

T H E P O P U L I S T

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The design ideas of this camera.

Whenever I've given a pinhole photography workshop, at the end I always get asked where the materials can be acquired and how the participants can continue. Because of the difficulty and expense of acquiring photographic paper and chemicals and the necessity for a safe-lit darkroom, very few actually follow through.

My purpose here was to design a camera that can be built and used by anyone without any particular fabrication skills or background in photography and without the need of a darkroom.

I set out to fill the following requirements

1. It is easy to build out of easily available materials. Most of the materials most people will already have around the house, and if not are available at almost all hardware stores.
2. It is reliably light-tight without a lot of trial and error, and easy to load and unload without a darkroom.
3. It uses standard 35mm film which can be processed at any one-hour processing center without special treatment.

I've gotten some of the ideas from the Dirkon Camera, which is kind of complicated to build, and difficult to make light-tight, (http://www.pinhole.cz/en/pinholecameras/dirkon_01.html)

and from Alspix' Matchbox camera, which I'm rather fond of, but is tricky to get light-tight every time it's loaded. (http://alspix.blog.co.uk/index.php/alspix/2005/11/23/1/matchbox_pinhole%7E428481)

If you have a tripod, it really makes it easier to take pictures in many situations, and vastly increases the options for placing the camera, and keeping the camera steady during the long exposures common to pinhole photography. This design does include provisions for mounting the camera to a standard tripod screw.

The tripod mount is optional, and in some places steps are slightly different or can be skipped if you're not including the tripod mount.. If you don't have a tripod it doesn't make sense to put several extra holes in the camera body. Look over the directions and especially the section on finishing tripod mount on pages 10 and 11. If you do decide to do the tripod mount, in addition to the list on the right, you'll need

A 1/4 inch x 20 nut


A 1/4 inch x 20 bolt of any length.

(Known outside the U.S. as 1/4 inch x 20 BSW or Imperial)

Supply list.

A print of the diagram on normal paper:

The diagram is the next page of this file, a two page version is on p.15 & 16 if the one page version won't fit in your printer margins)


Some thin cardboard 

A cereal box or a soft drink twelve pack

Glue.

A permanent (not repositionable) glue stick, Elmer's glue, wood glue or Spray adhesive. A white glue like Elmer's makes a stronger bond, but takes at least several hours to dry completely. Even glue sticks require a few minutes to dry before you go to the next step.

About 3 1/2 feet (1m) of opaque black tape, 1/2 to 3/4 inch (12 to 20mm) wide

I recommend Scotch Plastic Repair and Decorating tape which is commonly available in hardware, department and grocery stores and is inexpensive. Black masking tape is not opaque, but a double layer might work. Black duct tape is opaque but a little thick. "Electrical" tape doesn't stick very permanently to paper surfaces. 3M #235 opaque black photographic tape is the ideal, but expensive and hard to find. 

A scissors

A ball point pen and a straight edge

A nail and a sharpened pencil OR An exacto knife¹

An empty 35mm film cassette

Any place that processes film will give you handfuls of them. You probably want to get several so you have spares to practice with.

A bottle opener

A 1 1/4 inch (32mm) piece of 3/8 inch (10mm) wooden dowel

A small saw and a pair of pliers or a vice.

A common pin, or better yet a #10 sewing needle.

A 3/4 inch (20mm) square piece of soft drink can aluminum, plus another 1/8 inch by 1 1/4 inch (3 x 32mm) strip.

Soft drink cans are pretty easy to cut apart with an ordinary scissors. Be careful, they can have some pretty sharp edges.

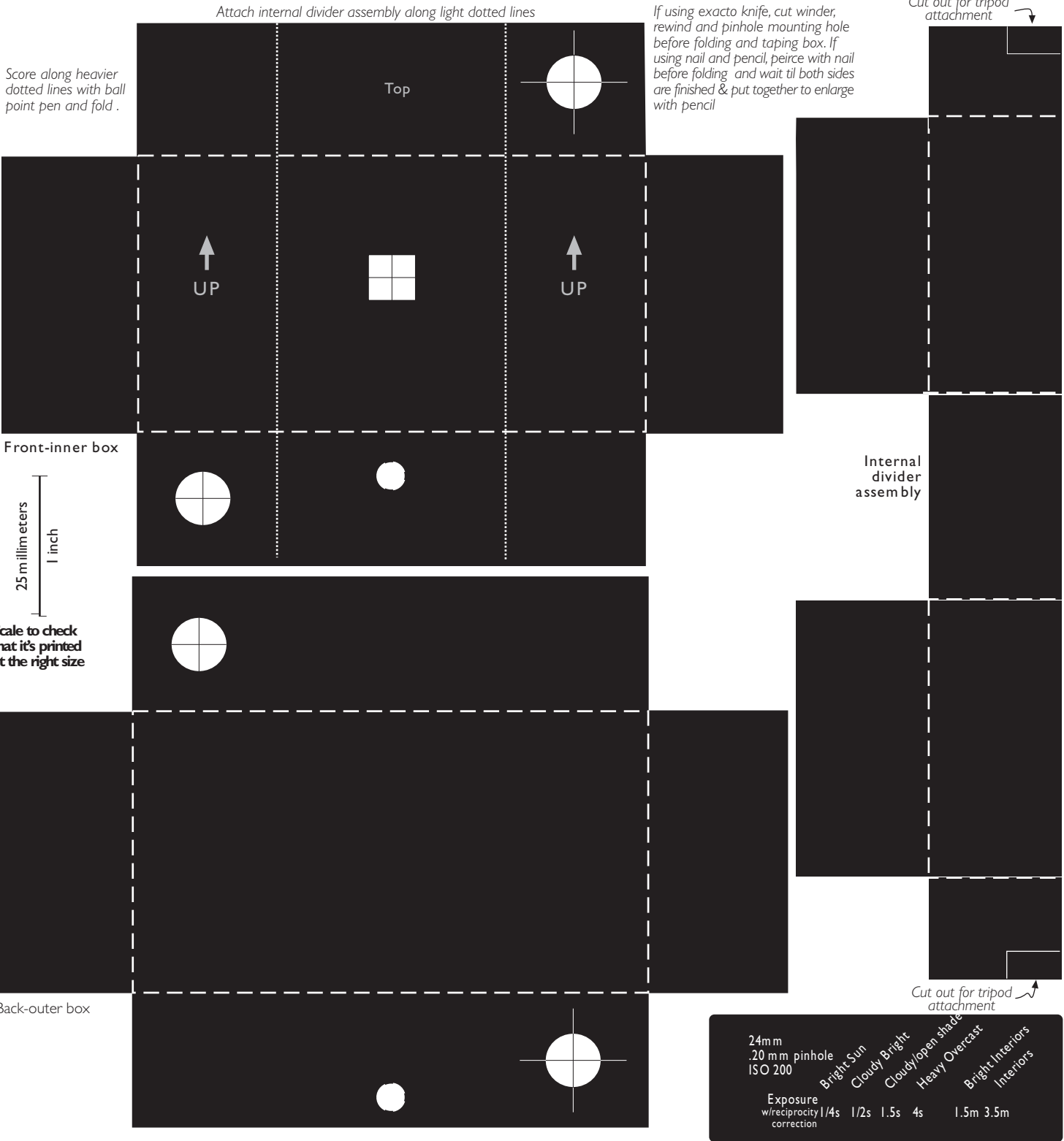
A small piece of very fine grit sandpaper

Two kind of heavy rubber bands

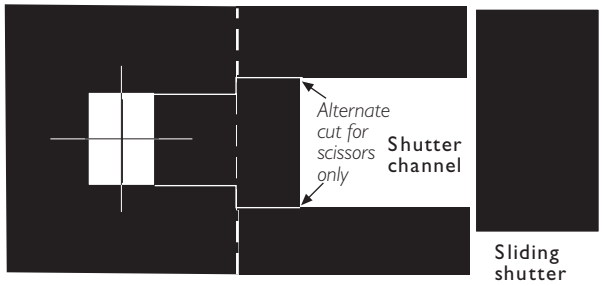
The ones that hold brocolli or asparagus bunches together are perfect

A fresh roll of 35mm film, preferably ISO 200.

