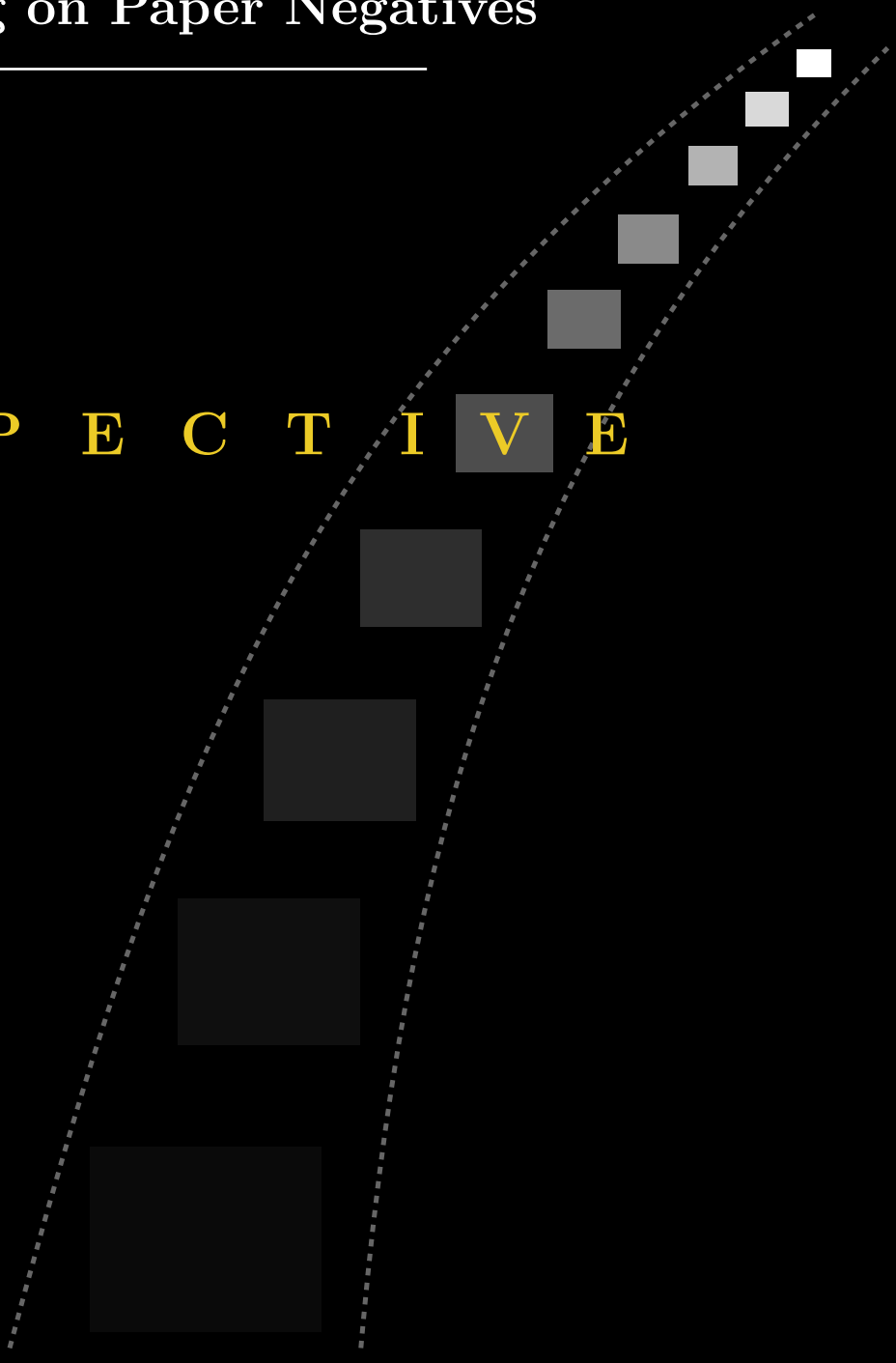
Constructing a “Sliding-Box” Camera for Photographing on Paper Negatives

James R. Kyle



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Abstract

A sliding-box camera is the simplest form of camera that allows manual focusing and aperture control. Other more primitive box cameras either had a fixed focus/aperture lens or were just pinhole cameras. The sliding-box camera could liberate the creativity of photography while being simple enough to be constructed at home. In this document, I have provided a well illustrated list of instructions on how to build such a camera. The images provided are from the construction of my own model 1838-A-5 sliding-box camera.

Keywords: sliding-box camera, construction, large format camera, film camera.

1 INTRODUCTION

A *sliding-box* type of camera was first used around 1838 to about 1850 [1]. This camera type was used by two of the "fathers" of photography, namely, Louis Jacques Mandé Daguerre of Paris, France, inventor of the Daguerreotype Photographic Process [2], and William Henry Fox Talbot, inventor of the Paper Negative Process [3], of Lacock Abby, England. These were the first cameras used till they were replaced by the Bellows Focusing [4] system about 1850.

