

DIY Panpin BN

110 degree curved film plane panoramic pinhole camera



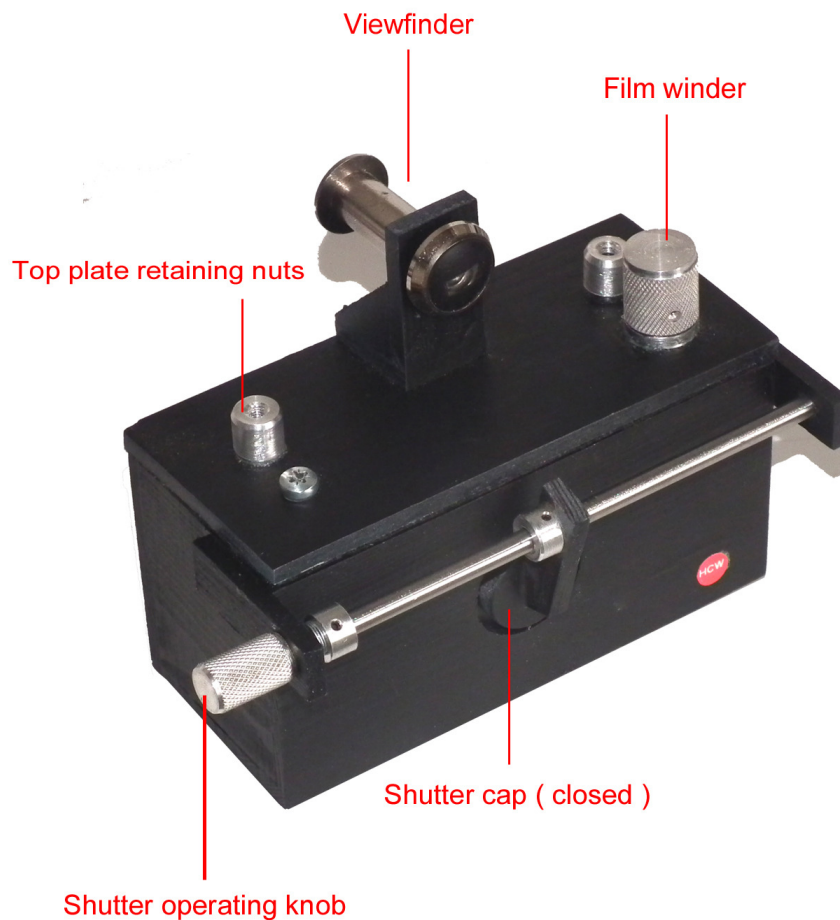
Drawings and data to enable the construction of this camera

Specification of your finished camera

Pinhole effective "focal length"	50 mm
Pinhole aperture	f 166 (with a 300 micron pinhole)
Film type	120 roll film
Negative size	43 mm x 110 mm
View angle	approx. 110 degrees
Frames per film	6
Shutter	Manual
Viewfinder	WA reverse telescopic
Double exposure facility	Yes
Double exposure interlock	No
Body dimensions *	H 82 mm W 70mm L 163 mm

* (Excludes knobs, viewfinder etc.)

Camera description



The HCW Panpin BN that forms the basis of this document is designed to take 6 panoramic shots on a roll of standard 120 film. The film plane is circular, this providing even illumination over the entire field and thus avoids the light fall off associated with some flat plane pinhole designs. This is explained in the following pages

A tripod bush is located on the bottom of the camera , since exposure times with any pinhole design are usually of the order of seconds. The shutter is manually operated by the **Shutter operating knob**

To facilitate loading the film around the curved plane, the loading is performed via the top which is removable by releasing the **Top plate retaining nuts**

Now let us get into the interesting part so that your hand skills may be exercised.

Tools and materials for the job

In a perfect world, every DIY enthusiast would have a complete machine shop with a lathe, a mill, vertical drill stand and flat bed finisher, alas we do not live in such a world and so we can build the body with a simple saw and sanding block to get straight edges (when needed). The illustration shows some turned parts and if you have a lathe these will not present a problem.

Plan B is to find a friend who does have a lathe, however **Plan C**, which is outlined in parts of this document shows how an acceptable camera can still be made without this luxury.

All dimensions are shown in millimetres.

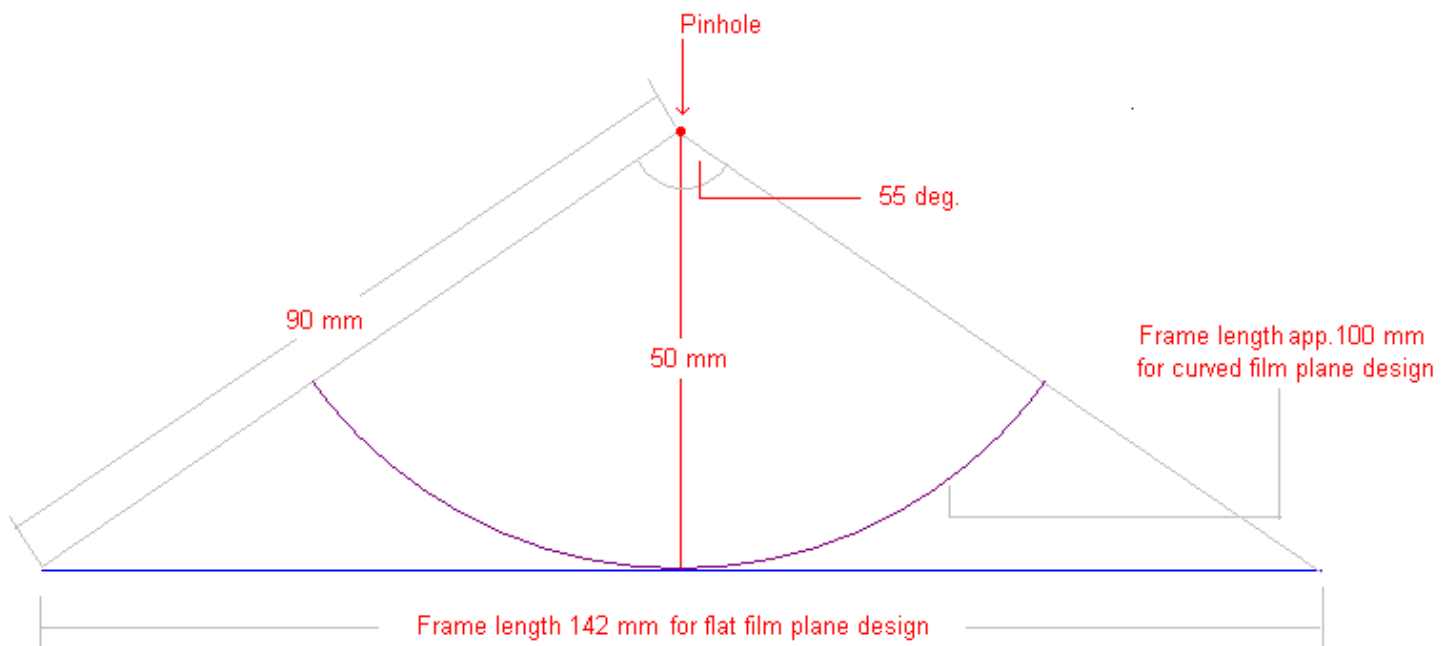
Do not forget that this is a DIY project and that the contents of your store / junk box may well influence the final outcome and cost.

As an example, the body is shown as being built from 6 mm thick material. If you have a stock of 12 mm material, then as long as the inner dimensions of the body are retained, go ahead with the thicker material. The finished job will be heavier, it may even add to the sense of a good solid job !

Always remember that this document should be considered simply as a guide , not an absolute rule book. Anyone with DIY skills can usually find another, often better way of making anything from another's drawings.

The curved film plane

It must be accepted that straight and flat pieces of wood are easier to work on than curved parts, but in this design there is a good reason for this item. The camera uses a 50mm “focal length” pinhole, or to use non optical terminology, the space between the pinhole and the film is 50 mm !. To make an acceptable wide angle design, the figure of 110 degree coverage was chosen as being greater than the legendary 18 mm Distagon which covers a mere 99 degrees, however, the problem, the definition provided by a 300 micron pinhole can hardly compare with the 100+ l.p.m obtainable with this optical icon but as a pinhole enthusiast you will be looking for a softer image.



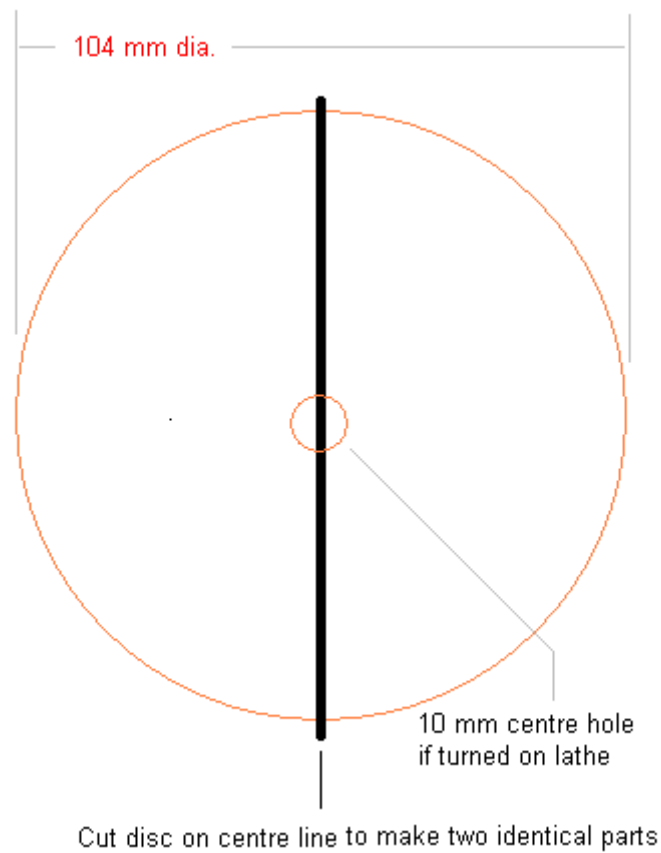
The difference between the curved and flat pinhole designs may be seen from the above drawing. With a 50 mm “focal length” and 110 degree coverage, the frame width of a flat plane design is 142 mm, the curved plane is only app. 100 mm. This has two advantages, firstly it will only use 2 frames of the 12 on 120 format, giving 6 exposures per film as opposed to 5 when fitting the longer frame, however the real advantage is in the even illumination over the frame that results from the use of a curved plane. It can be seen that the pinhole to film distance is constant, giving a working aperture with a 300 micron pinhole of $50 / 0.3$ or f166. The centre of the frame in a flat plane design will also be working at f166 but the edge of the frame will be enjoying a working aperture of $90 / 0.3$ or f 300. This is hardly a good design feature for an evenly exposed wide angle shot, hence the curved plane, which although more complex to build has this great advantage.