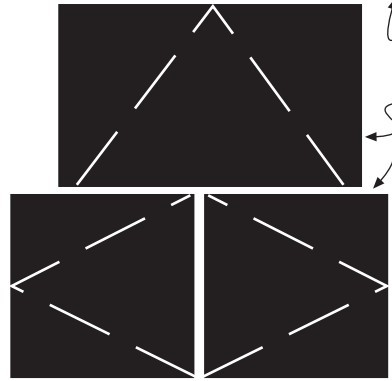
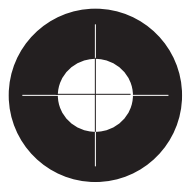
Binder clips to use as clamps when gluing some parts are handy and kind of necessary for the tripod mount.



Shutter Assembly
glue entire area dotted area to cardstock and cut hole or drill and enlarge before cutting out.



Winder collar, glue entire area dotted area to cardstock and drill or cut hole and insert dowel before cutting out.

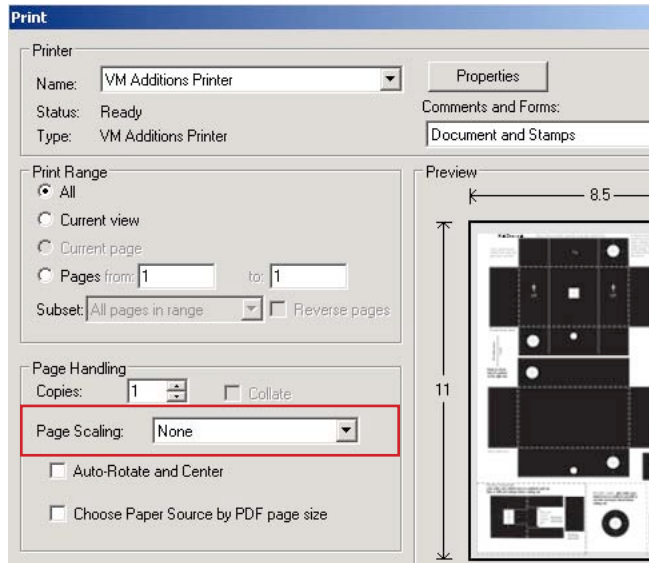


Viewfinders - align point with pinhole on cardstock, attach to camera after assembly

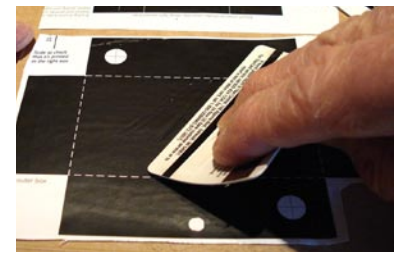
Don't glue to camera after assembly

Print the camera diagram

Print the camera diagram on normal paper. It's an Adobe Acrobat file. **When you print it make sure "Page scaling is set to "None" so all the dimensions will be correct.** This should be automatically selected for this file.



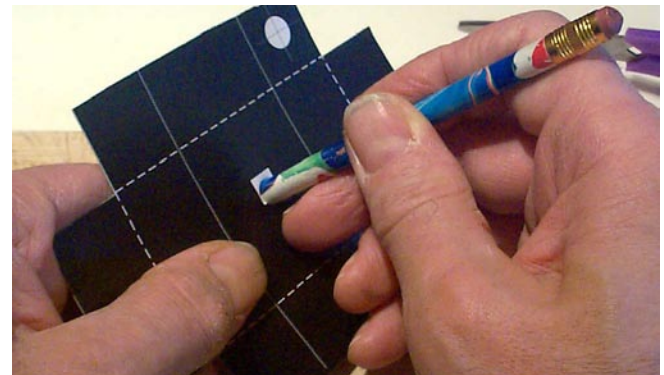
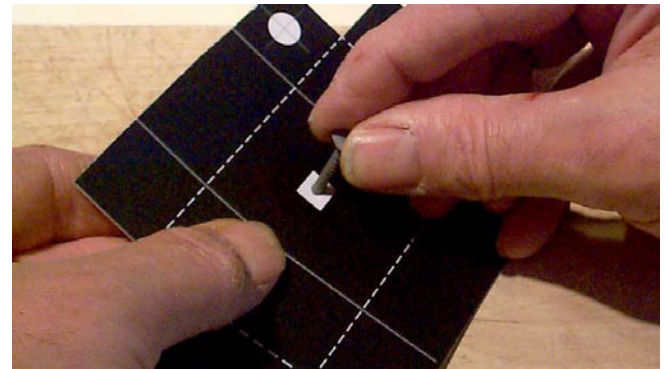
Burnishing with something flexible like a credit card or drivers license will make a better bond.



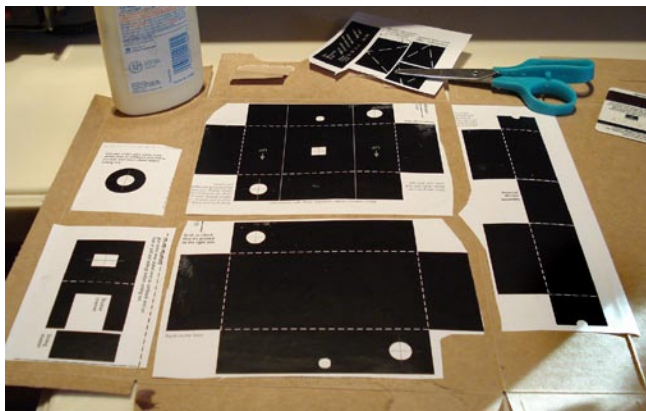
Make sure the glue is dry before continuing.

The front of the camera.

First cut the hole in which the pinhole will be mounted. If you have an exacto knife, cut the hole out. If you don't have an exacto knife, use a nail to pierce the hole in the center. Then with a sharpened pencil, gently enlarge the hole to the full diameter of the pencils. With the tips of your scissors, cut the hole to its final dimension. Try to cut it with as clean an edge as possible.



Glue the diagram to card stock.

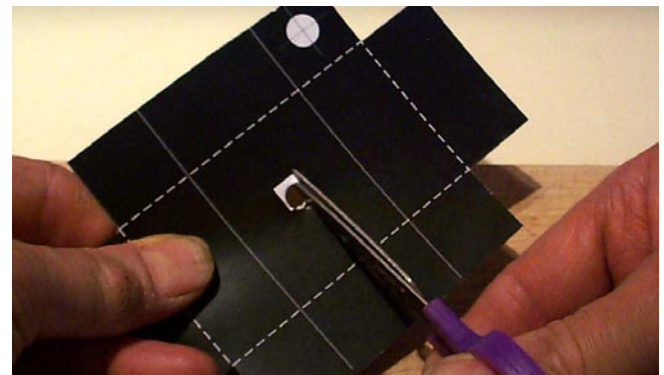


Cut the viewfinders and exposure guides from the diagram. Don't glue them to the cardboard.

