Getting It Straight

Tips on wheel alignment / by Wayne Hadath

A WHILE AGO I replaced the motor mount of my F1 Rocket because of cracking, and reinstalled the gear legs into the new mount's sockets. The legs are titanium rods with a taper at the top to fit into the motor mount sockets. At the top of each leg is a machined square boss that fits into a square hole in the cap of the socket. There is no means of adjusting the toe setting by rotating the gear leg – the square prevents that, so any realignment must be made at the bottom of the gear leg. The original F1 spec was 3 degrees positive camber (positive has the tops of the wheels farther apart than the bottoms) and 3 degrees toe out. This spec was later changed to 0 degrees camber and 0 degree toe due to excessive tire wear at the original specs. These measurements were with the aircraft in a 3 point attitude on the ground with full fuel. When I had the old motor mount on, I purchased shims and set my F1 to the new 0 degree specs. The F1 was now much easier to move by hand on the ground and I experienced excellent landing and ground tracking and good even tire wear.

But after installing the new motor mount I began noticing rapid tire wear, burning off a set of tires in only 20 hours of circuits. Also the plane was hard to push around, requiring quite a bit of effort to make it roll. At first I thought it was the torque on the Matco wheel bearings but loosing them did not help the tire wear. The motor mount was such an exact fit on the airframe that I did not even consider that the camber and toe settings would be different with the new motor mount. Thanks go to a local RAA member who suggested I check my wheel alignment.

Top: Jack the gearleg up and spin the wheel to check trueness. If the bearings are loose, snug them up for the measuring. Left, Using a plumb bob mark centerline points on the floor. Note the tennis ball on the tip of the antenna.

After installing the new motor mount I began noticing rapid tire wear, burning off a set of tires in only 20 hours of circuits... thanks go to a local RAA member who suggested I check my wheel alignment

The handiest surfaces for measurement are the brake discs or the wheel rims. The first matter was to jack up each gearleg and give each wheel a spin to be certain that both run true. Because my tires were worn I installed new ones and pumped them up to 55 psi to ensure that they were as round as they could get. Both of my wheels and brake discs ran true so I was able to use them for alignment purposes. If yours have runout you will have to allow for this in your measurements. My F-1 has stub axles that mount with four bolts and it uses tapered spacers to make alignment adjustments. Changes are effected by reclocking the spacers or replacing with different ones.

To find the center line of the aircraft I dropped a plumb bob from rivet holes that are on the fuselage bottom centerline. Mine are at each end of the cabin section of the fuselage. This involved a lot of crawling around under the plane so I impaled a tennis ball on the antenna instead of inadvertently using my eye for the purpose.

Using the plumb bob I marked small centerline dots on the hangar floor, taped a string to the rear dot, and pulled the string forward to establish a centerline for toe measurements. I could not use the tip of the prop spinner because there is no guarantee that it is actually on the centerline. Don't fall in love with this first centerline because every time you make an adjustment you will be dropping the plumb bobs again and moving the string.

On my plane the calipers prevented using the discs for alignment purposes so I removed the calipers from each wheel and put a c-clamp on each piston to ensure that these would stay in place. This might not be absolutely necessary but it does give comfort that I would not have to bleed the brake system if one piston oozed out.

It is easy to measure camber with a framing square on the flat floor. To measure toe is a lot harder. I have a five foot level that I used as a straightedge, set it on the floor under a brake disc. By sighting straight down from the top I placed it parallel to the disc. Toe measurements were then taken from each end of the straightedge to the string centerline. The centerline allows me to measure toe for each wheel independently. My wheels were toed out an

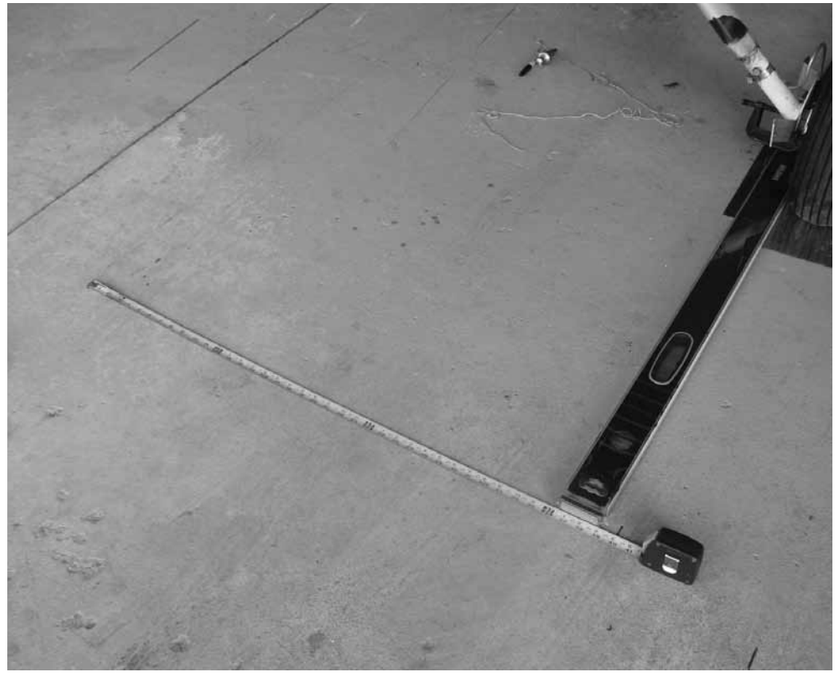
awful lot, hence the difficulty in pushing it around and the rapid tire wear.

