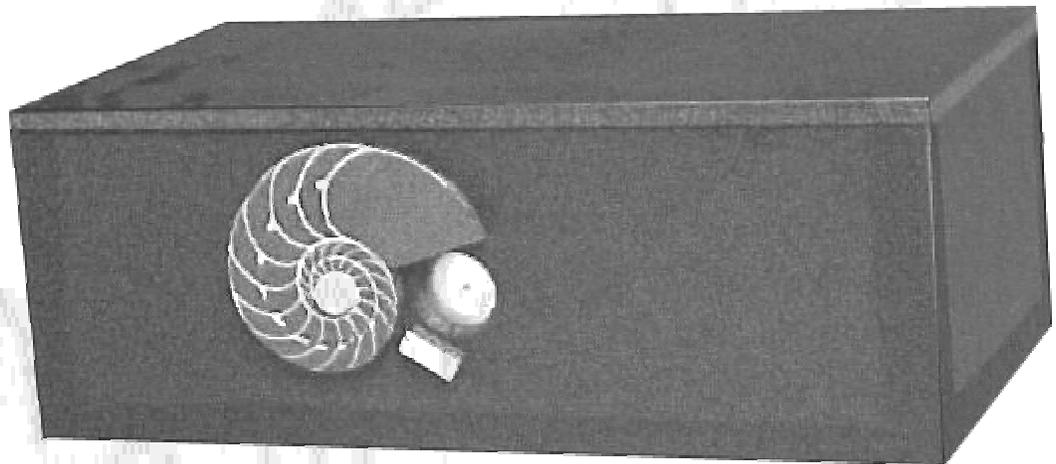


How to Build the Ipanorame' Pinhole Camera



Ipanorame'
Camera Company © 2003 DGC LLC.

How to Build the Ipanorama' Pinhole Camera, First Edition

DSC LLC All Rights Reserved
Copyright ©2003 DSC LLC

Notice of Rights

All rights reserved, no part of this book may be reproduced or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission of the publisher. For more information contact DSC LLC at ipanorama@netfirms.com.

Notice of Liability

The information in this book is distributed as-is without warranty. While every effort has been made to assure the accuracy of the information contained within this book, neither the author or DSC LLC shall have any liability to any person or or entity with respect to any loss, injury or damage either direct or indirect as a subsequence of following the instruction and producing the product(s) described herein.

Trademarks

Ipanorama' and DSC LLC are trademarks of DSC LLC. Wherein many designations made by manufacturers , service organizations and publishers are claimed as trademarks, when DSC LLC is aware of these trademarks, they are represented in this book as they appear as requested by the manufacturer. All product names, trademarks and services indentified throughout this book are used in editorial fashion only and for the benefit of such companies. No use, or the use of any trade name is intended to convey endorsement or other affiliation with this book.

Printed and Bound in the United States of America

Beginnings

Most people are quite amazed by the idea that a picture can be taken by a camera that has no lens. It's the unique qualities light that allows pinhole cameras to capture photographs in their most basic form. You're about to build a wonderful camera that takes advantage of these simple qualities and produce beautiful, creative images.

The Nature of the Camera

Since light travels in a straight line, light reflecting off of a surface will converge into a pinhole camera's aperture and emerge within the camera as a cone of light onto the film's surface.

Pinhole size determines the clarity of the image. Too small a pinhole and diffraction effects occur. Too large and the light fails to converge in an organized manner - either way blurring the resultant image

The proper size pinhole is one that allows the best image to form on the film and is determined by the focal length - the distance from the pinhole aperture to the film's surface.

The Image

A pinhole camera's image will be slightly fuzzy, inverted and horizontally reversed. Also, since the aperture is so small, depth of field will be infinite and the image will be in focus across the whole surface of the film.

People often feel that the images produced by pinhole cameras are somewhat ghostly and delicate. This is a desirable characteristic of pinhole photography and is part of the fun of building and using your own pinhole camera.

Construction Philosophy

Building a durable and useful pinhole camera shouldn't be a difficult task. With the advent of materials such as Foamboard™, it's no longer necessary to have a collection of wood or metalworking tools to create a high-quality camera - in fact, the only tools you'll need are a good quality metal straightedge, a hobby knife, some 'T'-pins, clothespins and glue.