The arguments on distortion in extreme wide angle shots have been discussed *ad nauseum*, you have simply opted for the low distortion model !

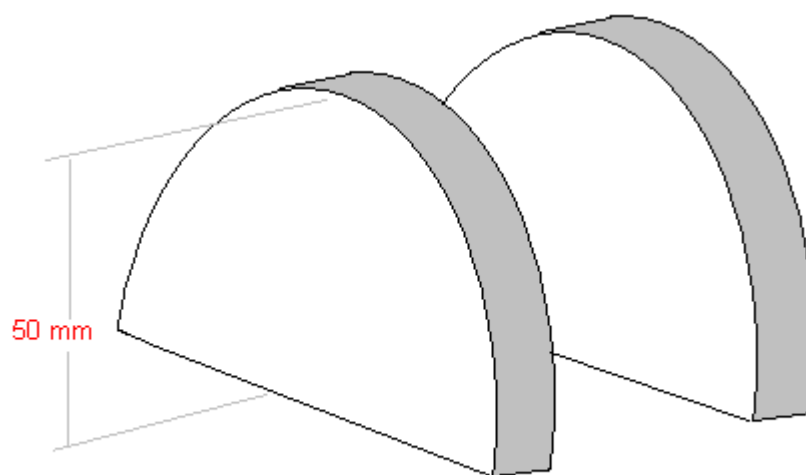
Now it is time to cut some wood, MDF is perfect, but any 12 mm thick wood will suffice.

Just remember to use a face mask when working with MDF

The first step is to make a 104 mm diameter circle of 12 mm thick MDF (or wood). If you have a lathe a 10 mm hole in the centre of a sheet of MDF, will serve to insert a mandrel and then simply turn the wood to the correct diameter. If you do not have lathe then cut the wood with a jigsaw to a little in excess of 104 mm diameter and then cut the disc in half.

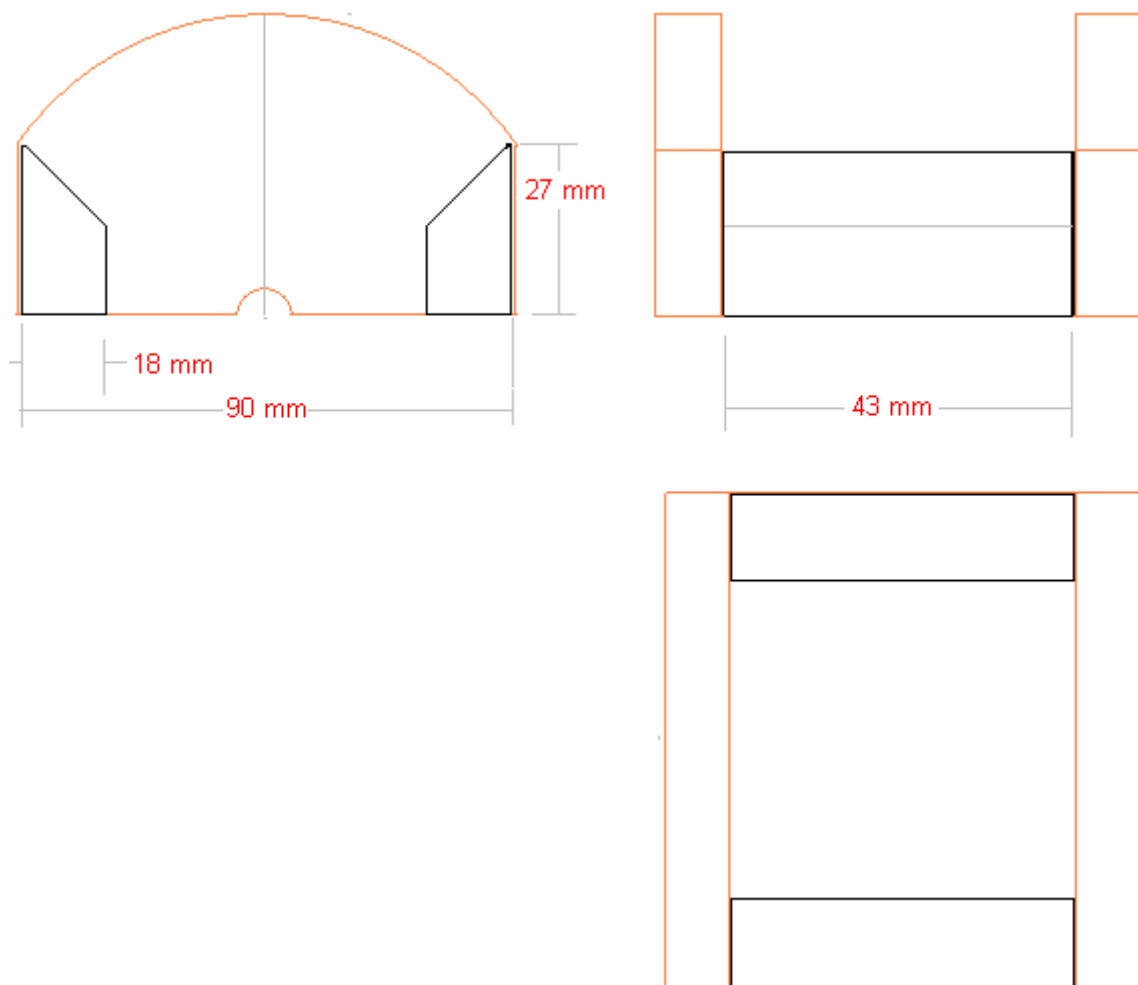


The two halves, if not turned, must be placed side by side and then sanded so that the two halves are identical. The object is to make two identical parts as shown below.

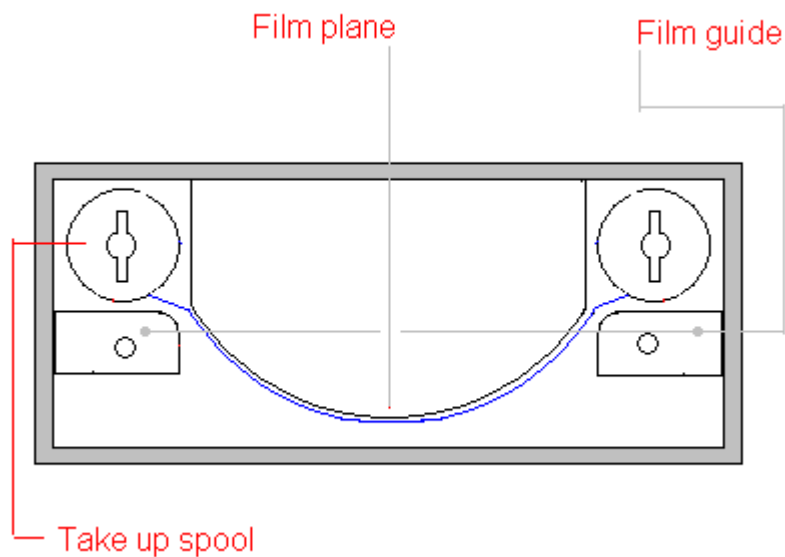


Now all that remains is to space the two parts by 43 mm using two pieces of wood app. 18 mm thick with the edges cut at a 45 degree (approx.) angle as shown in black. These parts should then be glued to the curved parts in the location shown, making certain that they are at right angles to the curved parts. When the glue is dry, it is trimmed down to make the complete assembly 90 mm long as shown in the drawing..

It is accepted that the normal frame height in 120 film is greater than 43 mm, but since the film must follow a semicircular path, the support for the film edges must be closer than normal to avoid the film trying to take a short cut across the semicircular route.



The film plane being curved demands that the body should locate the film such that it will naturally follow the curve. The plan view of the completed camera shows the method employed

