have seated it in the hinge tongue, it will not rotate. In order to change the position of the eccentric opening, you will push the bushing out, rotate it slightly, and re-insert it. If you need to replace or reposition the eccentric bushings in the Comanche door hinge, the Piper Service Manual implies that you can push them out by hand. In fact, it says that when removing the door hinge pins, you should take care not to let the serrated bushings fall out. In particular, Piper does not describe any special procedure or tool needed for the process.



Figure 3: Bushing press (left).

Figure 4: Bushing press in action (below).



The cabin door hinges in Comanches are mortise and tenon style and were designed so the hinge pin is mounted in a static configuration with reference to the door side of the hinge, i.e., the pin remains stationary with regard to the two leaves of the mortise part of the hinge. Since there is little or no movement between these parts, there is very little wear in the location they are in contact. The tongue-shaped tenon or *fuselage* side of the hinge has an eccentric bushing mounted in it that interfaces with the hinge pin. The bushing and the hinge pin were designed to be the primary support of the weight of the door and to handle the rotational forces applied upon them. The secondary support

I don't think Piper foresaw that approximately 45 years later these parts would have never been removed, would have rusted in place, and would not come apart easily. I asked one Comanche repair facility how their mechanics removed these bushings, and they replied that they used a large punch, a hammer, and a bucking bar for support. While I am sure that method works, I was not comfortable with putting that much stress on my door hinges. Therefore, I came up with an idea for making a small tool that would press the bushing out of the hinge tongue in a more controlled fashion and would be less traumatic to the airframe. As I have sometimes done in the past, I enlisted the help of my hangar neighbor, Bob Lakey, and we sat down and designed a device that would be simple to use, easy to make, and above all, not risk any harm to the airplane.

After initially making the *bushing press* out of two pieces of steel welded together, we realized that we could fabricate the tool in an even easier manner by milling it out of a small solid block of aluminum. We employed a cap screw to press out the bushing.

Following are instructions on how to replace an eccentric bushing (see Figure 3):

1. After applying a drop of penetrating oil to the bushing, place the *bushing press* over the fuselage hinge tongue. (We placed a recess in the tool that accommodates the tongue part of the hinge and prevents the tool from actually touching the fuselage or marring the paint.)
2. Once the *bushing press* is visually aligned with the cap screw centered over the bushing, tighten the screw by hand until it engages the bushing. Then using an Allen head wrench, tighten the screw further to press the bushing out. With the mechanical advantage of the screw, this is actually quite easy.
3. Inserting a new or re-worked bushing is essentially the same process. Align the new bushing and push it by hand into the mouth of the serrated opening, being careful not to cock it to one side.
4. Then put the *bushing press* in place and tighten the cap screw to seat the bushing. Very little practice is required to learn just how far to seat the bushing so that it is flush with the hinge tongue above and below. If

