

Building the P6*6 3D Printed Pinhole Camera

These instructions describe the assembly of the P6*6 3D printed pinhole camera, freely available for download from Thingiverse.com.



The P6*6 is assembled from 3D printed parts, and is glued and fastened together with 3mm nuts and bolts. All individual parts print without support and fit on a six-inch square print bed.

The P6*6 comes in two focal lengths, 35mm and 50mm, uses 120 roll film, and makes a 6 cm square negative – roughly four times larger than a negative from a 35mm camera. 120 film is widely available and can be found at camera stores that cater to professional photographers, or from Internet vendors.

P6*6 Specs -----

120 film, 6X6 format

50mm focal length

f-stop of f/167 with 0.30mm pinhole

62 degree vertical and horizontal angles of view.

35mm focal length

f-stop of f/135 with 0.26mm pinhole

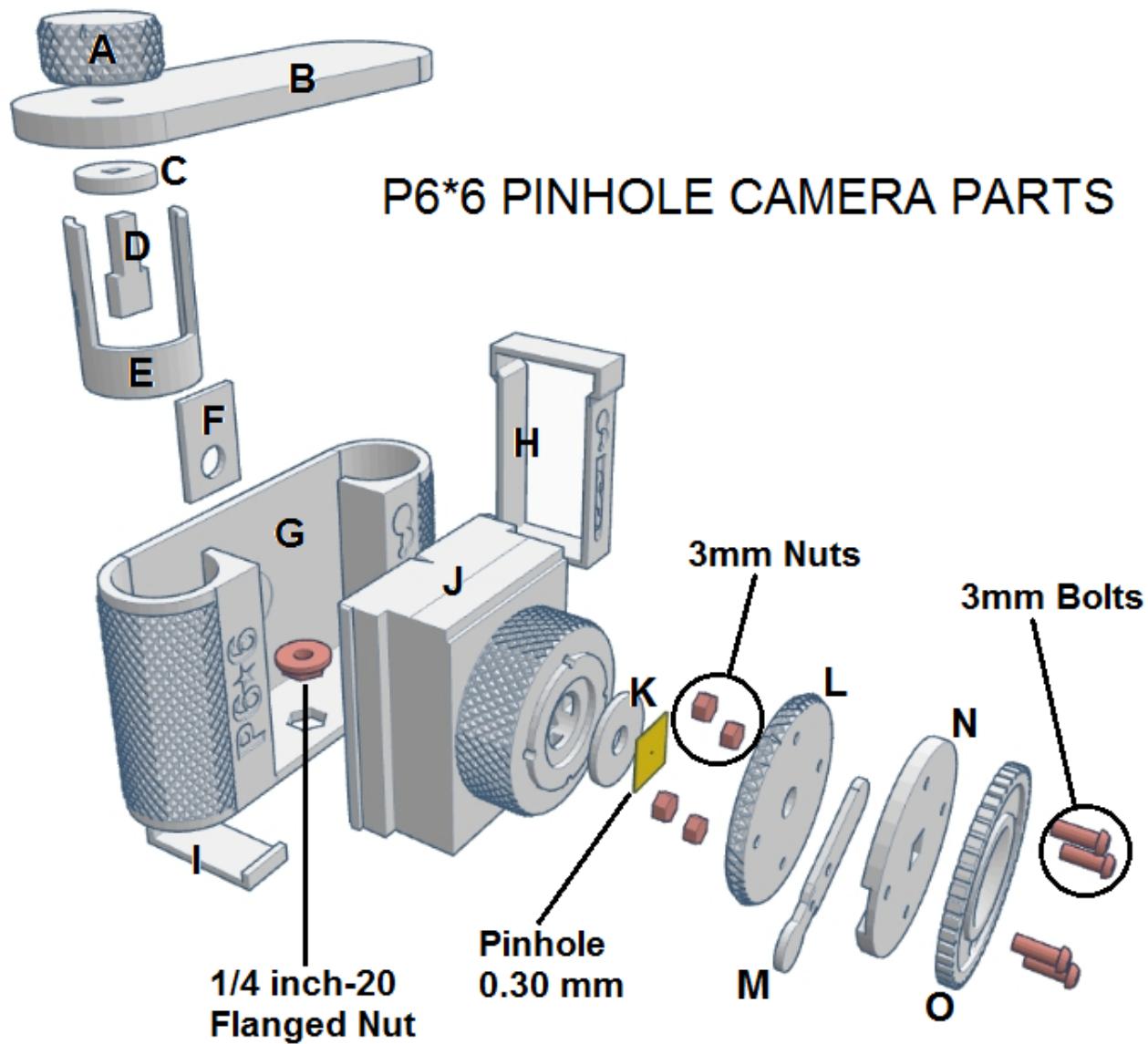
77.4 degree vertical and horizontal angles of view.