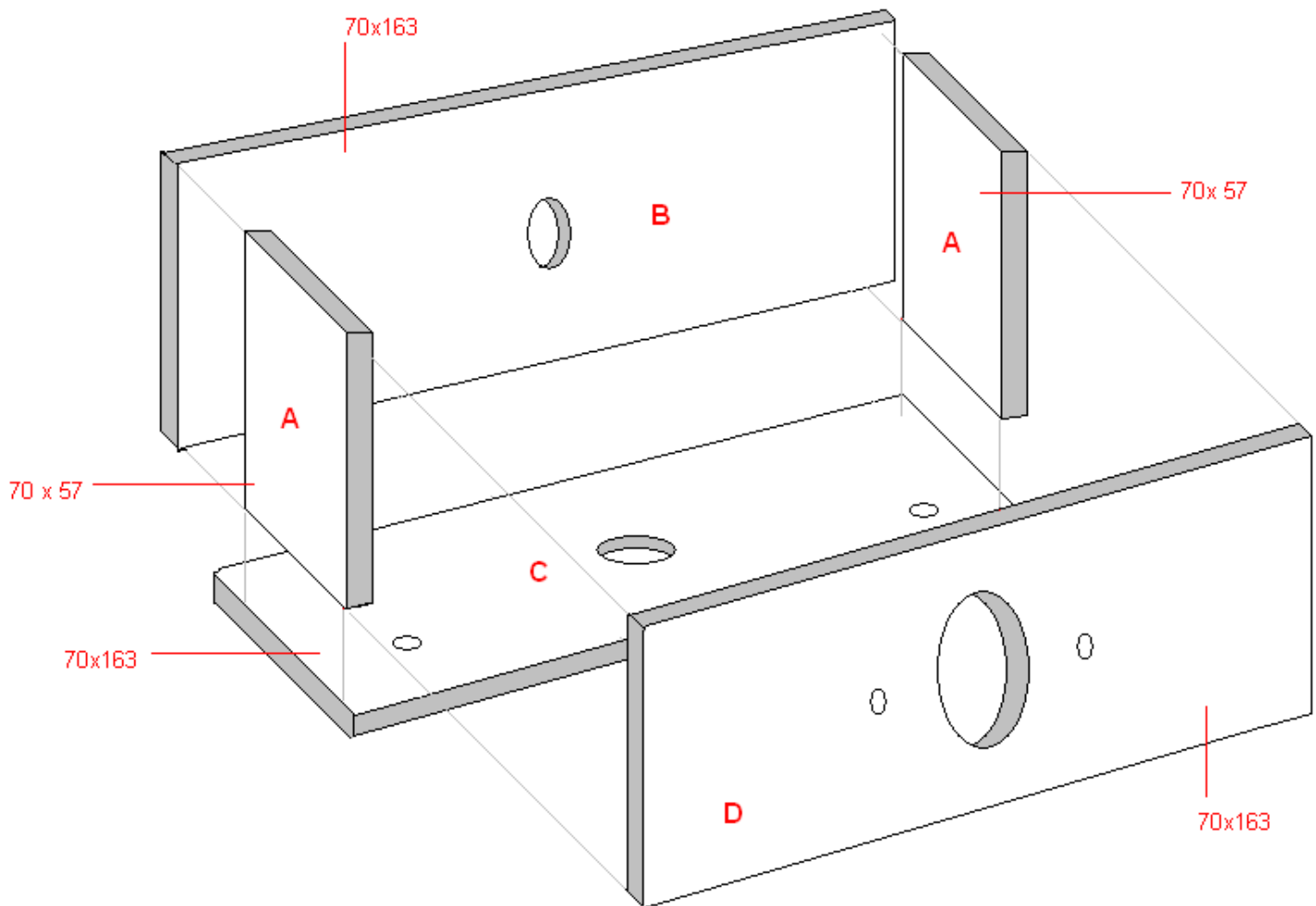


Body construction

The main body of the camera may be made from virtually any 6 mm thick material. MDF or plywood are all acceptable as is mahogany, the latter making a superb looking camera , but alas at quite a higher cost since to maintain the “vintage” look, all turned parts should be made in brass thus further adding to the final bill. Just to tempt the true enthusiast a picture of a mahogany and brass version of this camera is shown below..



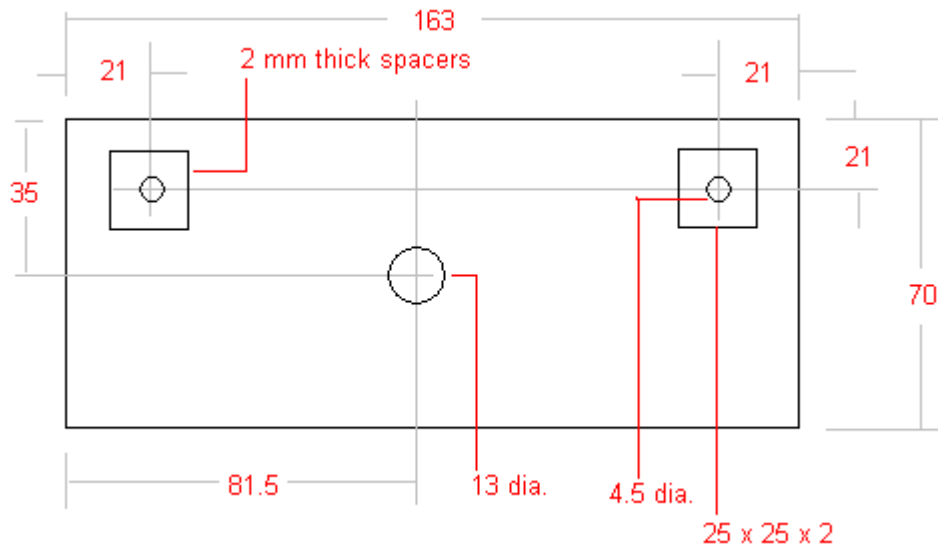
The body will be constructed from 6 mm material and is made from 6 individual parts shown in the exploded view below, The top is the sixth part which will be shown separately



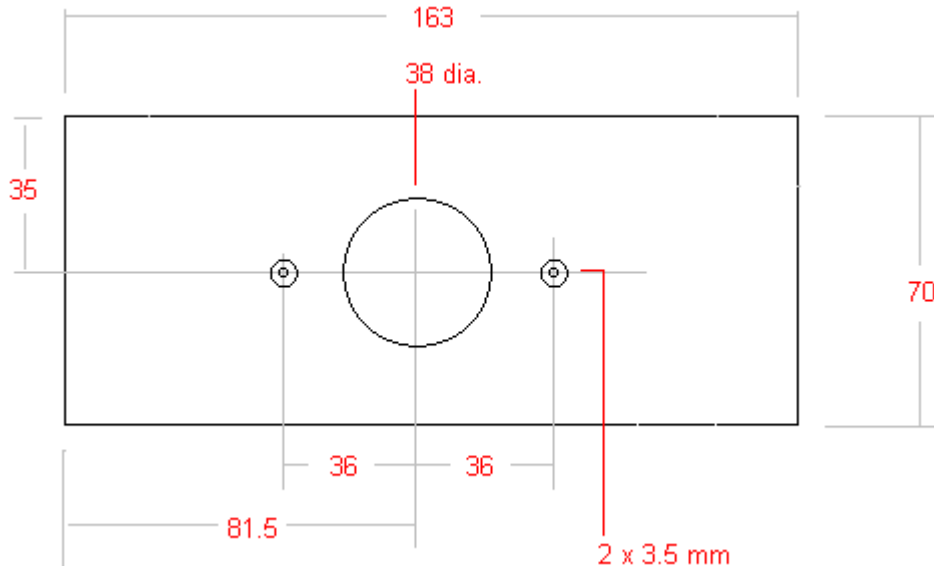
Parts A have no drillings and are identical. Part B, the camera back has a single 13 mm (approx). hole in the exact centre of the part, this is the viewing window for the film backing paper and will be covered inside by a piece of red filter.

The base plate has three holes. The large centre hole is 13 mm diameter and will accept the tripod bush, the two smaller holes accept 5 mm screws which locate the film spools. If these are drilled 4.5 mm diameter it is possible to get an M5 screw to self tap into the hole.

Since the length of a 120 spool is 66 mm, to centralise the spools in the camera, 2 mm thick spacers are fitted concentrically with the fixing holes as shown in the following drawing. These may be made from any available material, if no 2 mm material is available a 6 mm x 25 mm square piece can be cut down the centre to make two 25 x 25 x 3 mm parts (approx). that are then sanded down to size .



Part C Base plate detail



Part D Front plate detail

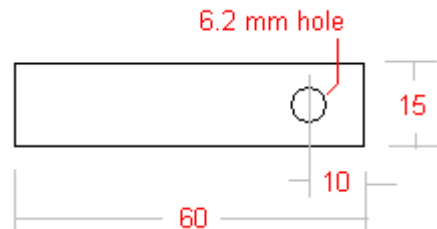
The 38 mm hole opens onto the plastic plate supporting the pinhole which will be described later. The 3.5 mm holes allow screws to pass through into the curved film plane, thus fastening it to the front panel.

Having made all these parts it now only remains to glue them together (film plane excepted) making certain that they are at right angles and vertical. When the glue has hardened the sanding may commence. Sanding to comers to make a smooth surface is really a cosmetic operation and it is up to the maker to achieve as much perfection as the builder wishes. The critical part is sanding the upper surfaces of the finished body, these must be absolutely flat, since in the finished camera they form part of the light trapping system, albeit aided by a felt gasket.

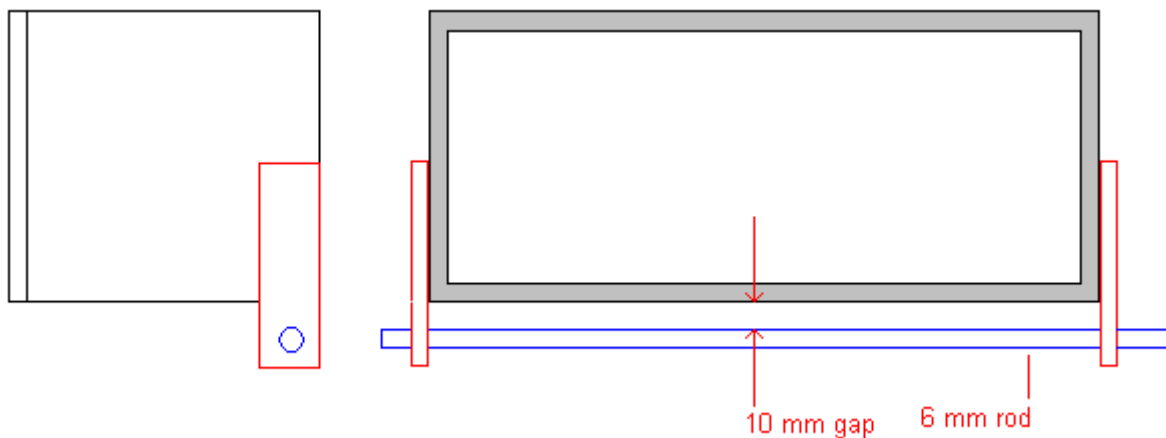
If you have a flat bed linisher the job will take 1 minute, if not you will need a flat surface onto which you lay a sheet of sandpaper and move the body back and forth until when the body is turned upside down and placed on a flat surface, with no gaps are visible.

Shutter bearings

The shutter mechanism bearings are the next part to add to the body. Examination of the cover shot shows these parts, whose function is to support the 6 mm rod that couples the shutter operating knob to the shutter cover. The basic bearing, made from 6 mm material is as shown below.



