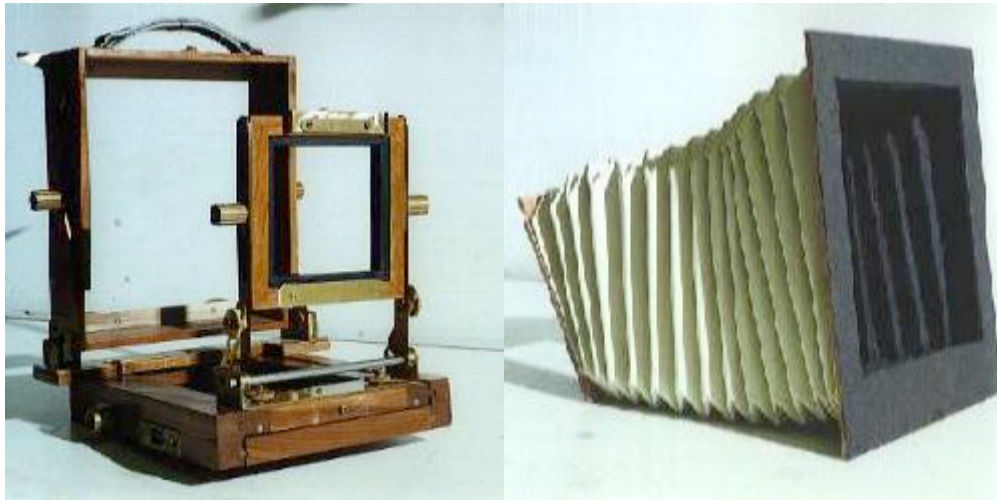


Welcome to DIY bellows page

I am sure there are many other ways to make bellows. I've had only two commercial bellows on which to formulate a method of making them. So let's make a bellows.



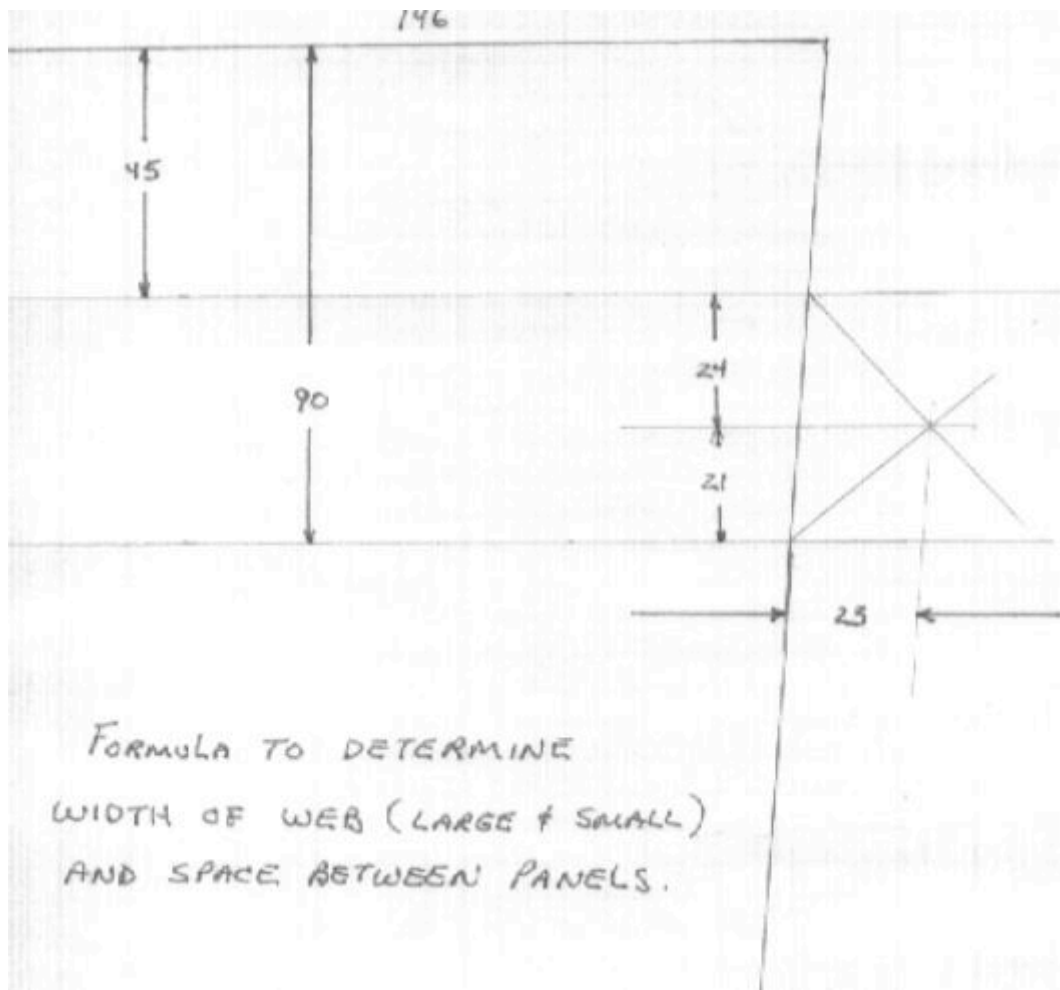
Before making the bellows using expensive materials, I use brown wrapping paper and card stock or bristol board and ordinary white glue. All dimensions in this project are in mm.