The simplicity of a sliding-box camera makes it less expensive, and easiest to build. The only one that is easier to construct would be a shoe-box camera [5] made out of a shoe-box. A pinhole is used for an aperture, which would project an image on to a sheet of photographic light sensitive paper at the rear of the box (also called a pin-hole camera). These cameras are a lot of fun and usually the first camera that anyone can make, but they do not render a very sharp and clear image. The sliding-box was about the form, but it used a glass lens to project an image on to the light sensitive medium. Later on the glass lens would be refined with the addition of selective holes called *apertures*. These apertures, when applied correctly, allowed the selective focusing of any part of the overall image and could control image depth-of-field [6]. The first camera lenses, and up to the invention of the in-camera shutter system [7, 8], had a lens cap which is used to let the light enter the camera body. The sliding-box focusing system is just that. Two boxes are slid within one another to attain a sharp image, that is projected onto the ground glass focusing screen at the rear of the camera. When the film holder is placed into the rear of the camera, the same distance as the ground glass the intended image will be in focus.

When I first saw a sliding-box camera, I was very interested in one making of my own. It took almost forty years from that time till now to get the time and the wanting to do so. In this document I have detailed my construction, attempts, failures, and most importantly, my

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successes. Anyone can build this type of camera with simple hand tools, and little knowledge of woodworking. However, it is easier with a powered table-saw. As of the writing of this document, I have made four similar models. Model #1 is simple sliding-box camera with the addition of a spring-back film loading attachment from a Speed Graphic 4×5 Graflex press camera. It was beyond simple repair and I only kept it for my collection of cameras. The next addition was a brass lens, with a shutter, made in 1901. Model #2, feathers a covered back on the movable box that is hinged to permit viewing of the intended image, to focus and compose on the ground glass focal plane. I cut a slot to admit a film holder and I placed a sheet of ground glass to view and focus the image. This slot is also where the film holder is placed that contains the light sensitive paper that will record the image. The focal plane is located near the rear of the movable box. There are guide rails on the front sliding box that will permit straight and unencumbered movement for ease of focusing.

Both models operate the same as any view camera, except for the moments of "up and down," "tilt and shift" of the rear and front standards [9], since these two models are built on the basic principals of the early cameras, before the Scheimpflug principle [10] was developed in 1909 by Theodor Scheimpflug. A sliding-box camera design is not true box-camera like the Kodak Brownie® or the Kodak Hawkeye®, that have a fixed focus lens. The sliding-box can manually be adjusted to attain a true focus on the selected subject, and with the aperture adjustment that one may make use of, a selective focus is attainable.

One concern is that of the distance required for the focal distance. This distance is attained by placing the lens in front of a white sheet of paper at the back of a cardboard box and the lens pointed at an object over 300 feet distance. The lens is moved away, or toward the paper, until a sharp image of a far away object is found. This is the infinity focus distance for that lens and would be the minimum separation required between the lens and the paper. The closer that the camera is from the object to be photographed, the longer the distance will be needed to focus the image. I used a 127mm (5 inches) Graphic lens made by Kodak. permit focusing for nearer objects.

This camera I built is of the same principal as the four others I have built in the past, with the exception that the rear is square. This shall permit the photographer to use not only horizontal (landscape), but also vertical (portrait).

I used poplar wood in my construction along with $\frac{1}{8}$ inch plywood, glue, screws, and a few small brass nails. The camera design was centered around the lens, the most expensive item. A similar lens and a 4×5 inch film holder can easily be obtained from the used market.

Though this document is instructed with adequate illustrations, you may have a different way of accomplishing the same result. Also the drawings are not formally rendered and true to the built dimensions. They were supposed to be a guide. I did make changes as I went

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along with the building, and so might you. You may also see some "mistakes" that I have made, or might feel that you have a better way to do the build.

The pencil sketches are copied from my "Brainstorming Notebook." I use notebooks as not only a way to remember things, but to just get "stuff" out of my brain that I do not have a need to remember. In so doing, it leaves my mind in a clear state to think of other things more pressing.

The camera illustrated here is my fifth camera, I shall call it the "Sliding-Box" Model 1838-A-5. The "1838" represents the year of the first sliding-box camera, the letter "A" stands advanced and the number "5" represents the number of cameras that I have built.

In the remainder of the document, I have first introduced the informal bill of materials and a list of necessary tools in Section 2. Section 3 contains a well illustrated narration on the steps required to make the camera. Some concluding remarks are in Section 4 and finally there is an appendix of drawings that I used.

2 TOOLS AND MATERIAL

At the beginning of any build, it is essential to get organized and ensure that all the necessary tools are available. Figure 1 show a list of hand tools and paraphernalia that I used to build the cameras. You would not have to have a very elaborate woodworking shop,

(a) (b)

Figure 1: Tools required for construction.

but you do need these basic tools and some elbow-room to do the work properly. The tools shown in Figure 1(a) are

1. chisels

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   (a) 1”
   (b) 3/4”
   (c) 1/2”
2. file card (to clean out files)
3. files
4. scissors
5. pocket knife
6. 90° clamps
7. combination square
8. plastic centering ruler
9. small hammer
10. pencils and
11. markers.

Figure 1(b) lists

1. miter box
2. hacksaw
3. drill motor
4. drill bits
5. sander
6. electric saw
7. hole cutter
8. countersink and
9. saw blades.