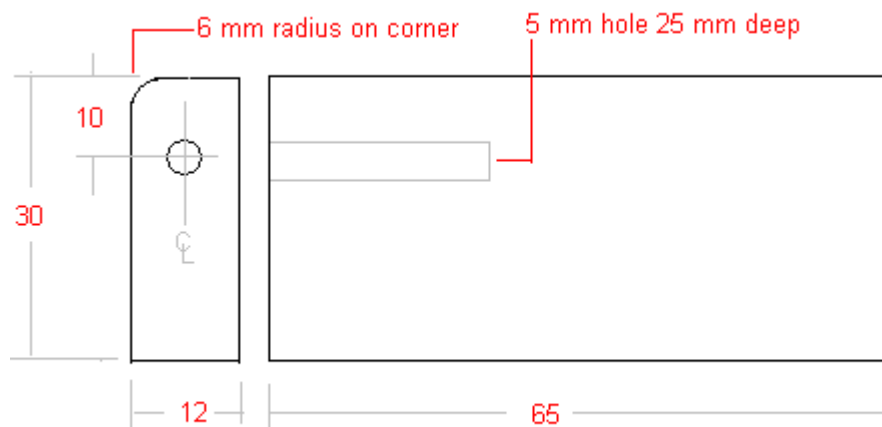
These parts are then glued to the upper edges of the body



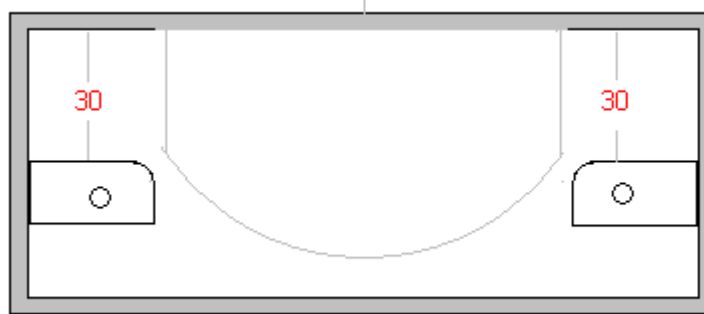
Film guides

The film must follow the contour of the curved plane to minimise distortion and to maintain an even exposure. The film guides visible on the camera plan view on page 8 show this function. .

Each guide is made from another piece of 12 mm material. **Note 1 LH and 1 RH**



These are now glued into the body cavity allowing a 30 mm gap between the inside of the front panel and the guide.

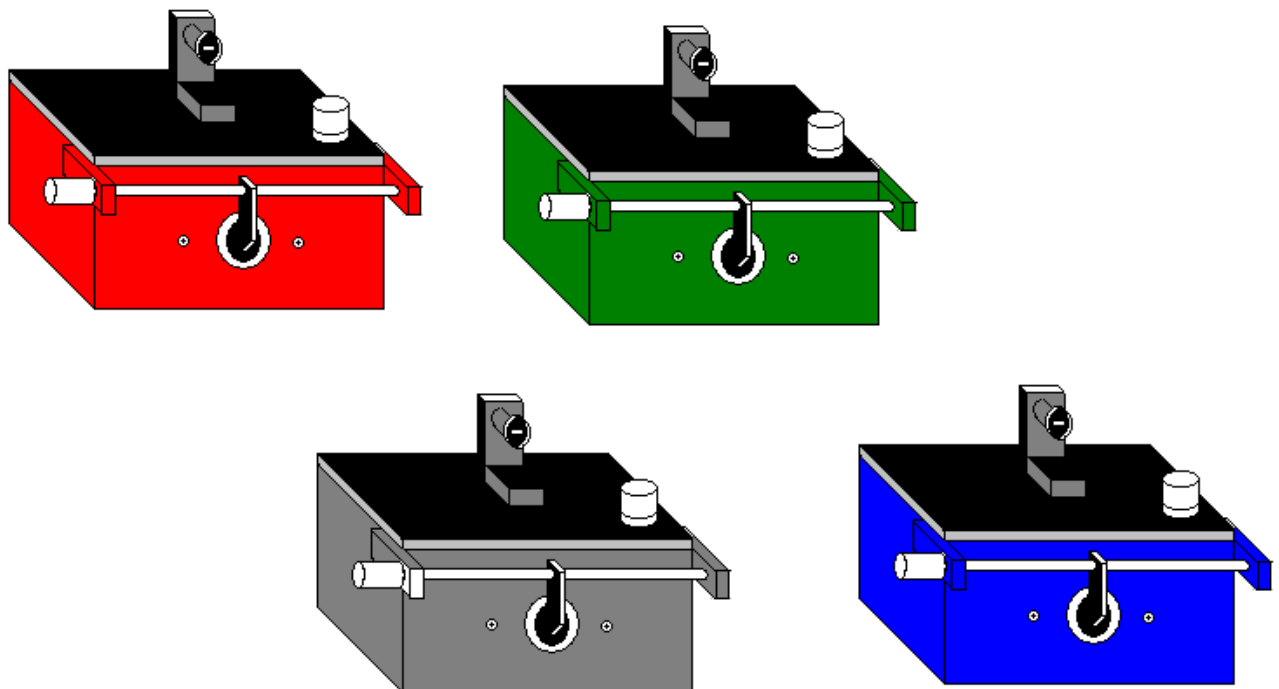


Paint job 1

This stage of the build is now complete and it is time to get out the paint pot / aerosols.

At this point I must half reiterate the famous Henry Ford expression "Any colour you like as long as it is black". Fortunately in this design, this is only half true. The curved film plane and the body interior must be matt black, as for the exterior it is up to the builder to mask off the black interior and turn the finished object into a splash of colour. The cover shot shows the simple way out, namely make both the same colour, it will save you a lot of time masking off. The exterior surfaces should however be primed, the interior will provide an even more matt finish if unprimed.

The matt black paint of preference is Halfords Matt Black. Having tried several manufacturers offerings, this is truly matt.



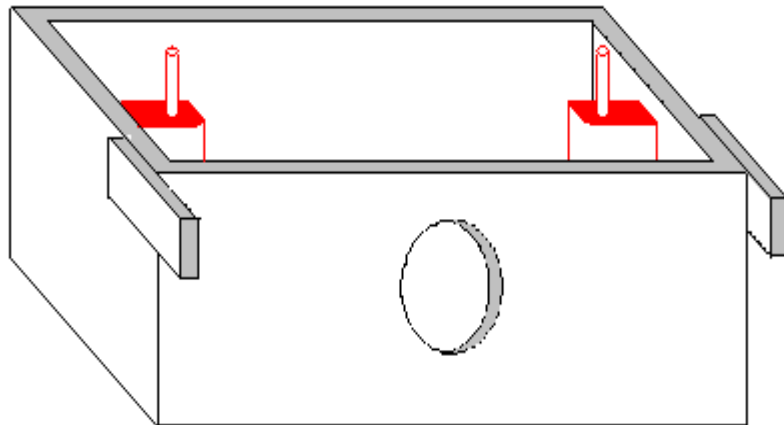
At this point some fittings may be added.

The drawing of the base plate is shown on page 10. where two 4.5 mm holes are shown, these are the location for pan head M5 x 12 mm long screws. These may be screwed into these holes and will form their own thread, these becoming the locating pins for the bottom of the film spools.

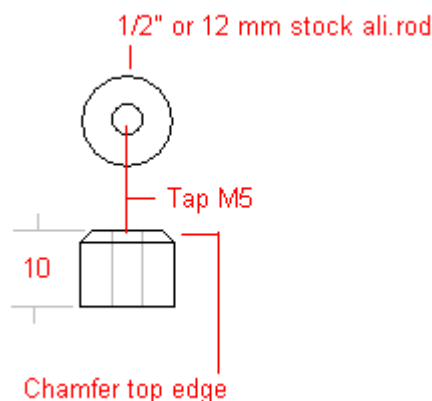
Now remove the heads from two 50 mm long M5 screws, thus making approx a 50 mm length of M5 studding. These are now fastened with epoxy into the film guide blocks and in the finished camera they serve as the means of holding the camera top plate in contact with the upper edges of the body.

This will require a pair of M5 nuts ,

The body should now appear as shown below.



If you have a lathe the fixing nuts may be made from 1/2" stock aluminium rod 10 mm long and tapped M5. These are visible on the illustration on page 3

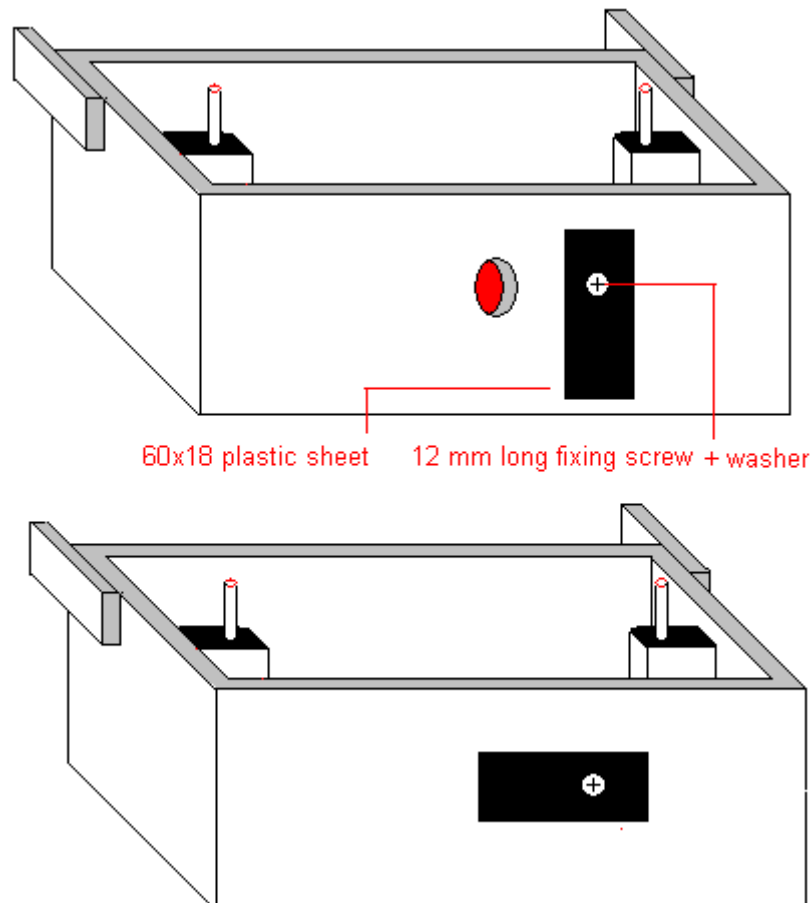


Plan C

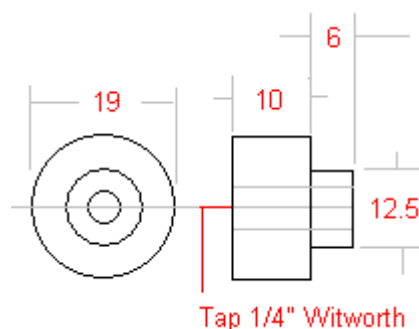
If you do not have access to a lathe, the M5 nuts and a larger washer will do the job, only the cosmetics will suffer.

