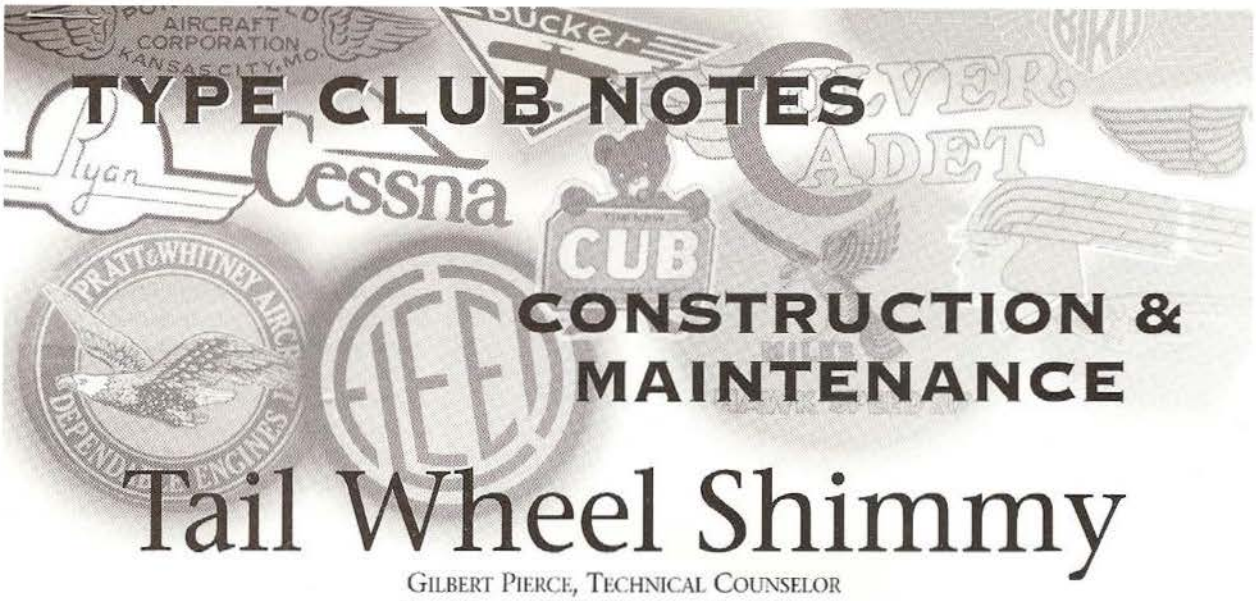


# TYPE CLUB NOTES

## CONSTRUCTION & MAINTENANCE

# Tail Wheel Shimmy

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I noticed when flying my Piper Clipper heavily loaded, I experienced tail wheel shimmy on my Scott 3200 when landing on a hard surface such as concrete or asphalt. Several years ago I was parked at the landing end of Runway 36L at Oshkosh. I always get tail wheel shimmy when landing there. This afforded me the opportunity to observe many landings as I lounged under my wing. It was here that I made the discovery that about 50 percent of the tail wheel airplanes landing on 36L experienced tail wheel shimmy. I believe the grooved runway exacerbates the problem. Anyway, those tail wheels were not just shaking side to side, they were rotating around their pivot axis 360 degrees, and doing so violently. On my recent trip to Alaska I had tail wheel shimmy on almost every landing unless I really greased it on. On my return I vowed to solve the problem.

I started the quest for a solution on the Internet. I was told that if you raised your tail wheel tire air pressure, it would assure the tail wheel would shimmy no more. I was told to reduce the tail wheel air pressure. I was told I had too much grease in the tail wheel. I was told that if the tail wheel didn't spit grease at you when you walked by it, it did not have enough grease, hence the shimmy. I was told to loosen my steering springs. I was told to tighten my springs. I was told that the pivot axis must be absolutely vertical so that the surface the tail wheel swivels on is parallel with the ground; hence the pivot bolt would be vertical. Mine was. I was told the pivot bolt must face forward at the top. I was told the pivot bolt must face aft at the top.

So what did I do? I took the tail wheel apart and made sure it was mechanically in top-notch condition and adjusted to the manufacturer's specifications again. It was. Then I tried each and every remedy listed above except changing the angle of the pivot bolt; none helped. The Scott 2000 tail wheel does require some tension on the steering springs to control the unlock tension and hence any shimmy. The Scott 3200 installation instructions say that chain tension is not required or recommended. The tail wheel condition and installation was determined to be in accordance with all of the available manufacturer's literature I could find. I still had shimmy on pavement with the aircraft close to gross weight.