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1. Gather Parts, Tools, and Materials

3D printed parts



The P6*6, as illustrated, consists of fifteen 3D printed parts. The latest version of these parts can be downloaded in STL format here:

<http://www.thingiverse.com/thing:157844>

Black ABS or PLA is recommended, but other colors will require a coat of flat black paint on interior surfaces.

- A** – Knob, used to advance the film
- B** – Cap, snaps onto the body
- C** – Baffle
- D** – Winder, engages the take-up spool
- E** – Film Clip, keeps film tightly wound on the spool during unloading
- F** – Frame Slide, allows viewing of frame number on film backing
- G** – Body
- H/I** – Body Clip and Leveling Spacer, prints as joined pieces
- J** – Extension - 50 mm or 35 mm length
- K** – Pinhole Disc, replaceable pinhole mount
- L** – Pinhole clamp
- M** – Shutter Blade
- N** – Shutter Clamp
- O** – Trim Ring

STL Slicing Settings:

0.25mm layer height

Two perimeters

Three solid layers top and bottom.

50% infill

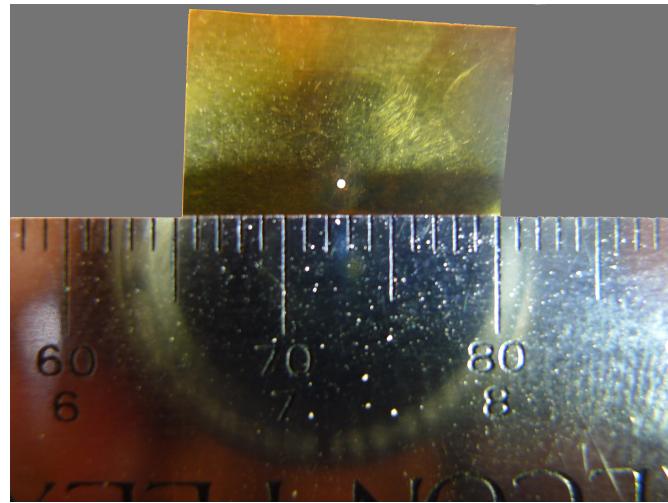
Non-printed parts

Hardware –

4 x 3mm nuts and bolts, 15mm long, washers optional.

A 1/4-20 nut provides a tripod mount; use a flanged nut.

Pinhole – 0.26mm or 0.30mm in thin metal stock. Relax - This is not as critical as it seems. You can purchase a precisely laser-drilled pinhole on the Internet or easily make your own from brass shim stock, a soda can, pie plate, etc. (Aluminum foil is too fragile.)



See: <http://www.withoutlenses.com/articles/how-to/drill-your-own-precision-pinhole-apertures>

Self-adhesive Velvet or Similar – Used to “trap light” that would leak through and around joints in the assembly.

Disc of Translucent Red Plastic – 15-18mm. A cheap plastic binder is a good source.

Tools and Materials



The following tools will prove helpful:

