Building the Bearhawk®

Builder's Assistance Manual

for the
AviPro Aircraft, Ltd.
Quick-Build Bearhawk Kit

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BEARHAWK ASSISTANCE MANUAL

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Welcome to the Bearhawk Family

This document will help you find your way into the world of the Bearhawk. It's not a step-by-step guide so much as it is a map that will tell you where to go and when, as well as what to do as you visit each mini-destination on the way to the big one. We're assuming you know which end of a screwdriver to hang onto, so some of the basics will be skipped. If there is a function that you do not *clearly* understand, AviPro suggests you seek out a qualified A & P mechanic. Additional information is available from many sources, including the EAA, its chapters and its Technical Advisors. *This manual is NOT intended to be the final authority.*

It's important that you consider the plans you received from the designer, Bob Barrows, as the final word on everything. This document is designed to smooth out some of the concepts along the way. Further valuable information will be found in the following sources and it is of paramount importance you have the following and refer to them constantly. Do not proceed without them:

- Beartracks newsletters & Bearhawk Book
- Tony Bingelis books (see EAA)
- Russ Erb's CD (www.qnet.com/~erbman/bearhawkcd.htm)
- FAA A/C 43.13. This is your Bible
- ***Other Builders' Websites (Important!)***

Help is ALWAYS available

It is important you join the Bearhawk Quick-Build chat group on-line. This puts you in contact with dozens of other builders AND gives you a direct link to AviPro's tech people. Normally you'll get an answer to a question in a few minutes. In addition, AviPro has people available 24/7 via cell phone, 602/738-2045. It would be appreciated, however, if you didn't call after 9 pm Phoenix, AZ time. ALSO, PDFS OF THIS MANUAL WILL BE UPDATED CONSTANTLY SO CHECK THE BEARHAWK WEBSITE FOR THE LATEST.

This document will make no attempt to train you in standard aircraft construction techniques. What this document will do is tell you how and where to apply those techniques , but it will not mention every single operation.

At first, when you receive that huge package and start spreading the parts out, the concept of building an airplane not only becomes very real but often just a little overwhelming. That's a natural reaction. This is a big project, but it isn't even close to being a difficult one. It's not brain surgery. If it were, so many others wouldn't be doing it.

Project Orientation

If you'll permit us to throw a little philosophy at you, the key to finishing this, or any other major project, is to develop a very definite "project orientation" mindset. This doesn't mean you lock yourself in the shop and have your significant other slide pizza's under the door periodically. What it means is that you have to approach the project with a very definite strategy in mind. You have to have a plan and that's where this document will help. It makes many of the decisions for you and is constantly supplying an answer to the never ending question "what do I do next?"

What this manual cannot give you is the basic mindset that is made up of certain ways of looking at the project along with developing certain building disciplines. At the risk of sounding a little basic here, we'd like to mention a few subjects that, if you go into the Bearhawk-build with them in mind, the heartburn quotient will be much lower. Some are aimed at helping complete the airplane while others attempt to keep peace in the family.

Build time is agreed upon. It's essential that not only your family be behind you, but that you feel no guilt blocking out enough hours in the week to keep the project momentum going. The average BH builder is flying in 1,200 hours, so to finish in two years, you need twelve hours a week.

Work space is sacrosanct. The family has to realize a work shop is not where they store bikes, lawn mowers and other stuff they don't know what to do with. It's called a "work" shop for a reason.

The build-schedule accommodates honey-does and family time. The family won't be behind a project that impacts their own priorities, so both have to be scheduled.

Every day something gets done. You don't have to build a part every day, but you at least have to do something positive. Call and order parts, doodle an instrument panel. It's like working-out or dieting: a day off quickly becomes two, then three, then.... *It has to stay in the forefront of your mind.*

Getting Started

Make sure you Know What you Have

As soon as you can, spread all the parts out and do a complete inventory. We're not super-human, and it doesn't happen often, but we do make packing errors. Also, when checking all the parts remember that some small parts are packed inside the wings. Also, check to make sure that, if there is supposed to be a right and left of something, you don't have two rights, etc.

Be prepared with a large number of trash bags or have a dumpster handy because there is A LOT of packing material involved.

And don't even think about scrapping or cutting up the steel wing shipping crates. They have a number of uses we'll mention further on.

Required Tools Shopping List

The Bearhawk does NOT require you to own a welding torch or major sheet metal breaks or rollers. What it does require are the following:

- Air Compressor, min. 3 hp, 9 cfm, 125 psi
- Rivet gun, 2x or 3x
- Rivet Sets,(3,4, flush swivel head)
- Rivet squeezer, # 3, #4 sets and dimpling dies, dimple die for #6 screws, flush sets, .
- Bucking Bar assortment
- Back Riveting set for tank area
- Rivet cutter
- Moisture/oil filter/separator for air comp.
- Pressure regulator for air compressor
- Spray guns, touch up and full coverage
- Clecos, 300 3/32, 100-1/8, 20-side grip
- Hole deburring tool
- Micro-stop, cage countersink and cutters 3/32 and 1/8
- Pop rivet puller, w/3/32, 1/8 sets
- Duckbill snips
- Wiess snips, left, right and straight
- Nicopress squeeze tool
- Nut plate drill jig for No. 6 screws
- Small sheet metal break (cheap one), 18"
- Small sheet metal shear (optional)
- Drill press
- Thread taps, 1/4 x 28, older kits need 5/16 & 3/8 fine thread taps.
- Personal paint protection (free air hood)
- Fly-cutter or Matco punch for panel
- Side deburring tool
- Dozen each #40 & #30 bits
- Dial caliper, high quality steel rule

Work Space

Although airplanes have been built in single-car garages, that requires planning and a place to store finished components (wings, etc.). It can be frustrating. A two-car garage, however, is fine.

The wing crates are made from 1" square steel tubing and are five by fifteen feet and fifteen inches deep. With the fuselage bolted on top of the wings, the bundle is seventeen feet long and 92" high. The crates have jack points on the corners so you can use a bottle jack to put casters under it and the entire thing weighs about seven hundred pounds. With the engine and rudder on the fuselage it is twenty-one feet total length.

To work on the wings you'll need a flat table fifteen feet long, but don't build one. *Take one of the wing crates and turn it upside down and use it as a table*. You can sit it on saw horses or use the steel tubing from the top to make legs. Lay the foam from inside the crate on top and you have a perfect wing table.

Hardware Required

You'll need to purchase all the hardware (nuts & bolts, pulleys, cable, etc) and you might as well do it all at one time. Wicks offers a complete hardware kit or you can use the detailed listing that's in the appendices and shop it yourself. The vendors for all of the parts are also listed there. Don't be surprised if a few of the bolts are the wrong length: in a welded structure it's nearly impossible to get every one of them right.

Duplicate Your Plans and Newsletters

You absolutely need your plans and your newsletters right at your elbow every second you're building the airplane. They are the final authority on the airplane. At the same time, you'll want them in the house where you can refer to them from time to time. You can buy duplicate plans (minus Drawing 7, the airfoil mylar) from Bob Barrows for $30. Just give him your serial number.

Let's Talk About Engines and Props

We're going to talk about engines now because we want to make sure you understand that the engine is the very last thing you need to worry about. From the firewall back, all AviPro Bearhawks are identical. The only thing that changes is the motor mount. So, you can put off that one gigantic expenditure until much later. However, let's talk about the different engine options and the pros and cons of each.

It should be mentioned that Bob Barrows prefers to see the engine weight kept under 400 pounds. Continental 0-470/520 engines weigh a little more than that so he has compensated for that in the design of the motor mounts.

Four-Cylinder Lycomings

When buying any four-cylinder Lycoming make sure it has the Type I Dynafocal mounts because that's the most popular and the only one AviPro makes a mount for. *We do not support the conical mount engines*.

The pros and cons of the different sizes and types of engines are summarized below;

0-320, 150/160 hp

Absolutely adequate for the airplane but requires the builder pay particular attention to keeping the airplane light. Kept reasonably light, the overall performance will be better than a C-172 by a measurable amount.

