Construction of an 8 X 10 Field View Camera

James Vail

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Foreword

These instructions were developed as a result of a burning desire to have a 8 x 10 field view camera and lacking the justification to stretch the family budget to buy one. The decision was made to build one from scratch for the cost of the wood and hardware along with about a hundred hours of time.

The set of drawings that are presented here reflect how my camera was built. If I were to build another one, or if I had more or less to spend on materials, some things would be different. In the instructions that follow, both the methods I used and some hindsight recommendations will be included.

My woodworking shop is humble and much of the work was done with hand tools. A small table saw, a drill stand and a Dremel Tool came in handy but are not necessities if you have a lot of patience. A small router with a dovetail kit would have saved time but my design worked around it. The wood must be strong because it is thin and the metal should be soft enough to work. Hardwood and brass reflect the value I put on my time, Basswood and aluminum along with a small roller chain rack drive would have cut the material cost in half. The cost will run between $150 and $300.

Most of the materials will be available to you locally in hardware, fabric, craft, and model hobby stores. Those things that are hard to find, I have tried to find mail order sources. I cheated a little by using knobs and rack rails from an old broken 5 x 7 camera but I included how I would have built them anyway.

I hope this project is not just a means to an end, but enjoyable for itself as a ship model would be. In either case, I wish you luck in building a camera that will give you a lifetime of enjoyment.

Jim Vail 1995
Materials

**Wood:**
Strips 24 in. long in the following sizes: (These are made by Midwest Industries and appear in hobby shops in the form of basswood and balsa. Cherry, maple, walnut, and mahogany are available by special order.)

- 1/8" x 3" 2 ea
- 3/16" x 3" 1 ea
- ¼" x 3" 8 ea
- ¼" x ¼" 5 ea
- ¼" x ½" 23 ea
- 3/8" x 3/8" 6 ea

Thick Wood:
- 1" x 1" x 12" 6 ea
- 1½" x 1" x 12" 1 ea

**Glass:**
8" x 10" ground glass 1 ea (Available from Steven Shuart, 102 Pine Ave., Kane PA 16735 for ~ $22 or from Calumet, 890 Supreme Dr., Bensenville, IL 60106)

**Stainless Steel:**
0.020" shim stock ½" x 9" 2 ea (Available from Small Parts Inc., 13980 N.W. 58th Court, P.O. box 4650, Miami Lakes FL 33014-0650 / Tel 1-800-220-4242 Send for catalog.)

**Brass:**
(Also available from Small Parts Inc. or your local hobby shop)

- Strips 12" long:
  - 0.064" x 1" 1 ea
  - 0.064" x ¼" 1 ea
  - 0.064" x ½" 1 ea
  - 0.032" x 2" 1 ea
  - 0.032" x ½" 1 ea
  - 0.032" x ¼" 2 ea
  - ½" x 1" hinge 4 ea
  - 1/8" x 12" Guide channels 4 ea

- 10" to 12" 48 or 32 pitch rack & pinion set 4 ea (W. M. Berg Inc. 516-599-5010 has US/Metric sizes with $100 min order) (Also available from Small Parts Inc.)
- 10-32 wood inserts 5 ea
- ¼-20 wood insert 1 ea
- Drawer handle 1 ea
- Small 10-32 knobs 8 ea (You can make your own knobs and round nuts)
- Large 10-32 knobs 2 ea
Large 10-32 round nuts 2 ea
3/16" x 3 ft Rod 1 ea
#10 washers 10 ea
#6 Flat head screws 1" 9 ea
#6 Flat head screws 1 ½" 4 ea
10-32 Flat head mach. screws ½" 4 ea
10-32 Flat head mach. screws ¾" 4 ea
10-32 Cap nuts 4 ea
Small brass corners 4 ea
Misc. #2 tiny screws flat & round and wire nails 1 pkg ea
Elmers wood glue & Oil stain