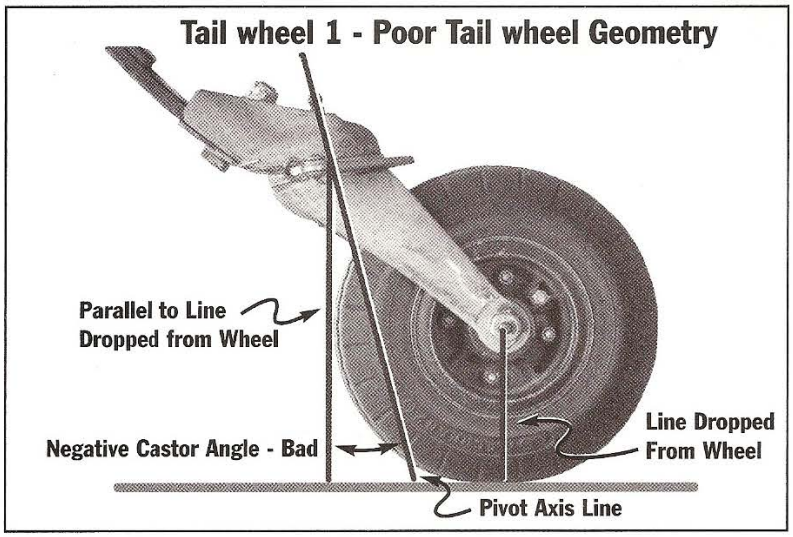
Next I got out an old 1950s auto repair manual that explained kingpin front wheel suspension systems and steering castor angle. If you have ever pushed a grocery cart through the supermarket with one of the front wheels shaking side to side, you have experienced wheel shimmy and improper castor angle. What I learned from the chapter on steering alignment was basic steering geometry.

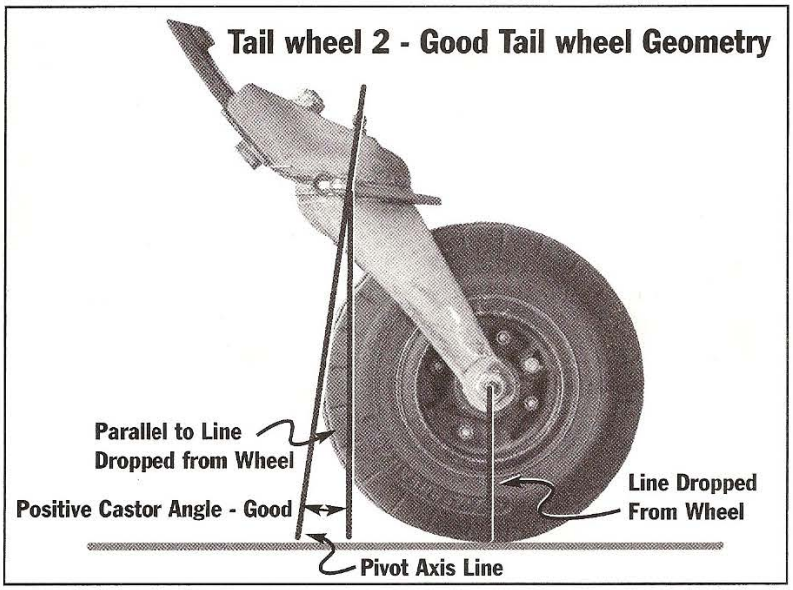
To measure your tail wheel steering geometry, drop a line drawn parallel to and through the pivot axis (pivot bolt) and extend it to the floor and make a mark on the floor where this line hits, or use a straight edge parallel to the steering axis shaft (pivot bolt). Next, drop a line vertically from your tail wheel axle to the floor and make a mark on the floor, or use a straight edge. This will also be where your tail wheel contacts the floor. Now move this line or straight edge that passed from the axle to the wheel/floor contact point horizontally until it intersects the pivot axis line at the pivot axis midpoint. The line that is parallel to the steering axis

must hit the floor ahead of the line dropped vertically from the wheel axle. The angle formed by these two lines is your castor angle. The larger the castor angle the better, as far as tail wheel shimmy is concerned. In other words, the farther ahead of the tail wheel that the steering axis line hits the floor, the greater the castor angle and the less likely the tail wheel will shimmy. To put it another way, the steering axis pin or bolt must be vertical or tilted with the top pointing behind or to the rear of the airplane when the airplane is fully loaded. Emphasis on fully loaded.

When my airplane was empty, the steering axis bolt was vertical. When I loaded the airplane, the tail wheel spring compressed and the top of the steering axis bolt was pointing to the front of the airplane. This would put the extension of a line drawn through the steering axis behind the tail wheel contact point. Bad news—it will now shimmy. You don't want the castor angle to be too large because it will make steering on the ground more difficult. A large castor angle will tend to lift the rear of the airplane slightly as you turn the aircraft. This is called the self-centering effect. Having the steering axis bolt vertical or inclined slightly with the top pointing back when fully loaded should be sufficient.

So how do you correct this angle? There are two easy solutions. If your airplane is like most, the spring is bolted at the front to the airframe with a bolt that passes through the spring leaves. The spring then rests on a pad several inches behind the point through which the bolt passes. Usually the spring is clamped to the pad at this point. You can add a shim between the pad and the spring to increase your steering angle. Or you can take the route I took. I took the spring off and laid it on a piece of poster board and traced out its arc. Then I took the spring to a spring shop and had them rebend the spring until the tail wheel end of the spring was about 1-1/2 inches below the original as drawn on the poster board. In other words, I increased the arc slightly. Voilà—no more shimmy when loaded.




**Tail wheel with positive and negative castor angles—exaggerated. The terms positive and negative are simply the naming convention I choose to use, as they agree with my textbook references.**

One other point. You should carry sufficient air pressure in your tail wheel to keep the tire firmly attached to the rim when it hits the pavement on landing. Because of the small diameter of the tail wheel, it accelerates very rapidly on contact with the runway. If you have insufficient pressure in the tire, it will slip on the rim and cut the valve stem. You now have a flat tail wheel tire. I know; it's happened to me twice. I now carry a minimum of 45 pounds of pressure in my Scott tail wheel. The same thing can happen to your main tires, but with more surface contact area around the rim it is less likely to happen unless your plane lands at very high speeds.