0-360, 180 hp

The 180 hp engine is probably the best choice for 90% of BH builders and is not only available new in the various "XP" experimental engine kits but offers performance in excess of a Cessna 182, although cruise will be lower, around 135-145 mph. Although not a requirement, a constant speed propeller will make it possible to better utilize both ends of the airplane's speed envelop.

0-360 Barrows Special

200 hp engine from Bob Barrows.

IO-360, 200 hp

A little heavier, the IO-360 gives additional performance, although any fuel injection system can complicate the fuel system

IO-390, Lycoming, 210 hp

A brand new engine, it appears to offer the best of both worlds in many situations. None have been flown in a Bearhawk yet, but it should be a good choice. The XP-400 would be another good-choice and probaby less expensive.

Six-Cylinder Lycomings

The 0-540 series of engines are heavier, but provide an increase in overall performance that is hard to believe. However, nothing is free, as the useful load will go down nearly two hundred pounds.

Any 0-540 can be used as long as it is of a parallel-valve configuration. *NOT angle-valve*. The angle-valve engines weigh over 80 pounds more than the others. Whether it is a "wide deck" or "narrow deck" engine makes no difference.

There is a bewildering number of variations on the 0-540 theme but the most significant facts include:

• Available in 235 hp, 250, hp, 260 hp

• 235 hp engines ("B" series) are lower compression engines capable of burning automotive fuel. They are also cheaper and easier to acquire. Performance is still unbelievable.

• Hartzell constant props can only be used on O-540 A4XX, 0-540-B4XX, -J3XX engines. All other series of 540's, which are usually early engines, must be modified w/heavier crank shaft counterweights or use a McCauley prop.

• ALL 540 Lycomings can be easily modified with the heavier counter weights and they can be installed without disassembling the engine by removing cylinder No. 6. The parts and instructions are available from Johnston Aircraft Svc, Inc, P.O. Box 1457 Tulare Municipal Arpt Tulare CA 93274 United States, 559-686-2161, www.johnstonaircraft.com.

• The average fuel burn of a 540 is approximately 12.5 gph versus, 9.5 for an 0-360 at 65%. However, if the 540 is throttled back to the same speed, the fuel burn is about the same as the 0-360.

• There are two types of mount ears on 0-540s, the Type I has 1 3/8" holes the Type II has 2" holes. These determine which AviPro motor mount you need and which motor mount rubbers to buy. The mount lugs bolt to the engine case so are interchangeable, but expensive.

Continental 0-470/520

The six-cylinder Continental 0-470 engines represent good buys on the used market and are smooth running, well known engines.

- Usually heavier than 0-540 Lycoming
- Use McCauley props
- 215-230 hp
- 0-520, 260-285 hp, heavier but adaptable.
- IO-470 is 260 hp, but there's the probability of firewall interference with the longer fuel handling unit at the rear so it's not recommended.
- Some cowling mods required

Automotive Engines

AviPro does not provide any support services for automotive conversion so you'll be designing your own motor mount, cowling, etc. We do not discourage these kinds of installations, as that's what homebuilding is all about, but we have no information on them and can be of no service to builders who decide to go that direction. Several are being built to use Mazda rotary engines and one plansbuilt BH is flying with a Rover V-8.

We can put you in contact with builders who are using automotive conversions.

A Propeller Discussion

Even though most people use a constant speed propeller on the airplane, that is not a necessity. A fixed pitch prop will work fine and it'll save around thirty-five pounds and many thousands of dollars.

The downside to using a fixed pitch prop is that, of necessity, it will be a compromise in most parts of the flight regime. Because the Bearhawk has such a wide speed envelope, regardless of how you have a fixed pitch prop pitched, it will be slightly wrong at least part of the time. However, if you just want to enjoy flying and maximum performance isn't your goal, there's no reason not to use a fixed pitch prop but build light for CG.

A constant speed propeller allows the prop to adjust itself to offer maximum engine and propeller efficiency through out the flight envelope. It won't necessarily take off faster than a fixed pitch prop that is pitched for max takeoff rpm, but it will cruise much faster than that same prop. It is simply the best way to optimize both takeoff and cruise.

When using a constant speed propeller, however, you also have to factor in the cost of the governor ($1,300-$2,300, new, 2006 dollars) as well.

The longest propeller you can use when turning the engine 2,700 rpm is 84" but in certain cooler environments that may be too long as the tips will come too close to supersonic. However, limiting it to a lower rpm, will remedy that. The shortest should be in the 80" range.

Three-blade versus two-blade

This is a very controversial subject and the results of using a three-blade versus a two-blade vary greatly from prop to prop and between manufacturers. As a normal rule it is seldom that the same three-blade prop offers consistent advantages across the speed range. Some will give a very slightly higher cruise but climb isn't improved and some will improve climb but speed remains the same or even goes down. In all cases, the differences are so small that they are difficult to measure. Plus a three-blade prop is a minimum of eighteen pounds heavier, requires a different spinner and is approximately $1,200 more.

One very big improvement instantly realized from a three-blade prop is that they are much smoother than a two-blade. They also give more ground clearance, although the two-blade has plenty. Besides the foregoing, three-blade props look very cool.

Robbie Staton hung a three-blade on the front of his fire breathing, Monte Barrett, cold air induction 540 hotrod.

What Do You Do First—What's the Building Sequence?

Before even unpacking your kit, make sure your work shop is ready to go to work. As tempting as it is to started opening crates and unwrapping things, get the work area ready first, then you have a much less chance of losing or damaging some part of the kit. Ideally, a series of shelves and/or pegboard hangars to visually display the parts should be ready to go.

Fuselage or Wings? Which First?

It makes no difference which you start first, the wings or the fuselage. With the obvious exception of the wing fittings, struts and fuel system/control system interfaces, the wings and the fuselage represent different building entities, so you can build and complete one in its entirety before starting on the other.

If it makes any difference in your decision, the fuselage takes significantly longer than the wings to complete. However, the wings, when completed, can be put back in the crates and easily stored where the fuselage is a pretty good sized unit and more difficult to store, when finished. Especially with the tail mounted.

All that having been said, most people like to start on the fuselage first, if only because it looks more like an airplane and gives them more visual pleasure because of that.

Regardless of which you start with, it is essential you have a formalized plan of attack in which you begin on a given aspect of that particular unit and finish that part of it before progressing on to the next. Hop Scotching around the airplane is a great way to forget where you're at and do something wrong.

Assembly Sequences

The following sequences lay out a suggested order of events, but, with only a few exceptions, this isn't cast in concrete. There is some flexibility, although some operations can't proceed until another one is at least started.

Fuselage Sequence

Here's a very, very strong recommendation concerning fuselage construction: *have the fuselage completely finished, meaning all the control sys - tems in, the cables run, fuel lines in place, seats ready to go and all wiring done BEFORE covering the fuselage*. It is so tempting to put the covering on so it looks more like an airplane but fight the temptation. Covering greatly complicates access to the inside of the fuselage and it is so much easier to work on the systems inside the fuselage before the covering OR the boot cowl is attached. Plus, when the fabric is on the airplane and you're working around it, you always have to be doubly careful not to accidentally poke or tear it.

Mark Goldberg was at this stage at 130 hours

Here's a suggested sequence of events for doing the fuselage. When doing any of this kind of work, always refer constantly to your plans and Beartracks. They are the final authority. There will be detailed explanations for each of the following operations later in this assembly manual.

- Put bare fuselage on saw horses high enough to put the gear on it.
- Assemble shock struts
- Install brake calipers
- Attach landing gear
- Install wheels and tires
- Install tailwheel spring and tailwheel.

<u>*Now the airplane can sit on its gear*</u>.