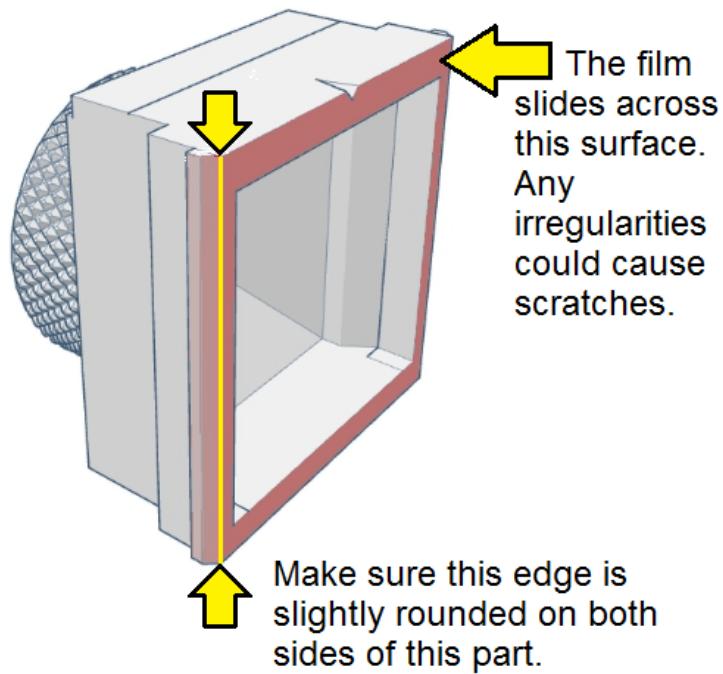
- **Flat files**, large and small
- **X-Acto / hobby knife**
- **Fine sandpaper** (500-1000 grit)
- Glues –
 - **Black ABS plumbing glue**
 - **Epoxy** like JB Weld.
 - **Super Glue**
 - **Plastruct “Plastic Weld”** will bond all manner of plastics
- **Black marker or Sharpie** for back side of pinhole (no internal reflections!)
- Small **Allen wrench** is handy for manipulating tiny nuts inside the extension when assembling the shutter.
- **C-clamp and/or stout rubber bands**

2. Working with 3D Printed Parts

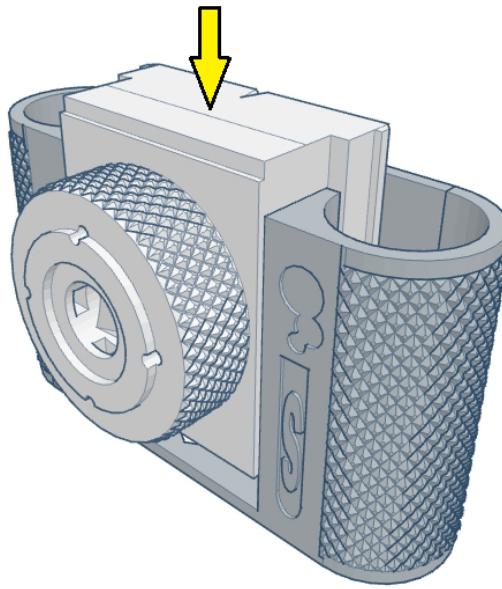
Every joint between parts in the P6*6 has a potential for photo-ruining light leaks (unintended openings that allow light into the camera). Careful attention to fit will ensure awesome photos. If necessary, smooth mating surfaces with a file or fine sandpaper.

Carefully enlarge all bolt holes with an 1/8 inch drill bit.

Pay special attention to the frame surface, formed by the bottom of the *extension* – the film slides across this surface when winding and it forms the margin of your photographs. Surface irregularities could scratch the film, and an unevenly trimmed inside perimeter will be preserved as an uneven border on every photograph you make. Additionally, slightly radius and smooth the bevel at the outside of the frame to avoid scratches on the film.



Before proceeding, check the fit of all mating parts. Refer to the exploded parts diagram. All parts should fit together without distorting. The *cap* should fit the *body* securely. The *shutter blade* should be slightly snug between the *pinhole clamp* and the *shutter clamp*.



3. Final Assembly

Tripod Mount

A 1/4-20 nut is the standard tripod attachment. Carefully bond the flanged nut flush with the bottom of the body with epoxy – just a bit on the inside.

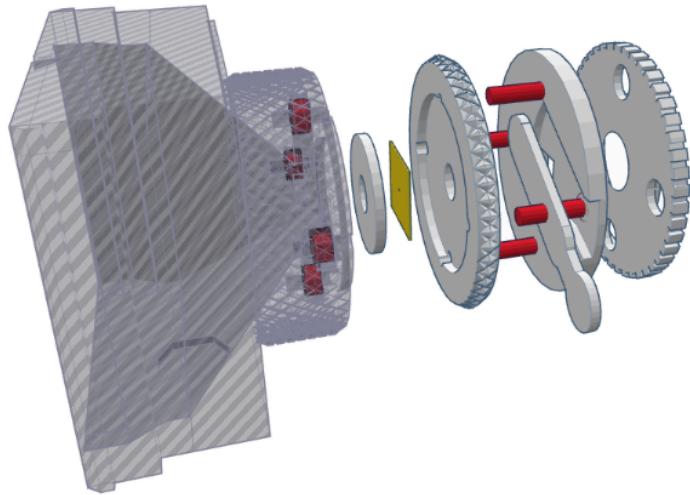
Cap and Winder

Parts A, B, C & D. See exploded parts diagram.

