



# ***MAKING YOUR BELLOWS***



*René Smets  
September 2014*

## MAKING A BELLOWS FOR A VIEW CAMERA

*I have built wooden view cameras for quite some years now.*

*Making the bellows always was the main challenge. In order to understand all their mysteries, I examined closely several old bellows. I found out that if there are numerous variants, these bellows have all in common their triple layer construction: the inside is made of fine cloth, the middle layer of hard cardboard cut into strips, and the outside of a thin leather layer. I realized quickly that the middle layer was the one shaping the folds of the bellows.*

*I also discovered that, if the first bellows showed 90° angles, from the early 1900s onwards 45° angles were preferred as they were much more resistant to wear.*

*But practically, how were these bellows made?*

*On the internet one can find all kinds of descriptions giving the impression that this is not complicated, but none seems really based on a specific project or practical experience. No way to achieve a valid bellows when following their instructions – at most you get a sort of pleated bag. So I sat down at my drawing table and did my own research. After a few years (I didn't work full time on this ..), I developed a method of making a bellows without problems and with good results.*

*The following, illustrated with sketches and pictures, shows you the way I do this.*



### **A. THE MATERIALS.**

As already stated, a bellows has three layers:

1. a thin black cloth with a paper backing (bookbinder's cloth)
2. 300 gr/m<sup>2</sup> black cardboard in the middle
3. leather, leatherette or canvas on the outside, as thin as possible, but light tight.
4. bookbinder's glue (or double sided tape, but this will add thickness).

See picture P1.

A drawing table or board, with a pantograph and a 45° square can be very useful.

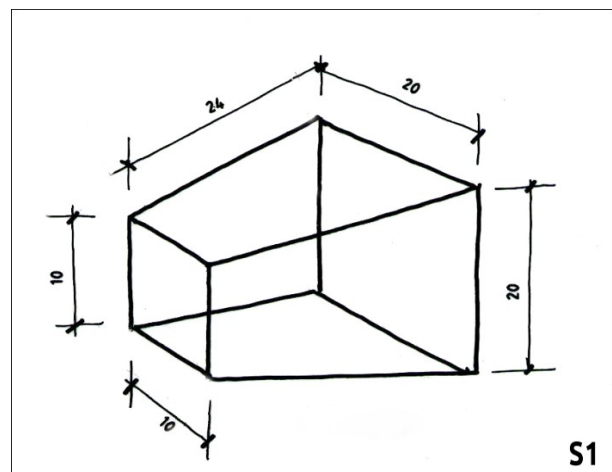
### **B. DRAWING A CONICAL BELLOWS.**

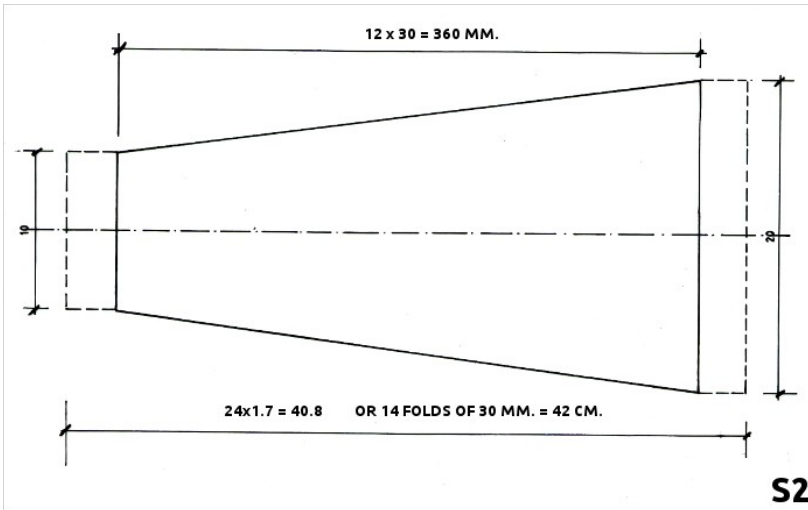
*First of all, we need to know the dimensions.*

*We measure:*

- (a) the inner side of the front standard and the diameter of the lens.
- (b) the rear standard and the ground glass.
- (c) the focal length of the lens when focused at infinity

See sketch S1.





Let's take for example a bellows of:  
 - 10x10 cm. (front)  
 - 20x20 cm. (rear)  
 - focal distance: 24 cm.