- Install rudder pedal assembly
- install flap assembly
- install control stick assembly
- Make floor boards
- Install tail and tail struts
- Run control cables and pulleys
- Run fuel lines and fuel valve
- Install seats
- Install trim system
- Install fuselage stringers
- Fabricate rear cargo bulkhead
- Install firewall

- Install motor mount
- Fabricate/install instrument panel
- Install instruments, wiring (optional)
- Fabricate/install boot cowl
- Install brake reservoir, master cylinders
- Run brake lines
- Install windshield (optional)
- Install engine, prop, spinner
- Fabricate/install cowling.
- Fabricate door skins
- Install doors
- Install covering

Wing Building Sequence
- Unpack wings
- drill out pop rivets
- Install flaps system
- Install aileron actuation system
- Install flaps and ailerons
- Install fuel tanks & fuel lines
- Run electrical conduits
- Plumb pitot tube
- Torque all bolts
- install stiffeners at trailing edge
- Rivet top skins
- Install aileron pocket skin
- Rivet tank bay stiffeners
- Finish access panels
- install wing tips

Finishing sequence
- Set incidence and finish drill wing fittings
- Set dihedral and drill struts
- Hang wings
- Finish fuel line hook up
- Connect flaps controls to wings
- Connect wing fuel lines to fuselage
- Make wing/fuselage fairings
- Make tail/fuselage fairings
- Cover
- Paint
- Reassemble
- Go Flying

This is what 100 days of building gets you. Jan Gutwein of Francisville, Indiana shows off his family and his handiwork

Putting its Legs Under it: The Landing Gear

With the exception of drilling and tapping the shock struts for a fill plug, which is not necessary on later kits, installing the "O" rings, assembling the struts and mounting the brakes and landing gear is very much a bolt-on process.

Assembling the Shock Struts

You need to assemble the shock struts before you can attach the gear legs and put the airplane up on its landing gear. If you look at the plans (drawing No. 25) you'll see how the struts go together. There's a big spring that's compressed within the tube and a bronze cap inserted in the strut that is held in place by a snap ring.

Before doing any assembly work, you need to drill and tap the fill hole as indicated on the plans. Not necessary on later kits. Be sure to drill the plug hole on what will be the *upper, outside* of the gear strut–the highest point–as this allows for getting the maximum amount of fluid into the strut. It is critical that the shock strut always have as much fluid in it as it will hold for the gear to function properly. Ideally, there should be no air in it.

The following does not apply to later kits as the plug is already in place. The filler plug uses 1/8 National Pipe Thread threads (you need a NPT tap, NOT a regular machine thread tap and the hole is drilled with a 11/32" drill bit) and make sure, when you screw it in, that it bottoms out on the threads BEFORE the end of the plug protrudes inside the strut where it can impact the function of the parts. Depending on how deeply you cut the threads, you might need to grind the nose off the plug to get clearance.

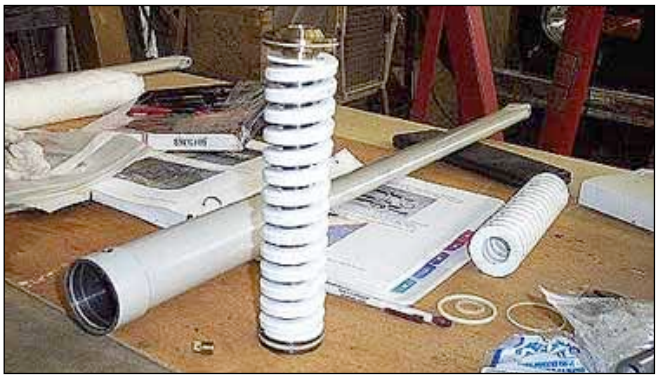
When assembling the strut itself, first, deburr all the parts with emery cloth to make sure that the O-rings have a nice, smooth surface to slide on when assembling the shock strut. In fact, try to get a smooth polish on the top half of the shaft.

Do a trial fit of the small parts first to see where the O-rings are going to go, because if there are any sharp edges on anything, it might cut those O-rings rather than compressing them. You should lubricate the O-rings with grease before you attempt to assemble anything. Once you've done all of the above, put the O-rings in their appropriate grooves and prepare to assemble the strut.

The biggest trick in doing the assembly is compressing the heavy spring about 1/4" to allow the snap ring to slide into the retaining groove in the shock strut on top of the bronze top cap.

Follow these steps: Slip the heavy spring over the rod/tube that's welded to the plunger. Then place the bronze top cap, with the O-rings installed, in place on top the spring.

Place a 3/4", 1/2" drive socket on top of the top cap and over the shaft to act as a spacer.



The O-rings form the seal between both the bronze cap and the shock strut and the shaft coming through it. When installing, lube the rings slightly with oil and be careful not to nick them.

Thread a 1/2"x 20 bolt into the rod. As it is tightened, this will compress the spring. Keep tightening the bolt (you'll need help holding the strut) until it's short enough to allow inserting the snap ring into the groove in the shock strut when the unit

When installing the internals in the strut, it is much easier if you compress the spring using the above method--run a bolt through a socket and compress just enough to get the snap ring in the grove.

slides into the housing. It is a very tight fit, but with minimal tapping, it will slide in fine.

The top cap needs to be pushed down just enough to barely allow the snap ring to be inserted. If the groove isn't ready accessible, remove the spring assembly and tighten the bolt some more.

Have have the snap ring ready to go on your snap ring pliers. Snap ring pliers that have 45 degree angle noses work well. They stay out of the way and get the snap ring in place. Use high quality snap-ring plies as the cheap ones will drive you nuts. You may need to "chase" the snap ring down

into the strut with a big screwdriver. An extra set of hands or a vice to hold the unit helps.

Tap the snap ring in place to make sure it's well-seated before taking the bolt out. Nearly half of its width should disappear into the machined groove (1/16" plus).Notice, however, that the snap ring is tapered so the amount visible won't be even. USE ONLY THE APPROVED SNAP RINGS AS SUPPLIED BY BOB BARROWS OR AVIPRO.

Replace the bolt with an Aurora XAM-7M

Typical brake line routing, although it is advisable to have the last part of the line going into the caliper be a flexible line. Matco brakes are shown.

rod end bearing (**grease the threads with thread sealant**) and you're ready to put the strut into the airplane. You will only have room for a very thin jam nut between the bearing and the shaft. If you don't have room, use blue Loc-Tite on the threads. *Don't tighten the jam nut or use Loc-Tite until the very final phases of assembling the airplane because you'll be adjusting them* to align the landing gear AFTER THE AIRPLANE IS COMPLETELY FINISHED.

When the aircraft is complete you will adjust the landing gear to give a tread of 72" at normal flying weights and 74" at gross. Just roll the airplane forward and backward a number of times and the gear will center up for measurements.

Do NOT use any bearing other than the Aurora specified.

You'll find two small 7/16" diameter bushings in the kit that are used to bush the inside diameter of the bearing down to 3/8".

Now, put the struts aside while you finish putting the brake assemblies on the gear legs.

Installing the Brakes

The following breaks down the specifications on the various Cleveland brakes. A single-puck brake is more than adequate for all but the harshest applications using bigger tires.

The clearance for the caliper nuts is minimal and may require grinding at least one nut for clearance. Three 5/16" bolts is adequate for the installation.

Cleveland Part Numbers:

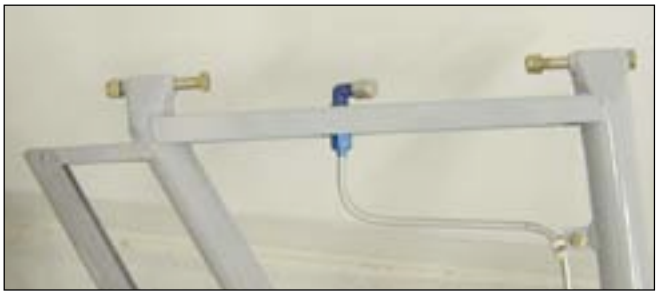
199-104 - Magnesuim wheel 1750lb static and single puck

199-105 - Aluminum wheel 1500lb static and single puck

199-60 - Aluminum wheel 2500lb static and double puck 6.00x6 tire only three bolt

199-62 - Aluminum wheel 2500lb static and double puck 6.00/7.00/8.00x6 tire three bolt

The brake mounting flanges on the gear legs have no holes drilled in them allowing the brake assemblies to be positioned at any angle. However, the most practical (better ground clear-



Install a 90-degree bulkhead fitting at the top of the gear leg and a flex-line from there to the brake line inside the fuselage. This is to allow the gear leg to move.

ance, maintenance, etc) is to mount them pointing straight ahead to slightly down.