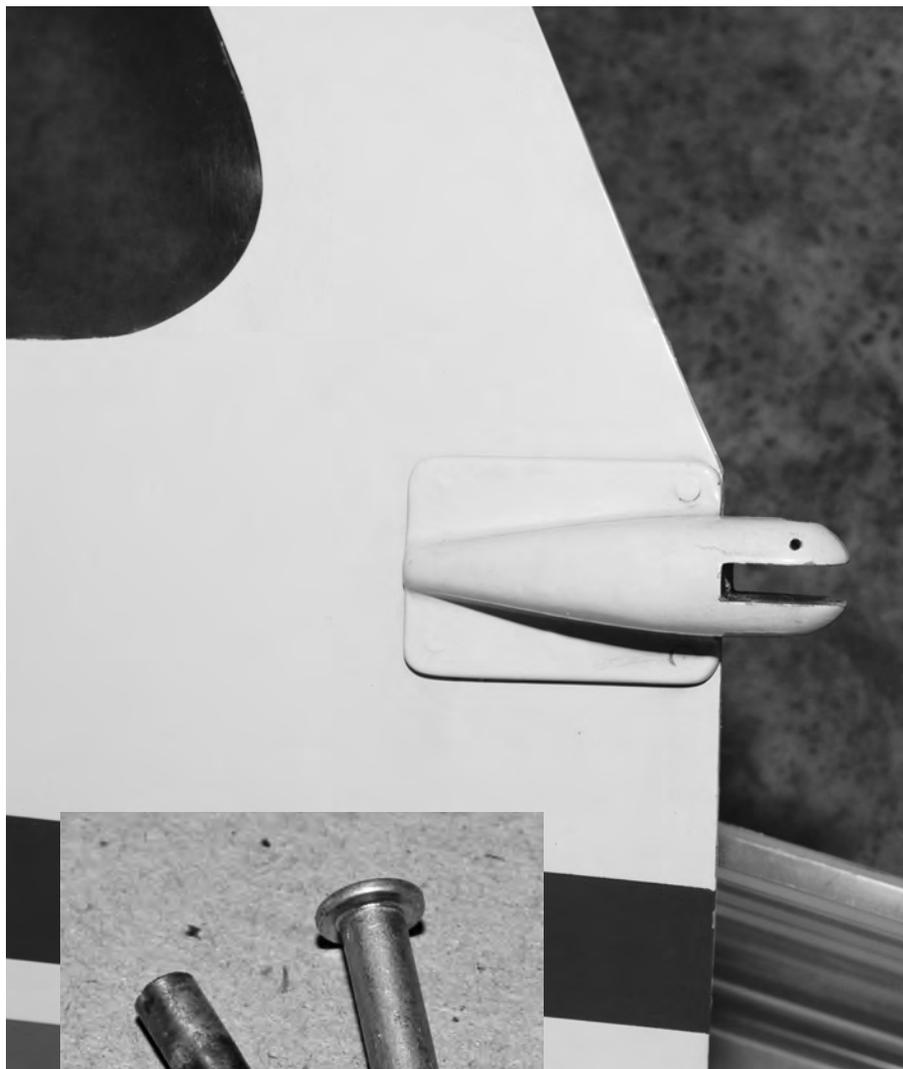


Figure 5a: Hinge pin and clevis pin compared (left).

Figure 5b: Hole for roll pin (above).

you seat the new bushing too deeply, you can just turn the bushing press over and push it back into better position. After removing an old bushing and cleaning out the serrated opening with a fine wire brush, inserting a “new” bushing usually does not require nearly as much effort as removing an old rusted bushing. However, I still could not quite do it by hand (see Figure 4).

If you are replacing the cabin door or just re-positioning it, be careful not to lose or damage the eccentric bushings or the hinge pins. These parts, like so many others in our Comanches, are frequently unavailable from Piper. Two years ago when I first discovered that the cabin door in my Twin Comanche

was getting a bit wobbly in the hinges, I found that Piper did not have the bushings or hinge pins in stock and could not tell me when they might have them again. I was able to get a pair of these bushings from Webco at that time. When gathering background for this article, I called Webco and they informed me that while they currently have a few of these parts on hand, their re-supply from Piper is not dependable. Likewise, Webco told me that they had a new pair of Comanche door hinges, but that they were “expensive and hard to come by.”

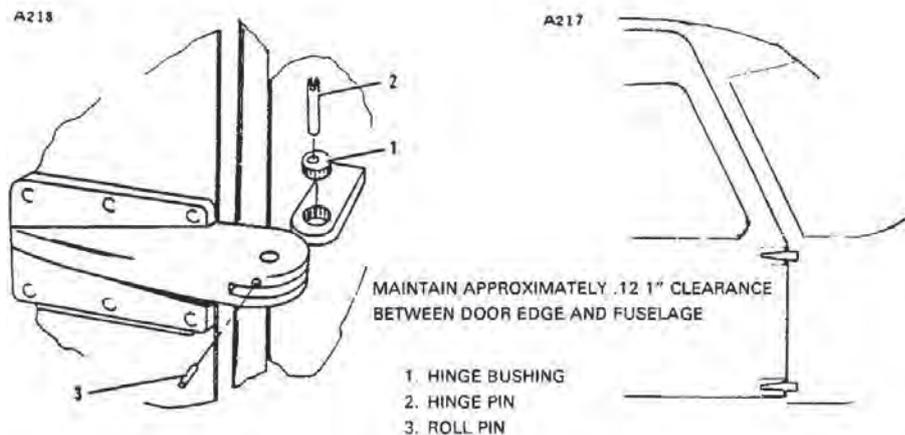
If you do find the need to replace the eccentric bushings or the hinge pins because of excessive wear, here are the alternatives:

The Serrated Eccentric Bushings

1. Buying some new bushings from Piper or Webco is probably the easiest option, if they are available. If they are not, you would have to consider option two or three below.
2. Making some new bushings is not out of the question. I discussed this with a machine shop I frequent, and they said they could reverse engineer them and make them, though they would be expensive – “about \$100 for two of them”.
3. Reconditioning the old bushings is a possibility also. This would require a skilled welder filling in the worn internal opening in the old bushing. Then you would have a machinist re-bore a new eccentric hole of the correct diameter in a new and slightly different eccentric location. This option would be cheaper than making some new bushings.
4. *Over-sizing* is not a good option in my opinion. This would entail not only enlarging the opening in your old bushing, but it would mean enlarging the openings in the door side hinge as well as using a larger hinge pin. I think you are treading on dangerous ground when you start changing the structure of the hinges and likely weakening them in the process.