The parts of the bellows are the web (the flat part of each folded section, usually 2 different widths in a tapered bellows. The hinge, the space between the webs that allows the bellows to fold flat or stretch out to maximum length.

There are some dimensions that are required. The inside of the front standard that will hold the bellows and the inside of the rear standard (I'm assuming that this will be a square bellows mounted on a rectangular board). The width of the web is determined by the thickness of the front standard. It would not work for long if the front of the bellows was larger than the front standard, it would soon be worn through by the brackets that support the standard.

Another consideration is the length of the finished bellows. In my experience the difference is about 30% reduction in the length of bellows before and after construction.

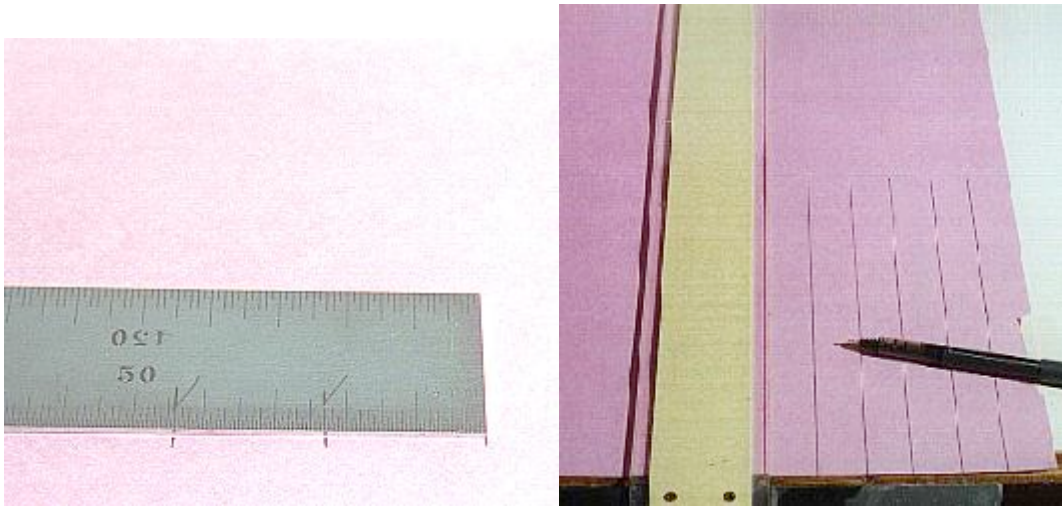
From our example camera, the small i.d. = 90mm, the large i.d. = 146mm and the length(for demonstration purpose) is 390mm. The front standard has a width of about 20mm.