The *winder* drive passes through the *baffle* and *cap*, into the *knob*. This is designed to be a friction fit. If the narrow part of the *winder drive* is slightly too large to fit through the *baffle* and into the *knob*, enlarge the holes in the *knob* and *baffle*, rather than reducing the size of the *winder* shaft.

Extension and Pinhole/Shutter

Parts J, K, Pinhole, L, M, N, O, & Nuts and 15mm Bolts (and/or washers). See diagrams.

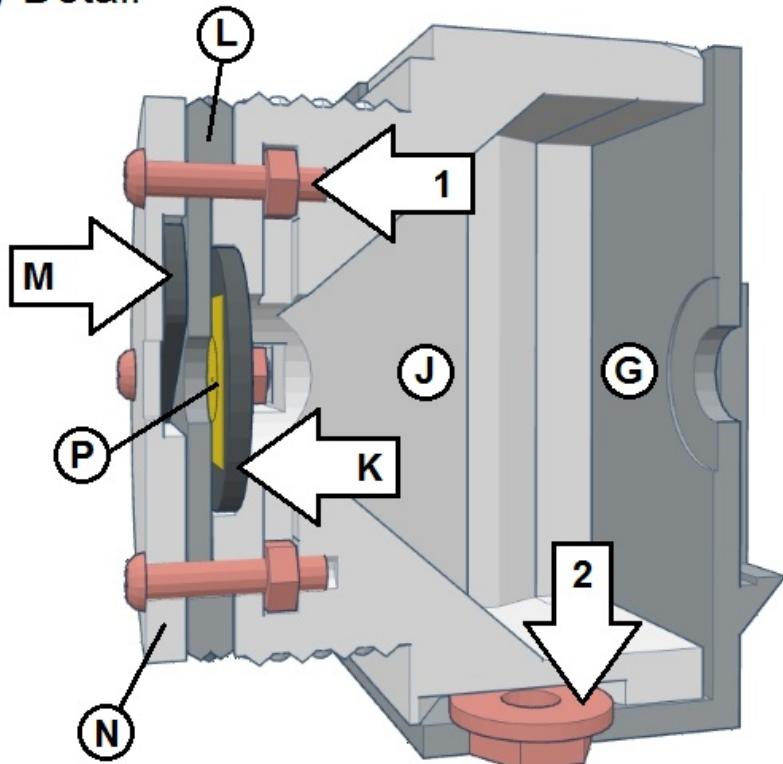


Everything should fit together tightly prior to fastening. The *extension*, *pinhole clamp*, and *shutter clamp* must fit without interference.

P6*6 Cutaway Assembly Detail

G - Body
J - Extension
K - Pinhole Disc
L - Pinhole Clamp
M - Shutter Blade
N - Shutter Clamp
P - Pinhole

1 - 3mm Nuts & Bolts
2 - 1/4 inch -20 Flanged Nut



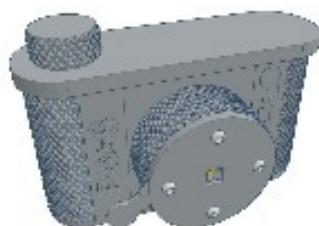
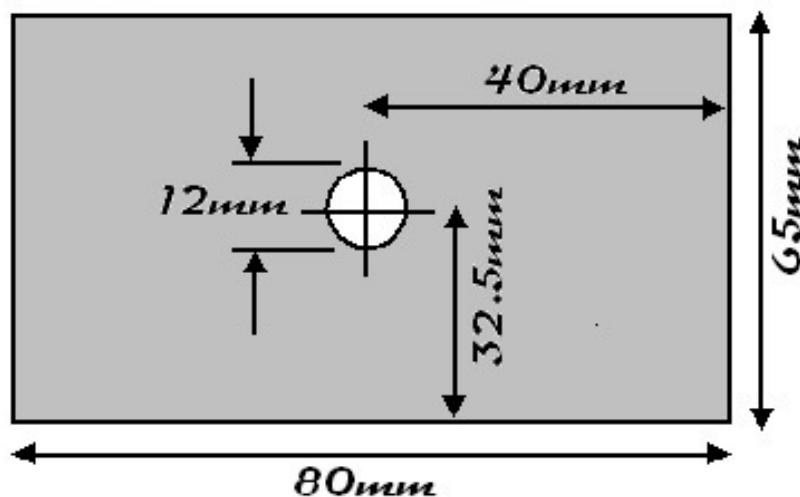
Bolting all these parts together can be a bit fiddly - it is important to assemble them before gluing the extension and body together. A small Allen wrench is handy to position the nuts in the nut traps (in the extension) during assembly. The *shutter* should snap open and closed. It is easy to over-tighten the bolts. Use Super Glue to mount the *trim ring* on the face of the *shutter clamp*.

