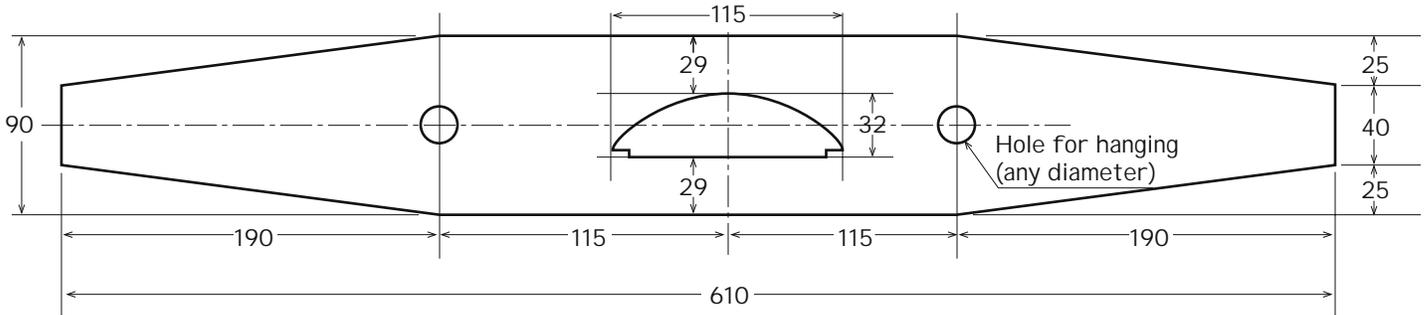


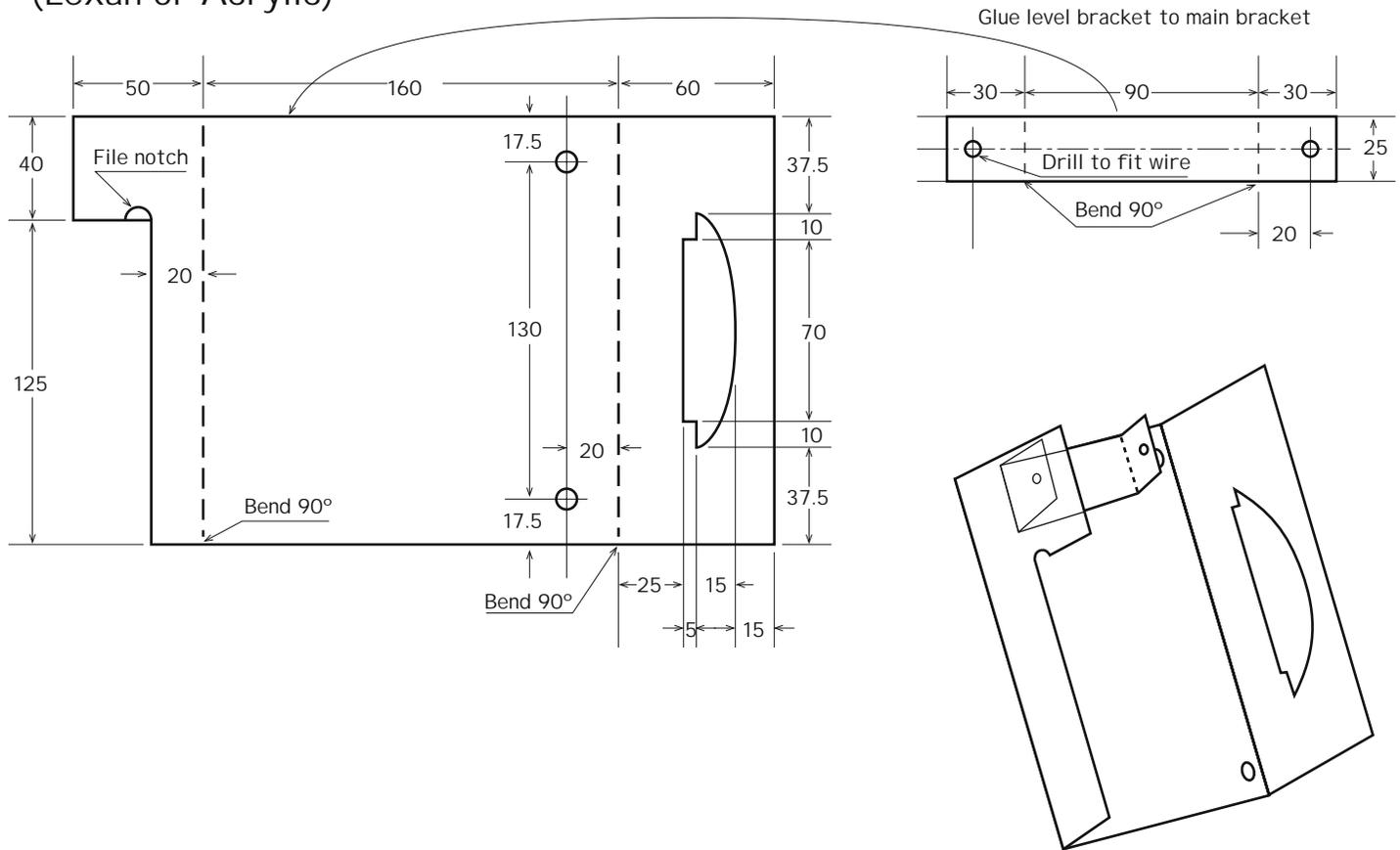
Propeller Wrench

Material: 1" x 4" x 24" wood (poplar)



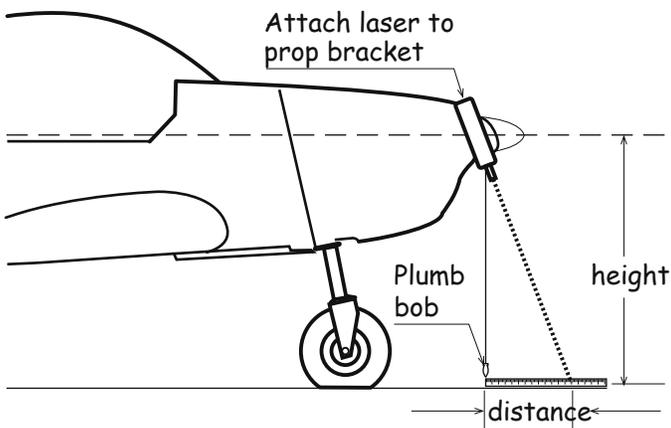
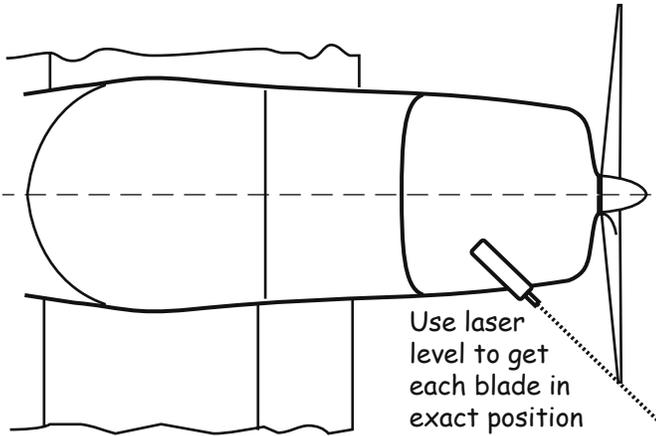
Prop Protractor Bracket

Material: 1/8-inch Plastic
(Lexan or Acrylic)



NOTE: All dimensions in millimeters
(unless otherwise noted)

Laser Prop Positioning



To find the distance for any desired prop angle:
Multiply height times the tangent of the desired angle
Distance = H x TAN(angle)

degrees	tan(n)	degrees	tan(n)
11	0.194380	21	0.383864
12	0.212557	22	0.404026
13	0.230868	23	0.424475
14	0.249328	24	0.445229
15	0.267949	25	0.466308
16	0.286745	26	0.487733
17	0.305731	27	0.509525
18	0.324920	28	0.531709
19	0.344328	29	0.554309
20	0.363970	30	0.577350

Propeller Adjustment

By Michael Mossman

CH 601 HDS, Serial 6-3795

Those of us who are flying aircraft equipped with ground adjustable propellers don't have to experiment with buying many propellers to get the best performance for our aircraft; we can start with one prop, and through adjustment of pitch, get the best combination of climb and cruise performance that meets our needs.

One very important consideration with adjustable props is that the blades must be set very closely to the same angles, so that each blade has the same "bite." Set them precisely and you're likely to have a smooth-running installation. Get one or two blades out of adjustment and you'll have more thrust on some blades than on the others. Fly that way and you'll experience a great deal of excess vibration from your engine and propeller. If you fly that way for very long or if your blades are too far out, your engine's crankshaft and bearing will wear prematurely; your engine mount may fail, too. So let's get that prop blade pitch set accurately.

Adjustment of the CGS ground adjustable propeller can be a pain if you don't have the right tools. Fortunately, the best tools are rather low in cost and easy to make.