Carefully mock up all the wheel and brake parts before drilling any holes, making sure every-

thing is in the right relation to each other. Notice how the bolt holes in the mount pad are going to be really close to the gear leg, so you have to be very careful about where you drill the mounting holes. This also determines, to a certain extent, the angle the calipers will be mounted on the mounting flange.

Drill and use at least 3 of the 4 holes to attach the caliper assembly (3 AN5 or 4 AN4 bolts). Depending on the brakes used, you may have to bush the caliper mount plate holes down in size.

The holes are very close to the weld beads, so you may have to grind a washer and put under the nut to get clearance on the inboard sides. You may also have to grind one or two nuts slightly to fit. Use Nyloc nuts.

With the brakes installed, you're ready to hang the gear on the fuselage using the bolts called out in the plans.

When installing the wheels, notice you'll need spacers between the wheels and the brake mounting flanges to align the brake disks up with the brake calipers. The spacers supplied with the kit will properly position most wheel and brake assemblies (Cleveland 199-60's) but there are bound to be those that require different spacers, e.g. Matco's and Groves. They can easily be made from commonly available aluminum tubing.

The single-puck 199-105 Cleveland brake.

The 600 x 6 tire will handle 99% of most Bearhawkers flying, but many go for the 7.00, as shown here, "just in case." The 8.50 is significantly larger and heavier and slows the airplane quite a bit.

If, however, you want to make sure, without going to a really big size, moving up to 7.00 x 6 tires will give you added margin and will cost almost nothing in performance. Below is a chart comparing the commonly available tires and their rolling diameter. Notice the big jump from 8.00 to 8.50 x 6.

Here's a double puck Cleveland for comparison.

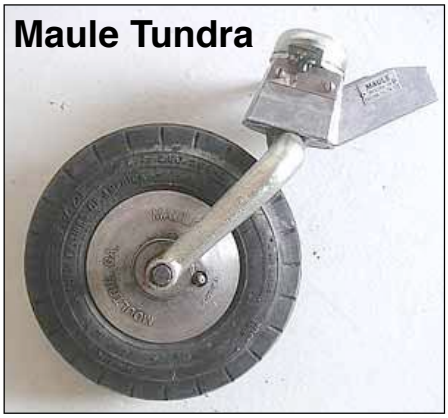
A discussion about tire sizes.

The Bearhawk is ideally suited to perform a wide range of missions from taking the family to see grandma to hauling a dead moose off a backwoods sandbar and about the only change necessary is tire size. However, there is a real tendency to think big tires are necessary to land on grass and dirt runways, which simply isn't the case. The normal 600 x 6 tires will handle most surfaces 95% of BH builders will ever see. Only if the runway is rutted, rocky, etc., is it necessary to go to bigger, more rugged footwear.

Tire Size Comparison

Size	Dia..	width
600	17"	6.3
700	18.25"	7
8.00	19.2"	7.95
8.50	22.1"	8.85
26	26	10

Tailwheel installation



Let's talk about tailwheels for a minute or two. In reality you have only three sources to chose from: Maule, Scott and The Bob Wheel. However, you can't use just any Scott or Maule. It has to be able to handle the tail weight of the BH. This means the field is narrowed to the Scott 3200, the Maule Tundra and The Bob Wheel (Scott Weinberg, www.irondesign-airparts.com/tailwheels.htm). The biggest difference between them is cost, as they'll all do the job. In terms of installation they are all the same. When buying your tailwheel, however, make sure you have the adapters (if necessary) to fit it to the 1.5" spring supplied in the kit

Spring Modifications

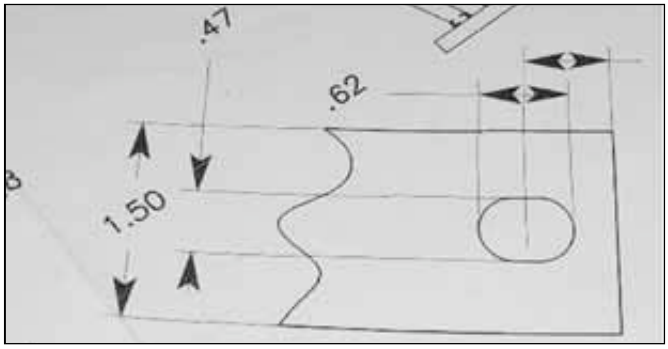
When installing the tailwheel start with the spring. It uses a bolt in front and is clamped to the fuselage at the back using a "U" clamp provided by AviPro.

A slight modification is required at the rear of the spring where the bolt that holds the tailwheel goes through. It is necessary that you make that hole into an oval so the scissor action between the two leafs that occurs while the spring is flexing doesn't try to fail the bolt in shear.

The easiest way to open up the holes is with a Dremel tool or die grinder and a small grinding stone or carbide bit, although a large chain saw sharpening file works too. Look down through the two leaves and grind the holes into an oval that is about 1/8" bigger, *fore and aft*, than the hole was. It'll be the original dimension side to side. This is clearly shown in the plans.

Installing the Spring Clamp

Notice that the "U" shaped spring clamp will nest around the spring but just barely lacks touching the mount that's welded to the tail post.



Open up the hole for bolt clearance with a file or Dremel tool. The very latest springs have the hole already opened up

That's on purpose so the AN4 bolts on each side can pull the spring up tight. The gap should be no more than .020" and bolt tension will take that up. If it is greatly more than that, contact AviPro and we will ship you a new clamp.

Open up the hole for bolt clearance with a file or Dremel tool. The smaller round file is for sharpening regular chain saws and available at hardware stores. The larger one (3/8") is for sharpening industrial chain saws and is available from Bishop Company, www.bishco.com.

When bolting the unit on the spring don't tighten the bolt too tight. The spring leaves need to be able to slide.

The springs to the rudder horn should have just enough tension on them that there is no slack in the chains.

Installing the Tail

The tail is inserted in fittings and in a short carry-through tube at the front. All holes were drilled with the tail installed on your airplane so, if the holes don't line up, you have it together wrong. The early, big trim tab is shown.

It is possible to assemble the tail parts in a number of different ways, but there is only one where the holes match. So, *if the holes don't match, you're doing it wrong* because the holes were all match drilled with the parts in place on the fuselage. The halves should be marked right/left.

The carry-through tube in the center of the fuselage—the piece the horizontal stab leading edge slides over—also has to be correctly oriented. It has a top and bottom, left and right and, if the holes don't line up, you're still doing it wrong.The parts should be marked left and right.

The 1/2" bushings supplied with your kit go between the carry-through tube and the fuselage mount and will give your horizontal stab the four degree down deflection called for in the plans (or very close to it).

Casting the Elevator Balances

Safety Note: Do not melt lead or otherwise work with it without wearing safety glasses and a respirator and do all lead work in a well ventilated area.

The plans and Bear Tracks both mention balancing the elevators with lead and, when the word "balance" is used, that means putting enough lead in the balance area (the part sticking ahead of the hinge line) so that, when the surface has paint and fabric on it, it will balance horizontally (push it down and it comes back up and vice versa).

There is a little guess work here because you can't balance the surface when it has the fabric and paint on it, so you have to make an educated guess as to how much fabric and paint weight will have to be balanced. See Bob's Bearhawk Book, pg. 29 for more detail. This is done by folding up the approximate amount of fabric that will be used to cover the tail and laying it in approximately the center of the elevator surface. At the same time, you'll have to add a little weight on the fabric to simulate the paint/finish. Fortunately, the tail doesn't have to be balanced exactly.