The film counter viewing window must now be fitted with red glazing and a hinged cover. The glazing material may come from several sources, unused gel filters from the old film days will be perfect, a piece approx 30 mm x 30 mm should be cut and glued onto the inner surface of the backplate, centralised around the viewing hole. A more readily obtainable source is to locate a chocolate eating friend who has recently consumed a box of Roses chocolates (or any similar brand), some of which will have been wrapped in red cellophane type paper.

A cover plate made from a piece of plastic sheet, 1 mm or 2 mm will do but in the absence of such material, a piece of 6 mm thick wood will suffice. It is fixed to the backplate with a 12 mm woodscrew and washer and tightened so that the cover plate has just enough friction to stay in either the open or closed position.



The tripod bush may now be epoxied into the 13 mm hole in the camera base. This is made from 19mm ali. rod, as shown below



Plan C If you do not have a lathe, then the solution is simple. Do not drill the 13 mm hole in the base plate and simply rest the camera on something solid during exposure. Remember your exposure times will always be 1 second or longer

Pinhole assembly

Since this is the heart of the camera it is now time to examine the options. The specification sheet for this design shows a 300 micron (0.3 mm) pinhole and as with so many things in this world it is a compromise.

The author has delivered many lectures on DIY camera construction and one point that has emerged on the subject of pinholes is quite simply, you cannot please everyone. On one occasion a shot taken with a 180 micron pinhole was greeted with the comment “ If I had wanted something that sharp I would have gone to Zeiss”. No problem, since on another occasion a 300 micron shot was greeted by a squinting observer who commented “ I suppose that is a house”. The author of this document is a retired engineer, not an artist.

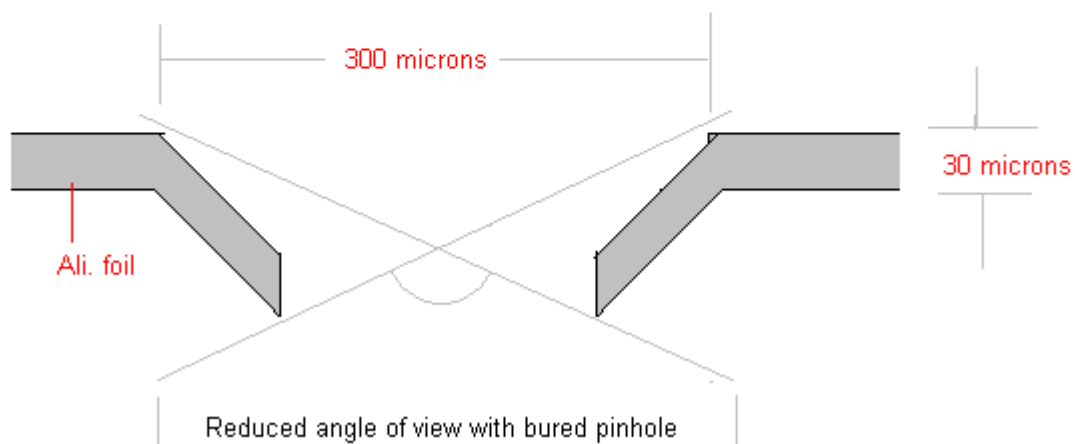
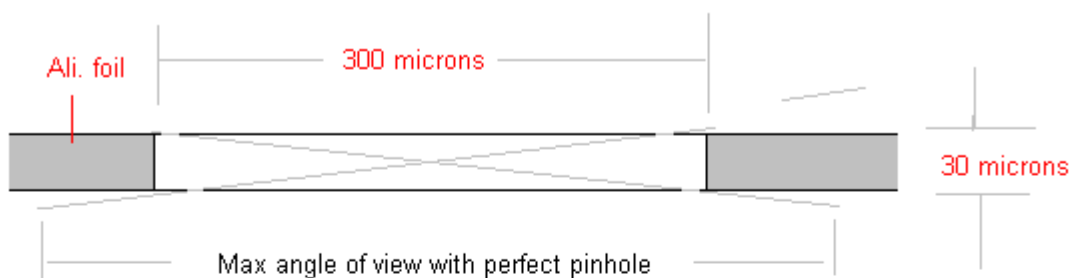
As an indication of the performance that can be obtained with a 300 micron camera , the following shots taken by Jean Luc Werpen are an excellent showcase .



Pinhole size is therefore really a matter for the photographer to decide since even a 1 mm pinhole will produce an image that is very soft, but nevertheless has some admirers. Experimentation shows that a pinhole smaller than 100 microns will not give a sharper picture due to the effect of diffraction, pinholes of this size also require a very thin base material to avoid effectively looking through a tunnel

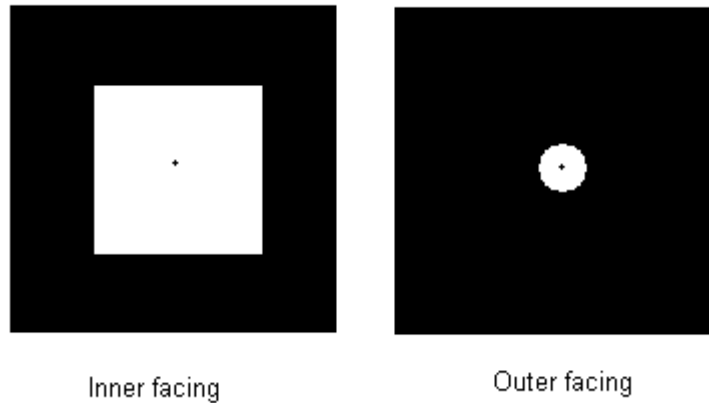
I feel that those on a diet may not enjoy this document, since having suggested consuming chocolates to obtain the red filter, I am now about to suggest the purchase of a Sainsbury or Mr. Kipling (other makes are available), Bakewell Tart which, having eaten the contents will leave you with a 30 micron piece of aluminium, just perfect for a 300 micron pinhole.

Traditionally you now take a pin, push it through the foil and then gently remove the burr by sanding down or sliding it over a fine carborundum block. If great precision is not required, this will provide an acceptable pinhole, but use a very high power loupe to see that you have a clean hole.



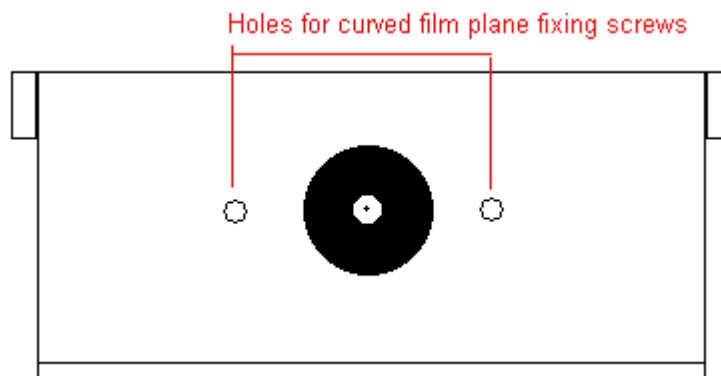
The preferred solution is to use a 300 micron drill, it will take about 10 seconds to cut the hole or alternatively purchase a ready made laser cut item.

Aluminium foil is quite fragile and must be supported. The complete assembly is shown below and comprises a 30 x 30 mm piece of foil with the chosen pinhole drilled in the centre. This is then mounted on a 50 x 50 mm piece of 1mm thick plastic (readily available at model shops). with an 8 mm hole in the centre. The foil is glued using Evostik to the plastic sheet making certain that the glue does not encroach on the pinhole area.



The inner facing drawing shows the location of the foil, in practice after assembly, this surface should be sprayed with a thin coat of matt black (too thick may block the pinhole)

The complete assembly may now be glued onto the inside of the front panel, making certain that the pinhole is in the exact centre of the aperture.

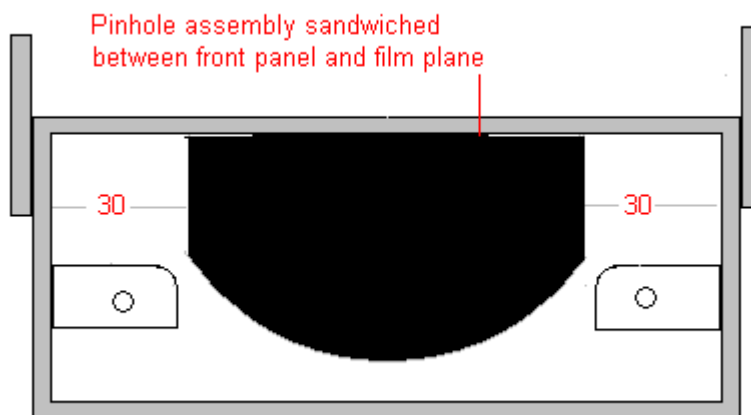
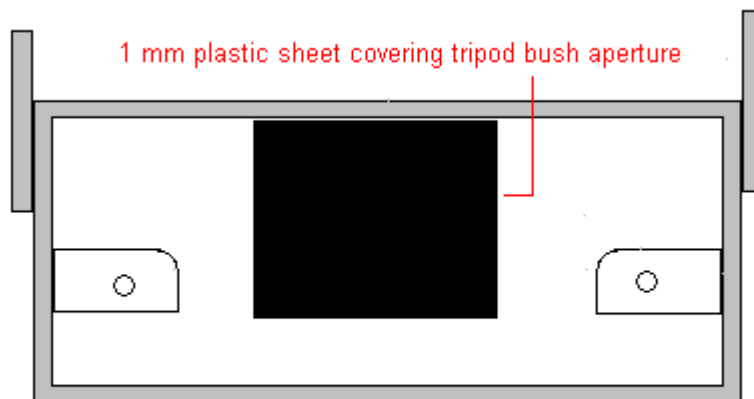


To complete this part of the job, it only remains to fit the curved film plane symmetrically and fasten it with two 12 mm long screws . It should be spaced 1 mm above the base plate.