**Bellows materials**
Darkroom cloth suitable for the inside layer is available from Porters, Box 628, Cedar Falls, Iowa, 50613-0628 or 1-800-553-2001. (2 yd is $18 Stock # 22-0116)
Outer cloth may be available from larger fabric stores as coated nylon for raincoats. If double seams are ok, a large film changing bag has enough material to make an entire bellows.
Photographic leather and cloth is available from Leather/Cloth, 1372 Playa St., San Francisco, CA 94122 (send them a SASE).
Good cements are Permatex High Tack Universal Adhesive #97A from local auto supply stores or Carters rubber cement from office or art stores.
Leather pliers are available locally from Tandy Leather Stores.

**Special Tools**
Nibbling tool (Available from Radio Shack)
Drill with guide or stand
Small table saw with fine tooth plywood sawblade (Wood is very thin)
Dremel tool with router adapter

**Overview**
A field view camera is made up of five major independent components:
The bed, including the rack movements used for focusing;
The lensboard and standard, including the front movements;
The back box, including the back movements;
The back, including the ground glass; and
The bellows.
These instructions will be organized in the same manner, building each components at a time.
A few caveats are in order before you start:
Working with very thin hardwood requires special care to avoid warping with glue, splitting with screws, and marring with clamps. All three of these problems involve clamping. Clamping should be done with several clamps if possible with a piece of wood between the clamp and the work. If glue sticking to the clamp wood is a problem, use wax paper. When sinking screws, drill out every screw hole, clamp the work so it can't split, and first use a steel screw to tap the hole then replace it with a brass screw. Avoid the use of power screwdrivers. When sinking threaded brass inserts, drill the holes 1/64" oversize and drive in the insert with a bolt installed rather than use the screwdriver slot on the insert. Finally, use a saw blade designed for thin plywood.
Working with sheet brass is almost half the labor of the project. I used a Dremel Tool with a cut-off wheel and a router adapter for cutting the slots in the 1/16" brass arms. If you do the same, remember that it is very hard service for the small motor and it should be allowed to completely cool between cuts. If you use a nibbling tool to cut the slots, use layers of 0.032" brass soldered together as the tool is limited to about 0.050" thickness. Many of the pieces are made of several parts of 0.032" brass soldered together. This has two advantages, cutting and bending thicker parts are difficult and the parts can be made more intricate. Don't drill or final shape the pieces until the soldering is done.

**Constructing the Bed**

**The Base**

The base of the camera is a 1/2" slab, about 11 5/8" square with a 1/4-20 insert in the center and a 3" or 4" round scratch plate around the insert on the bottom. Near one edge is a 9/16" groove about 1/4" deep. (See sketch 1.) It was made from eight 1/4" x 3" strips about a foot long put in two layers that were crosswise to each other. One strip was shifted enough to make the groove. After the glue dried, it was trimmed to size on a table saw. The center hole was drilled and the tripod insert was installed. I could have used a slab of hardwood or plywood and cut the groove but I felt the laminate was more resistant to warpage.

**The Film Rack Rails**

Along the two sides of the base run two strips of wood about 3/4" wide and 1" thick with a 48 pitch gear rack mounted on the top and a brass channel inlaid in the side. In the back is a strip of wood put in mostly for support and to close the back of the camera when it is folded up. (See sketch 1.) This back strip goes all the way across because I only had 10 1/2 " long gear racks. If you have 12" long racks, run them the full length of the sides. The channel groove can be cut in with a table saw but check the adjustment with scrap wood first. The racks and channels are attached with tiny wire brads in tiny holes drilled in the brass racks and channels, or if they are thick racks, they are attached through holes drilled in the side. The bottom edge of thick racks can be used instead of the brass channels thereby saving some effort. They don't have to be perfectly flat because the pinions and slide are spring loaded. I used gear racks recessed in the wood that reduced the gap between the back carriage and the base but that is very optional.