Casting the weights isn't as complicated as it would first appear because you are going to actually cast them in position on the tail by making up some crude forms and dams to contain the lead.

A word about lead: its fumes are dangerous. Only work outdoors and preferably with enough of a breeze to keep the fumes away from your sensitive nose. Using a paint respirator is a good idea and *heavy gloves and safety goggles are a must.*

You can get all the raw lead you need by going to a large tire shop and getting a couple of large coffee cans full of old tire weights. They will be throwing them away, so the price should be right. Don't worry about the clips on them.

You'll need a small cast iron pot or ladle to melt them in, although a coffee can and a pair of vice grips will work. A long, feathery flame on a welding or propane torch is all you need to melt them. Just play the flame directly on the lead and keep your face away as all sorts of fumes come up as the oil and dirt on the weights gets cooked. Make sure your weights are dry so they don't generate steam that can cause the lead to pop.

When the lead melts, the steel attach hooks and all of the impurities will float to the top and you can easily skim them off (it's called "dross") with a piece of wood, then you have perfectly pure lead.

You're going to cast the lead right in place on the elevator so your mold is going to be built around the tail and it's really pretty simple.

First drill a few holes in the tabs welded into the balance area to give something for the lead to hold onto. You might even put a screw through

Pouring lead. Note form is just 1/4" plywood clamed tight to tail. Drill holes in tabs and put screws in edge of tubing before pouring. to give lead attach points USE A FACE MASK, RESPERATOR AND DO IT OUTSIDE OR WITH PLENTY OF VENTLATION. LEAD IS NASTY STUFF!

the tabs but make sure it doesn't protrude above the surface of the lead. Also, run a few screws into the tubing and let them protrude. You can also run a couple screws through the rib surface. This is all to give the lead something really solid to flow around and lock it in place. .

Then take pieces of thin plywood (1/4" will work) and clamp them to the upper and lower part of the area that will receive the lead. That forms the surfaces of your mold.

Now, melt your lead and pour it into your makeshift mold making certain you pour in more than is needed so it runs over the edge (keep your feet out of the way). Once it cools, you can rough shape it with a cabinet rasp and 60 grip sand paper. Clean the rasp often as it'll load up very quickly.

An alternative is to mix a slurry of lead shot and epoxy. This will need a larger volume for the same weight but isn't hazardous to your health.

Now, install your elevator on the horizontal stab making certain the hinges are lubricated and free. Put your dummy fabric and paint weights on the bare elevator and see if it appears to be balanced. It's probably not but it'll be close and, if you put more lead than you need in the cavity, you can balance it by gradually drilling weight out of the rear-facing edge.

Trim Tabs

You'll need to cut the trim tab section free from the elevator, which is a simple hacksaw job. After freeing the piece up, make up an epoxy slurry of some kind (epoxy and microballoons, epoxy and saw dust, it's not important) and plug the holes where the cuts are. It won't take much as the fabric will cover it anyway.

To hinge the tabs, use .188" (3/16") clevis's.

Before you can put the two elevator halves together you need to install the trim tab actuating tube and arm because they run span-wise through the ribs and have to be installed before the two halves are joined. Before doing that, sand the paint out of the pivot tubes that are welded into the ribs and grease them.

Insert the trim tab tube (one on each side) then orient the actuation arm on the outboard end and drill and bolt it. See the plans and Bear Tracks and line the arms up so they are in alignment with their respective cable or arm. Make up spacers from hardware store aluminum tubing and slide over the actuating tube to hold everything in place left and

Install the black trim tab actuating tubes before assembling stab halves. Orient the bellcrank vertically and drill the holes, then do the same for the actuating arm on the outboard ends of the same tubes. Note the trim cable running from the bot - tom and top of the trim tab actuating arms. See trim wheel photo further on for more information.

right.

You don't need to install the trim tab actuating link now, but you might locate it. It's the long, 5/16" tube with a welded fork on one end and is threaded on the other. You'll need to bend it to clear the tail, when the elevator is full up.

Elevator/Rudder Hinge Details

Note! The following paragraph only applies to fuselages #23 and above:

Where the hinges slide forward over the horizontal stab spar, there are little "V"s welded to the rear of the spar. They are meant to support and reinforce the hinge straps. The same "V"s are welded on the vertical stabilizer spar inline with the rudder hinges. On earlier kits, all of these "V"s, six in total, are too long on purpose so you can file them down so the hinges can just barely be slid over them. Up to .020" gap is acceptable. IF YOU MOUNT YOUR TAIL SURFACES WITHOUT FILING THE V's TO FIT, YOU MAY DAMAGE THE HINGES. In later kits, these are already filed to length. You may also have to spring the hinge straps on the elevator and rudder apart so they are parallel because the welding will have pulled them in.

Fuselages #1 thru #22 use a reinforcing piece on the outside of the hinge and have no "V"s..

Greasing the Tail Surface Hinges:

Fuselage numbers 1-22 have holes in the tail surface hinges that have been tapped for a grease fitting. We recommend that instead of permanently installing grease fittings, a grease Zerk is modified to act as a removable tip for a grease gun.

Early kits used Zerks in a threaded hole. This was surplanted with a simple hole for greasing. It is advisable to NOT install the Zerk permanently but use a modified one for greasing and then remove it. AN3 bolts go in the empty tubes, top center, to act as rudder stops. Tap the bushings for threads.

It works best to take a common grease fitting and remove the little spring inside. The thread portion needs to be shortened, so screw a nut on the Zerk fitting and thread it all the way down. Then grind or file some of the threads off to shorten the unit. Removing the nut will restore the threads so that the grease fitting can be screwed into the tapped holes in the hinges. and used as a removable adapter for the grease gun.

Screw the grease fitting into the hinge until it lightly contacts the tube inside. Then back it out just a little. You can now grease the hinge with a grease gun. Then remove the grease fitting and use it on the remaining hinges .

From serial number 24 on, surface hinges have a small hole drilled on the top of the hinge (elevators) or the sides (rudder). Drip some lubricating oil into the holes and move the control surface until the oil spreads out. Lubricate at annual, or more often, if you fly in wet conditions.

The way the elevators are joined in the middle is pretty obvious but, when bolting them together, leave the outside holes empty for the elevator cables.

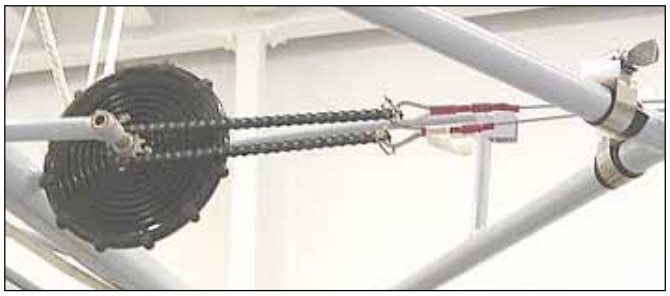
Don't do Anything Final

You're going to have the tail on and off the airplane a couple dozen times so there's no reason to bolt anything tight. It is, however, a good idea to put at least the tail struts on it so the tail is more stable and less likely to be hurt by backing into it or having a visitor sit on it.

A Word About the Tail Strut Clevis

Tail strut clevis fork needs washers to keep from crushing it. This is also an excellent example of why you paint all the parts separately, rather than when assembled. Painting hard - ware always results in flaking paint.

The fork at the bottom of the horizontal tail strut has a wider gap in it than the thickness of the attach tab that sticks off the bottom longeron. So, when you put a bolt through it, you can't tighten it up without bending the fork. To prevent that, when you do your final assembly, put at least one thin washer inside the fork against the tab. That way you can tighten the bolt down and not hurt anything. This will stop any sideways movement and keep vibration from wallowing out the holes.