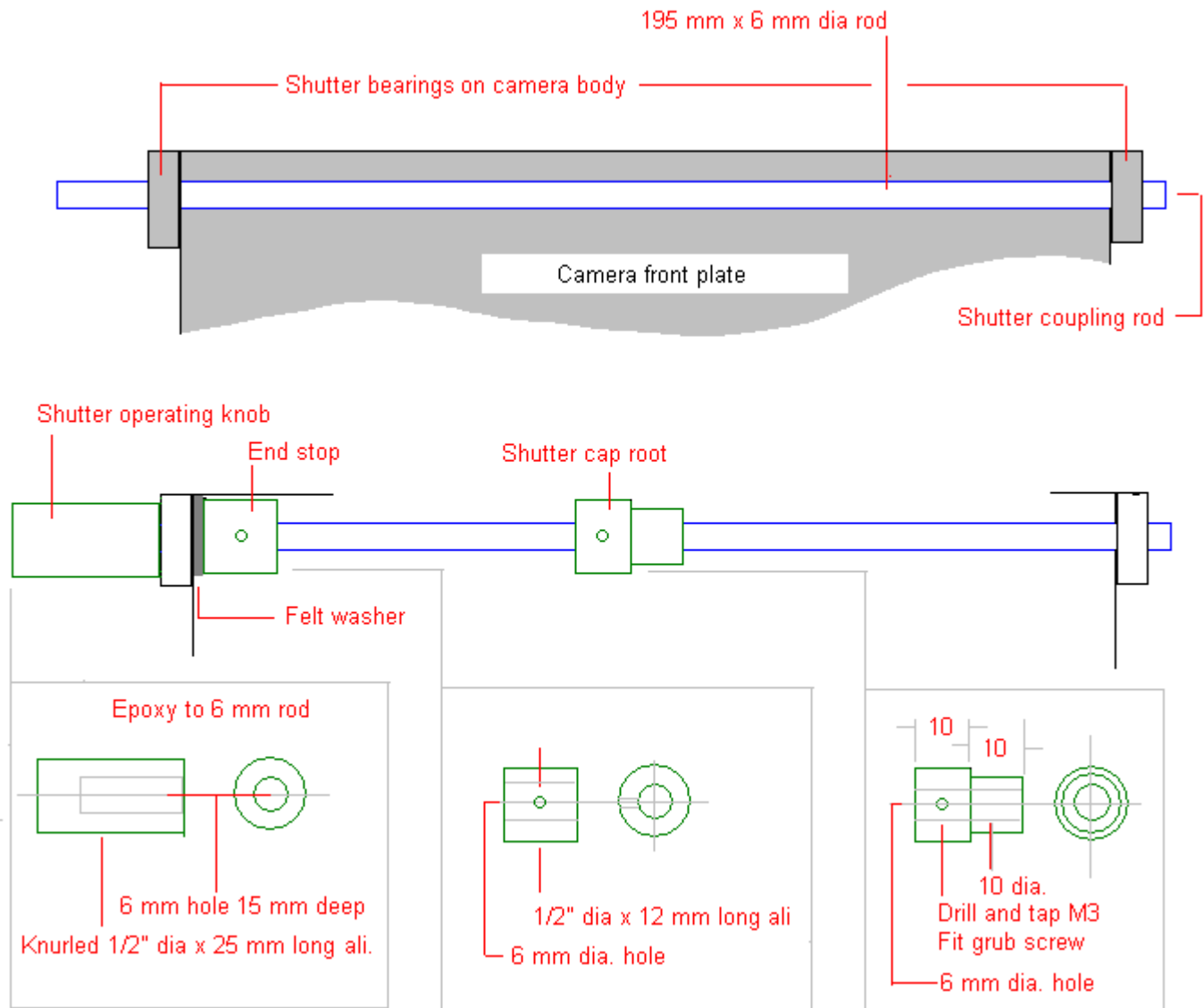
To assist in this operation a piece of 1 mm plastic sheet should be glued to the base plate as shown. This has two functions. Firstly it located the film plane at the correct height and secondly it covers the tripod bush aperture, which could leak light.

These two steps are shown below . The position of the 1 mm plastic sheet is not critical, it must simply cover the tripod aperture and act as a spacer for the film plane, 40 x 50 mm is ideal.

A more critical operation is the fixing of the film plane, this must be symmetrical within the body to permit the smooth passage of the film over the film guides and the semicircular film plane. Allowing for tolerances a cavity of approx. 30 mm square should be present to enable the film spools to rotate without contacting the inner parts.



Shutter detail



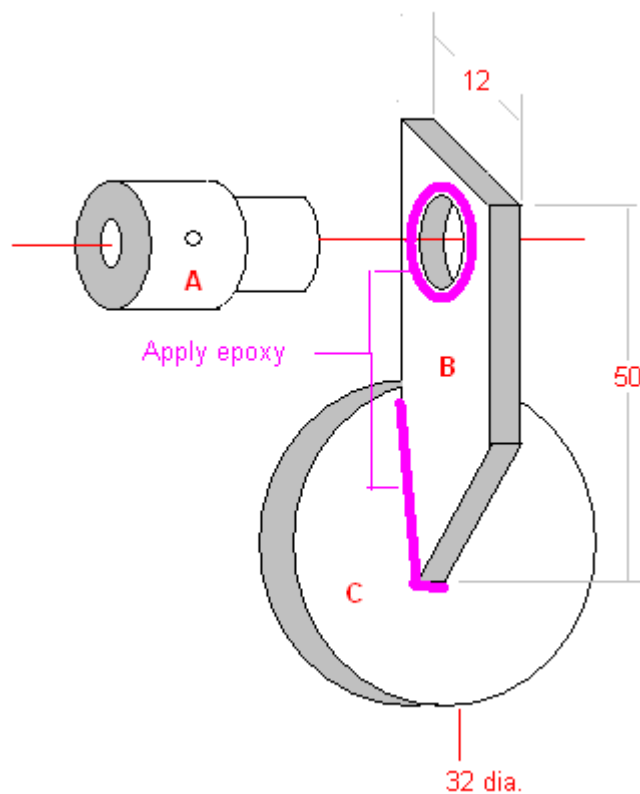
The materials used for this part of the job are not critical. The 195 mm long rod may be made from steel, but brass or aluminium are equally good. Plastic may be less suitable due to its tendency to distort with heat and time and it is essential that the rod stays straight to ensure perfect location of the shutter cap to avoid light leakage in the finished camera. The small turned parts may be made from aluminium, but brass, although more expensive is acceptable. The felt washer is compressed by the knob and the end stop, thus providing a friction brake to prevent accidental opening of the shutter.

All of the above parts may be readily identified from the photograph on page 3

The final part to be built is the shutter cap and the coupling to the shutter cap root. To allow for the build up of tolerances, this part is hand fitted. This simply means that the coupling and the cap are allowed to touch with the cap in contact with the pinhole assembly, apply epoxy and allow to set.

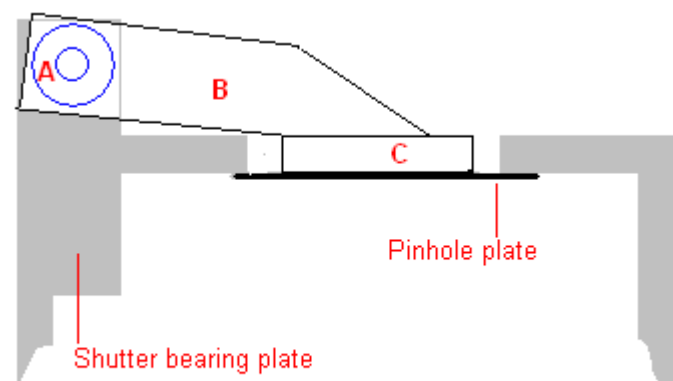
This operation is shown in detail on page 20

This assembly consists of the shutter cap root, a coupling section and a 32 mm diameter x 6 mm disc.



Part A, the shutter cap root is epoxied into a 10 mm hole in part B, the coupling arm. Part C, a 32 mm disc may, if a circular cutter was employed on the front panel, be available as a useful leftover, this being the part that can be extracted from the cutter. It should be noted that part B has a slope on the lower edge, this is to give the maximum contact area between part B and part C.

A cross section of the front panel and shutter parts is shown below, indicating the final shape of part B, since this must be in good contact with part C when it is in the correct “shutter closed” position.

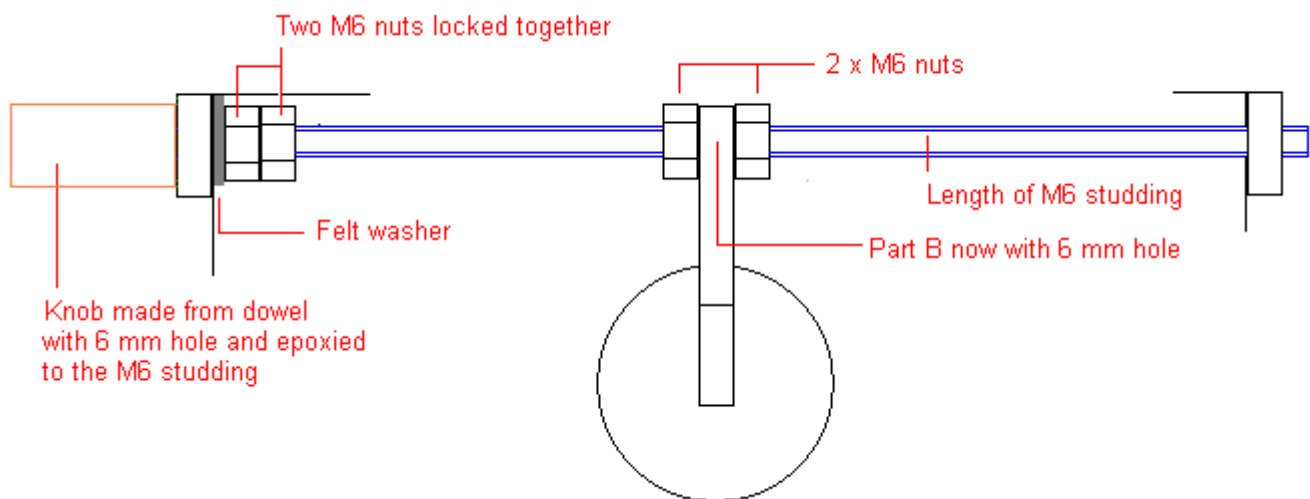


The epoxy should be applied with the camera in the position shown and not moved until the epoxy has hardened, this ensures a perfect light tight shutter cap

Plan C

For those that do not have a lathe, it is quite possible to make the shutter parts using 6 mm items available from any DIY store.