Velvet Lining and Red Window

For best results, the inside back of the *body* can be lined with velvet, behind the frame. The velvet provides a gentle friction which keeps the film in place, and serves to reduce the effect of stray light from the frame index window. Lining the inside surface of the *cap* also minimizes light leaks.

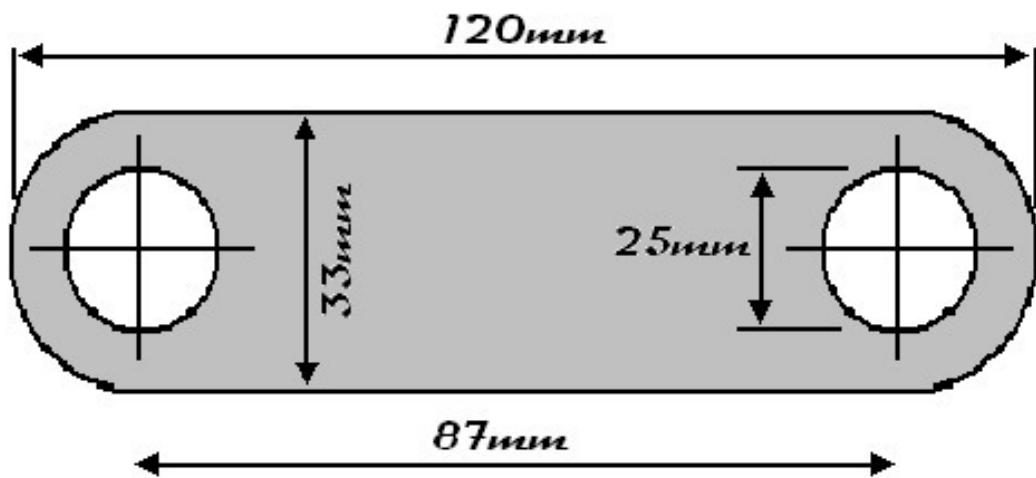
See dimensions on next page.

Apply this to inside of camera body



From the Schlaboratory!

Apply this to the inside, bottom of top cap



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Self-adhesive velvet dimensions
Nope, not to scale

<http://www.thingiverse.com/thing:157844>

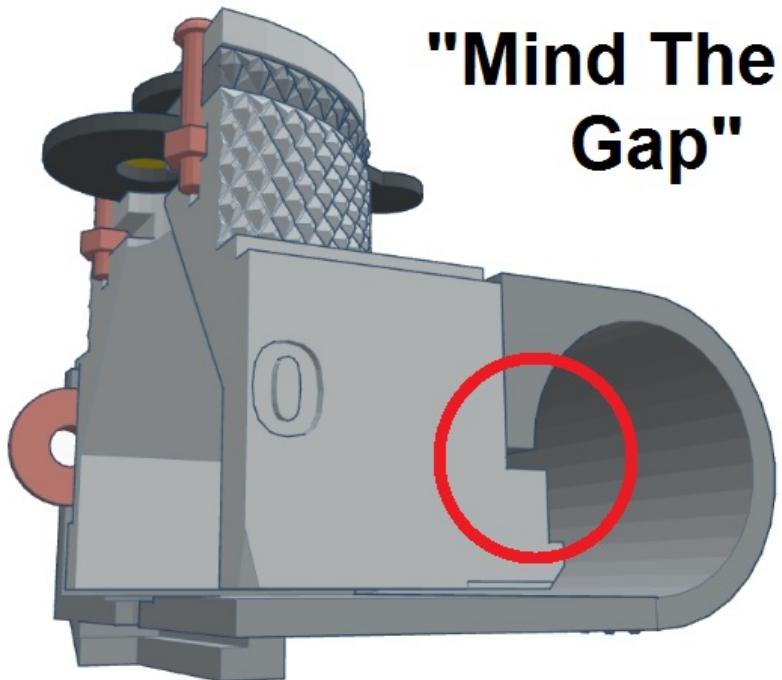
Cut a 15 – 18 mm disc from transparent red plastic and tack it in place in the recess *inside* the *body* with a couple *tiny* dabs of super glue. The hole in the middle of the self-adhesive velvet will overlap the disc and secure it in place.