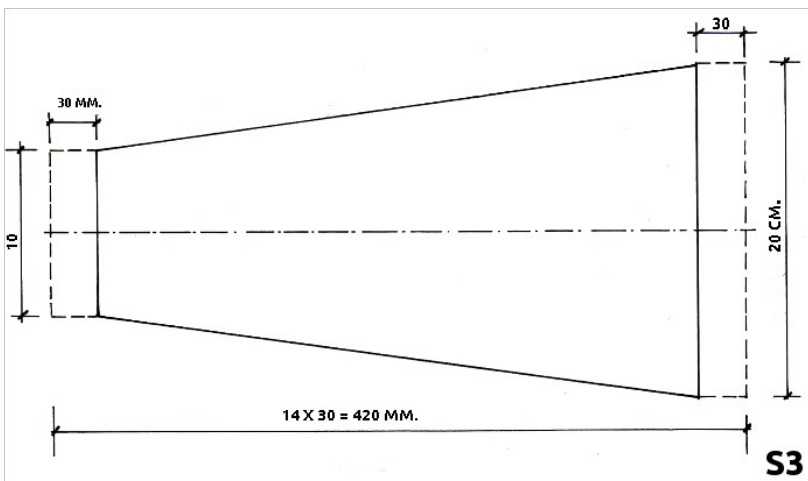
We make following calculations:

A bellows of this size gets folds with a 30mm. distance between two successive tops of them.

To make close-ups possible (still lives, etc.) the bellows must allow for sufficient stretching: to determine this length, we multiply by 1.7 the focal distance. This gives in this case : 24cm x 1.7= 40.8 cm. Dividing that figure by the width of

the folds gives  $408\text{mm} : 30 = 13,6$ , meaning that we should have 14 folds. The first and the last one will be lost when gluing the bellows onto the camera.

See sketch S2.