The drawing below gives a possible alternative solution.



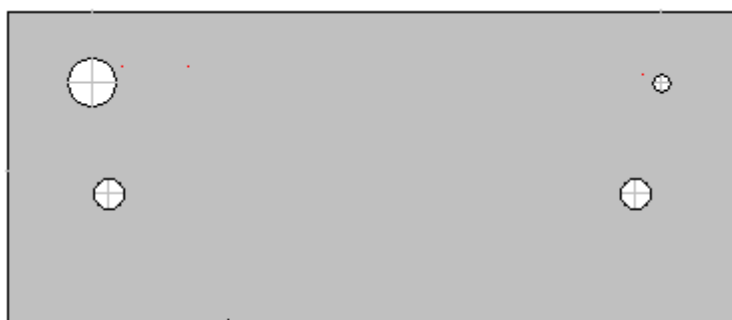
Top plate

The top plate is one of the most complex parts of the build, since it contains multiple drillings , a number of turned parts and finally it is the base for the viewfinder.



This part should be made from the standard 6 mm material and painted in the colour scheme of your choice. If you prefer a little contrast, it need not be the same as the body, however, only the upper surface and edges are painted, the inner surface will be covered by a thin layer of felt which makes a light tight gasket on the upper edges of the body. This is why it is so important to get these edges flat as noted on page 10

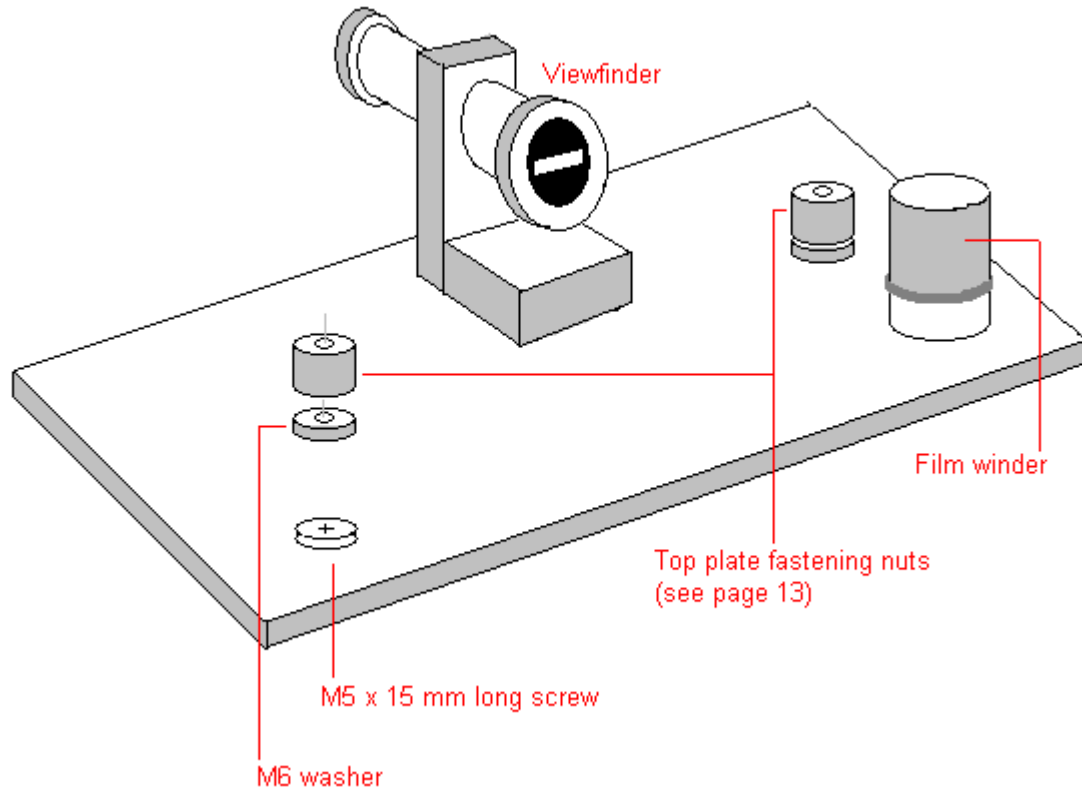
The completed felt gasket is the same size as the top plate and it may be made by marking the hole locations through the top plate onto a sheet of A4 and at the same time marking the plate edges. The felt about 200mm x 90 mm can then be attached with masking tape to the A4 sheet, allowing for overlap at the edges and the holes punched in.



Using wood glue spread evenly over the top plate underside, the felt may be positioned to line up with the holes in the top plate. When the glue is dry the felt can be trimmed to the edges .

Top plate components.

When completed the top plate will appear as shown below.

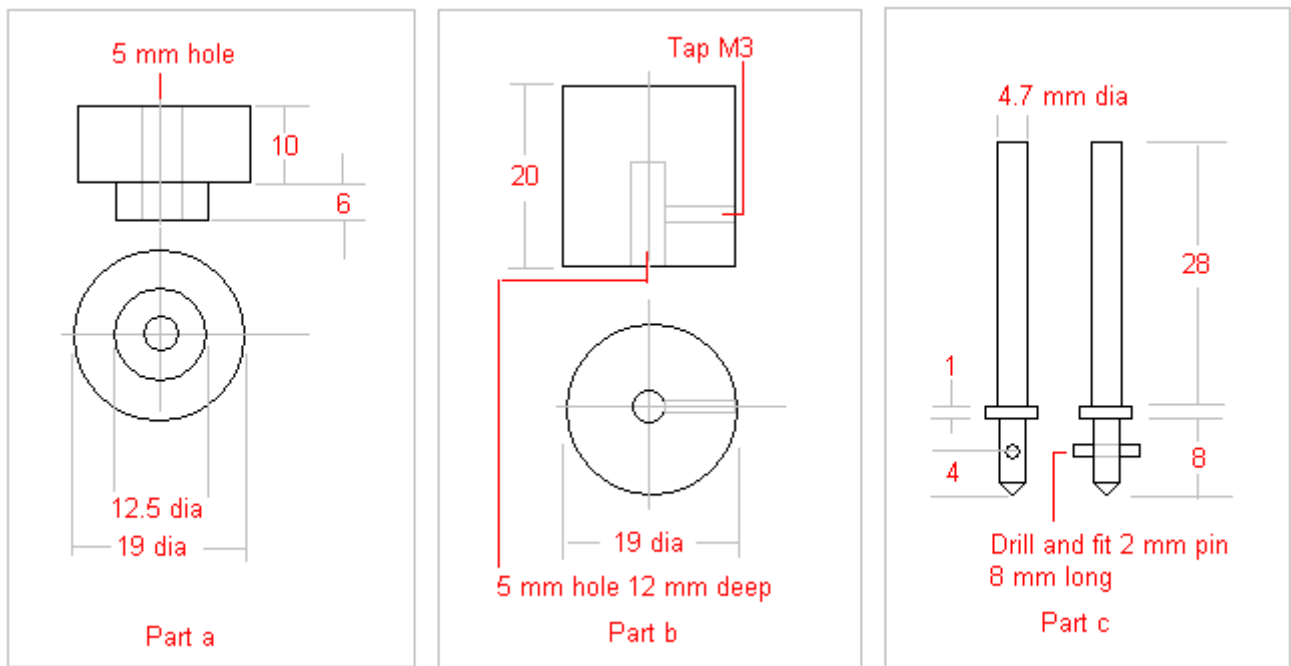


The M5 screw may be screwed into the 4.5 mm hole, thus forming its own thread. This is the upper support for the film spool

M6 washers are epoxied to the surface of the top plate to prevent the top fastening nuts damaging the wood. These are fixed in place to be concentric with the M5 screws that project through the plate. With a build up of tolerances during building, it may be necessary to stretch the 6.5 mm holes.

The film winder assembly is made up from 4 parts, these being :-

- a The part that fits into the top plate and provides a bearing for the coupling spindle
- b The knob that actually performs the winding, this knob should be knurled to provide a good grip
- c The coupling spindle (see drawing). This joins the knob to the pin that locates in the film spool
- d The felt washer. This provides friction to keep the winding knob in place to stop the film unwinding



Part a is epoxied into the 13 mm hole .

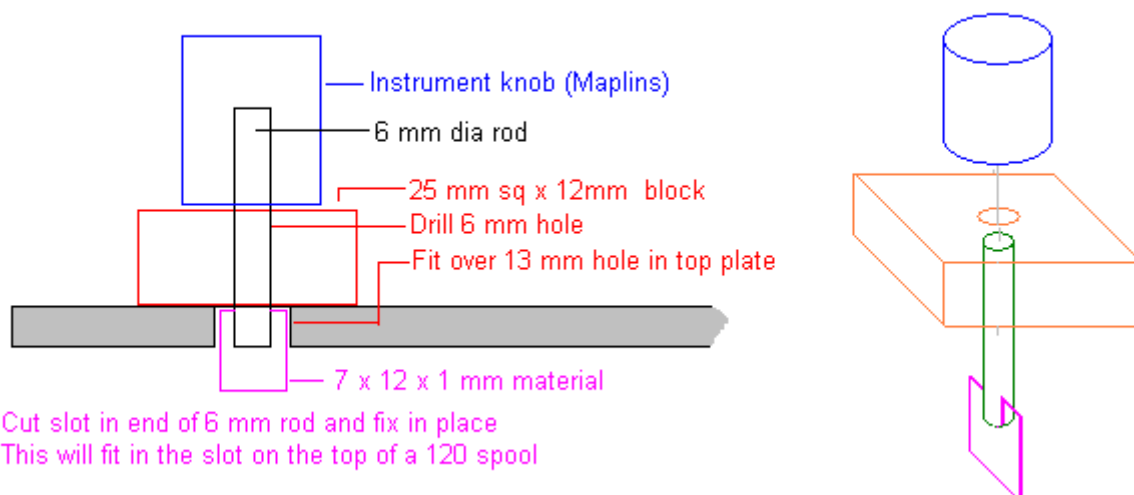
When the epoxy has hardened, the **part c** is passed through **part a** and a 19 mm felt washer placed on the upper surface of **part a**.