Glue the rest of the diagram to a piece of light cardboard. Cereal boxes or twelve packs of Pop cans work just fine. You don't want anything too heavy so it's difficult to fold.

You can glue the entire diagram if your piece of card stock is big enough, or cut the pieces apart and glue them individually.

I've used spray mount, Elmer's glue and Glue sticks to do this. It's important to make sure the entire surface is glued to the card stock. If you're using a liquid glue like Elmer's, make sure to make a very thin coat of glue. Too much will warp the paper. You can use a small piece of the card stock as a squeegee to spread a very thin layer.



If you have an exacto knife, cut the winding hole, the rewinding hole and the tripod mount hole (if you need one) out before folding. Be careful not to make it bigger than indicated on the diagram. If you don't have an exacto knife, use a nail to pierce the center of these holes. You'll enlarge them later after the front and back are assembled.

With a ball point pen and a straight edge, using fairly heavy pressure, draw over the heavier dotted lines. This will score the cardboard and make it easier to fold exactly.



Fold the four sides in. The black side should be the inside of the camera. Fold them one at a time and fold them completely over.



Tape the edges of the sides together with the black tape. Make sure the back ends align with each other.



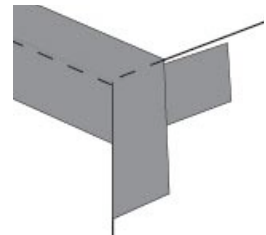
Then tape them along their length from the open side extending about a half inch (12mm) out in front of the camera. With the scissors, split the tape that extends out in front of the camera.



Then fold in these flaps, one parallel to the side and one parallel to the top. The front corners are a potential source of a light leak, so you want to make sure they get covered.



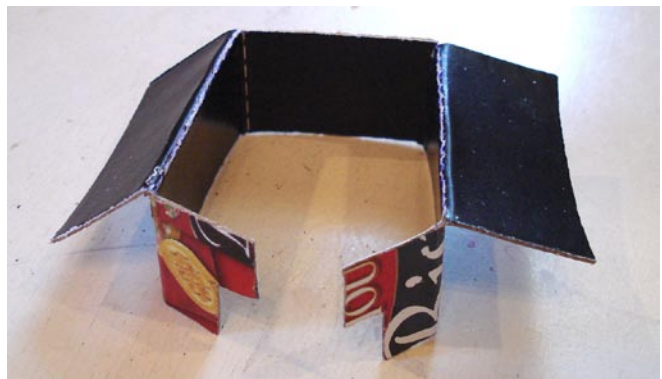
In case that's not entirely clear from the pictures, here's a diagram of how the corners should look.



Continue taping all four corners in the same manner

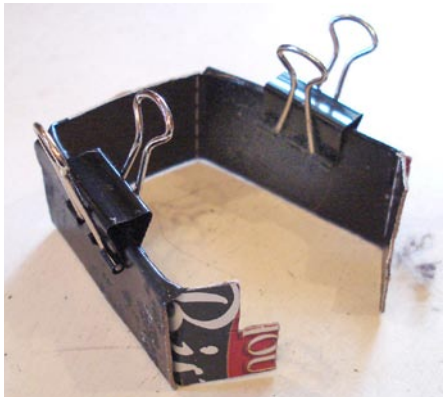
The inner divider

Cut out the inner divider assembly and score and fold it.



If you will be making the tripod mount, cut out the area to fit in the tripod mount nut.

The flaps that have folded over to become double thickness will be the sides of the interior divider assembly. Put some glue on the inside and tape them together. It makes a stronger bond if you clamp the sides while the glue dries, but the tape is probably sufficient to hold it together.



Place the inner divider assembly against the top of the camera front, positioned so you can just see the thinner dotted lines on either side and glue and tape it to the top.



Bend in the bottom of the inner divider so that you can just see the thinner dotted lines and glue and tape each side to the bottom of the camera front. **If you're going to make the tripod mount** be careful to place the tape so it only covers the full width part of the flap and doesn't cover the space for the tripod mounting nut, and be sure to glue and clamp it and let it dry. The bottom of the interior divider assembly should be well adhered to the bottom of the box for the tripod mount to work.



Cover the sides of the interior divider with tape. Make sure it's smooth without any wrinkles or bumps. The film will ride over this surface when you advance and rewind the film.



The back of the camera

If you have an exacto knife, cut out the winding, rewinding and tripod mount (if you're including it) holes. Be careful not to make it bigger than indicated on the diagram. If you don't have an exacto knife, use a nail to pierce the holes in their center. You'll enlarge them later.

Score the lines as you did with the front of the camera and fold completely. Fold the back around the front of the camera. Place a rubber band around the long end of the camera, and one around the short end. Do not cover the corners with the rubber band. The idea is to make the back fit as snugly on the front as possible. With small pieces of tape, tape the corners of the camera back, again, attempting to have the back fit tightly over the front.



Then go over each corner with the split and fold taping method as you did with the camera front (previous page). Be careful not to tape the back onto the front.

Cut the slot the winder.

Cut a slot in one end of the piece of wooden dowel. The way I did this was to put the dowel in a vice grips and slowly draw a saw across it. It might help to get it started by putting a slight notch in the end with a knife. Go slowly and be careful. The notch only has to be about a millimeter deep, but it should be the full width of the saw blade.



In order to advance the film, this slot has to fit over the bar inside the film take up spool, so it might be a good idea to widen it a little with a nail file or emery board.

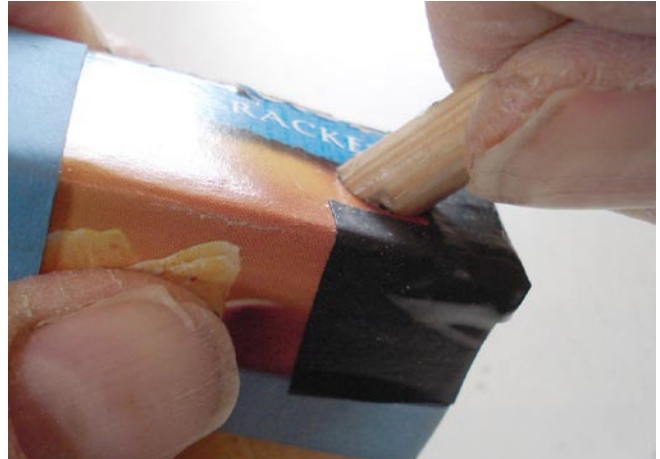


Make the winding and rewinding holes

If you cut out the winding and rewinding holes with an exacto knife earlier you're all set. If you just pierced the center with a nail, put the front and back together. The nail holes should line up. Now take a sharpened pencil and slowly enlarge the hole, twisting it as you push until it is the full diameter of the pencil.