In addition, we would need

1. screwdrivers
2. pliers,
3. c-clamps
4. large woodworker clamps
5. power miter-saw
6. table-saw safety goggles

Please ensure to use the above safety goggles during construction, and especially when using power tools.

For adhesion and finish, some consumable material like stains and adhesives would be required, as shown in Figure 2. Note three different stains (walnut, cherry and ebony), adhesives, including expanding adhesive, and flat black spray paint. I chose poplar wood for my construction. Those are sold 4-sided squared (S4S) by the board foot. Avoid warped

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Figure 2: Consumable material.

wood. Poplar does not have knots and is also a hardwood with Janka hardness rating of 540 lbf. I also obtained some angle trim for the front frame of the stationary box (forward box).

Remember that your personal safety is of paramount importance. Care and attention must be taken when using tools, particularly power tools. It is essential to work on a stable surface and work away from body parts.

3 DESIGN AND BUILD

The first step for making anything is the rough planning and brainstorming phase. Figure 3 illustrated the initial sketches that I had. In its simplest form, this kind of a camera contains a fixed stationary front box and a sliding rear box capable of nesting into the front box, as indicated in Figure 3(a). The front plate of the stationary box would contain a hole to accommodate the lens. The rear of the sliding box would accommodate a ground glass and must be capable of accepting the film holder such that the plane of the film replaces the location of the ground glass precisely. The film holder support at the back of the focal plane is sketched in Figure 3(b), and then in (c) the ground glass area is marked. Notice the right front and the left back stops for the film holder. Figure 3(d) shows the film holder that would be used in this camera.

The building steps are illustrated in Figure 4. The wood is first measured, then cut. Once the necessary pieces are cut for both the boxes, dry fit them and verify the dimensions. Then, glue the pieces together. When making these frames, use the squaring clamps to

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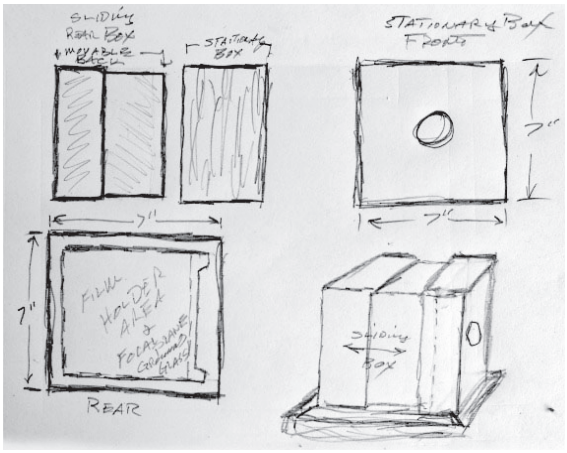
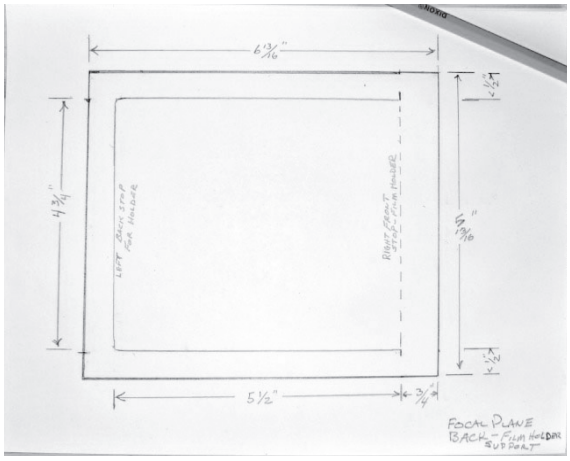
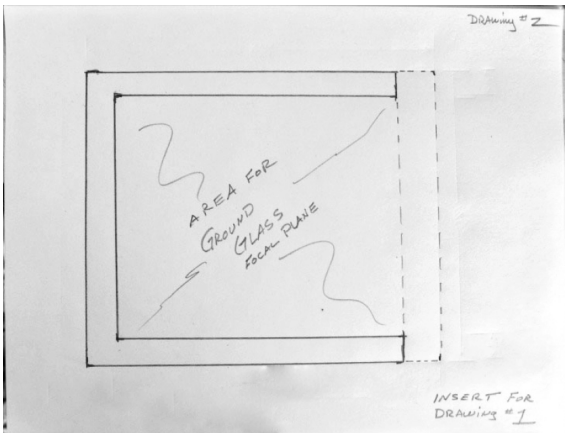


(a) Brainstorming Drawing



(b) Template for film holder area #1.



(c) Template for film holder area #2.

(d) 4×5 film holder

Figure 3: Initial layout thoughts.

ensure a perfect square join. Let the glue dry for about three to four hours, or as indicated on your glue bottle. Scrape or sand off excessive glue residue and test the fit.

An exploded view of the parts are shown in Figure 5. From right to left, notice the assembled front standard with the lens hole, the sliding box, the rear standard for ground glass and the film holder frame towards the back. With that in mind, start assembling the cut pieces.