The felt washer is a piece of felt 19 mm in diameter with a 5 mm hole punched at the centre.

The winding knob **part b** is then fitted to **part c** and the felt washer is compressed , the grub screw in **part b** is then tightened and the film wind mechanism is complete.

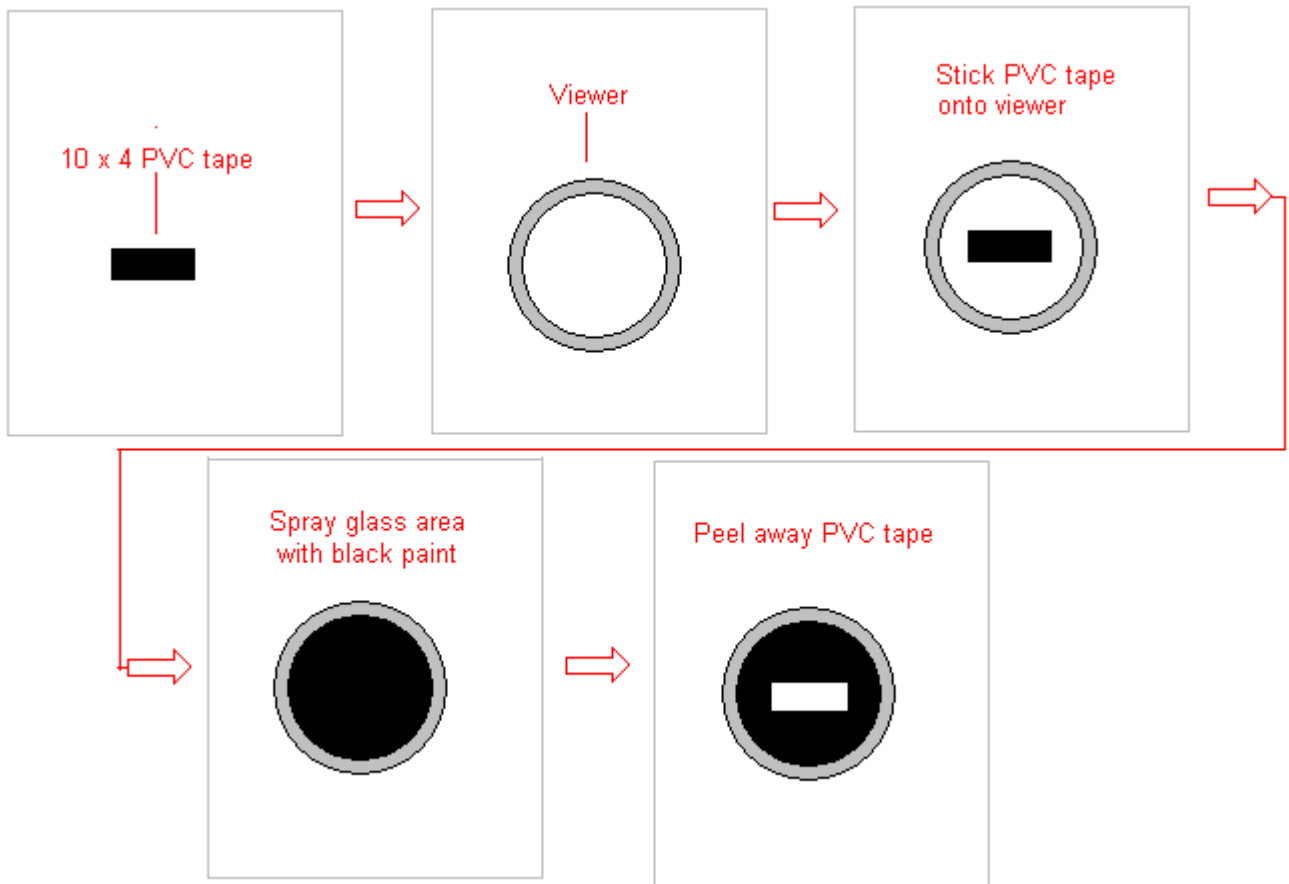
Plan C

All of the above parts assume the use of a lathe, however it is quite possible to make a workable film winder using the sketch notes below.

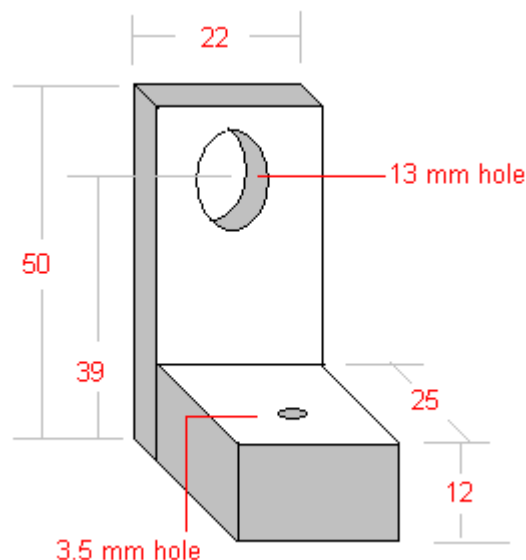


Viewfinder

Wide angle viewfinders are easily made from security door viewers. These cover an angle approaching 180 degrees and with a simple masking operation they provide a perfect optical finder. These may be obtained from most DIY stores or Screwfix. There are two types in common use, one having a front element of app.20 mm dia. The other 12 mm diameter. To facilitate masking , the 20 mm version is used. The build sequence is shown below



The support for the finder is a simple assembly made from 6 and 12 mm parts. It is then screwed to the centre of the top plate.



Fit viewer into 13 mm hole, screw assembly onto top plate and you have a camera !

Film loading

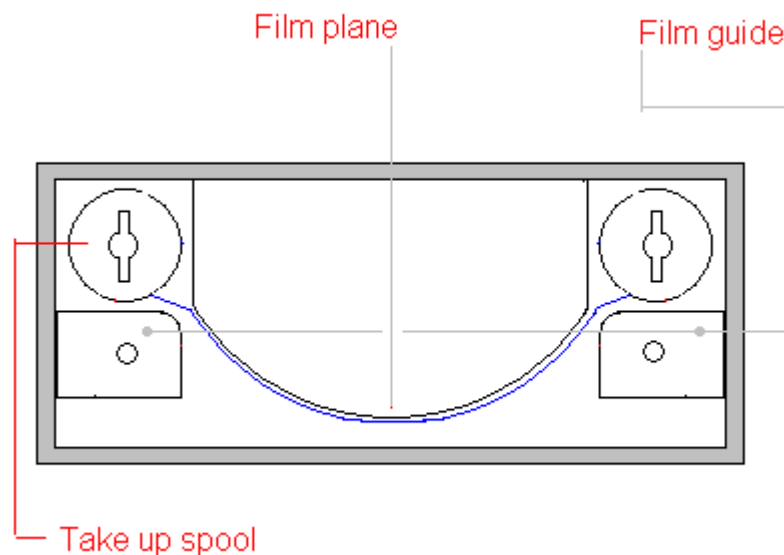
The film is loaded by releasing the top plate retaining nuts, this giving access to the inner body.

At this point you will realise that most 120 cameras are loaded through a hinged back. Before you become too worried, just consider how a screw Leica is loaded !

The following diagram shows the threading path of the film, the spools being located at the bottom by two M5 screws projecting from the base.

Care must be taken to make certain that the film is correctly seated on the bottom of the curved assembly otherwise the film may slip into the semicircular cavity and become wedged, resulting in the film becoming torn.

The film may be easily located by sliding a spatula between the film and the film plane. A spatula may also be used to manoeuvre the top surface of the film spools to line up with the locating spigot and the film wind knob. This is performed with the camera top plate nearly closed.



The top plate is then lowered onto the camera, noting to turn the film winder to align with the slot in the take up spool. A viewing window is located on the back of the camera to note the film position. This is normally covered by the viewing window cover plate. The film should now be wound on until exposure number 1 is reached, this being the correct starting point for the first exposure. Due to the length of the negative, each frame takes two normal 12 on 120 frames and so the following sequence will be used.

Frames 1, 3, 5, 7, 9 and 11

When the film has been wound on, the viewing window cover should be swung back over the film counter viewing window. .

Picture taking

With a working aperture of f 166 virtually all exposures will be of the order of seconds and it is assumed that all shots will be taken with the camera firmly mounted on a tripod. Typical exposure times for 200 ASA film are shown on the following pages and it should be noted that whilst a faster film may be employed, in the case of very brightly illuminated scenes, such as beach and mountain views, the resultant exposure time may fall below 1 second which is difficult to achieve manually, although modern C41 emulsions would doubtless accommodate the over-exposure.

Exposure times

All exposure times are of the order of seconds or tens of seconds, hence the use of a simple manual shutter capping system. The aperture of f 166 would normally provide a long exposure time, but due to the effects of reciprocity failure, the times required in very dull conditions are further extended. The table below shows the calculated exposures derived from normal usage for 200ASA film, whilst the adjacent column shows the increased times required to combat the reciprocity failure effect.

In very dull conditions it is always wise to overexpose and some workers have used exposure times of hours with interesting results, since due to the very small aperture the film does not tend to become completely blacked out.

Typical exposures for most types of lighting conditions are shown in the following table

Exposure times for 200 ASA film at f 166

Conditions	Norm exposure (sec)	Pinhole exposure (sec)*
Beach and mountain scenes	0.5	0.5
Normal sunny conditions	1	1
Sun and cloud	2	2
cloudy	4	4
Dull	8	8
Very dull	16	30

* Allowance for the effects of reciprocity failure