Carefully use the tip of an X-Acto blade to slide the velvet into position when attaching it to the *body* and *cap*. It must be wrinkle free.

Body - Extension Joint

Reminder: for best results, assemble the shutter and extension first.

“Dry-fit” the extension and body before gluing. It will only go together one way – the “50” will be visible. Any binding or interference could mean light leaks. The tripod nut and epoxy must fit without difficulty. Resolve any issues before you glue.



During gluing, space the frame from the velvet by approximately 0.50 mm. This can be accomplished using layers of printer paper (approx 0.10 thick each).

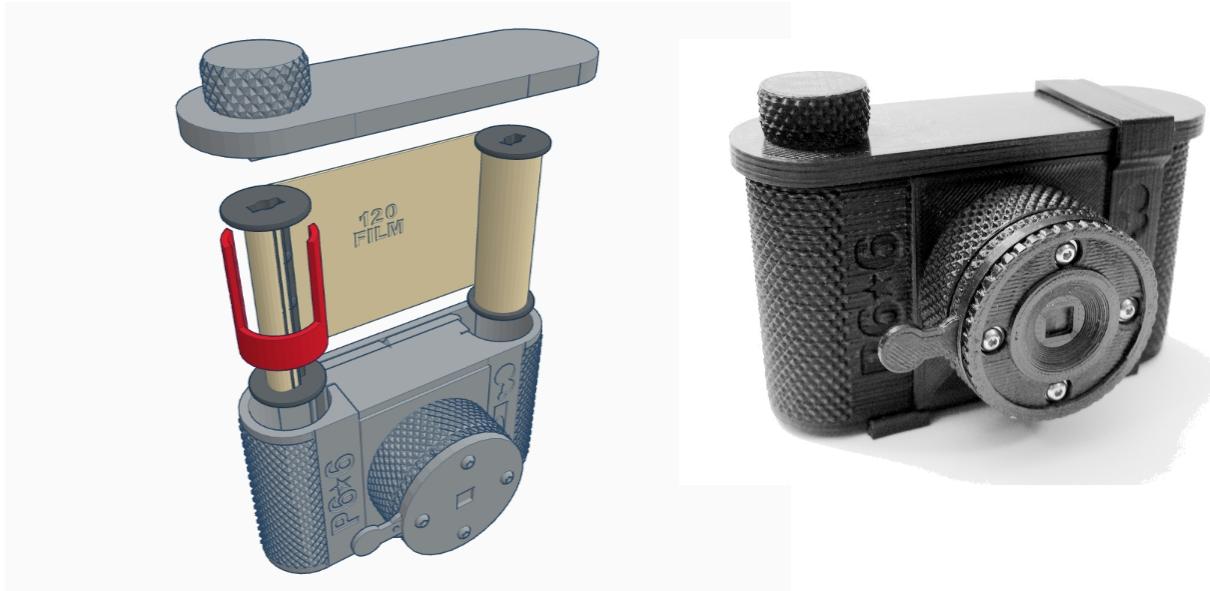
NOTE: There will be a gap between the extension and the body on each side when the two parts are properly fitted.

Gluing

For ABS, plumbing cement works well (and comes in camera black). Work fast – the solvent evaporates quickly and the cement gets rubbery.

For bonding PLA, a dark epoxy is best, but gap-filling Super Glues or “Plastic Welder” type glues give good results.

Follow the directions on the label. Too much glue will ooze out of the joint and muck up your lovely camera's appearance. A C-clamp or rubber bands can be used to precisely clamp the two parts together.



Allow glue to dry, load with 120 film, slide the body clip onto the camera, and **make some pinhole photographs!**