Building a Beech Jack

By George Steed

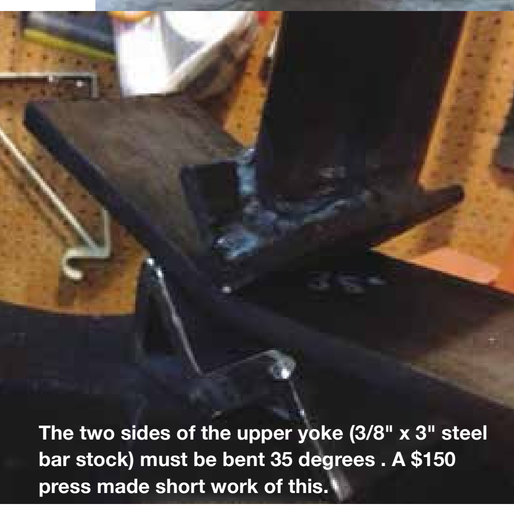
While finishing my A&P at Miramar College in San Diego, I noticed that Cruiseair Aviation in Ramona, California, was hosting an ABS Service Clinic. I contacted ABS inspector Bob Olson and he graciously invited me to come up and shadow as many inspections as I wanted. Over two days I obtained a great deal of very specific and useful maintenance information. Guys would fly in prior to their appointment time, the hangar doors would open, and their planes would be wheeled in. While they were registering, two Cruiseair mechanics would remove inspection panels, disconnect gear doors, and then position a remarkable wheeled jack under the plane. By the time Bob and the owners returned from the registration desk, the plane was ready to lift and inspect.

Though trying to learn Beech-specific maintenance tips while following Bob around, under, and on top of 16 airframes is like trying to drink from the proverbial fire hose, much of that experience has stuck with me. Another thing I remember was that jack easily lifting the plane. Too often I've seen individual jacks stacked up on 4x4s, which may have worked but just didn't fill me with confidence. So last summer as I was contemplating work on my gear, wheels, tires, brakes, etc., I began to wonder how hard it would be to build a Beech-specific jack.

I made a couple attempts to draw my own plans but then found a set of plans from 1965 on the T-34 website that looked promising. A gentleman named Larry Davis had drawn by hand seven pages of plans and included a parts list. I headed off to the welding shop and started buying steel.

While this project requires welding, there's nothing else that demands machining or tools beyond what might be found in the standard garage workshop. I used a band saw I had made 25 years ago, my great-uncle's drill press, a bench grinder, a hand grinder, a 20-ton press from Harbor Freight, and hand tools.

The jack worked flawlessly. Raised and secured, we were able to swing the gear with confidence.



The two sides of the upper yoke (3/8" x 3" steel bar stock) must be bent 35 degrees . A $150 press made short work of this.

A word about welding: Forty years ago I went to the local tech school and announced that I needed to learn to weld thin-walled 4130 tubing. The welding instructor listened, nodded, and took me over to a welding bench. He put a stick welder in my hand and started to explain its use. “No, no,” I said. “I want to gas weld tubing.” He replied, “I know what you want. This is what you need.” And he proceeded to run a very nice bead. He handed me a fistful of welding rod and said, “When your bead looks like mine, come and get me.” It was a month, of course, before I thought I could do it. This was followed with lap welds, butt welds, t-welds, vertical welds, and overhead welds. Finally, the end of the course was coming and I was getting nervous. But with a couple of weeks to go he put a gas torch in my hand and said, “Do the same thing, but use this.” And magically, I could. All welding, it seems, is about puddle control. Whether stick, MIG, TIG, or Oxy-acetylene, the skill is in manipulating the puddle of molten metal to properly join the two pieces … not that hard. Ten years ago at Oshkosh I visited the Lincoln tent and the demonstrator handed me a TIG torch. What a revelation. The same technique as a gas torch, but with exquisite control. It makes a project like this a pleasure.

While it’s possible to learn to weld on your own, the easiest thing to do is take a class at the local tech school.

A bimetallic hacksaw blade on an old band saw makes cutting the 3/8" bar or 2-1/2" tube easy.

They would rather teach kids who are going into the industry, but they’ll take us, too. You’re put in a booth with a machine, a handful of welding rod, five minutes of instruction, and told to get busy. It’s big, dirty fun ... sort of how men like to barbeque because it combines food and danger. We like welding because when you’re out in the garage with the helmet, smoke, sparks, and a mysterious bright arc light, people tend to leave you alone. They watch from a distance and retreat when you flip down that helmet.

The lifting arm being fitted and tack welded.