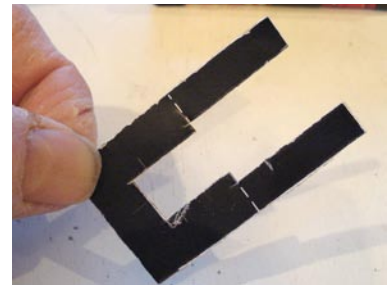
It should be just too small to insert the wooden dowel. Then take the wooden dowel and starting at an angle, rotate the dowel, enlarging the hole until it goes through. Make sure it has gone through both the front and back of the camera completely. Do this somewhat gently to avoid tearing the cardboard. There will be a burr of paper on the inside. Just leave it. It will help to prevent light getting into the camera.



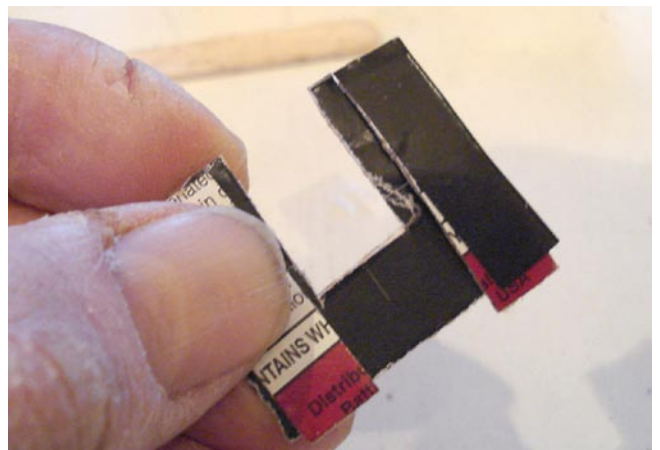
Repeat this process for the rewind hole.

The shutter channel

Cut out the shutter channel. If you have an exacto knife, cut out the opening. If you just have scissors, follow the alternative cutting lines, ending up with a shape like this.



Fold the shutter channel and glue and tape it together. If you using liquid glue be careful not to have any glue leaking out into the shutter channel. If you do wipe it off with a damp cloth.



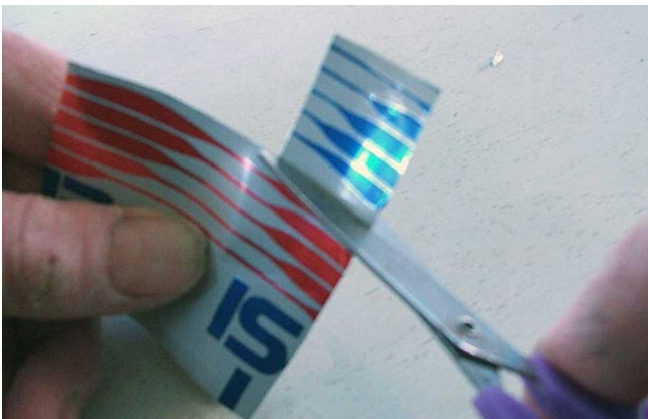
Tape the shutter channel to the front of the camera. Remember that the channel is actually slightly wider than the opening so don't put the tape right up to the opening.



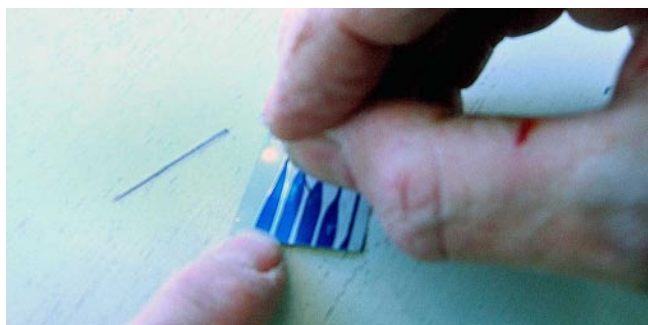
Cut out the sliding shutter; place it in the channel, black side in and fold over the end so it doesn't fall through the channel..

Make the pinhole

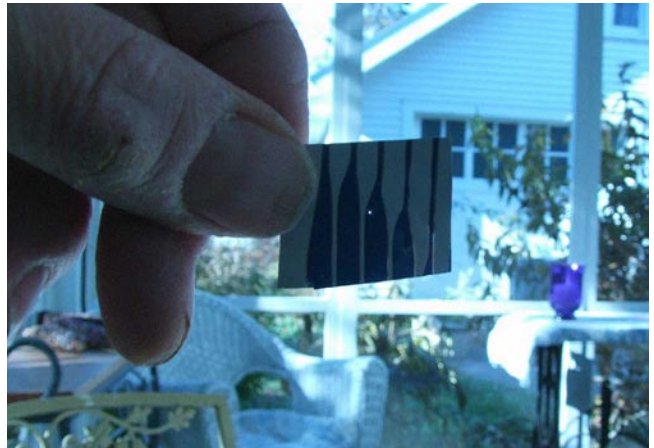
Cut about a $\frac{3}{4}$ inch square from an aluminum soft drink or beer can, These cans can be cut with a scissors, Be very careful, the edges can be very sharp.



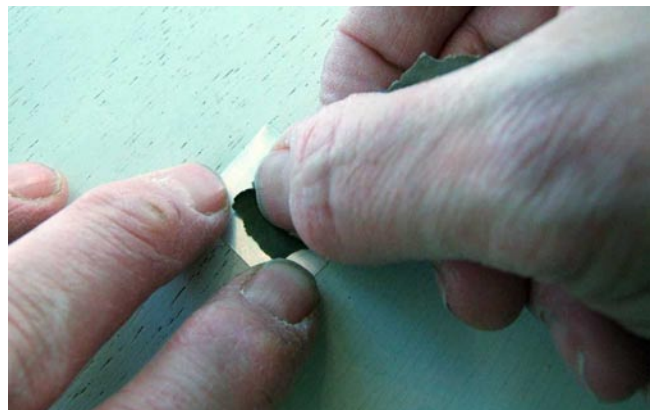
Place the square of metal on a hard surface, like a table or desktop. Take a pin or needle, the smaller the better (you might want to grip it with a vice-grips or a clothes pin), and press it straight down on the metal and rotate it, or rotate the metal if that's easier. Be firm, but don't press too hard, or you'll bend the pin and you might make the hole larger than you want.



Pick up the metal and hold it up to a light. The hole will probably be smaller than you can see clearly, but make sure you have gone through.



There will be a slight burr on the metal on the opposite side. Take the sand paper and gently sand off the burr. Be careful not to fold or crease the metal. Take the pin and just put the tip in the hole and give it a little spin to clear out any metal flakes made by the sanding. Don't press on it or you'll enlarge the hole. Hold it up to the light to make sure it's clear.



The hole will probably be somewhere around .15mm if you're using a #10 needle, a little bigger than .2mm if you're using a common pin.. The ideal size for this camera is .22, but in my opinion, a little smaller is better. (I typically use .15mm pinholes)

If you have a scanner; you can get a pretty close measurement of your pinhole, Scan the pinhole at the highest resolution available. Doing this in the reflective mode with the scanner lid open yields the most accurate measure.

Zoom in until you can see the hole. It might be pretty fuzzy. With the cropping tool of the software, crop the image to just the outside borders of the hole. Then check the image size. Change the units of measure to millimeters. If you can't change the units, .22mm is about .008 inches.