The four rack and pinion sets needed for this camera are the most expensive parts at $30 a set. I used racks salvaged from an old broken 5x7 but if you take a similar path, make sure you have matching pinions. The common sizes for racks are 48 pitch and 32 pitch. (Pitch means how many teeth per 3.14 inches.) Metric racks used on Burke & James cameras have 0.6 Module pinion gears which could be expensive if purchased by themselves. There are other alternatives such as miniature roller chain and timing belt drives but they look odd.

**The Lens Rack Rails**

Inside the cove created by the film rack rails lies a movable frame that transports the lens board fore and aft. It is made of the same cross section wood as the film rack rails but a little shorter. (See Sketch 1.) It is attached together with long wood screws and glue. The rack gear faces downward and rides on pinions that turn in the long groove in the bed.

The Rail frame needs to slide on metal strips like a desk drawer. I used a 1/4" strip of 0.032" brass half imbedded in the outside rails using a razor saw to cut a slit and then widened the slit with a sharp corner of a brass strip. The inside rails slide on it with brass channels. In hindsight, a narrow brass strip screwed to the edge of the outside rails with enough overhang to hold down the inside rails along with a bow spring underneath would have been easier to make.

The top inside edge of the lens rack rails has cavities cut in it to accommodate the knobs on the side of the lensboard. These can be made by clamping the rail to another piece of wood and drilling a large diameter hole half way through with a flat wood drill. The size will depend on the size of the knobs.

The front cross piece connecting the two rails has a 10-32 threaded insert installed in the middle. It is for connecting the front standard/lensboard to the rail frame.

Finally, there is a 1/4 " strip that runs all the way across the front of the frame. It provides a seating surface for the back box when the camera is closed.
The Pinion Gears

The shaft for the pinion gears is 3/16" Dia. and just under 13" long. It has a small groove cut at one end with a snap ring and washer and is threaded for 10-32 at the other end with about 3/4" of thread for the knob and lock nut. The pinions are fixed on the shaft at the spacing of the lens racks. 1/2" wells 3/8" deep are drilled in the bed to accommodate the pinion gears. Note: drill on a steel plate so you don't go all the way through the bed. A corrugated flat spring is placed in the groove in the bed to support the shaft. If the shaft bows, flatten out the spring more. Where the shaft comes out of the groove at each end, a slotted brass plate is screwed to the bed to take the slop and backlash out of the shaft movement.

The knob and lock nut are both threaded on the shaft. The knob is pinned and the lock nut is free to turn. A short piece of brass tubing is slipped on the shaft between the lock nut and the bed. By tightening the locknut against the bed the shaft can be locked. Some cameras have both ends of the shaft threaded with the lock nut at the other end. Take your pick.

The making of the knobs and lock nuts will be covered separately at the end of this book.

The Back Carriage

The back assembly rides on a short platform with brass plates on each end that slide in the channels inlaid into the side of the outer rack rails. (See Sketch 2.) It is cut slightly longer than the base because clearance of the base is required of the brackets on each end. I tried to create this clearance with bending of the brass end pieces alone in the prototype and it came out looking messy. I also used 0.050" brass for the end plates that may be hard to find. Use 0.032" brass if you have to but you can solder a reinforcing sheet to it if there is to much flexibility.

It is propelled by a shaft with two pinion gears that is identical with the pinion shaft in the bed except for the spacing of the gears. The groove that the shaft runs down is actually a cleft at the leading edge of the carriage. I used arm springs to load the shaft but I suppose a groove and corrugated flat spring as was used in the bed would have worked just as well.

Constructing the Lensboard and Standard

The front standard consists of a three sided box open at the top and a strip of wood that is connected to it by a hinge. (See Sketch 3.) 3½" slots are provided to allow for the lensboard movements. Interlocking joints provide enough strength for extended use. If a small router is used, the slots and the joints are simple. However, I made the slots and joint fingers from a laminated set of wood strips.