To further enhance the enjoyment of the building experience, the printed plans sheets that accompany this book are used directly as templates when cutting the Foamboard™. The need to perform tedious measurements is kept to an absolute minimum.

As for the building materials, simplicity is the keyword. 3/16" Foamboard™ is the main ingredients with a couple of brass or nylon hardware items thrown in. Total cost should be under \$10 depending on where you purchase your materials.

Patience is a good quality for a photographer to have, but there's nothing wrong with instant gratification. Building a camera need not be a long-term project. During the development of the Ipanorama™ Pinhole Camera, many prototype, experimental and production cameras were built. In most cases the total building time was between three and five hours. Depending on the glue type, you can build a camera in the morning and be out taking pictures after lunch!

Getting Underway

The first thing to do is acquire the building materials and tools you'll need to construct the camera.

This book was written to describe the construction of a single camera. However by buying the required amount of building materials and saving the template, several cameras could be built.

Building Materials

Here what you'll need. All of it can be found in a well stocked hobby or crafts supply store.

Qty	Size	Item
1 Sheet	18" X 22" X 3/16"	Black Foamboard
1 Sheet	Paper thin	Brass Sheet
1	6-32 X 1/2"	Nylon* Round Bolt
1	6-32	Nylon* Nut
2	6-32	Nylon* Washers

* Brass could substituted

Small Nylon™ bolts, nuts and washers can be found in any of the larger hardware stores. Either Nylon™ or brass is suitable.

Construction Supplies

Qty	Item
1 Tube	Contact Adhesive
6	Small Spring-type clothespins
1 Box	#11 X-Acto™ type blades
25	1" long T-Pins
1 Can	Stencil Spray Adhesive
1 roll	Masking Tape (Black preferred)
1 Sht	Light sandpaper

The best contact adhesive for Foamboard™ construction is Bond 527™ or similar. T-Pins are available in craft stores or hobby shops.

Tools

Qty	Item
1	Aluminum straightedge or ruler
1	Hobby knife for #11 blades
1 pr	Good scissors
1	Small Blade Screwdriver
1	Small Pliers
1	#10 or #12 Sewing Needle

Your Workspace

Find a well lit, flat workspace that is large enough to roll out the template plans onto the Foamboard™ and give you some working room to hold your tools and materials.

You'll need a cutting surface such as a section of Linoleum tile or something similar to cut on so you won't damage your work surface.

Some Foamboard™ Construction Notes...

Glue -

Choice of glue is critical in the successful construction of your camera. Avoid white or wood glue. It simply doesn't have the holding power of the newer contact adhesives.

Gap-filling Super Glue is well suited to building Foamboard™ structures. It hardens almost instantly but is expensive and can give off irritating fumes. However, you can build the camera very quickly using this type of glue.

The best glue to use is the Bond 527™ available in craft stores. It dries quickly and is very strong. Although the camera could be used within an hour of construction if handled very carefully, it's best to let it dry overnight.

With Bond 527™, the most durable glue joints are made by coating both pieces, pressing them together for a moment, pulling them apart and waiting 30 seconds, then pressing them together and securing with clothespins and T-Pins until dry.

Cutting

Always use a cutting surface and a new, sharp blade in a proper handle. Keep the blade as straight up as possible to maintain a good perpendicular Foamboard™ edge.

Cut Foamboard™ in several passes. Don't try to cut through all at once. On the first pass, cut through the top paper. On the second pass, cut through the foam and on the final pass, cut the bottom paper. This will give you the best cleanest edges and the best results.

Clamping and Pinning

Once the pieces are pressed together, push T-Pins into the mating edges to establish alignment and some clamping force. Use clothespins to clamp flat board section together while drying.

Start Building!