On a sheet of paper make the outline of the panel with the large id at the top and small id at the bottom and correct length. The conical bellows requires that 1 of the 2 folds be smaller. At this point it has not been determined what the smaller web width is.

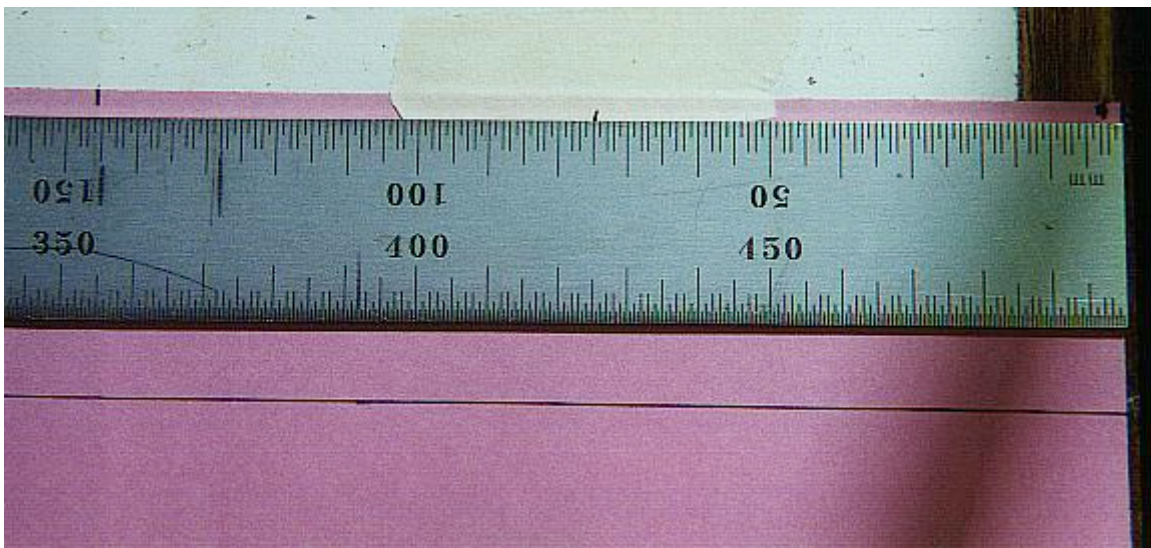
Draw 2 lines, 1 at 45mm (about double the width of the front standard) from the top and the other at 90mm from the top. With a plastic 45° triangle draw line down from the 45mm line, draw a second line from the 90mm line up at 45°.

This little triangle provides several bits of information. As illustrated above, measure from the point of the triangle to the 45mm and 90mm lines, this is the width of the 2 webs (24mm and 21mm). From the point of the triangle to the line which represents the length of the panel is the space required between the panels.

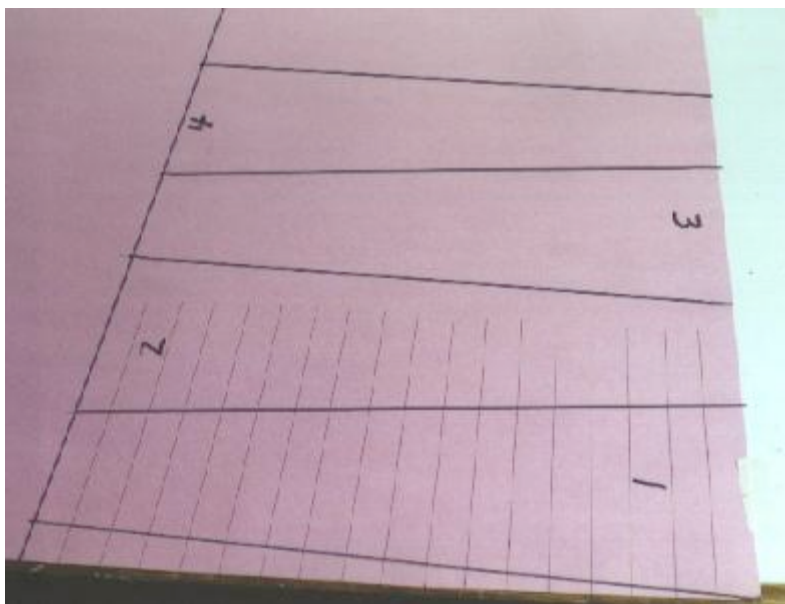


A sheet of card stock is layed out on a flat surface and with the use of a square is tapped down. Draw the first line at 24mm the next at 21mm, the next at 24 and 21 and continured for the width of the cardstock.