The Hinge Pins

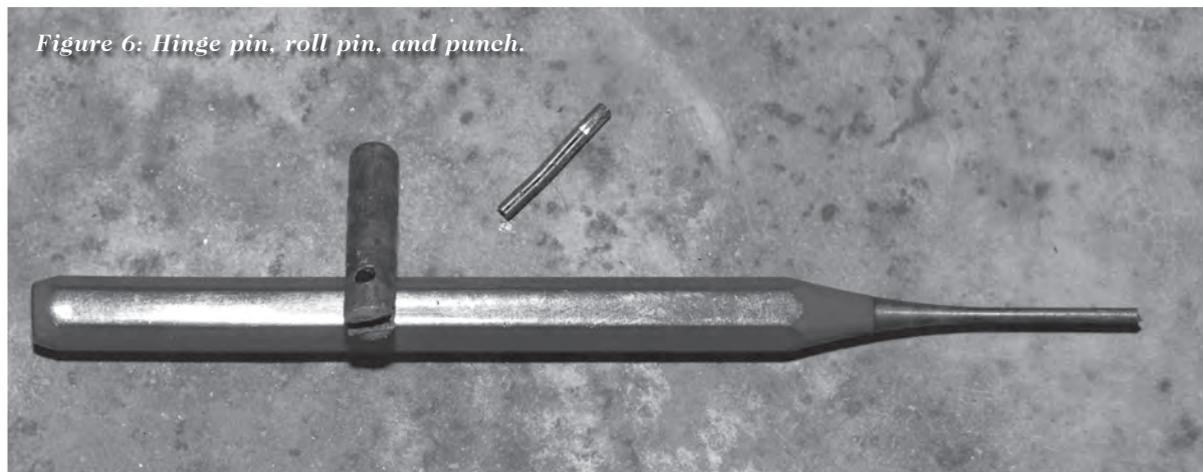
1. Here again, if new hinge pins are available, you could purchase them from Piper or Webco.
2. A very suitable and inexpensive replacement for the hinge pin is a steel clevis that is 3/16-inch in diameter and 7/8-inch long. This pin closely approximates the original part except for the slot in the end, and this slot is really not necessary (see Figure 5a). You can use the head of the clevis to turn the pin itself so that it lines up with the hole for the roll pin. The hole in the clevis will easily accept the roll pin in the door side hinge leaf.
3. Although the Piper manual says that you can use bolts on a temporary basis to hold the door in place while



you are making adjustments in the fit of the doorframe or when installing a new door gasket, it probably is not a good idea to use threaded bolts in place of the hinge pins as you have no easy way to fixate them with regard to the mortise section of the hinge. Without such fixation, the bolts would

be a different problem when a mechanic is not aware of the roll pin holes and tries to knock out the hinge pin without removing the roll pin. This usually results in a bent roll pin that is very difficult to remove from the hinge. To properly remove the small roll pins you will need a 1/16-inch or 1.5 mm punch (see Figure 6). The tiny

Figure 6: Hinge pin, roll pin, and punch.



turn freely in that structure, which would increase wear on the hinge.

You should also take care not to enlarge or damage the tiny holes in the door portion of the hinge that hold the small roll pins used to retain the hinge pins (see Figure 5b). If you enlarge these openings, you would have to go to a larger size roll pin which might prove problematical inasmuch as you could not enlarge the holes in the hinge pins without running out of metal. To be sure, you could insert a small cotter key into the hole, but that would create a couple of unnecessary sharp objects on the aircraft to snag clothing or skin.

On some Comanches, the holes for the roll pins have been painted over and are difficult to find. This can lead to a

roll pins are very easy to drop and to lose; however, replacements are cheap and can be obtained at any aircraft supply. Spread a towel under the hinge so you will have a better chance of catching the roll pins if they fall. If the cabin door is in good position before you remove the hinge pins and bushings, you will want to leave the eccentric bushing in the same orientation. In order to do that, you should make a small scratch mark on the bushing and the hinge tongue to maintain that relationship with the new installation.

Parting words: Take good care of these hinges and don't let passengers use the door for support. This is not only hard on the hinges, but it tends to bend that rather fragile cabin door and alter its fit in the doorframe. 