Beginning at the rear of the sliding box, align the film holder frame to the box. Check for extremely tight fits. A tight fit ensures a light-tight inside area, where the image will be recorded on light sensitive media, such as film or photo-sensitive paper. The mounting rear of the camera body is shown in Figure 6(a). Guides are attached to accommodate the film holder at a precise location as indicated in Figures 6(b) and (c). A hinged plywood door is also provided to protect the ground glass. This door is assembled as shown in Figure 6(d)

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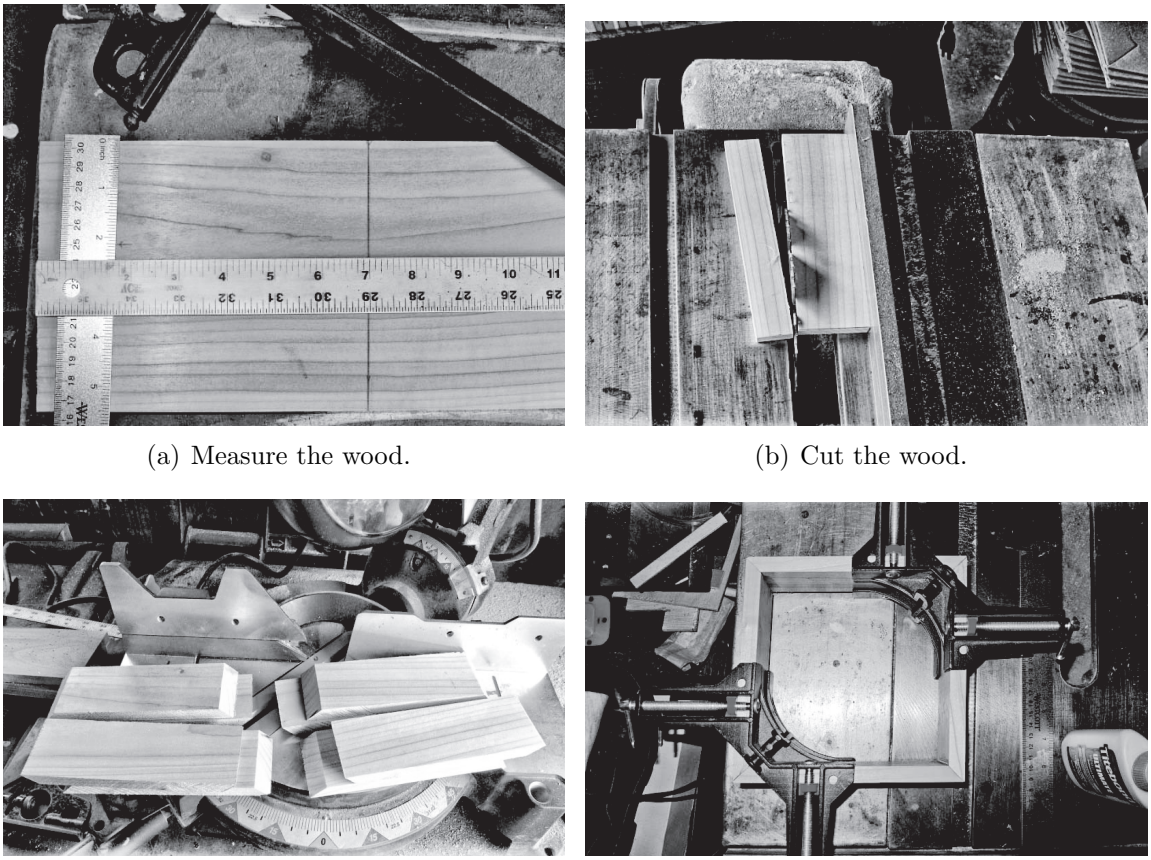

(a) Measure the wood.

(b) Cut the wood.

(c) Verify the cuts for both boxes.

(d) Glue the pieces.

Figure 4: Building the boxes.

Figure 5: Exploded view.

in a vertical, or portrait orientation. Cut slots on the rear door and the rear standard to house the film holder as shown in Figure 6(e). This will assure a good fit on the film holder, and keep out stray light from fogging the film/paper. Paint the inside of the boxes with flat black spray paint. The right working view in Figure 6(g) shows the gap that holds the film holder.

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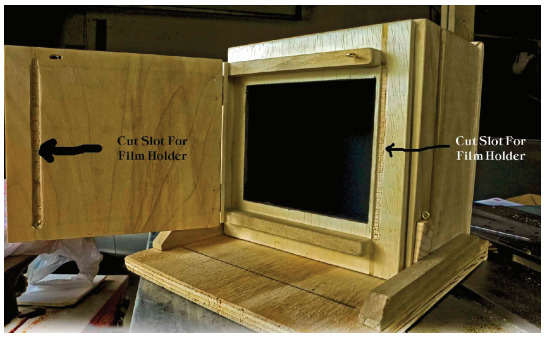
(a) Mounting rear.

(b) Rear focal plane area.

(c) Rear oblique view.

(d) Vertical orientation.



(e) Rear view of movable box showing slots for film holder.

(f) Lens mount on board.

(g) Working right side view.

(h) Glued and clamped forward box trim.

Figure 6: Testing fit.