** If you are going to make several cameras, save the template page by having it copied at any copy center or blueprinting service - or - trace the template onto another sheet of paper first and save the original.*

Cutting Out the Parts

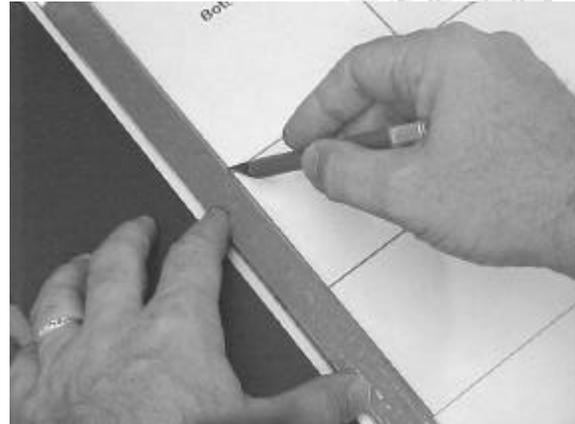
- Lay out the Foamboard™ on your worksurface. Prepare the template sheet by lightly spraying it with the Stencil Adhesive Spray in a well ventilated area away from any open flame- preferably outside.



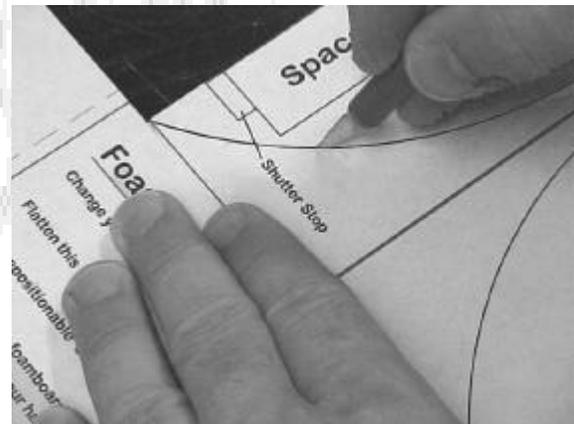
- Transfer the template to the Foamboard™ and smooth it onto the surface as straight as possible. Allow to dry about 5 minutes. Don't allow any wrinkles to form. The Stencil Spray Glue is removable, so adjust the template as needed to have a smooth surface.



- Install a new, sharp blade into your hobby knife. Using the straightedge as a guide, cut out the Foamboard parts. Read the instructions on the template page about the blade thickness allowance so the parts are cut to the proper size. Cut using the three-pass method describe on the preceding page.



- Carefully cut the curved edges of the Film Holder parts and the pinhole aperture hole on the front board. This is a freehand task. Follow the lines as closely as possible.

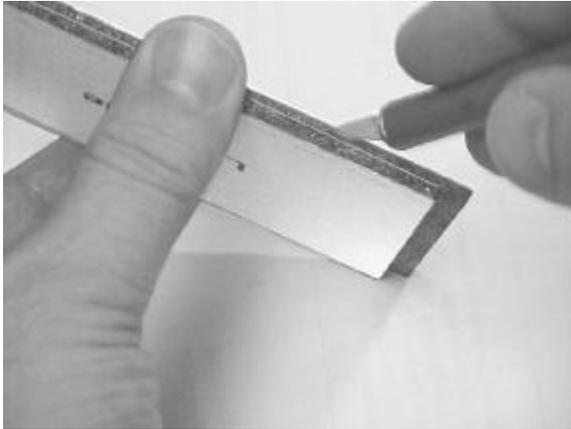


- When all the parts have been cut out, lay them aside in preparation for assembly. Wait until a part is to be glued before removing the white template paper

Cutting the Side Panel Channels

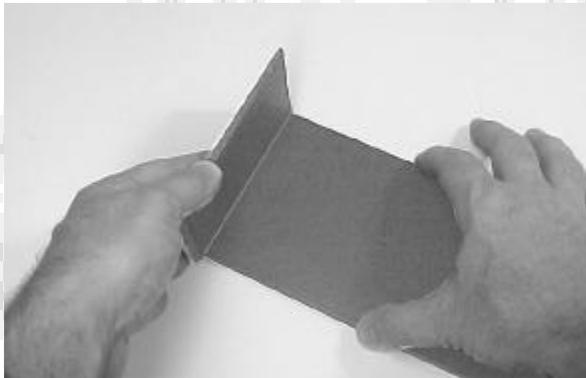
One of the keys to the camera's strength and durability is its undercut sides. A small channel is cut into three of the four edges on each side panel.