If you can't measure the pinhole, don't worry about it. It's probably about .2 mm. Any error will change the exposure. If

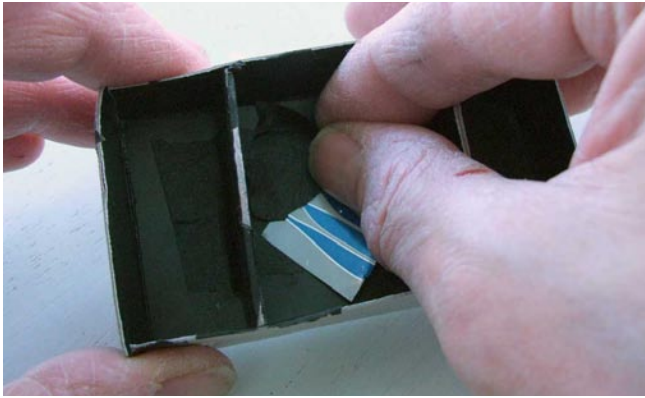
the pinhole is a little too large, your images will be a little over exposed, if a little too small, they'll be underexposed. With modern films, you should be able to get a decent print out of a range of exposures.

This is pretty easy to do and the materials are pretty cheap. Try it several times and use the best one.

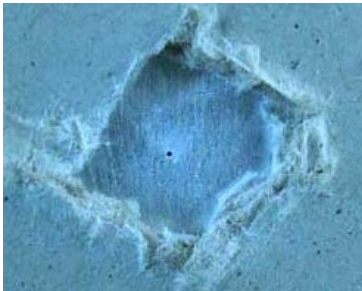
Later on we'll discuss exposure and provide exposure guides for other sizes of pinholes

Attach the pinhole to the camera.

Place the pinhole inside the camera.



Make sure it's centered in the hole in the front of the camera, and tape it down on all sides. It's a pretty tight fit inside the camera so be careful you don't cover the hole. Make sure the pinhole is centered in the hole in the front of the camera.



Open the empty film cassette

With a bottle opener, pry off one end of the film cassette.



Finish the winder

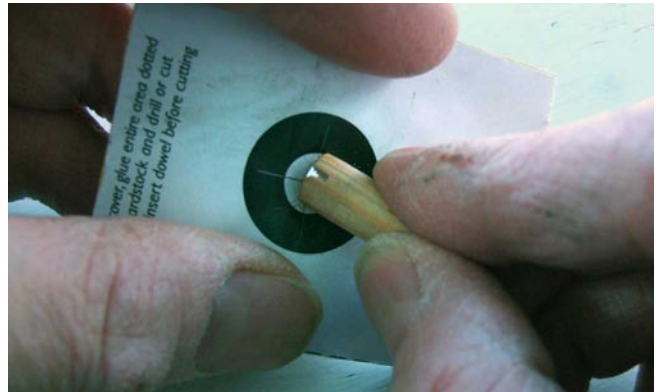
Wooden dowels and film spools both vary in size a little bit. Before continuing, try to fit the wooden dowel into the film spool so the notch engages the tab inside the spool. If the dowel is too large, take a piece of sandpaper or nail file and sand it down until it does fit.



Place the empty film spool inside the camera with the part that protrudes beyond the flange down.

Cut the area around the winder collar at the dotted lines. If you've got an exacto knife, cut the circle out. Again, be careful not to enlarge it. The dowel should fit tightly into it.

If you don't have an exacto knife use the nail and pencil and dowel method to create the hole the same way you did with the wind and rewind holes.



Once the hole is finished, cut out the winder collar

Put the front and back of the camera together. Place the dowel into the winder hole. Press it in as far as it will go and rotate it so the slot in the dowel engages the tab inside the spool in the film cassette.

Cut small pieces of tape to attach the winder collar to the dowel.



It will probably take four or five pieces to go completely around the dowel. Be careful not to tape the winder collar to the top of the camera.



If there are pieces of tape sticking out around the winder collar trim them off with the scissors.

This winder collar has two functions. One is to provide additional prevention of light leaks through the winder hole, and, with the rubber band over it, to keep the winder from falling out and getting lost. It's a good idea to draw an arrow on the top of the winder indicating that it should be turned in a counter clockwise direction. Since the rewind hole is on the bottom of the camera, winding to advance and rewinding are done in the same direction.



Attach the viewfinders & exposure guide

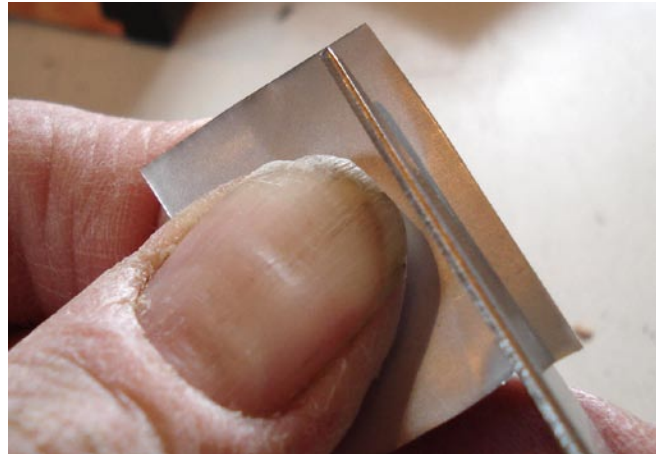
Glue the viewfinders to the top and sides of the camera. Make sure the points of the viewfinders line up with the pinhole. (The pinhole is slightly above center on the sides.)



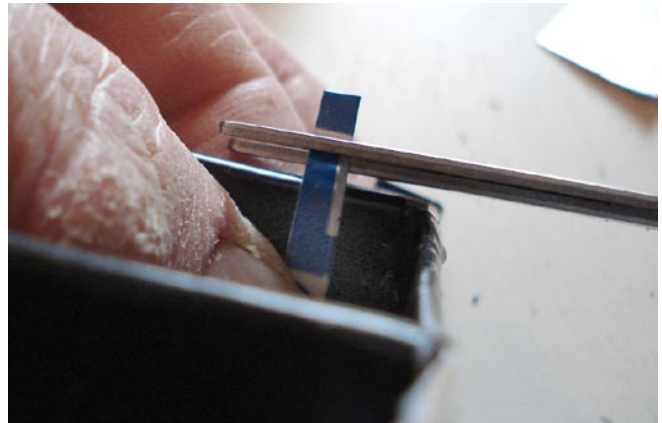
Glue the exposure guide to the back of the camera. (If your pinhole was significantly different from .20mm, we'll provide other exposure guides later on.)

Make and install the audible film advance clicker

Cut a strip of the aluminum can material about 1/8 inch (3mm) wide and at least 1 1/4 inch (32mm) long.



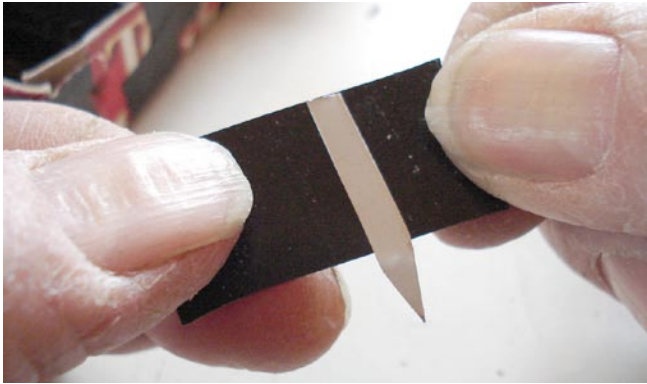
Hold the strip up against the interior divider wall with the bottom touching the front of the camera on the take-up side, and trim it so about 1/8 inch (3mm) extends above the divider.