One problem with adjusting the propeller is trying to set it precisely. If you have the bolts a bit too tight it's hard to twist it into position. A little too much force and it goes too far. When you try to set it back you overtwist in the other direction! How do you turn it precisely?

Make a simple propeller wrench from a piece of hardwood. In the center of the board cut an oversize slot that fits the propeller blade profile, then line it with some foam weatherstrip to protect the blades. It's a good idea to make the prop wrench reasonably balanced so that you can leave it on the prop without worrying that it will twist it out of adjustment while you are tightening the prop bolts. You don't need to finish the board other than cutting the hole for the prop blade, but a bit of shaping for the handles will make it much more comfortable to use.

CGS's goofy little prop adjustment gauge is just about useless. The angle gauge hangs straight down, as does the pointer. Regardless of how you set the prop, it always indicates zero. Consider riveting the angle gauge to the bracket that slips over the prop. You won't be able to read the exact angle from the gauge, but you will be able to read a relative gauge. That way you'll be able to add or remove degrees of pitch with some precision, and you'll be able to get all of your blades to the same pitch.

The universal prop protractor, like the one made by Warp Drive, is a great idea but it is difficult to set on a propeller. First, you need to locate it at the exact position for each blade, which means that you'll need to measure the location every time you use it. That's a time-consuming process. The other problem is that the protractor is flat on one side, and your prop blades are not flat. So you are never assured that you are getting a precise reading when you position it. Here's a great way to modify it:

Replace the clamp strap of the prop protractor with a simple piece of angle aluminum or plastic. Screw it down so it is tight and flush. Take a piece of lexan or other plastic and make a bracket that matches the part of the CGS prop that slides over the propeller blade. You could even use that same piece from the CGS prop adjustment gauge. Rivet that piece to the angle that you attached to the universal prop protractor. Now you can simply slip the prop protractor onto your blade(s) and be assured that it will be in the same location and same relative

angle for each blade that you adjust. That leaves one less tool that you will need when you set your prop.

When you adjust your blades you need to be sure that you position each blade in the exact position so that your prop protractor has the same reference. That usually means using a spirit level on the blade. You might have some difficulty jiggling the blade up and down trying to get it in position, and even then looking at the bubble in the level is subject to interpretation. Take the prop protractor bracket idea one further by making a channel out of lexan or acrylic. On the inner leg of the channel cut your slot that slips over the blade; on the outer leg trim to fit against the prop blade. File a little notch to hold it in place. Make another bracket from the same type of plastic to hold a small spirit level (I bought one from Harbor Freight for \$1). It is suspended with a piece of heavy, straight wire, like a hinge pin ("music wire") from a piano hinge. Glue this little bracket to the main bracket.

When you slip this modified prop protractor onto your propeller, you can make all of your positioning and angling references with one tool; no other measuring devices are required.

It's possible to make the prop wrench and protractor bracket into one tool but I don't recommend it. You'll want your prop wrench to have enough "give" so it won't mar the blades; therefore, it's not going to reposition exactly.

You might also try using a laser level to position your prop blades. Place the laser level on the front of the fuselage or perhaps on the wing. Tape it down so that it doesn't move. It doesn't even need to be a level; any cheapie laser will do. What's most important is that you can position each blade to the exact position. The laser will make positioning the blades easy. (CAUTION: Position the laser so that it doesn't shine into your eyes. Do not look directly at the laser!)

Taking the laser concept one step further, you can throw away your hard-to-read prop protractors. Make a little piece that slides over your prop like the gizmo that comes with the CGS prop adjustment gauge. Add to that a rigid clamp to hold a cheapie laser pointer. Slip it over the prop and mark where the laser lights the floor. If you want more pitch, the laser dot should move forward; less pitch the dot moves rearward. If you need more precision tape a yardstick or tape measure to the floor. This works great, but only if your wheels are thoroughly chocked!

You can calculate the distance required to get any given pitch. Multiply the distance from the prop tip to the floor by the tangent of the desired angle to get the distance forward that the laser needs to reach. If using Excel you'll need to convert degrees to radians, so use the formula $=\tan(\text{radians}(n)) \times \text{height}$, where "n" is the degrees that you want.

EXAMPLE: When the descending prop blade on my airplane is level, the tip is 1270 mm (50 inches) from the floor. If I want a 20-degree blade pitch I multiply 1270 times the tangent of 20 degrees (.363970), meaning that the laser should focus about 462 mm forward, or 18.2 inches forward using 50 inches as the height.

After you've set each of the prop blades to the desired pitch, check them one more time to be sure that they didn't move while turning the prop by hand. Once you're confident that they are all the same, tighten the prop bolts using a torque wrench set to the values recommended by your propeller manufacturer.