The lifting arm welded and painted. I found that painting as I went was a small morale boost and allowed me to gauge my progress.

To start building the jack I had six lengths of square steel tubing. It had been cut to length at the metal shop but I had to cut the miters (diagonals) at home. A bimetal hacksaw blade on the band saw made this easy. With some magnetic squares to hold things in place, I tacked the first tubes in position and began the welding. As welding projects go, this one was simple. New, thick, clean steel is the easiest thing there is to work on. Bit by bit, piece by piece, it came together according to the plan.

The only hiccup was the lifting arm wouldn't fit in between the arms of the bottom frame. It turns out that steel expands when you weld, then contracts as it cools. The problem is that it contracts more than it expanded. If you plan ahead and allow for this, it isn't an issue. But despite my bracing against it, my lower arms had come in an extra half inch. To solve this issue I stacked up some concrete blocks and used a bottle jack to push the arms out an inch past where I wanted them, and they relaxed right into place. Problem solved.

I'm pretty sure that every Bonanza ever made (and probably every Debonair, Baron, and T-34) has the same lifting arrangement: two conical nibs under the wing roots and a 3/8 x 16 nut about four feet back and

Welding causes contraction. To make room for the lifting arms between the lower frame arms, I had to move them out a half inch. An 8-ton bottle jack was perfect for the job.

The bottom frame coming together. The tubing is 2 1/2" square with a 1/4" wall … this was going to be heavy.

Fitting the upper yoke.

two inches right of centerline built into the belly. The upper yoke of the jack is positioned under these three points. Two sections of tubing engage the nibs and lift, and a bolt engages the 3/8" nut and holds the tail down. At this point you are ready to lift the aircraft. A separate tail stand/hold down is recommended, but more on that later.

I had some apprehension about my ability to cut, drill, grind, bend, and fit this 1/4" thick tubing and 3/8" thick bar stock – but my worries were groundless. I would check the plans; cut the piece; and bend, drill, fit, and weld. I painted with a rattle can both for corrosion protection and to gauge my progress.

Tacking the fittings for the hydraulic ram.

The plans called for a safety rod – I thought of a notched bar of 3/8" steel that easily holds the weight of an aircraft.

The one large divergence from the design was the hydraulic component – it called for a $30, three-ton bottle jack. This troubled me because I didn't want to be under the plane as I was jacking it up and I wasn't sure this small jack would be up to the task. I splurged on a 10-ton pump and a separate single-action spring return ram that I felt would do the job and allow me to be out from under the plane while jacking. These components doubled the cost of the project but seemed worth my peace of mind.

The jack in its initial form.

When the main components were in place, I took the jack to the airport. I made sure the yoke fit the lifting points and the structure of the jack wouldn't interfere with antennas, beacons, etc. A couple were close, but it fit and I brought it back to finish. With the addition of wheels, the hydraulic pump and ram, and a safety bar (not in the plans), the jack was ready. Out to the airport again, placed under N3706Q, and up she went. I wasn't worried about it collapsing as this airframe regularly drops to the ground from three feet up at 70 knots (I know, I know), but I didn't want it dropping when the gear had been retracted. So we left it up and went home. Three days later it hadn't moved an inch … success.

After discussing the point with other more experienced mechanics, though, the topic of a tail stand came up. As you jack a Bonanza, the nose with the engine in it wants to drop. The 3/8" fitting in the back of the yoke should keep things in place, but during an inspection there is a lot of movement and weight change in the airframe as you crawl around inside. The usual trick is to tie a pail full of concrete to the aft tie-down fitting. This keeps the tail down and the nose up ... until you move too far aft, then you have to prop the tail up. An easier and much sturdier solution is to create an adjustable tail

Before proceeding too far, I wanted to make sure it would fit the aircraft. I took the jack to the airport and checked all connections, fit, and clearances.

stand that will hold the tail in position. ABS Board member Stu Spindel forwarded a photo of a tail stand he had and I copied it. After the jack, this was child's play. I used cement paving tiles and created the tail stand around them. There is an extendable pillar that pins into the tail tie-down and makes the plane rock-solid when up on the jack.

Was this necessary? Probably not. If all you're going to do is change a tire or grease a bearing, a car jack on an axle stub will get a wheel off the ground. But if you want to swing the gear or change a rod-end bearing, you'll need to lift the whole aircraft, and not by the axle. We now have a jack at my home field at Bremerton, Washington, and any one of the eight Bonanza owners on the field are welcome to use it. I count it as time well spent.

It's possible to lift and move the aircraft with the jack alone, but in order to work on the aircraft, especially the aft fuselage, a tail stand makes things much more stable and secure.

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