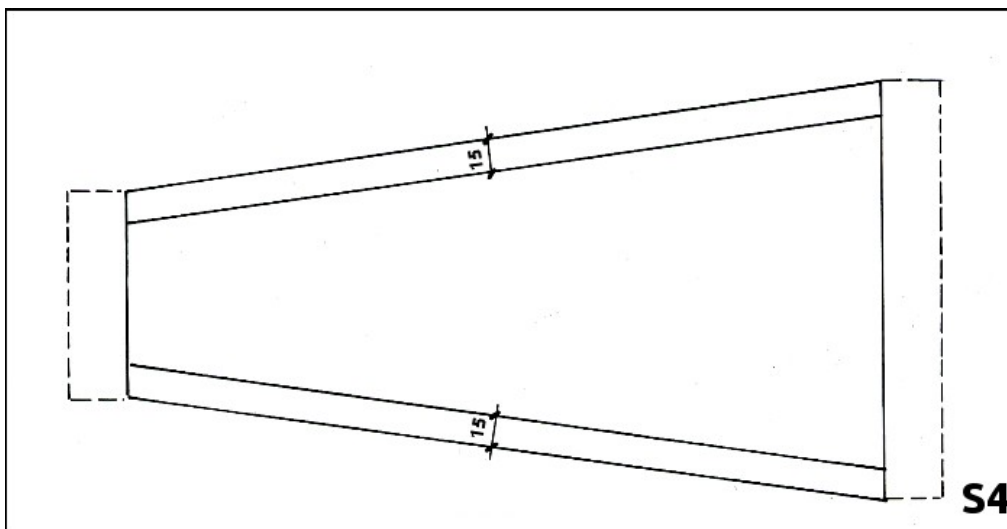


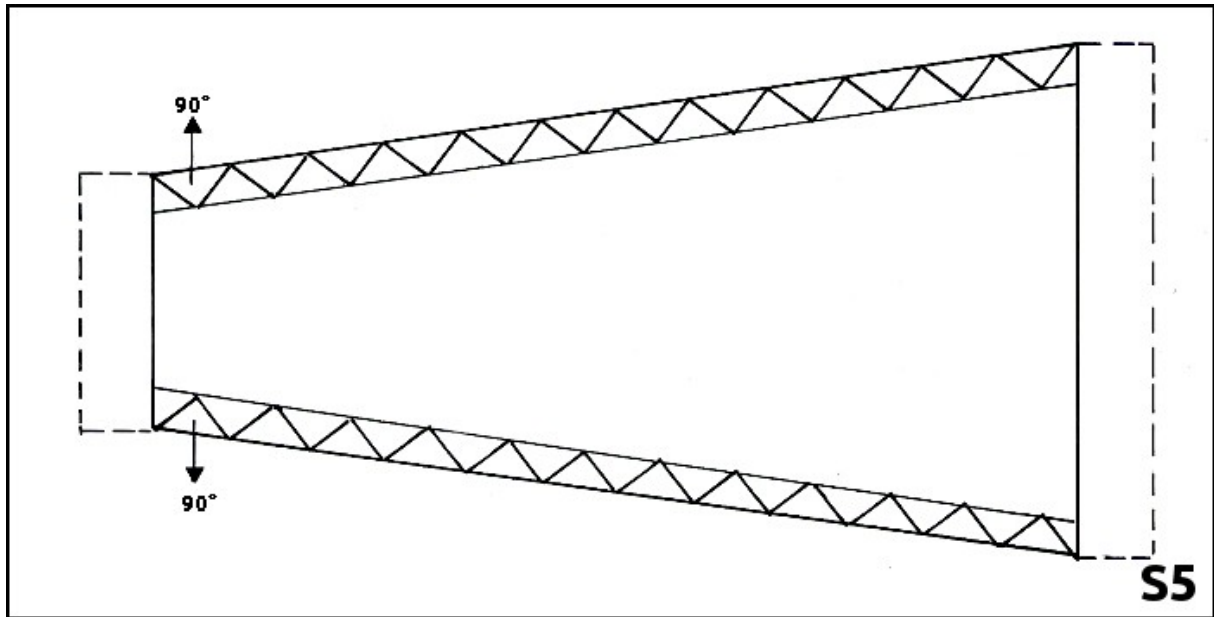
We now have sufficient information to start drawing the pattern of one lateral face of the bellows:  
See sketch S3.

Front face : 10x10 cm  
 Rear face: 20x20 cm  
 Length: 14x30 = 420 mm.

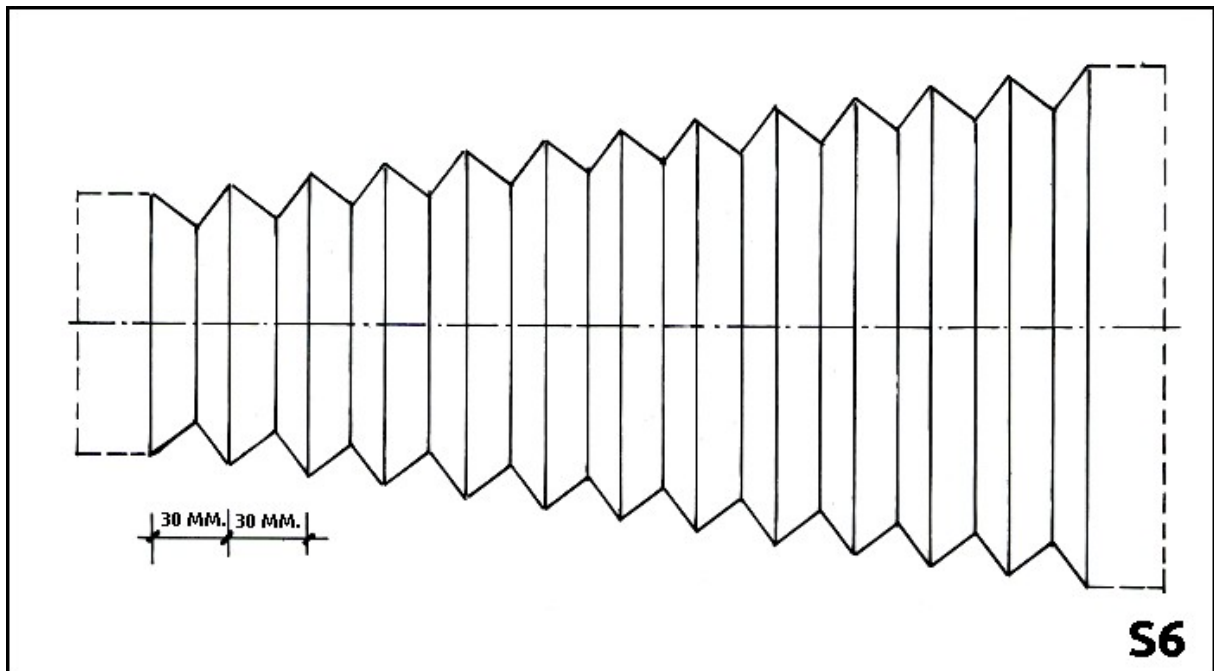
We also need an additional 30 mm. width for the 45° corners.