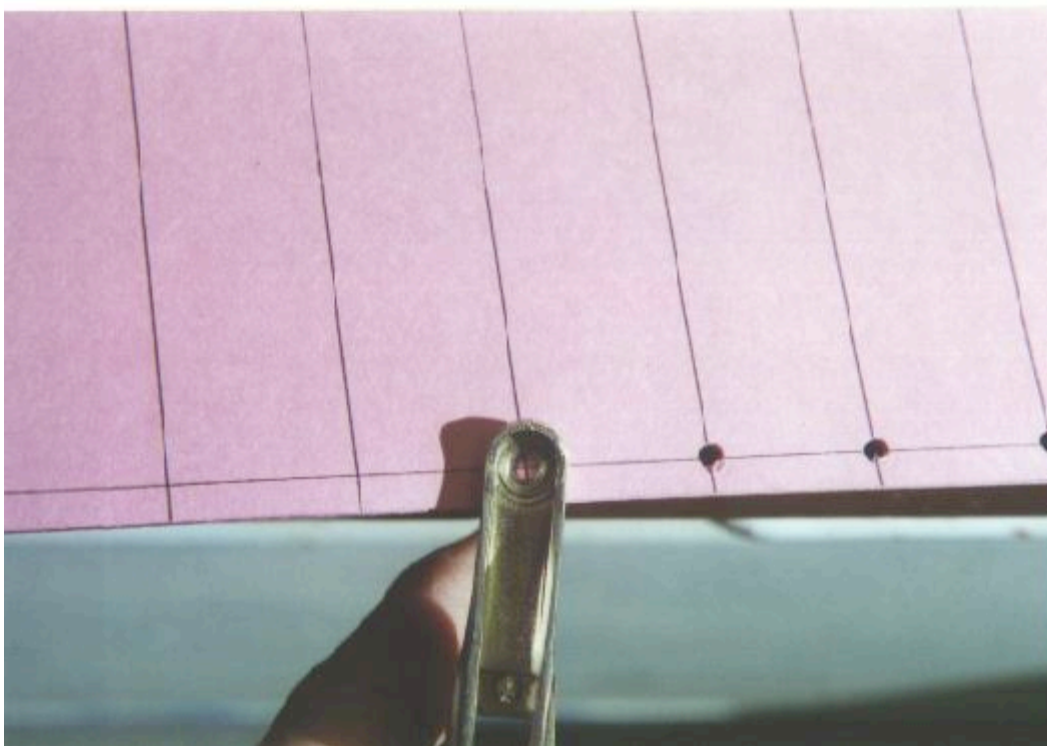
At this point find the length of the bellows that falls on the start of a wider web(so that there are even sets of webs 24 +21) and mark this line.



At the right edge mark of a small tick at 75mm (this is a little more than the center of the large end) measure each way from the center mark 73mm . On the left side of the cardstock at the line for the maximum length, make the same center tick at 75mm , measure each side of that at 45mm . Join the upper and lower two sets of mark to form a cone. This is one pattern, 3 more have to be made.