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Next, proceed with the front stationary-box. Find the center of the lens-board to mount the lens. The diameter of the hole should match the diameter of the lens being used, as indicated in Figure 7. West Yorkshire Cameras has published a list of various shutters

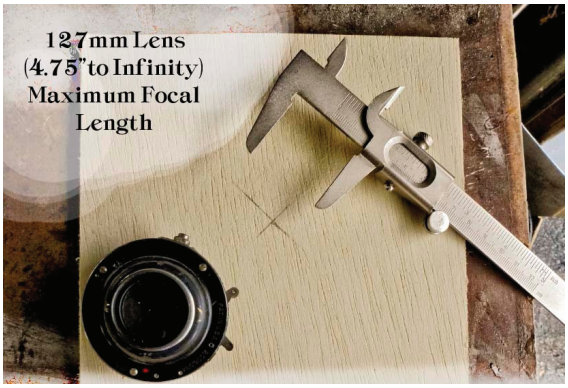

Figure 7: Cutting a lens hole.

and their diameters [11], as summarized in the Table 1. Note that the Compound shutter dimensions are only approximate. The threaded bushing-lock-ring of the lens should be glued

Table 1: Standard lens board hole sizes of various shutter types.

Type	Size (mm)
Compur 00	26.30
Copal 0, Compur 0, Prontor (pro) 0	34.60
Copal 1, Compur 1, Prontor (pro) 1	41.60
Ilex 3	50.52
Compur 2	52.50
Compound 3	60.00
Copal 3s	64.50
Copal 3, Compur 3, Prontor (pro) 3, Compound 4-X 9	65.00
Ilex 4	66.14
Compound 4-X 10/11	76.70
Ilex 5	85.47
Compound 5-X 12/I/II	90.00

to the lens board as indicated in Figure 6(f). I used expanding glue for this. Care must be taken to not get glue on the threads of the lens barrel. It is very difficult to remove glue from the threads. After mounting the lens threaded bushing, remove the lens, and proceed with the finishing trim on the forward box. The use of clamps and rubber bands will hold the trim in place, for the curing of the glue.

While the glue is curing, mix up some stain for the color of the finish. I use three different stains that I mix in random proportion to make a tone that is unique to each camera I make.

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The selection of stains is totally up to the builder. I also use some paint thinner to thin-out the mixed stain. This will assure not only an even coverage, but also will render a lighter color and have better penetration in the wood.

While the stain dries work on the focal plane part of the camera. This is where the photographer brings into focus the intended image. This area is were the photographer composes the given, and chosen scene or subject of interest. Since I had a few old wooden film holders, I thought that one would make a removable focal plane. This would contain a ground glass as a focusing screen. The relative position of the ground glass from the lens must be exactly the same as the paper/film used when the film holder is inserted. The tolerance is about a little less than $\frac{1}{64}$ inch. Any more discrepancy in this position would result in an unclear and blurry image.

Remove the dark slides of one of the film holders (Figure 8(a)). Carefully remove the rear of the frame as shown in Figure 8(b). Then remove the two inner sheets of aluminum, called the backer, that are inside the holder as shown in Figure 8(c). I used a pair of needle-nosed plyers to pull these out from the holder body. Some wooden film holders have little metal guides that the aluminum sheets fit into. You want to leave those in place in the holder. I was going to use a sheet of ground glass cut to fit the area intended in the holder, but decided on a plexiglas. Cut a small sheet of plexiglas to fit exactly into these guides. It would be of the same dimensions as the backer. Ensure a good fit. Remove it and protect it with frosted tape. This prevents breakage if dropped. I have used this before on my 4×5 and 8×10 cameras. After replacing the plexiglas back into the film holder, place a little wood glue on the fitted parts of the holder and place it back together with clamps to keep the hinged back from separating from each other. You will not have to do this part again.

After the first coat of Polyurethane, and when it is completely cured, lightly sandpaper with a very light grit 300 or finer. Finish with a light gentle, rubbing, with a Scotch-Brite® scrubbing pad by going with the grain of the wood. I usually give it three coats of Polyurethane, and each time give it a light rub with the Scotch-Brite® pad. Though I have used glossy stain, I do prefer the semi-gloss. After the final coat, wax and buff. Be sure to let the wax dry completely before rubbing it off with a soft cotton cloth.

Figure 9(a) shows the home position of a locking pin. This is to stop the movement beyond infinity focus position, or the home position. The rear door is locked in closed position using the mechanism shown in Figure 9(b). It assists in holing the film holder in place and keeps ambient light form entering the exposure area. Figure 9(c) shows the focus locking wedge. After the final focus of the subject is achieved on the ground glass, this lock will retain the relative position through the shooting process. All of these locking parts should be secured with a string attached to the Pin and the camera body to prevent losing