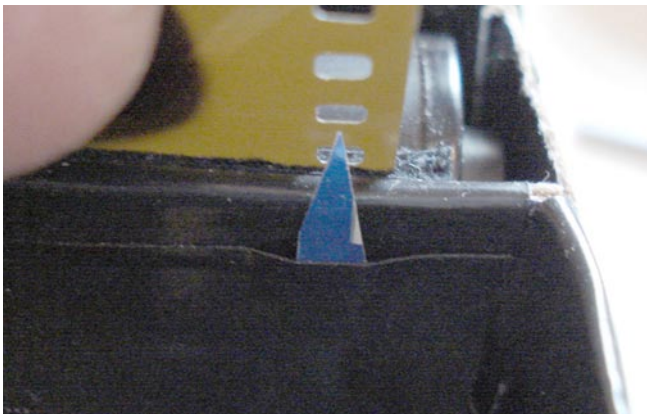
Cut a point on to the aluminum strip. Be careful not to reduce the length when you're doing this. If you do make it shorter, you've got lots of this material available, so cut another strip and try again.



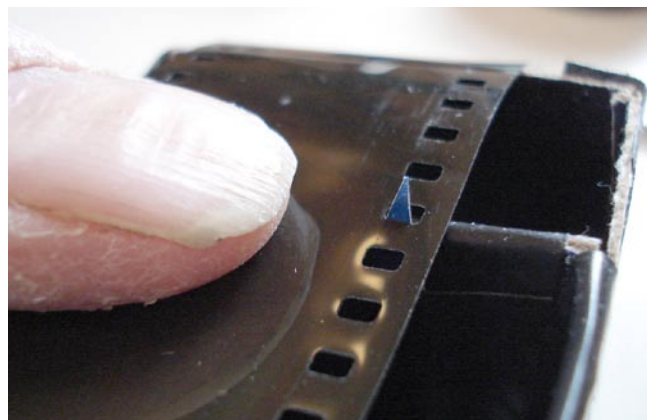
Cut a piece of tape about $\frac{3}{4}$ inch (19mm) \times $1\frac{1}{4}$ inch (32mm). Attach the pointed aluminum strip about $\frac{1}{2}$ inch (12mm) from the bottom end, with the bottom flush with the edge of the tape and the point extending about $\frac{3}{8}$ (9mm) above the tape.



Temporarily place your full roll of film in the take-up side with the sprocket hole facing down (yes, this is kind of backward), hold the film up against the internal divider and place the tape with the aluminum strip on the inside of the divider so the point is aligned right in the middle of the sprocket holes..



Press the tape firmly and burnish it down with the pen or pencil. It's important that the tape is firmly attached for the clicker to work right. Then take the film out and put in into the supply side and check to see if the clicker lines up with the sprocket holes.



If it's misaligned, try again, maybe with a new piece of tape. It's important that the point of the clicker is centered on the sprocket holes.

The tripod mount

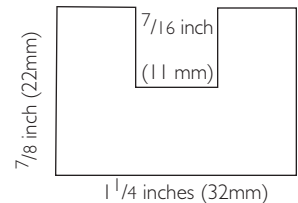
You'll need a $\frac{1}{4}$ inch by 20 nut and any length $\frac{1}{4}$ \times 20 bolt. I've used a $\frac{7}{16}$ (11 mm) square nut, but I think a hexagonal nut would work. From side to side the hexagonal nut is the same measurement. Be careful to cut the openings for the nut so that it fits tightly. Outside the United States you would specify a $\frac{1}{4}$ \times 20 Imperial or BSW thread. This is a standard size for all tripods.

It's important that the tripod mount is pretty strongly adhered inside the camera or when you insert the tripod thread it will just lift it up and won't thread into it. This means you will have to glue it together and clamp it while it dries, in several steps. I use an $1\frac{1}{4}$ inch binder clip for the clamp. With a glue stick, 10 minutes of drying should be sufficient. With a liquid white glue, wait for several hours.

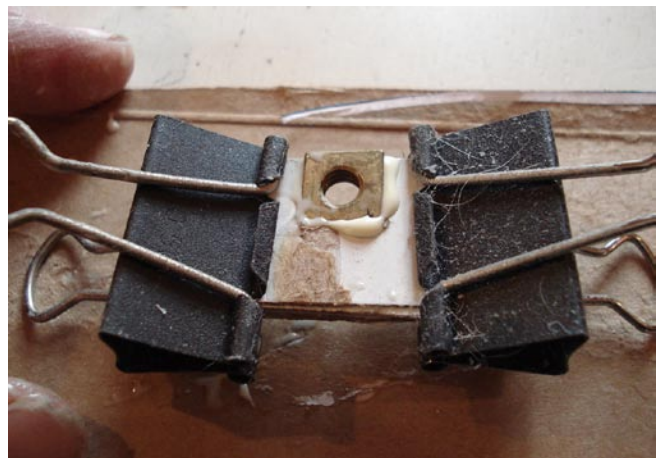
When you are placing the tripod mount parts and clamping them, be careful not to bend the clicker.

First cut 6 pieces of your card stock $\frac{7}{8}$ inch (22mm) by $1\frac{1}{4}$ inches (32mm). In five² of them, cut out a slot in one side just big enough to fit the nut, centered on one side. Here is a diagram, to scale, of what this should look like.

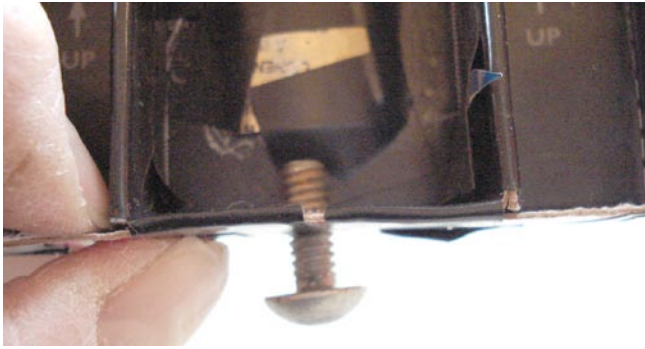
Instead of measuring, you might just trace around the nut, but make sure they will line up when assembled. When you cut the openings make sure the nut just fits.



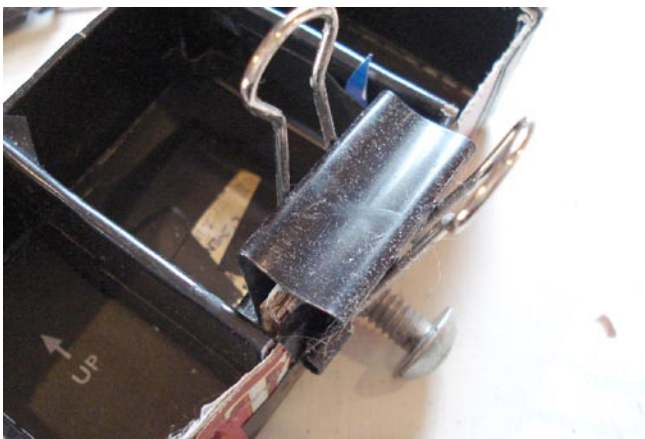
Glue the five pieces with the cutouts for the nut together. Actually put the nut in the cutout when doing this to make sure they stay aligned. Clamp them together and let them dry. If using liquid glue, use a damp paper towel to wipe excess glue that squeezes out when you put on the clamp.