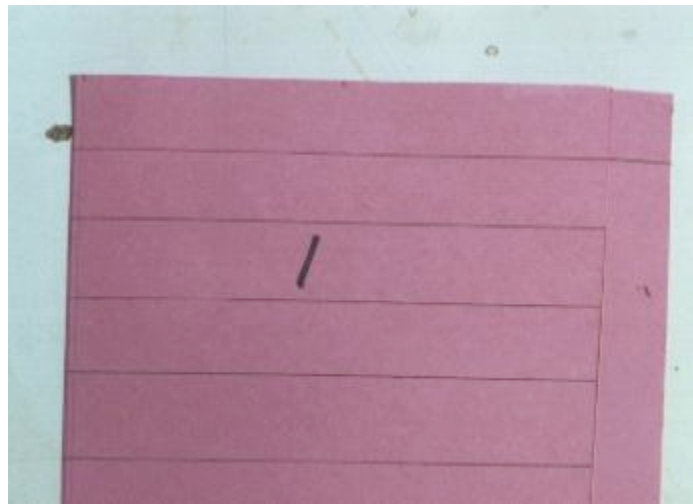
On the right starting at the tick mark (about 147mm) mark off 90mm (the small end). On the left mark (120mm) mark off 145mm (the large end) continue reversing the patterns until 4 have been marked out.



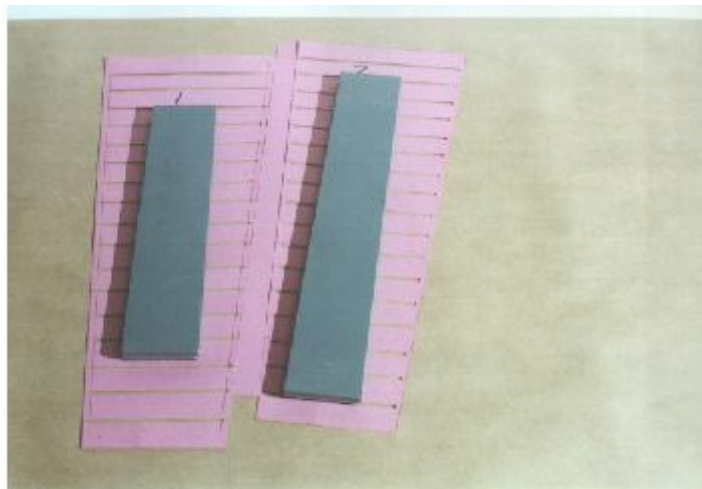
Staple the 4 patterns one over the other with one staple near each end at the center. Draw a line down each side of the length about 4mm in from the edge. Where this line intersects with those lines drawn earlier for the webs; use a 3mm hole punch to put a hole near the edge for the entire length of each side.



I generally place a piece of glass or masonite as a cutting board. With the large end at the right use a ruler and exacto knife, cut out the hinge using the edges of the holes as a guide(generally takes 3 or 4 passes with the knife to cut cleanly through).

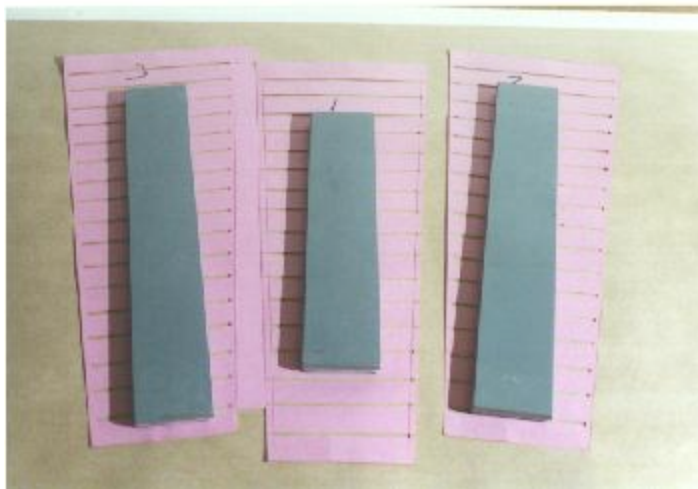


Remove the staples from the patterns and layout on the brown paper. In order for the patterns to fold properly there has to be a space between them. From the formula above, it has been determined that this space is 23mm. Now is the time to cut a spacer 23mm wide by the length of the bellows. At one end of this spacer mark of a right angle line at 21mm.