Here a Cessna trim wheel has been used. Be careful when selecting trim wheels so they clear the fabric overhead. AviPro now makes a trim wheel specially designed for the application.

The trim wheel from AviPro clears the fabric. It is designed for 1/4" roller chain available a hardware stores. Attach the 1/16" cable by threading it through the end links and nicopressing.

Trim System

Essentially the trim system is nothing but two 1/16" cables running from the top and bottom of the actuating arms on the black trim tab torque tube. They are connected to a length of 1/4" roller chain that runs around the small sprocket on the trim wheel. The trim wheel is suspended between the two standoffs in the middle of the main spar

The relationship of the elevator horns and the trim horns are clearly seen with the trim horns being on the black tube.

carry through tube overhead. The cables run through fairleads that are located in the middle top of the fuselage. Early kits relied on twisting the cables upon each other or a separate tension block to supply friction to the cable. Later kits, which have stand offs only about an inch and a half apart use a friction system as described in Bear Tracks or later plans. It includes tensioning washers against the trim wheel. All ends are nicopressed or swaged.

About Flying Wires

The flying wires and clevis's are available from Steen Aerolab. The most popular combination is streamline wires on the top and round wires on the bottom of the tail where they can be damaged.

The rudder horn. Note the shackles and Nicopressed cables.

Another view showing how the trim and elevator cables are routed.

Installing the Control Stick System

Mount the control stick torque tube to the tabs in the fuselage. Then, when the rudder assembly is also attached, make the floor boards and fit them between. This builder opted to make his floor boards permanent and bolted everything through them.

General Considerations

When installing the control stick torque tube and its related items, don't worry about where the control stick itself is in relation to the seat or in relation to the length of your arms. That is all adjustable by varying the length of the pushrod to the bell crank to make the sticks sit right where you want them. You do, however, need to pay some attention to where the torque tube assembly mounts in relation to the fuselage mounting tabs AND in relation to the aileron cable pulley at the bottom of the struts. Also, there are four small bushes supplied with the kit for bushing a 1/4" shackle down to 3/16".

Position the stick torque tube so tit aligns with the aileron pul - ley as closely as possible. However, some angle is okay.

Cable/Pulley Alignment

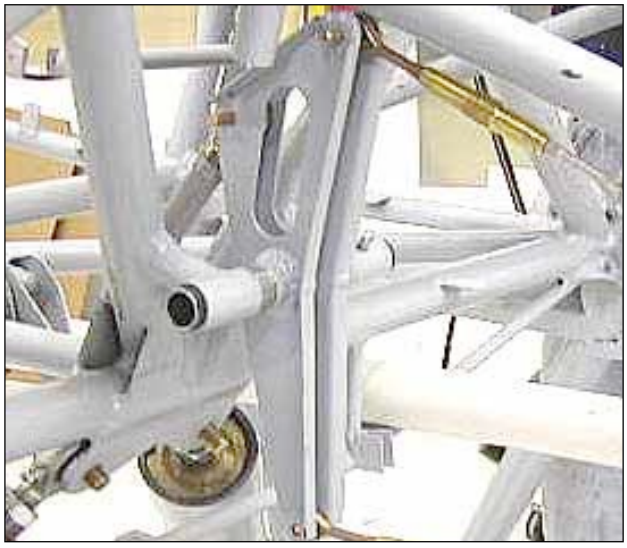
The stick assembly needs to be attached to the metal brackets on the fuselage so that the aileron cables coming out are as closely aligned as possible with the pulleys on the fuselage sides AND with those further back in the fuselage in the belly. They can be out of line just a little, but you should strive for perfection.

The mounting tab in the picture will have to be moved forward at least 1/8" to give room for the rear nut, which will have to be ground on one side to clear.

Bolting the Assembly in Place

Be careful where the bolts that secure the stick assembly to the fuselage tabs fall. If you move the stick assembly too far aft, you will not be able to get nuts on the rear bolts because the tube that

crosses from side to side behind the tab will interfere. Again, the idea here is to align the cables to the pulleys at the fuselage sides (at the bottom of the wing strut) and back in the belly.



Elevator bellcrank as seen from left, rear: Use tubing spacers to move it slightly off center to avoid interference with flap cable. Cable from top of bellcrank goes to the left pulley behind it and bottom cable goes through the middle pulley.

If you're using the .032 aluminum floor boards, as recommended, you can bolt directly through the floor boards. This, however, means you won't be able to remove your floor boards easily.

If, you elect to use 1/4" plywood, cut rectangular holes in the floor boards over the tabs and make 1/4" steel spacers so the torque tube is secured in a metal-to-metal fashion. Do NOT bolt through the plywood because it will let the torque tube move. Better yet, cut the floor boards short of the torque tubes so the torque tube contacts the steel structure directly.

The preferred method is to bolt the rudder and stick assemblies directly to the tubing structure and make up aluminum floor panels that fall between the torque tubes. Bend 1/2" lips on the panels where they come up against the assemblies. This leaves a 3" gap in front of the rudder pedal assembly and the firewall that some builders don't fill, However, it is advisable to make up a small panel to fit in there.

Take note that it is standard aircraft procedure that all bolts holding parts that move are drilled and secured with castellated nuts and cotter pins, not Nyloc nuts. If the parts don't move in relation to one another, e.g. where the torque tube mounts to the fuselage tab, Nyloc nuts are acceptable.

Elevator Cable Routing

The stick assembly is connected to the elevator bell crank via a small pushrod with a rod end bearing on either end. Then the elevator cables are routed from the top and bottom of the bell crank and aft through the first pulley bracket towards the tail of the airplane.

Install the three pulleys, as per the drawings. There is nothing unusual here

The cable at the *bottom* of the elevator bell crank passes through the *middle* pulley of the three pulleys on the bottom of the airplane. The cable coming from the *top* of the elevator bell crank runs through the far *left* pulley (looking forward). Just for future reference, the flap cable goes through the remaining pulley.

The elevator bell crank just aft of the torque tube at the front edge of the seats is free to move

Belly control pulleys looking AFT. The far pulley, left, when looking forward is the cable from the top of the elevator bell - crank. The cable from the bottom goes through the middle and the flap calb goes through the right one.

left and right, if not fixed by spacers fabricated from tubing. To prevent the spacers from rotating, drill a hole through each of the tubes and insert a cotter pin. It is a close fit with the cable coming from the flap handle, so make sure there's no interference before you finalize the side-to-side location of the elevator bell crank.

When routing the elevator cables through the aft fuselage only the cable that attaches to the bottom of the elevator horn goes through the fairlead that's located about half way back. The other cable floats in space.

Installing the Rudder Pedal Assembly

This builder bolted his pedal assembly through the plywood floor boards. The preferred method is to bolt them directly to the tubing structure and shorten the floor boards so they fall between the torque tubes. Note this approach to plumbing the brake cylinders, which utilizes a firewall reservoir. Other approaches will be seen throughout the manual, none of them wrong. Also, note that these rudders have the tabs on the ends of the pedals of the later kits. Earlier kits utilize fender washers bolted to the ends of the pedals to keep the pilot's feet from slipping off.

Note: The designer never intended for the floor boards to run under the rudder pedal assembly, although, this is possible if using the .032 aluminum. By shortening the floor boards, the pedal assembly doesn't bolt through them, which makes it much easier to remove the floor boards.

Position the Assembly

Before drilling any holes, it is suggested that you collect all of the appropriate parts, including the master cylinders, and, if being used, the right side brake pedals and do a test assembly to see how everything goes together. You can slide bolts through the holes and "C" clamp the entire assembly in place.

Note that this builder ran the end of the spring through the hole in the bolt making it double as a cotter pin. Because of the limited space ahead of the rudders, a spring at least one-inch in diameter should be used.

If bolting through the floor boards, a hole (barely visible under the right pedal) must be cut to allow the "V" connecting structure on the torque tube room to move.

Pay particular attention to the clearance between the master cylinders and the firewall.