If you had decided to include the tripod mount, you've probably already pierced the tripod mount hole with the nail. Use the sharpened pencil and eventually the 1/4 by 20 bolt to enlarge the hole.



Put the bolt through the hole and screw the nut on it inside to make sure the nut will be aligned with the hole. Put lots of glue on the stack of parts with the cutouts, and being careful not to bend your clicker, slide it over the nut and put the clamp on it.



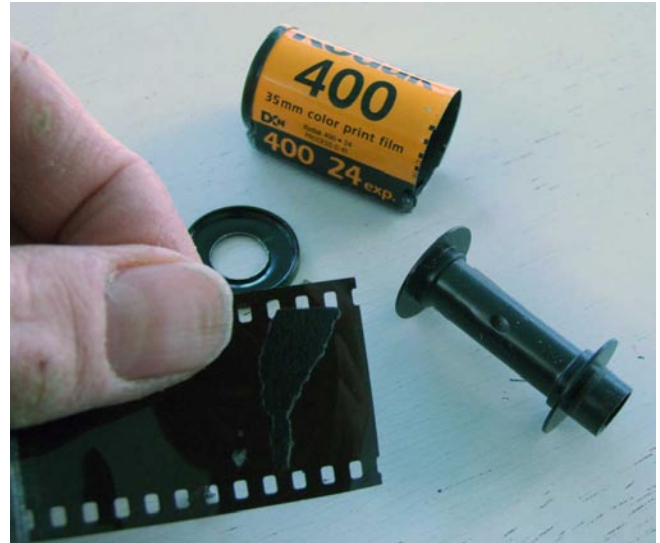
Wait a minute or two, and unscrew the bolt, and being careful not to move the stack, remove the clamp, remove the nut and reclamp with the main pressure of the clamp right over the hole. It's important that the stack is well adhered so when you try to put it on your tripod, it engages the nut and doesn't just push it up out of the way.

After it has dried, put the nut back in the hole, generously glue the last piece without the cutout on top of the stack to hold the nut in place and clamp and let dry.

Be sure to cover the tripod mount with black tape or blacken it with a magic marker.

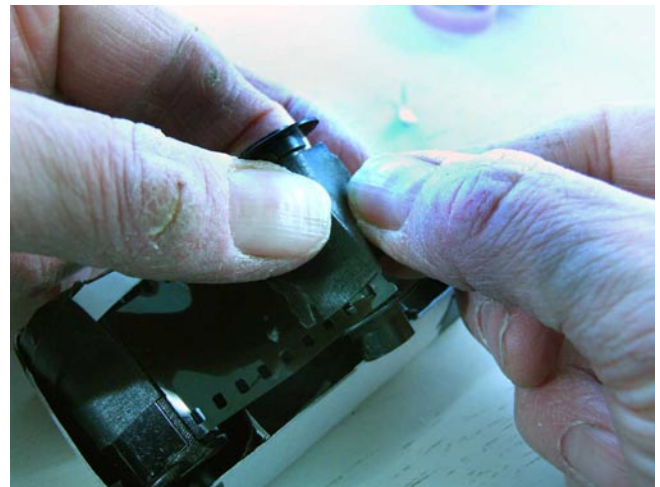
Loading the film

Cut the leader off so the end of the film is square. Load the film into the left hand side and pull just enough film to attach it to the take up spool. When attaching the film to the take up spool, hold it so the knob which extends out of the cassette is down.



Tape the film firmly on to the take up spool. By the way, it's not necessary to use opaque black tape for this, almost any tape will do. Try not to cover the sprocket holes.

You want to adhere it strongly enough so that it doesn't come off when you rewind it. If you pull the tape back into the supply cassette when you rewind, it makes it difficult for the processor to get it back out of the cassette, and could cause problems inside the processor. More about rewinding later on.



Place the empty film cassette over the take-up spool. The camera should be light tight, but just in case there's a bit of a leak through the winding hole, this will protect your exposed film.. It's not necessary to close the bottom of the cassette.



Place the film and take-up cassettes into the camera. Adjust it slightly so the clicker extend through the sprocket holes. You may have to put the winder into the winding hole and advance it a bit to tighten up the film.



Place the camera back on the camera.

Cut two pieces of card stock about the 1 inch (25mm) and 3/4 inch (18mm). Slide them between the front and the back of the camera on the take up side. The bottom one will cover the rewind hole while you are taking pictures,. When you rewind the film, you'll slide the top one over the winding hole when you remove the winder.



Place the two rubber bands around the camera.

Put the winder into the winder hole and slowly turn it counter clockwise to advance the film. It may take a few turns before the slack in the supply cassette is taken up and the film begins to advance. You should be able to feel the film get taut and you should hear the clicker as the film advances. It isn't very loud, but is clearly audible.

Advance the film eight clicks to move the exposed leader onto the take-up spool and place a fresh frame of film in the camera ready to take pictures. **When you're taking pictures, advance eight clicks for each picture.**

Slip one of the rubber bands over the winder collar to keep it from falling off and getting lost.

What to do if you don't hear the clicker.

If the clicker isn't well aligned with the sprocket holes, it can ride along side them and not make a sound as the film advances.

You could just do nothing and advance the winder one revolution for each picture. The images will be unevenly spaced on the film with more space between each picture the farther you go, but the equipment that processes, scans and prints the film can automatically compensate for that. You'll also get a few less pictures per roll.

You could also rewind the film until you feel it stop (Slide the piece of card stock over the winding hole when you remove the winder, and obviously slide the card stock over the rewind hole out of the way when you put the winder into the rewind hole). Then open the camera and see how the clicker is misaligned. You could then take a tweezer and try to nudge it back into alignment.

Another problem that can occur is the tape adhering the clicker to the inner divider can come loose. This is more common with electrical tape.

Taking pictures

With a pinhole camera the only control to compensate for different levels of light is the length of time the shutter is open. Because the size of the pinhole is so much smaller than a lens, the amount of time is much longer.

The times will vary depending on the size of the pinhole

The exposure guide is one for a .20mm pinhole. On the next page are guides for pinholes of .15mm and .25mm.

If you haven't measured the pinhole, use the guide for the .20 pinhole. It likely to be within the range of printable exposures. After you have shot a roll of film you can adjust the times to be shorter if the negatives are consistently overexposed (prints turn out too light) , or longer if they are consistently under exposed (prints turn out too dark).

Exposure guide for .15mm pinhole

24mm .15mm pinhole ISO 200	Bright Sun	Cloudy Bright	Cloudy/open shade	Heavy Overcast	Bright Interiors	Interiors
Exposure w/reciprocity correction	1/2s	1.5s	4s	12s	3.5m	8m

Exposure guide for .25mm pinhole

24mm .25mm pinhole ISO 200	Bright Sun	Cloudy Bright	Cloudy/open shade	Heavy Overcast	Bright Interiors	Interiors
Exposure w/reciprocity correction	1/8s	1/4s	1/2s	1.5s	36s	1.5m

It can be difficult to measure exposures accurately under one second in length, but modern films have a wide latitude for exposure and usable images can result from fairly extreme errors in exposure, so don't get too hung up about it.