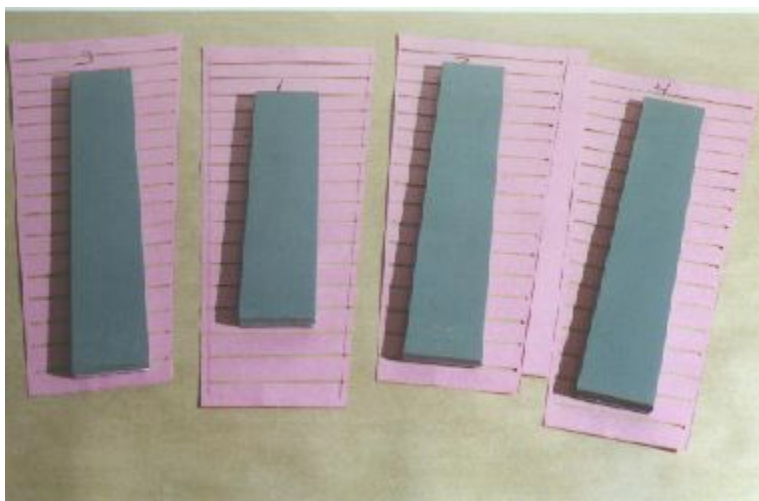


At this point there are a couple of options. The first patterns can be cemented down one at a time or they can be outlined with a pencil and cemented later.

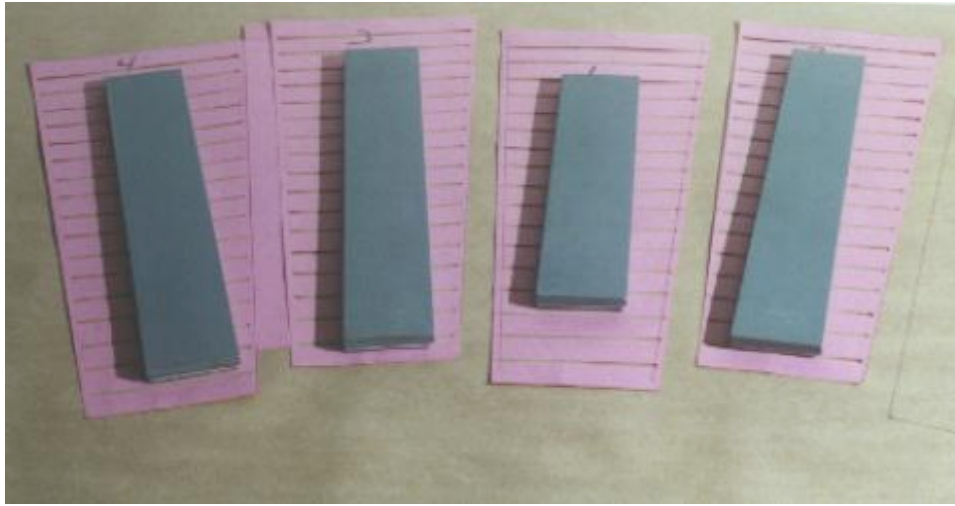
Layout the first pattern (#1) in the center of the brown paper. Place a weight on it. On the right, use the spacer with the mark end and place the mark on the top of the right edge of #1. Place another pattern(#2) against the spacer right to the top (The patterns will be out of line by one web width) and weight it down.