- Slide the hobby down the exact center of the Foamboard's edges on three sides. Cut into the edge at least 1/4"



Test Fitting

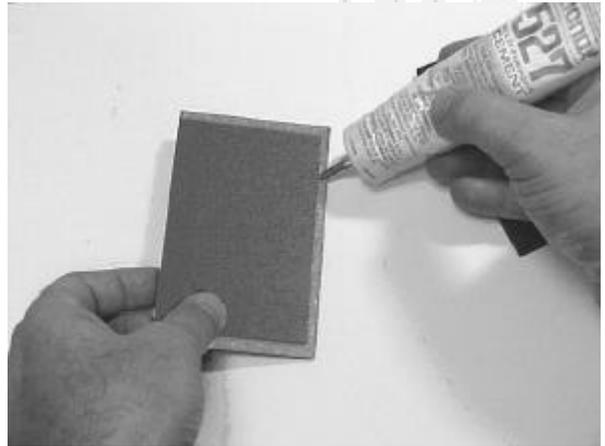
- Test fit each part with its mating part before glueing. This assures that construction will go as smoothly as possible. You will need to trim parts to make things fit as needed.



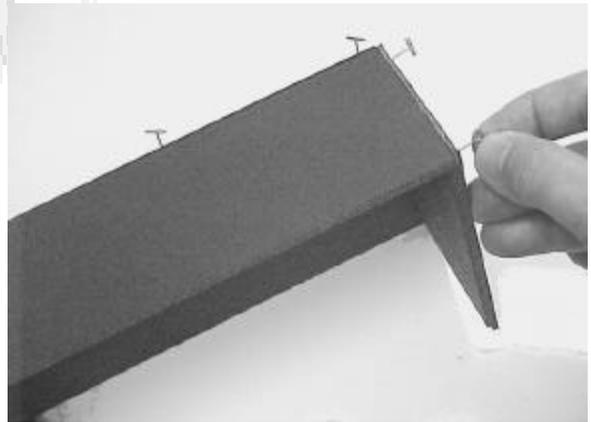
Glue the Parts Together

- Follow along as the parts are aligned and glued together.

- Place the bottom part on your work surface. Take the right side and place a small stripe of glue along the bottom channel and place the side into position on the bottom part. Pull the pieces apart for 30 seconds and place back into position (use this technique at each glueing step). Hold in position for a few minutes until the glue sets up.



- Apply glue around the inner sides and lower edges of the bottom as shown. Apply the parts, pull apart, wait and reapply. Hold into position or press some T-Pins into place along the edge to align the parts.



- Perform the same task with the front panel.

- Apply T-Pins where needed to keep the parts in place and aligned. Allow this entire assembly set up for about an hour to be on the safe side before proceeding

Installing the Film Plane Curves

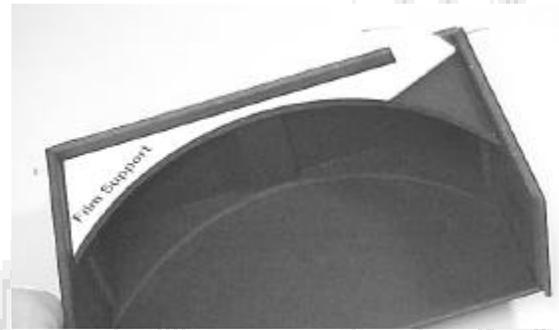
- These parts hold your photographic paper in place in the proper curvature.
- Place one of the curve parts into place to be sure it fits without forcing it. If not, trim as needed to get an easy fit. If you are trimming the parts, make sure to trim equally from both sides to insure that the curve is still centered in the box.
- Put a few drops of glue on the bottom of the curve and press into place and up against the back of the camera



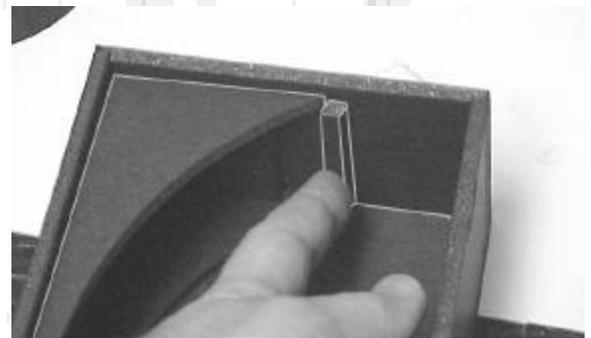
- Glue in the spacers that separate the upper and lower film curves as shown. Locate the side spacers up against the back corners of the camera box



- After trimming as needed for a proper fit, glue the upper film curve into place by placing glue into the top edges of the spacers and back edge of the upper film curve. Press into position so that both curve parts are lined up against the back section.