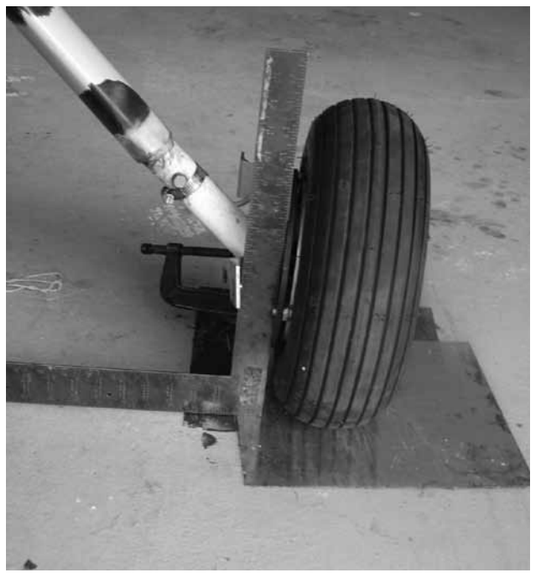
Toe is sometimes given in degrees and sometimes in inches. A high school Tan table shows that one degree is close enough to 1 inch over 5 ft. that this is a usable number. Mine was 5 inches wider at the front of the straightedge than at the rear, so 5 degrees total toe out.

I jacked up the gearleg using a hose clamp as the perch for the floor jack, and unbolted the stub axle from the gearleg. On my plane the mounting holes are in a square pattern so I reclocked the tapered washer and bolted everything up to recheck with this setting.

With spring gear it is necessary to roll the plane back and forth to allow the gear to find its relaxed position. This is a pain and difficult to get it right and to get a repeatable measurement. An alternative is to use grease plates under each tire. I made mine from squares of .032" aluminum, pairing them with grease smeared between. With grease plates under the wheels the legs can displace easily and it is not necessary to

Left: Tape the string to the rearmost point and extend it forward, crossing the forward point. Below, left, sight down the rim or disc and set the straightedge on the floor. Below, measure the distance to the centerline at both ends of the straightedge. One inch difference over 5 ft is 1 degree.





Above left: My Rocket has a tapered aluminum spacer between the gearleg and the bolt on axle. I was lucky that by rotating I could use the same spacer. Otherwise I would have been off to Spruce or to a friend's machine shop for a custom part. Right: Camber can be checked with a framing square. The grease plates have moved quite a lot during the iterations of the test. If they pick up grit they will stop sliding, so keep the floor clean

roll back and forth. It was amazing to see how flexible the titanium gear legs are and how much I could move them on the grease plates by wigging the tire by hand.

It will still be necessary to re-establish the centerline every time the plane is jacked because the jacking will move the plane. Drop the plumb bobs again and move the string. This will be necessary for each adjustment so you will get good at it.

I was lucky and got near enough to 0 camber and 0 toe just by repositioning my original tapered washers. If this had not been enough I would have gone to Spruce for more, or perhaps made some by sawing off sections of aluminum bar stock and having them faced with a mill or a lathe. Planes with welded gear will not find alignment as easy, and an adjustment might involve heating and bending.

The result of getting to 0-0 is that the plane now rolls easily around the hangar. When taxiing it also rolls much more easily, and on my test flight I found myself cruising rather quickly along the taxiway. Next I will be adjusting the injection to idle more slowly. It never ends… R

Wayne Hadath *is a family man and a private pilot who built an F-1 Rocket from parts at a time when a manual was not available. He has successfully competed with that plane in many US races, finishing first several times against American teams.*

When he is not building or flying, Wayne enjoys rock crawling in his highly modified Jeep, taking along his son for remote camping trips, while his wife stays home and enjoys the blissful solitude.