The lens board plate is made up of laminated layers of wood strips that are overlapped to prevent a straight light path. The front cavity in the center is stepped to fit a six inch lensboard with the first step 3/16" deep. The back cavity is sized for a 6" bellows frame.

10-32 inserts are imbedded in the sides. One pair of inserts is at the centerline and an optional second pair is near the bottom so the lens can be elevated higher.

Constructing the Back Box

The back box is the connection between the bellows and the back. It also serves as the protective shell when the camera is closed. (See Sketch 4.) I made the box of 1/4" by 1/2" sticks that interlaced at the corners. The two strips at the rear make a seating surface for the back and the bellows. The seating surface for the back required a thin foam plastic gasket to eliminate light leaks. The bottom is partially cut away to clear the back carriage. The front edge is shimmed with a strip layer that allows it to seat flat after it is attached to the hinge.

Brass plates and spring latches at each top and bottom corner must match for pin hole spacing. An easy way to align them is to drill the holes for the pins through the spring clips at the top and then attach the bottom plates to the back box using the pins as a guide.

The back box is hinged to a plate that is the same size as the back carriage and is held upright by two slotted side struts. (See Sketch 2.) This plate has a long slot that allows turning and shifting movements of the back and is attached to the back carriage with a single bolt going up through the back carriage and the plate slot. The slot was formed by making the plate out of laminated sticks.
**Constructing the Back**

The back holds the film holder and provides a ground glass focusing screen. Construction is with two laminated layers of 1/4" sheets and a sealing layer of 1/8" sheet. Again it is important to overlap the joints to make it light tight. Pins in all four edges permit either horizontal or vertical orientation. ([See Sketch 5 and Sketch 6.](#))

A key measurement is the recess depth of the ground glass surface. Film holders are made with a 7mm (0.275") film back to face distance. This spacing should be kept to within 0.015" all around. Precision of this kind can be achieved by shims. I sanded down washers to achieve a 0.270" spacing. The 0.005" difference is to compensate for the film thickness. A #6 washer is 0.0025" thick. ([See sketch 7.](#))

Check film holder fit before the glue sets for smooth sliding. A bad fit is hard to fix. the lock groove should also be checked for allowing the film holder to lie flat without much slop.

The springs were made with stainless steel because of its higher yield strength. Brass could of worked in a layered leaf spring arrangement.

The ground glass is held in place with 6 small stove bolts and cap nuts with rubber washers. A nylon washer cut in half was used as a spacer for the unsupported side of the nut.

**Constructing the Bellows**

Bellows are made of a sandwich of cloth with cardboard strips in between. The inside layer of material is opaque dull cotton on the exposed side of the bellows and is a smooth or coated surface on the other side that permit you to glue on cardboard strips. The strips are made of manila folder material. The outside layer can be leather or plastic cloth.

Plastic cloth used for the outside of bellows can range from a thin form of leatherette to plastic cloth made specifically for bellows and curtain shutters. Vinyl cloth may be found locally in fabric stores as raincoat material. Avoid vinyl upholstery such as "headliner" material for the tops of automobiles because it is usually (but not always) too thick.

Although plastic cloth makes the strongest bellows, leather maintains an antique or classic look. Leather can be dyed with shoe dye but plastic can't. Thin leather that is not entirely light tight can be used for the outside layer since the inner liner is light tight. Leather pliers, as they are called, typically come in small pieces so they would need to be spliced to make a large bellows.

Bellows should be larger than the film opening. The bellows for the 8x10 camera has a 11x11 inch back with a 6x6 inch lens opening . The method presented here is adaptable to other sizes. The material needed can be estimated by the sum of the sides plus a seam with about an inch overlap at the bottom that is slightly more than the width cloth you need. The length is the film to lensboard distance plus an inch at each end. A tapered bellows like this will need a few extra inches on the length to make up for the curvature of the layout. Drawing it to scale on graph paper gives a better estimate.