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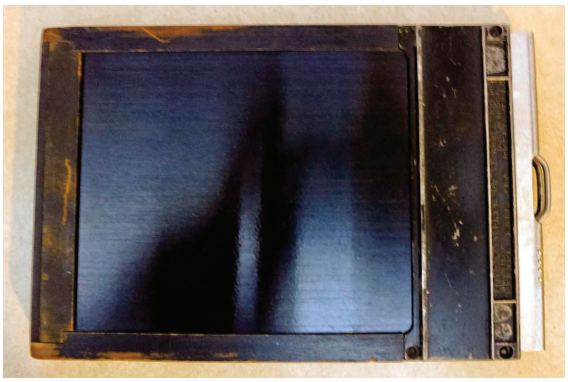
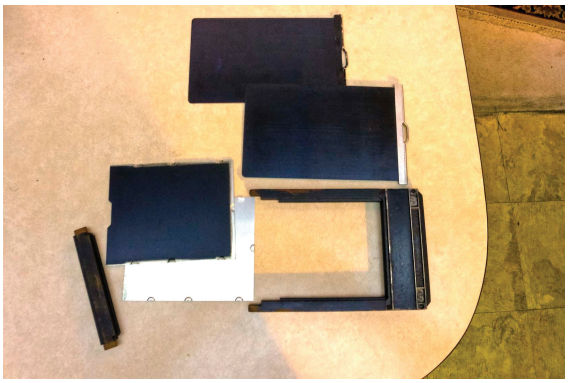
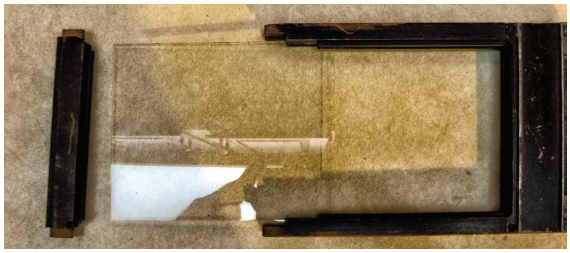


(a) Film holder.

(b) End removed.



(c) Plates removed.



(d) Ground glass inserted.

(e)

Figure 8: Checking fit for rear focal plane.

them.

At this point the camera building is complete and the final product is shown in Figure 10. Note that most of these features were never found on the original sliding-box cameras. That is the why I have the "A" in the model numbers denoting "Advanced."

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(a) Detail showing "home position" locking pin.

(b) Hinged door in closed position when exposing film.

(c) Focus locking wedge to hold focus.

Figure 9: Rear view.