To secure this, we draw two parallel lines at 15 mm. from both sides: see sketch S4.



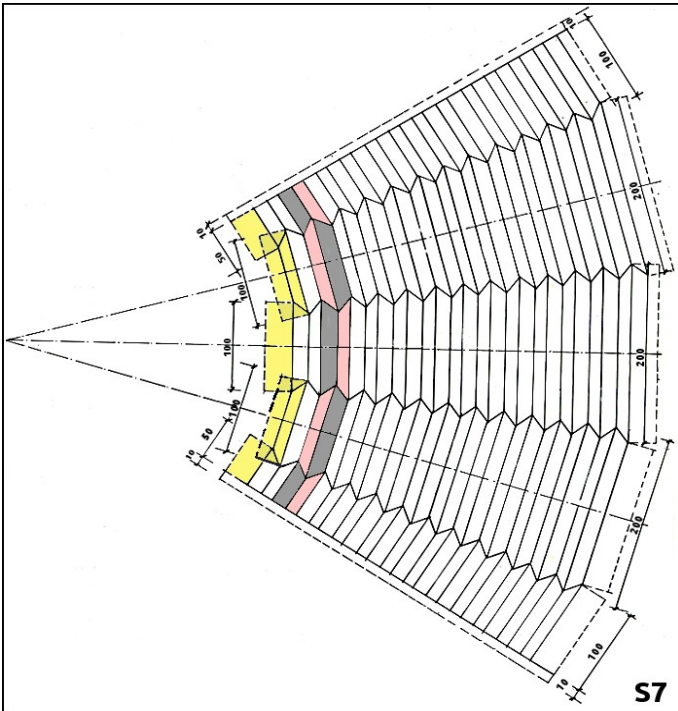


We have to take into account as well that with conical bellows, both slopes of the folds are not equal, the front side being smaller than the rear side. How can their dimensions be determined?  
 By drawing right angles between the 15 mm. distant parallel lines drawn previously. In doing so, we connect the folds' crests by right-angled broken lines. See sketch S5.



We do this on both sides, making sure to invert the direction of the angles. When connecting the summits of the so formed triangles, we obtain the hollows of every fold, and see that both slopes of them are indeed uneven. See sketch S6.

This sketch represents one face of the bellows, and we have now all the materials' sizes we need.



We continue by drawing all four faces next to each other, positioning them in such a way that there is an alternation of narrow/wide slopes when passing from one face to the other. An example of this alternation is shown by the grey and pink colors on sketch S7.

The fourth face of the bellows is not drawn as a whole, but in two halves located at the extremities of the whole set; a gluing margin of 10mm is also added to their outside. One of these margins will be used for the inner cloth layer, the other one for the outer leather layer.

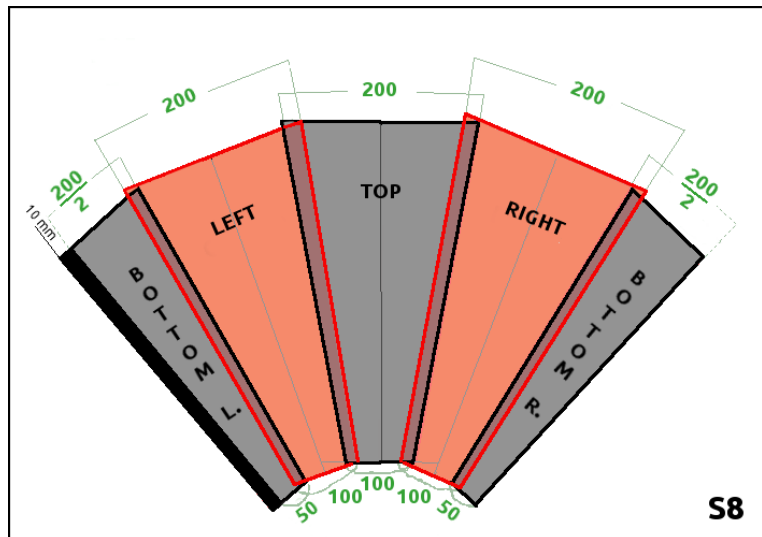
See sketch S7

( yellow: folds lost for the mounting of the front face, grey: wide slope of the fold, pink: narrow slope of the fold - large scale sketch available in annex, page 10)

### C. THE CONSTRUCTION

1- We cut a cloth more or less four times as big as our pattern, and transfer carefully on its paper side the drawing of our pattern by juxtaposing it four times. As already said, the black cloth will stick out by 10mm on one side, for gluing.