Cut a paper pattern of one side of the bellows. Starting in the middle-bottom of the liner cloth, trace the top of the bellows with a white sewing pencil. Next, trace the two sides with the pattern. The bottom is traced on both ends with the pattern folded lengthwise to give each half of the bottom. Care should be taken to keep the fold in the pattern on the outside when tracing. finally add an inch to the left end for overlap at the bottom seam. Placing the seam at the bottom will hide it. The seam can be slanted for a more compact fold up but this is seldom necessary. ([See Sketch 8 for how it should look.](#))

Cut out the liner cloth and using it as a pattern, cut out the outside material so that it is face up when it is laid on top of the penciled pattern on the liner cloth.

Cut the cardboard stiffener strips short and narrow enough for a 1/8" margin each side of the folds. The ends are cut at 45 degrees. Take care to center and align the strips, errors can cause a twist in the bellows. Penciling in the fold lines on the liner cloth will help a lot.

Two types of folds are popular. In one, the folds on the top and bottom alternate with the folds on the sides. in the other, the folds match all the way around and the little "dog ears" are alternately folded horizontally and vertically. ([Sketch 8 shows the alternating row stiffener pattern.](#)) The other pattern would be matching all the way across.
Rubber cement the strips on to the liner and let dry. Rub off any big lumps of extra cement. The strips for the bottom are placed on the left side half of the bottom liner with half of each strip hanging out over the edge. Paint all of the inner liner and all the strips with rubber cement except those strips that stick out and the right hand part of the bottom of the bellows without strips. These will be cemented later in the assembly. Apply the inner liner and the outside material together without wrinkles. Let it dry for a day under a sheet of plywood or a table top that is weighted down.

Fold the bellows into a box shape. Coat cement between the liner and outer layer section that was left unglued. Mesh the strips hanging out of the other half in between taking care to align each strip. Now glue the overlap. Dry overnight on its side.

An aid in avoiding a twist in the bellows is to use the paper pattern of one side of the bellows, made for the initial layout, to cut out a foam core board tapered box to use as a form for gluing the sides even. If the tapered box form is used the inside cloth can be wrapped around the box and the edge glued before the stiffeners are applied. The outside layer can be glued and wrapped around the box also. This is a much less clumsy way.

To corrugate the bellows, make the top and bottom folds first. Using your fingers, start at one end and pinch the gaps between the stiffeners to fold it out. Crease each fold. When you get to the last fold, press the bellows flat for a few hours with a heavy weight.

The bellows is attached to the camera using thin wooden frames. Center each frame in the opening, fold down both layers together over it and cement the bellows to the frame. Cut the corners to avoid bunching but not so deep as to allow light leaks, and let dry.

**Brass Work and Knobs**

The brass work sketches ([Sketch 9](#), [Sketch 10](#) and [Sketch 11](#)) are drawn full scale so that they may be copied and used as glued on patterns for cutting each piece. The locations for each piece are not shown on the sketches but do appear on the photographs.

The location is seldom critical with the exception of the matchup to the pins that hold the back onto the box. The alignment procedure for the pins on the back is:

1. Drill a pair of pin holes through the spring clip holes (top corners of the box).
2. Rotate the back 180° and locate the pin latch plates on the bottom of the box based on the pin positions. Drill and screw down these plates.
3. Repeat step 1.
4. Rotate the back 90° and Repeat step 1.
5. Rotate the back 180° and Repeat step 1.

The prototype camera used a foam gasket on the box flange so the above procedure was necessary. If you feel you can do it with measurements alone, good luck.

**Knobs**

Knobs can be made with knurling by laminating coins using solder. US dimes, quarters, and half dollars are laminates of silver and copper that solder well. A stack of 3 or 4 coins should be coated with rosin flux (not on the edges) heated up and thin solder touched to the edge gaps until a shiny ring appears all around the gap. File the faces off the end coins and solder on a neck of the knob. This can be a short stub of brass or copper rod soldered on the coins or even a stack of brass washers.