The recommended brake cylinders are Gerdes "long shaft" cylinders. They are available from B & B Aircraft. If they are unavailable, use a short shaft Gerdes with a clevis fork.

The hydraulic cylinders are attached to the rear of the curved brake pedal with clevis pins and cotter pins or drilled bolts and castellated nuts, but not tightened down. Do the same where the cylinders attach to the fuselage tabs.

Floorboard Clearance Hole

If you run the floor boards under the pedal assembly, you will need to cut a slot in the floorboard for the little tube "V" that connects the two sides of the rudder pedal assembly. Make sure you have enough room in the slot for the pedal assembly to move its full travel fore and aft. And don't forget to put a little lubricant in the bearing areas.

As we've said, the designer actually prefers that the rudder pedal assembly be bolted directly to the fuselage tabs with the floor boards stopping on the back side (pilot/passenger side) of the assembly. This means there is an opening on the front side of the pedal assembly that can be filled in with a smaller piece of floor board, but it's not necessary.

Attaching the Rudder Pedal Assembly

When attaching the curved brake pedals on top of the rudder pedals, use AN4 bolts and castillated nuts with cotter pins

Attach the rudder torque tube assembly to the fuselage tabs with AN3 bolts and Nyloc nuts.

Running the Rudder Cables

When attaching the rudder cables to the outboard sides of the rudder assembly, we recommend bolting flat 4130 steel (.050) extension straps (provided in later kits) to each pedal using an AN3 bolt that is drilled and secured with a castle nut and a cotter pin. It is left free to rotate. An 1/8" cable with a shackle and thimble (cable secured by nicopress) is run through the other end of the strap.

This is the correct rudder return spring and will do a much bet - ter job than the smaller ones.

Another approach that Bob Barrows uses on his own Bearhawks is to make the tabs in two pieces (.050") and sandwich the 1/8" cable and thimble between them. A bolt or clevis pin is run through the sandwich and the cable thimble.

Rudder Pedal Return Springs

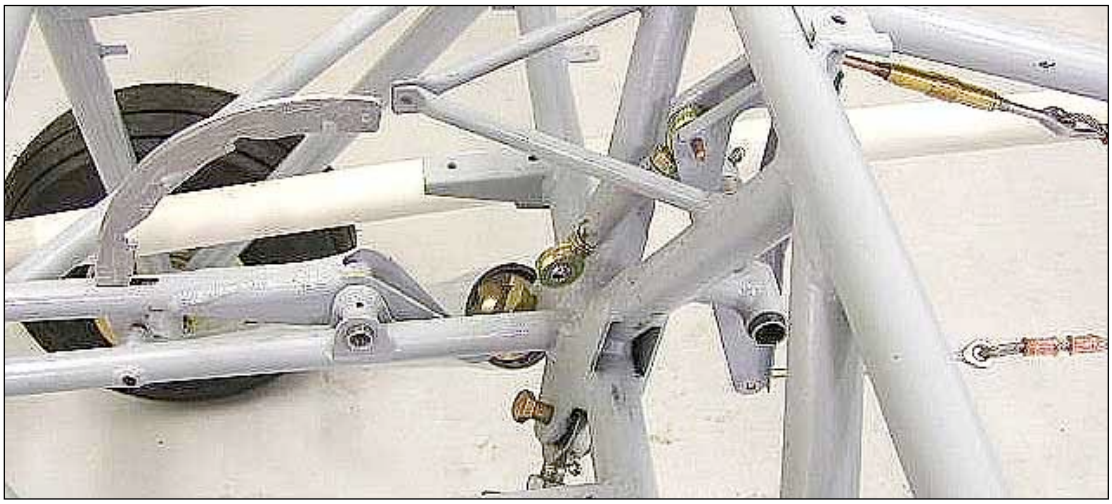
It's necessary that return springs be connected to the rudder pedals to maintain tension on the cables and keep the pedals from folding backward toward the pilot. Use springs of 1 inch diameter. Most Ace Hardware stores have a selection of springs that work perfectly.

There are a number of methods of attaching the springs to the rudder pedals. One involves drilling a small hole in the pedal itself, but a more professional way is to build the spring attach point into the .050 steel rudder cable connection strap. When you make the straps that bolt to the pedals and the rudder cables are attached to, just make them long enough that they extend forward and mount the rudder return springs. In other words, that .050 strap has three holes with the spring catching the front one, the middle one bolts to the rudder pedal and the rear most one has the Nicopressed rudder cable shackle going through it. Later kits have a flat connector strap supplied with enough adjustment holes that turnbuckles won't be required.

Turnbuckle Placement

Where to place the turnbuckles is optional, but we recommend placing the turnbuckles to tension the cables just aft of the baggage compartment area, where you can easily gain access to them but they are out of the way. If you put them too close to the rudder pedals they can get in the way and hang up on shoes or clothing. As previously mentioned, the designer, Bob Barrows, does not use turnbuckles on his rudder cables He extends the two pieces of .050 aft about an inch and drills three holes spaced 1/4" apart. You then connect to the hole that gives the cable the right tension and leaves the rudder pedals in the right neutral position.

The Flap Control System



The flap system, as shown in the plans, is pretty self explainatory. The button is depressed, which com - presses a spring and releases the locking pin in the detents, allowing the lever to be pulled up, which pulls the cable connected to the flap system (not shown here).

Understanding the System

Essentially the flap control system is nothing more than a handle that pulls on a cable, which, in turn, pulls the flaps down. Springs in the wings hold the flaps up, when sitting on the ground. The flaps are held in position by notches in a quadrant on the cabin floor.

Assembling the Flap Handle

Study the assembly shown on Drawing No. 28. Note that a spring inside the handle pushes a pin into notches in the notched quadrant. The spring is a type commonly available at hardware stores. Buy one that is quite a bit too long because you can fine-tune the. button's resistance by cutting coils off the spring.

The Quadrant

The half-moon shaped bracket with the notches in it is attached at the top and the bottom in a way that is self-evident. It slides through a slot cut in the handle and the two can only be final assembled when the spring is installed.

Routing the Cable

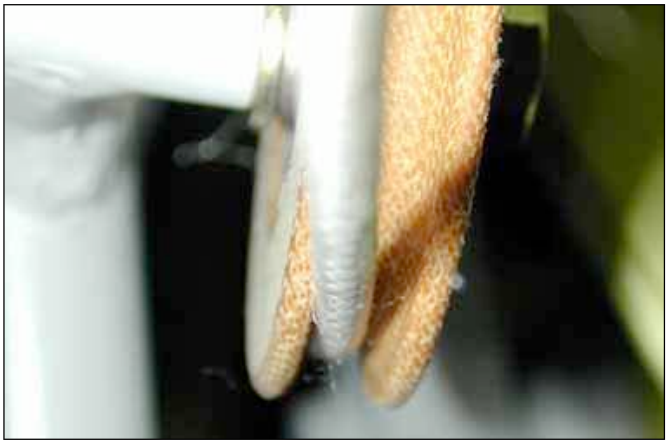
The cable that activates the flap runs aft through the *far right* (looking forward) pulley of the three pulleys underneath the fuselage. The cable continues to the back of the baggage compartment where it turns upward through the pulley located there. As it turns up parallel to the back of the baggage compartment, it attaches to the bottom point of a triangular piece of 1/8" steel. This is supplied in later kits and available to all builders at no cost. A turnbuckle is attached to each of the upper corners with a cable going to pulleys located in the upper, rear corners of the baggage compartment. Make sure you are using forked turnbuckles that go on each side of that triangular plate .

Another view. Note that this airplane has the early, unsatisfac - tory rod end bearings on the landing gear struts that have the grease fitting in them. Do NOT use this kind of bearing. Only the Aurora XAM-7M is approved by the designer.

If you're doing the fuselage first, you can run your cables through the upper pulleys, but can proceed no further until installing the wings. Leave the cables long enough that you can trim them and install thimbles when hooking up to the flap actuation arms. Run them forward to the rear spar, add twelve inches, trim and then coil them up and tape them out of the way until you're ready to work with them.