Exposure with pinhole cameras are longer than with lens cameras, and in most cases, too long to hand hold.

If the camera is moving during the exposure, even the slightest, the image will be blurred by the motion. When making pictures, make sure the camera is firmly supported on some surface. This can be a little tricky with a camera this light. If you have included the tripod mount, that is the best solution.

If you're setting your camera on a table, bench or wall, be sure to place it on the edge so you don't fill half the frame with the surface the camera is sitting on.



You can hold the camera still by holding it against a wall.



With longer exposures of multiple seconds, take your hands off the camera if you've got it sitting on a horizontal surface. With shorter exposures, be careful not to move the camera when you're opening and closing the shutter. Hold the camera firmly down on the surface it's resting on. Practicing before hand is a good idea to get the hang of this.

To determine what's in the picture, sight along the lines of the viewfinders. Look straight down the lines, it's difficult to determine where the edge of the frame is if you're looking at it at an angle.



This camera is rather wide angle, probably wider than you're used to. Get close to your subject.

Advance eight clicks for each picture.

Rewinding the film

When you can no longer advance the film, you're at the end of the roll. In subdued light (well, not in direct sunlight anyway), remove the winder from the winding hole, and slide the piece of cardboard at the top over the winding hole. Then slide the piece of cardboard at the bottom out of the way of the rewind hole, insert the winder, and again going counterclockwise, rewind the film. Stop when you feel it get to the end. Don't pull the tape off and rewind it into the supply cassette.

Remove the rubber bands and the winder; open the camera, (catch the sliders which cover the rewind and wind holes),, remove the tape, wind the leader into the cassette and take it to your favorite photo processor..

You might want to warn them about what you're doing. Film processors sometimes don't include images they consider to be too blurry or too far off exposures.

You can get normal prints from the negatives from this camera. If you don't have a scanner, one good choice to give you a little better control of the images is to get a CD of the images (for about \$3.00US). Then using your image editing software use the brightness/contrast controls to try to improve the image. (For windows computers, Irfanview, a free downloadable program works great <http://www.irfanview.com>)

You can then take the digital file to the processor to be printed.

Worldwide Pinhole Photography Day.

Worldwide Pinhole Photography Day is the last Sunday in April (April 29 in 2007). Take a picture on that day with this or any other pinhole camera and submit it to the online gallery at <http://www.pinholeday.org>.

I'd like hear from you

If you have any questions or comments, my email address is dvoracek@uwosh.edu

I'd like to hear about your adventures with the Populist. I've created a Flickr group if you wish to share your photos.

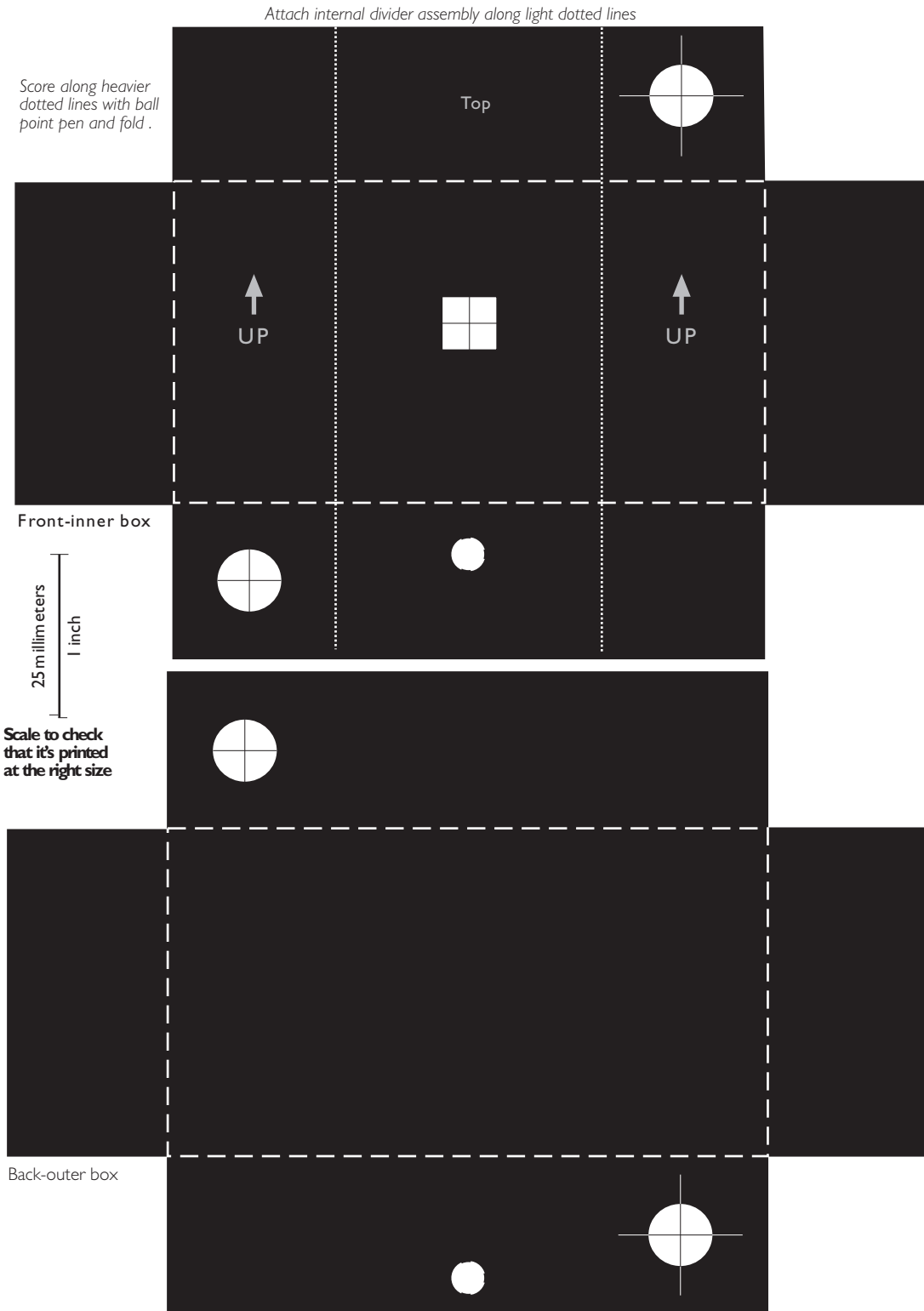
<http://www.flickr.com/groups/thepopulist/>

Endnotes & Addenda

¹ One of my criteria was to use only readily available materials. I had thought of using a standard paper punch for the holes, but didn't think that was a very commonly available item. I have since discovered, due to the popularity of scrapbooking, paper punches are pretty commonly available, for as cheap as \$.99 at Hobby Lobby and Target. They're great for making the wind, rewind, shutter channel and tripod holes. You have to nibble out the larger holes, but with a little care you can make a nearly circular hole.

² The hexagonal nuts are a little thicker than the square nuts. You'll probably need six pieces with the cut out.

Alternative two page diagram in case the one page version won't fit within your printer margins



24mm
 .20mm pinhole
 ISO 200
 Exposure
 reciprocity 1/4s 1/2s 1.5s 4s 1.5m 3.5m
 correction
 Bright Sun
 Cloudy Bright
 Cloudy Open shade
 Heavy Overcast
 Bright Interiors
 Interiors