- Glue in the 1/4" paper stop pieces 1/8" from each end of the film curves. Make sure they are vertical.



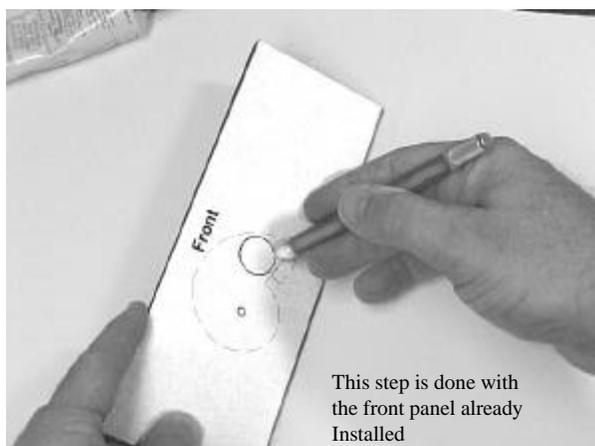
Making the Top

- Test fit the inner lid's fit and trim as needed to get a good fit without gaps between it's edges and all four sides of the camera's box. Apply glue around the inner surface of this part about 1/4 from the edge. Press the inner and outer lid together so that the inner lid is spaced equally all around within the outer lid.

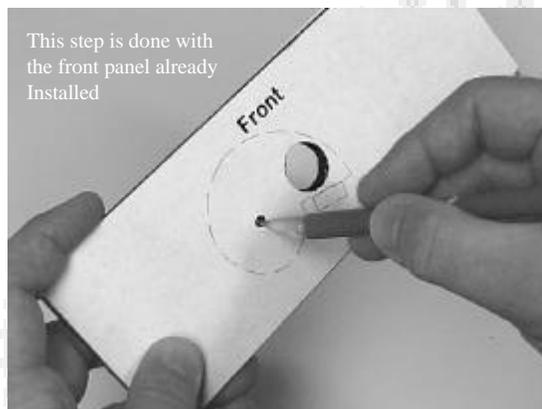


Cutting Aperture Opening

- Carefully cut out the pinole aperture by pressing into the circle with the hobby knife's blade and then using a 'sawing' motion to work around the circle and remove the disk. Trim any paper that might have torn away from the opening. There should be no bevel to this opening. The sides must be straight.



- Locate the small shutter pivot hole on the front template and shutter and bore a small hole into it using your hobby knife blade. The bolt should be a tight fit in both holes so the shutter swings accurately.



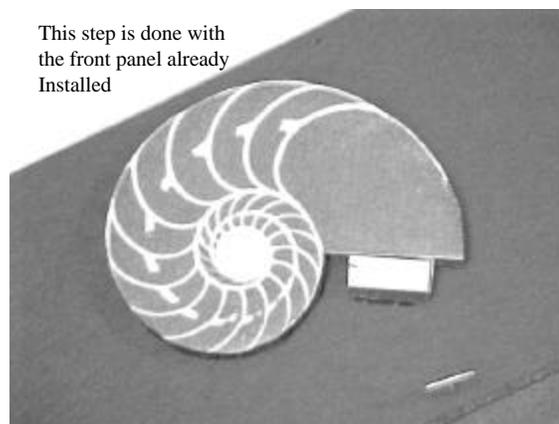
Creating the Shutter

- The shutter is created by cutting its shape into a section of Foamboard™. Glue the shutter template to a section of board and using the freehand technique, cut out the shutter
- Be very accurate in this step! If the shutter is not cut to the right size, it may not cover the aperture opening.