Drill and tap through the center of the stack and drill a hole through the side of the neck for a pin or set screw. Use a vise when drilling and tapping the neck so as not to wedge it apart. Put the knob on the end of a threaded rod chucked in a drill and sand the faces smooth.

**Film Holders**

[Sketch 12](#) is a dimensional drawing of a wood (Agfa) filmholder. I have included it in case you want to build your own. I have never even tried to do this and can't offer much advice.
Sketch 1

BASE PLATFORM

1/2 TO 1 SCALE

1 1/4"

11 3/8"

8 7/8"

1/8" BRASS SLOT GUIDES

48 PITCH RACK + 3/8" PINION

5/8" PINION WELL

FLAT SPRING

3/32" SLOT

1/2" 1/4-20 INSERT

1 3/8" 10-32 NF INSERT

1/2" 10-32 NF
Sketch 3

LENS BOARD STANDARD

7 7/8

6 1/2

5 5/8 SQUARE
3 1/2 DEEP
5 SQUARE

4 LAYERS OF WOOD
3 X 1/4 X 3/4

WOOD PATTERN TO BLOCK LIGHT PATHS

1 3/8

3 1/2

1/4" THICK FROM A LAMINATE OF 1/4 X 3/4 STRIPS

1/4 X 1/4 DEEP

1/4 X 1/4 DEEP

1/2" THICK FROM A LAMINATE OF 1/4 X 3/4 STRIPS

8 3/8
ReeA Box

Made of 1/4" x 1/2" interlaved wood strips.
Sketch 6

SKETCH 6

BACK (OUTSIDE VIEW)

$11\frac{3}{8}$

$\frac{3}{16}$

$9\frac{3}{8}'' + 8''$

FILM OPENING

$\frac{3}{32}$
Sketch 9

Front Standard Brass
AND MIS. STAINLESS STEEL

Front Standard Arm Alignment Plate

2 each
0.020” S.S.
Screw mirror image

FOLD

0.032” Brass
Screw head soldered on inside 1/2” 10-32

1/8”

Reinforcement hole, with soldered on washer.

2 each

0.024” Brass
3/16” hole

3/4”

3/16”

Ground Glass Frame
Strings

4”

0.032” Brass

1/2”

2 each
0.020” S.S.

Front Pinion Shaft Springs
Sketch 10

REAR BOX BRASS

1:1 SCALE

2 EACH 0.032" BRASS
MAKE MIRROR IMAGE
MOUNT ON UPPER CORNERS OF BOX

2 EACH 0.064" BRASS
MOUNT ON LOWER CORNERS OF BOX MIRROR IMAGE

BASE PLATE BRASS

TRIPOD SOCKET PLATE
3" ON 4" SIDE SHOWN

2 EACH 0.032" BRASS
Sketch 11

REAR CARTRIDGE BOX

BRASS FINDINGS

2 EACH 0.064" BRASS
MAKE MIRROR IMAGE
Goes on 3" portion of box
where it transitions to "L"

COUNTERSINK FOR FLAT SCREW HEAD SOLDERED ON INSIDE 1/8" 10-32 NP

2 EACH
FOLD MIRROR IMAGE
 Goes on ends of rear carriage
1/8" with bracket shown below
1/4" Screwed to underside of carriage
0.23" - 0.18"

FOLD MIRROR IMAGE
0.032" BRASS
Solder to inside of above piece
Before drilling the holes but
after bending.

COUNTERSINK FOR 1/8" 10-32 SCREWHEAD
SOLDERED ON INSIDE

0.032" BRASS
2 EACH
MAKE MIRROR IMAGE

DON'T DRILL UNTIL
SOLDERED TO PIECE ABOVE
REINFORCE HOLE WITH
SOLDERED ON WASHER

REAR PIVOT SHAFT SPRING
Sketch 12

8x10 Film Holder

10 13/16''
11 5/8''

8''

24 3/32''

9 5/16''

1/32'' thick
0.27545'' face to film

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