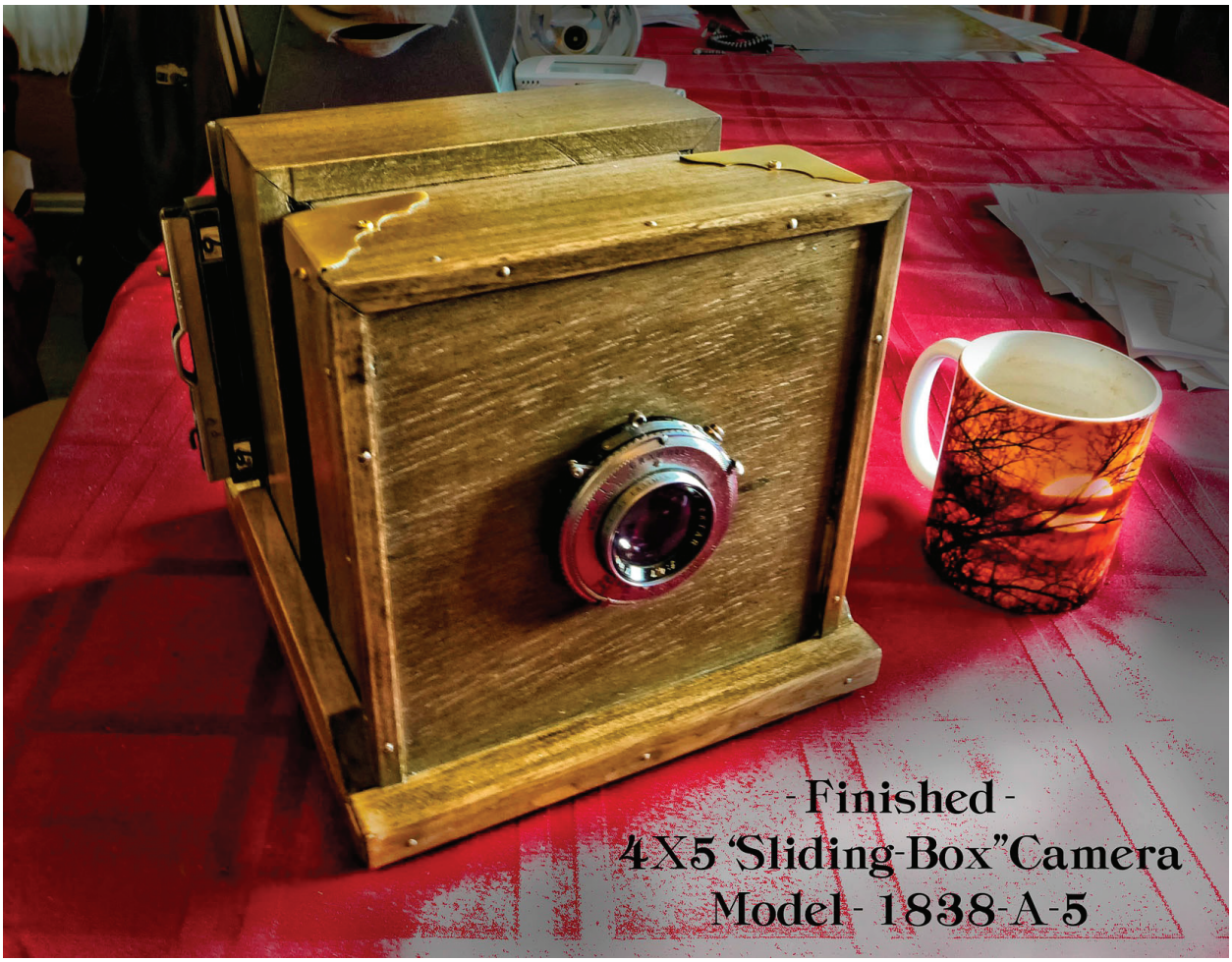

Figure 10: A finished 4 × 5 sliding box camera.

Testing is mandatory in that one must see how things worked out. I suggest that you use different f-Stops, and focus on different objects — far and near. This usually takes about eight to twelve exposures. Now you realize as to the why I enjoy making paper negatives with my own cameras that I built myself.

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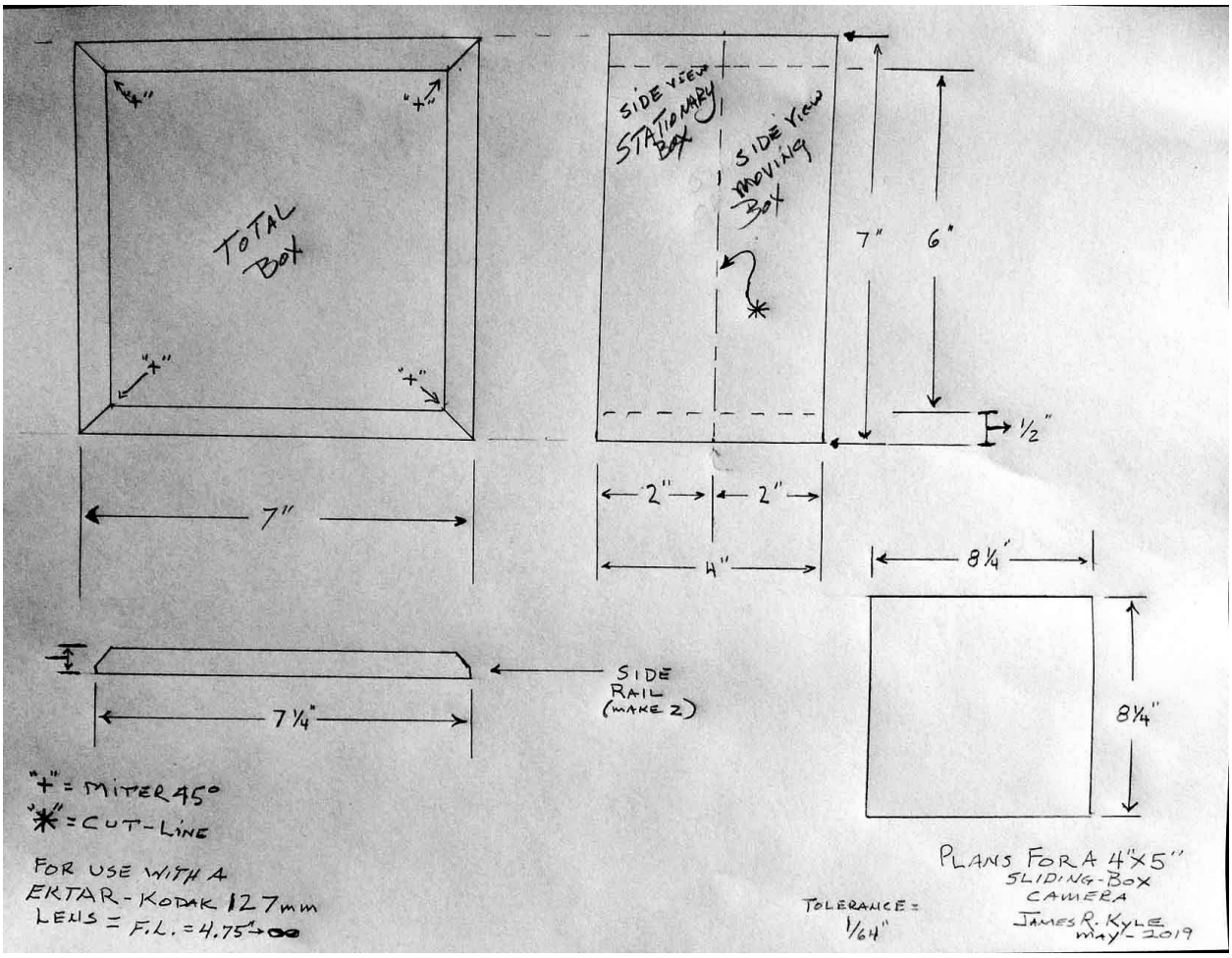
4 CONCLUSION

In this document I have walked you through making a sliding-box camera. I have also provided a bill of materials and tools. A well illustrated instruction guide communicates design and purpose than just a drawing. In fact, the drawing provided here was as a guide and not a technically accurate one. With a camera such as this, one can enjoy making film or paper negatives. Though the design here was for a 4 inch by 5 inch negative, easy adaptation can take the user to any custom size negative or paper. The 4×5 format allows for more economic choice of materials and parts.