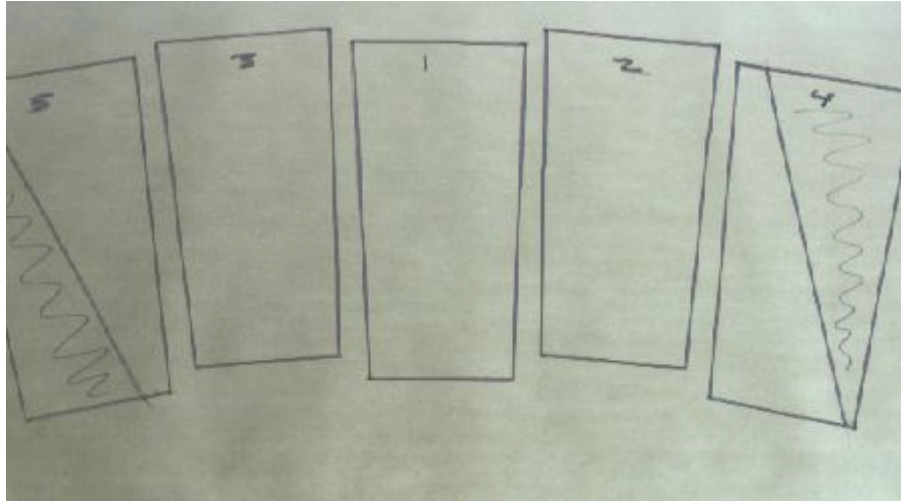
Do the same for the left side on #1 with #3.



On the right side of #2 the spacer matches the pattern and #4 is lowered to the mark on the spacer and weight down. Draw lines around all the patterns.



Remove #4 and place it to the left of #3 with the spacer matched and lower the pattern to the mark, weight it down and outline it.

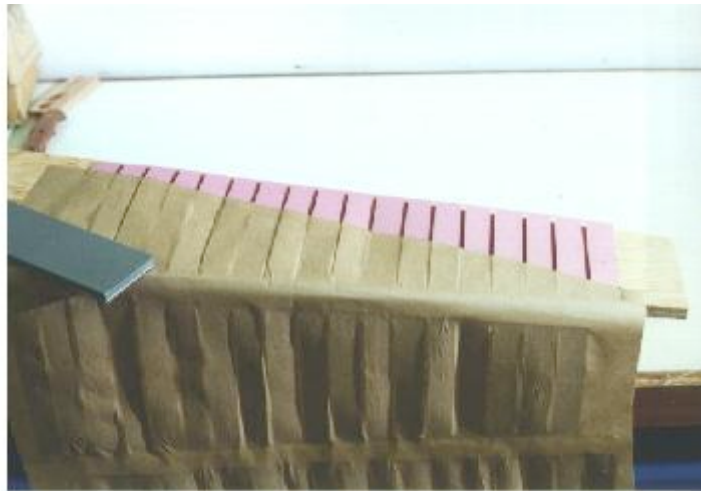


Remove all patterns. The reason for 5 patterns is that #4 and #5 will overlap to produce one pattern. The lines in pattern #4 and #5 are for the over lap, the area with the squigly lines will be cut off. On pattern #5 from the upper left corner make a mark at 15mm towards the right, and on the lower right corner make a mark at 15mm towards the left. Join these two mark down the length of the pattern. On pattern #4 at the upper left corner make a mark at 25mm towards the right and on the lower right corner make a mark at 5mm towards the left. Join these two marks down the length of the pattern.