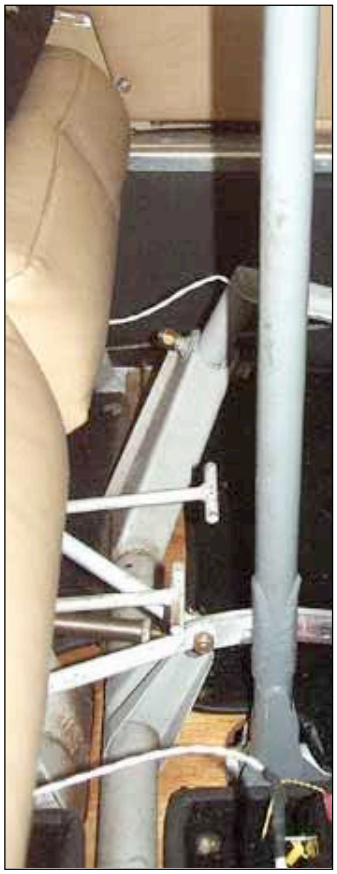
When it comes time to set up and adjust the flaps, the flap return springs (supplied0 must have already been installed in the wings. The return springs are an important part of that assembly because they provide the tension necessary to pull the cable system tight so you can see if everything is adjusted properly.

The installation of the wing part of the flap system is detailed in the section devoted to the wings.



Check the flap cable routing at the pulley that's on the outside of the fuselage behind the wing (it's inside the fairing, when finished). Some mis-alignment is unavoidable because the cable runs from one side to the other, as the flaps are low - ered, but if it is too much, as pictured here, grind the end off the bushing so the pulley moves in and minimizes the angle. Cable alignment for controls (not flaps), which are in constant motion, should be as perfect as possible.

Flap Handle Variations



The new flap handle includes a doubler around the quan - drant slot to reduce flexing and improved geometry to make it easier to get full flaps with the right seat full forward.

Beginning in mid-2006, an engineering change was made in the flap handles that changed the geometry of the arm coming off the bottom of the lever itself. This gives better ergonomics for the pilot as well as increasing the mechanical advantage and lowering the felt pressure in the lever. At the same time a doubler was welded around the quadrant slot to stiffen the handle and reduce flexing. These levers and their matching quadrants can be retrofitted to any vintage of Bearhawk with little or no modification.

Fuselage: Floor Boards

The floor boards can be aluminum or plywood, although plywood is heavier and requires some dimensional adjustments, if anything is bolted through it. Plywood has some sound deadening qualities. The plans call for .032 2024-T3 aluminum and that is what's recommended. Here the flange at the front of the floor boards is visible where they are stopped short of the torque tube, as rec - ommended. Incidentally, most BH fuel valves are mounted where this one is and it has been suggested that the building of a guard around it to keep from kicking it out of the detent might not be a bad idea.

Before installing your floor boards, ask others on the BH chat group for a copy of the floor board patterns. They will make your life much easier.

Essentially, making the floor boards is like installing linoleum: most of the work is in getting them cut to the right shape, so don't hesitate to get the patterns, as they are free. Otherwise, do them in poster board first.

The front floor boards will be built in sections (we're addressing aluminum here: .032 2024-T3) that nestle down between the rudder pedal assembly and the control stick torque tube. A small lip (3/8"-1/2") is bent on each end.

The rear floor boards simply bridge the empty spaces and it is up to you whether you bridge the spaces between the various structures under the seats or cover the structure. See the photos for the various ways it has been done by builders.

Regardless of how you do it, *note the areas where you may want to put an access panel, such as right over the top of the shock struts to help when servicing them.*

Attaching the Floor Boards

The mounting tabs for mounting the floor boards run throughout the cabin area and provide plenty of places for attachement. The floorboards can be attached in several ways, each of which has it's advantages and disadvantages.

• **Nut plates.** Nut plates offer the advantage of never working loose and using machine bolts/screws, which are very secure. Nutplates are much more work to install with two rivets per unit required, which must be machine counter sunk.

• **Tinnermans/Sheet metal screws**. Sheet metal Tinnermans offer the advantage of speed: you need only drill the appropriate sized hole and slide them over the tab and you're in business. Their disadvantage is that if a screw works loose, the Tinnerman sometimes comes off the tab and is lost in the belly.

• **Monadnocks and machine screws.** These are a Tinnerman type unit that uses a machine screw rather than a sheet metal screw. They require a larger hole than normal Tinnermans but they index in that hole so they have a smaller chance of being dislodged. They cost more than the other methods, but are fast.

Sound Deadening for Floor Boards

There has been a lot of conversation about the floor boards possibly drumming and needing insulation. However, there is no conclusive proof that the sound deadening material actually works,

Fitting around the many mechanisms on the floor is a way to show how well you find solutions that are neat and clean.

View from rear: The rear floor boards are often done in different ways. Here they are done in an elegant, simple manner: they are two panels, one each side with a vertical lip down each side. Notice in the middle where the vertical lips are joined with a simple cover that lets the flap cable come down through the rear of it. The center flanges add significant stiffness to the floor. It's worth noting that they were designed and fabricated by Phoenix builder Scott Williamson's wife, May Beth.

and it is very heavy. A small square glued to the middle of a large panel may help. The panels could also be beaded using one of the inexpensive beading machines available from places like Harbor Freight, however, some experimentation is required, when doing that to understand the limitation of the concept. Also, most of the cheaper beading machines will require that the rollers be polished so marks aren't left on the aluminum.

Cable Covers

The rudder cables run above the floor boards and flap cables can run inside the headliner. Some builders fabricate small covers that screw to the floor boards or bend a 45 degree edge in the floor boards to hide those from view. This is strictly a cosmetic feature and not a necessity.

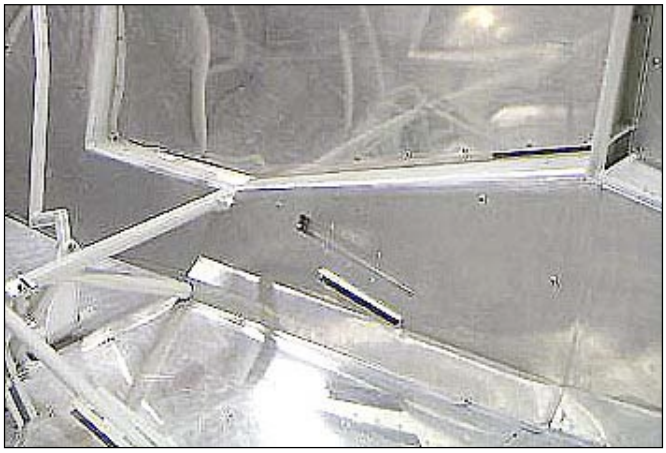
Rear Bulkhead

The rear bulkhead is where your ingenuity and taste come into play as it has been done any number of ways. Some builders lace or snap a canvas cover in place, which is light and provides good rear access. Others make it of aluminum and incorporate a trazoidal "ski tube" of .020 aluminum that goes some distance back in the fuselage (light articles only, for CG). Some hinge the bottom portion to provide foot room for when they are sleeping in the back. There are any number of ways it can be treated.

When doing the rear bulkhead, regardless of your approach, make sure you provide easy access to the flap cables that run right behind the bulkhead.

This trapizoidal opening is the maximum size possible and parallels the tubing behind it. This one is hinged upward for easy access to cables, etc.

This builder went for a square ski tube that goes back several feet. He also installed a ground power plug in the upper left - corner.



Notice how this builder incorporated cable covers at the cor - ners of his floor boards. Also, notice how the seat tracks bare - ly stick through the aluminum sidewalls.

Another approach to the rear floor under the seats that's flat - ter with bigger outside flanges.

Another view of the cable covers down the walls.

Diamond plate aluminum isn't going to be the lightest floor boards, but this builder was looking for rugged durability. We'd say he got it.