A DRAWINGS



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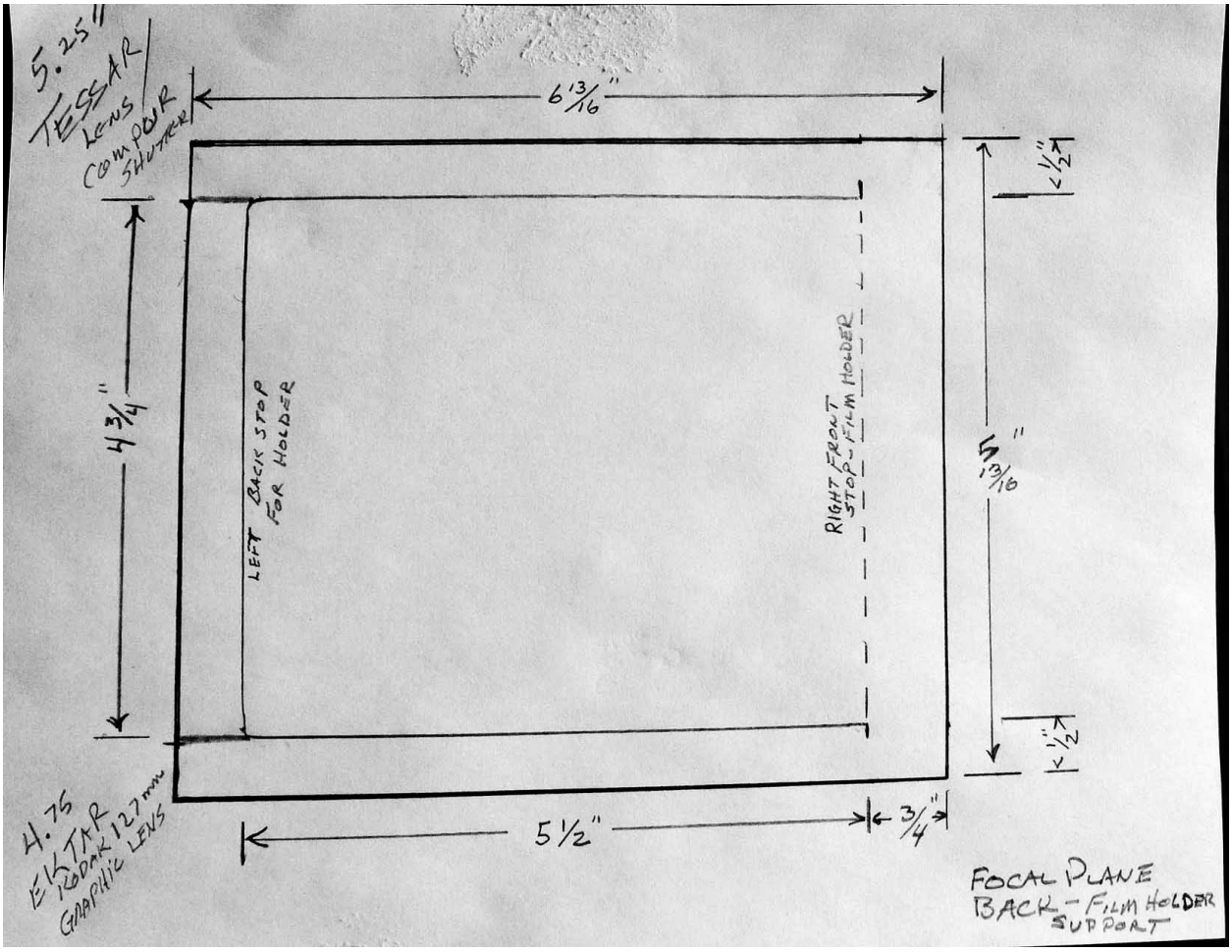

AUTHOR BIOGRAPHY

James R. Kyle is an autodidact and all his formal education has come through diligent study in public libraries and more recently, search engines. He is currently a retired electrician / electrical lineman. Since the age of thirteen he has had an over-whelming interes in the "art and science" of photography and he has ever since sought to improve his photographic abilities through study and practice. His started camera was a gift from his mother at thirteen, a Kodak Brownie "Hawkeye" 120 roll film camera. Along with his friend James started out in a cardboard-constructed darkroom with his friend's "Federal" 8×10 enlarger. In high school he and his friend enrolled in photography class and seeked out Walter Smith to be an understudy. Later, Mr. Smith donated James a 1941 Ansco 8×10 camera, and a 1948 4×5 Crown Graphic along with some film holders which he uses till date. He invested in a digital camera in 1996 but later in 2012 re-immersed himself in film

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photography. He has since experimented with paper negatives, X-ray film and various other medium of photographing, and retained copious notes of his process and outcomes. After developing the negatives, he would then process and digitally scan the negative scan the negatives to achieve his final result. James believes in free dissemination of his knowledge and would share with anyone who asks.

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