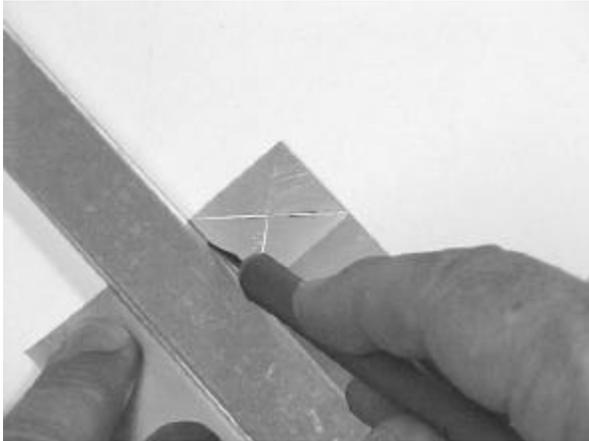
Installing the Shutter & Stop

- Slide the bolt through the shutter opening and through the front of the camera. Use the washers in the positions shown on the plans and only tighten enough to provide some friction but not bind against the camera front. Check that it moves freely and covers the aperture opening properly when shut.
- Rotate the shutter so the aperture is completely covered and glue the shutter stop to the front board just at the bottom of the shutter's straight edge. Once positioned, rotate the shutter out of the way so that it doesn't cause the shutter to stick! Allow to dry completely!



Making the Pinhole

- First, cut a 1” brass square by scoring the brass and bending carefully until it separates. Using the back edge of the hobby knife, lightly scribe a line from each corner diagonally to the opposite corner to locate the exact center of the brass piece.

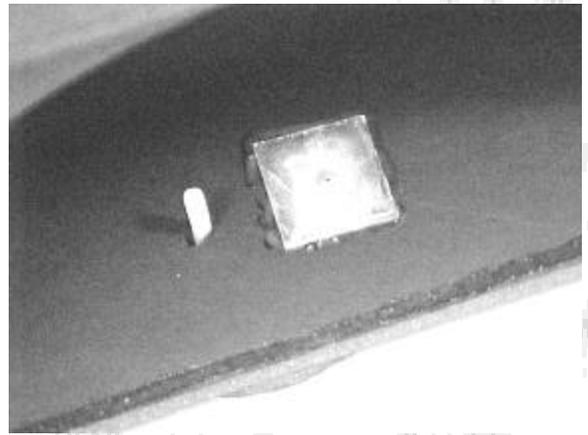


- Place the brass piece on a firm surface and using the sewing needle, slowly press a hole into the center of the brass. Use a spoon handle to press the pin into the brass and tap lightly.



- After the needle has penetrated the brass, turn the piece over and lightly sandpaper the backside of the brass to remove any burrs. Make sure the brass is flat and the hole is clean.

- Carefully place a circle of glue around the inner opening of the pinhole aperture on the front board. Don't apply so much that it oozes out too much! Then press the brass square onto the glue and align the pinhole to be exactly in the center of the front opening.



Taping the Edges

To assure that the camera is light-tight, we need to tape the edges where the parts intersect with opaque masking tape - preferably the black crepe' type you can buy at craft stores.



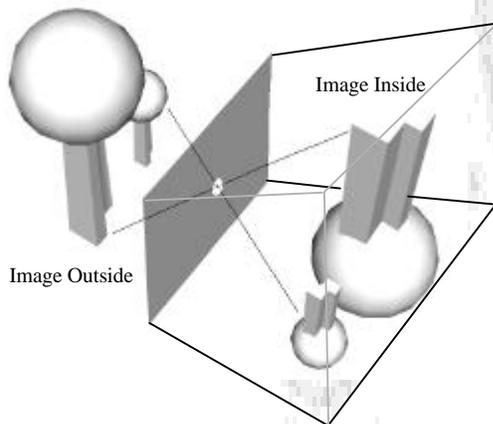
Simply cut a length of tape slightly longer than the edge it will be applied to, press it onto the edge down the middle of the tape, secure it on both panels and trim it with the knife. Repeat at all edges except for the top.

Using Your Camera

A camera is really a projector. A pinhole camera directs light into an image just as a lens would, except it uses a small opening in a metal sheet instead of a glass or plastic lens to organize the light's rays.