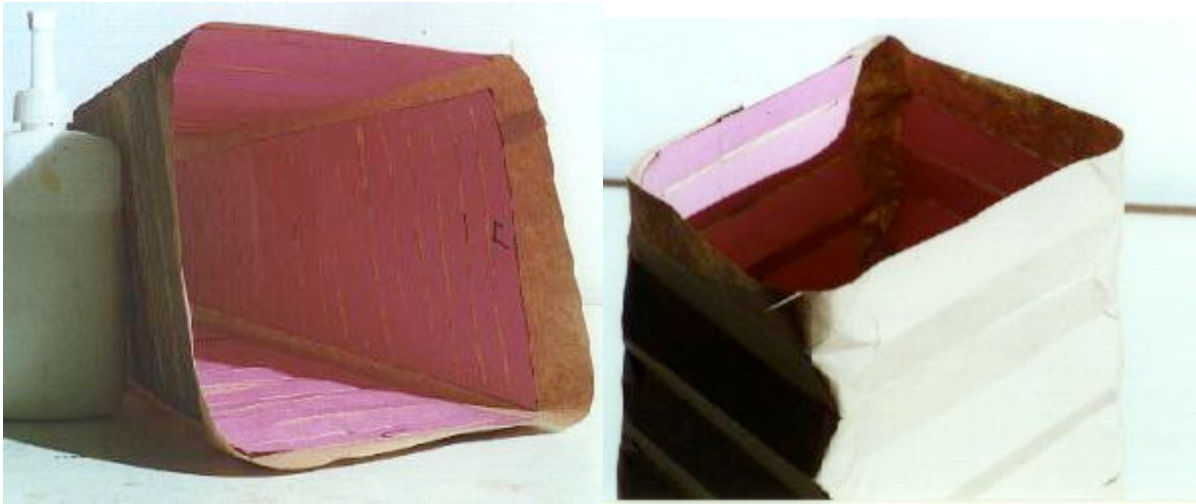


Apply glue to one pattern at a time and place them on the brown paper. On the back side of #4 mark a line 10mm from the edge for the full length, also feel through the paper and outline some of the pattern. It will be easier to glue the overlap in place.

Recently I have been cutting out the inner liner to the exact shape of each panel. While all 4 panel are flat on the table top. Glue the liner on each panel.



To make the overlap joint between the patterns, a piece of plywood about the same size as the pattern but longer is required. Clamp the wood down to a table top, place pattern #4 on the wood and pull the other side of bellows approximately in place and weight it down. Apply the glue and position the paper on the overlap line. Let the glue dry for an hour or so.

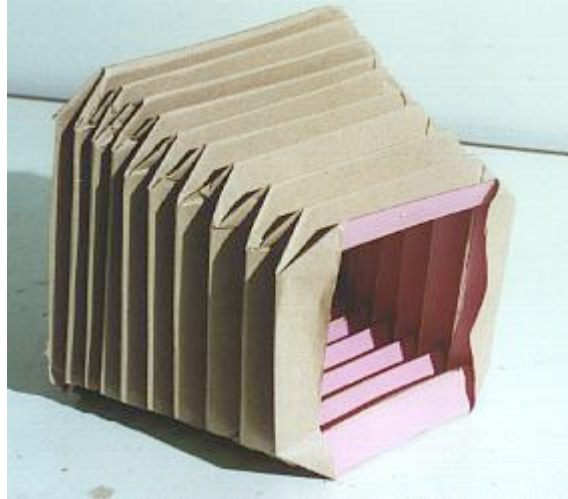


The bellows should look somewhat like these pictures, place the large end down, the upper most web will be the first one to be folded. I took many pictures of the folding process however the pictures do not tell the story, so I will try to explain the process.

Fold the two uppermost webs toward the center of the bellows. With the forefinger and thumb of each hand flatten the first fold, as the folds flatten the second hinges has a tendency to fold toward the inside of the bellows. Rotate the bellows 180° and repeat the first steps. Notice that the hinge on the adjacent side will tend to fold to the outside. Again with fingers and thumbs flatten the hinge. It is now a case of moving around the bellows making the folds flatten down. Don't worry too much about the corners, they will flatten as you proceed down the bellows. After a few rotations of the bellows it will be easier to follow. Remember that if the fold your working on is towards the inside the, the opposite is also to the inside and the adjacent folds are towards the outside.



The corners of the bellows will require some work to straighten out. As in the photo, imagine my right hand (which holds the camera) would be on the corner opposite my thumb. Pull lightly and flatten the seam, then without moving the left hand grasp the next seam and do the same etc etc etc, until all for corners have been done. With small end up, press down evenly with the palms of your hands and flatten the whole bellows. If the real material had been used at this point a weight would be placed on it for a few hours.



With the bellows stretched out it should look similar to the above picture. I recall on several occasions that I had fold one of the faces in the wrong direction. If this has happened to you simply straighten the bellows out and refold it.

As I mentioned at the top of this page, regarding dimensions; if the distance between the patterns is larger than called for the folds will overlap each other more than is necessary and reduce to overall dimensions.

There are more detail about the type of glue and material that can be used. Rather than make this page too long and therefore slow to load I will write another page covering these topics.

I hope that these directions are understandable and you have sucess in making bellows for your camera, enlarger and other applications.

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