Unlike a pinhole, a typical camera lens gains thickness when measured from its edge to its center. Light passing through the lens will focus at different points depending on where it came through the lens. That's why a large aperture has a shallow depth of field and a small aperture has a deep one. Lens thickness with a small aperture is almost constant, since the opening only allows light to pass through the center of the glass. A large opening allows light to pass through varying thickness of glass and focus at different points.

A pinhole on the other hand has no thickness variations. Except for the brass it's drilled into, it has no thickness at all. The pinhole's size determines the sharpness of your image. If the pinhole is too large, too much light enters, blurring the image. Too small and the edges of the brass hole interfere with the light and the image loses form.



Since light travels in straight lines, any rays that reflect off the subject on the right, would show up on the left side of the film and vice versa. For the same reason, any rays reflecting off the bottom of subject will strike the top of the film. Images taken with your camera will be upside-down and backwards when the film is developed.

Exposure

The Ipanorame' camera is designed to use black and white print paper rather than the more traditional film.

Compared to film, paper is rather insensitive to light. Its ISO rating is down around 6, which means that it takes a lot of light to create an image.

There are advantages to using a slow film. Since our exposure times will generally be about 30 to 45 seconds for brightly lit outdoor scenes, we can be lazy when it comes to opening and closing the shutter.

Pinhole cameras are very experimental in nature. Determining the best focal length, pinhole size and exposure is often trial and error. Fortunately there are some guidelines that can be applied to you going in the right direction.

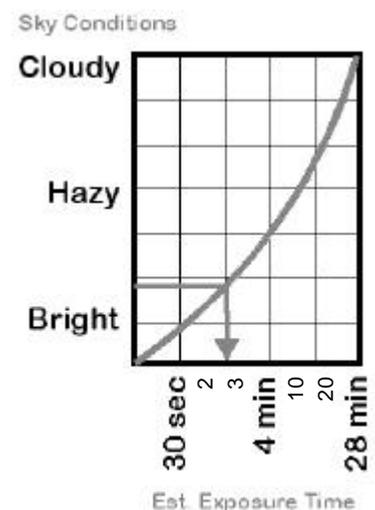
Using a #12 sewing needle, the Ipanorame' has a .018" diameter pinhole. The distance from the pinhole to the paper's surface is 4.8", so the f-stop used to estimate exposure is about f/300.

Film and paper suffer from 'Reciprocity Failure'. This means that the longer you expose it to light, the less sensitive it gets and you have to compensate with more exposure time.

To Use -

Consider what the sky conditions are on the left side, follow over to the curved line and then, where it intersects, follow down to the estimated exposure time.

On a really sunny and glaring bright day, follow the example arrow over to the curve, then down to an estimated exposure time of about 40 seconds.



Taking all of this into account, the chart above serves as a guide as to how long to keep the shutter open when making an exposure.

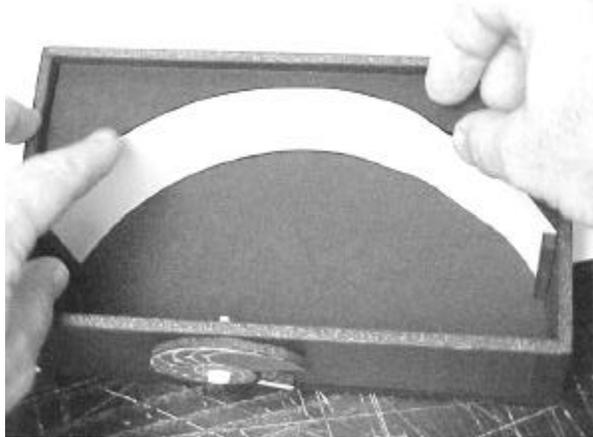
Loading the paper

In a dark room, with a safelight or very dim red light bulb, cut a piece of 8"X10" glossy black & white resin coated (RC) photo paper with a contrast grade III into four 2-1/2" by 10" strips.

Use the generic rather than the brand name paper to save money. All of the adjustments for brightness and contrast will be done on the computer.

Before you load the paper, be sure that the shutter is closed!

Take a paper strip, determine the emulsion side (it should reflect the darkroom safelight better than the back side) and place both ends into the film curve as shown



Be sure that the paper's ends are placed inside the film stop blocks and push the paper into the curve area so that it lays flat against its edges and flush with the camera's interior floor.

Place the lid onto the camera and secure it tightly with two wide rubber bands around the camera body.

Taking a Picture

Place the camera on a level surface and aim it towards your subject. It helps to sight along the camera's lid to be sure that your aim is good.

Using a watch with a second hand rotate the shutter open and exposes the full brass face of the pinhole for the duration you determined from the estimated exposure chart. Then rotate the shutter closed until it rests on the stop block.

Development

You'll need to prepare only two chemicals to develop your images. Any standard black and white developer and fixer will work. The Ilford line of liquid chemicals is very easy to use and is almost odor free.

Obtain four shallow tanks or bowls that will allow the paper to be covered with chemical. 8 X 10 plastic darkroom trays are very inexpensive, but you could also use deep baking dishes or the like. Also, two of the trays will hold only plain water, so you could also use a sink instead.

The chemical mixtures needed to create the working solutions are usually printed on the containers or bags. Mix according to the instructions and the size of your trays. You don't need real 'Stop' bath, so don't buy that chemical. Only developer and fixer are required.

Pour your developer and fixer solutions into their respective trays. Place a tray of water between them as a simple water stop bath and another water tray or bucket at the end as a wash bath. Ideally you want to work from left to right in this order:

developer → water → fixer → water

Once your work area is ready, under safelight carefully remove the paper from the camera and place it emulsion side down into the developer for a few seconds. Using tongs, lift it out and turn it over in the developer. Make sure it is covered with chemical and is not just floating on top.

Rock the tray gently for 2 minutes while the image develops. Because it's dark, the image you see may be rather dull. Develop for 2 minutes - no more and no less.

Pull the paper out of the developer and place into the water stop bath for 30 seconds, then into the fixer for about 1 minute - rocking each tray as you go. Finally, remove it from the fixer and place it into the water wash tray for about 5 minutes. With the lights on, remove the paper from the wash and hang up to dry overnight.

Scanning the Image

If all went as expected, you'll notice that the image on the developed paper is a negative, mirrored image of your subject. You'll need to scan it into an image editing computer program to invert and remirror it to the proper orientation.

While there are too many computer programs available to discuss each one, there are some guidelines for scanning, manipulating and printing your picture

First, remember that the greater the DPI - Dots Per Inch of the scan, the bigger the file size. A good compromise would be 150 DPI for scanning - or try 300 DPI if you don't like the picture quality.

Place your picture face down on your scanner and using whatever software application you're chosen, scan the image. Most likely you can tell your scanning program that the picture is only 2 1/2" X 10 so you don't have to crop it later.

Invert and Mirror

Once the picture has been scanned and is on-screen to be edited, you'll need to invert the image then mirror it horizontally. After it looks the way your subject did, you can adjust it's brightness and contrast to suite your expectations.

If you feel that the image is a bit fuzzy and could use some sharpening, the best way to do this is with the "Unsharp Mask" filter available on some of the higher-end image editing software.

This is a good time to name and save your image. A common image file format is the .JPG. While this is a good choice, it can degrade the quality of your picture through it's ability to compress the file to make it smaller. If you choose a .JPG format, select a compression quantity of 25% or less to keep your picture looking good.

Printing

Modern inkjet printers have the ability to produce pictures that rival and sometime exceed the quality of those generated by traditional photographic printers. While the quality of the printed picture is dependent on a number of factors - the scanned image, the paper, ink and delivery method, the overall results are usually quite good.

One drawback of the average inkjet printer is it's use of color mixing to produce black or grey. If yours does this, and most do, you may see some slight color cast to your black and white printed picture. The printer used to develop and test the Ipanorame' is the Canon i470 Photo Printer.

Nevertheless, if your printer requires it, choose the 'photo' cartridge option and the highest printing resolution for your output and always print on photo quality inkjet paper, not the plain letter type. Don't be tempted to scale your picture larger or smaller either, it will degrade the quality and you won't get the best results.

That's about it!

Pinhole cameras are supposed to be fun to build and use. If they are too much work, neither goal will be fulfilled. Hopefully you'll enjoy your Ipanorame' camera and will be inspired to come up with new ideas for your own pinhole cameras.