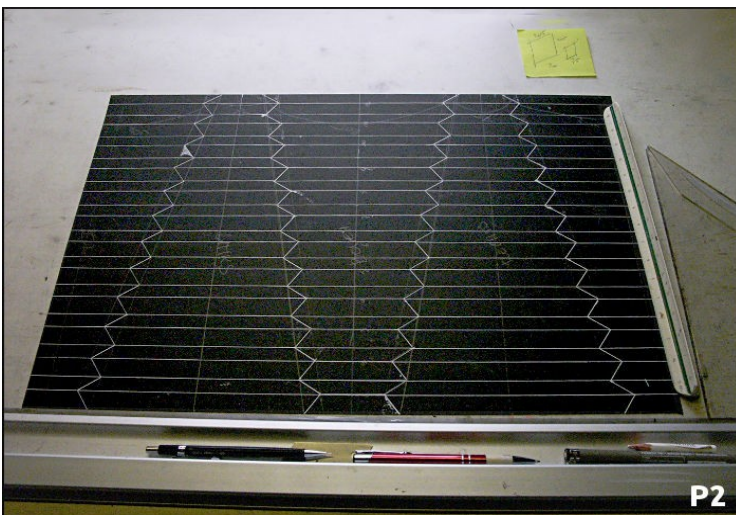
See sketch S8. (large scale sketch as annex, page 11)

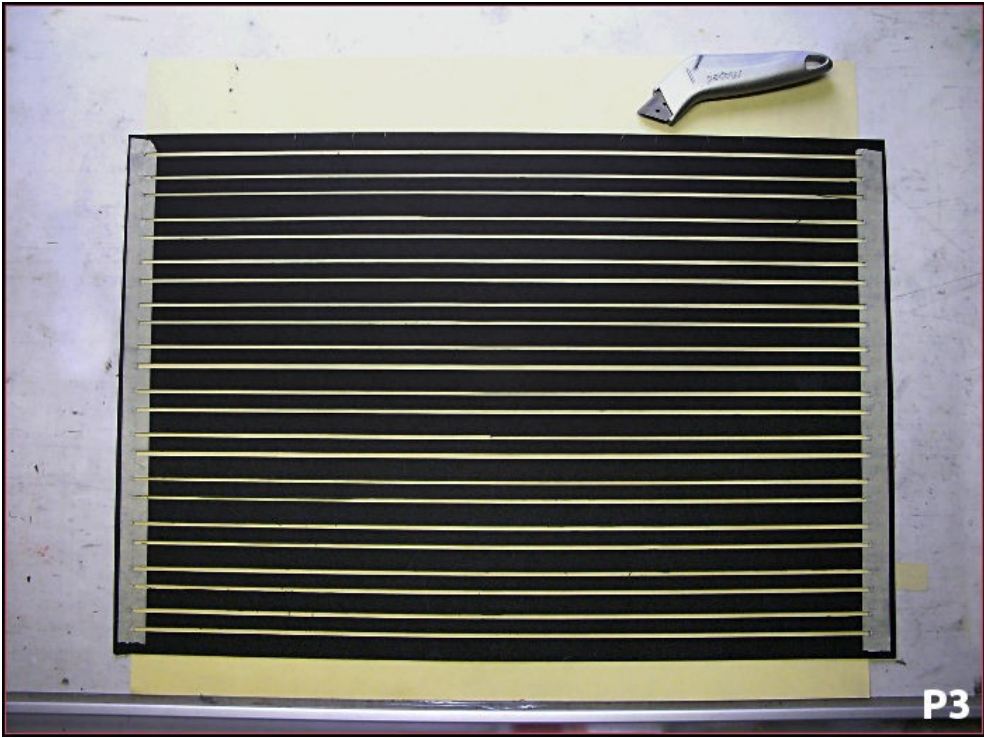


2- Now we make the middle layer of our triple sandwich. We cut from the black cardboard a piece slightly overtaking the four sides once the pattern's pieces are juxtaposed in a top-to-tail arrangement. Three patterns are arranged that way, taking care to leave enough space at the extremities for two half-patterns.

We also draw the lines of the various folds.

See picture P2.





It is advised to draw over all lines with white ink.

We can now cut out the longitudinal lines with a double bladed stencil cutter, taking care to stop the cuts before reaching the edges of the paper, so that all strips stay in position.

I made such a cutter myself, but they can now be found for sale.

See pictures P3-4-5.

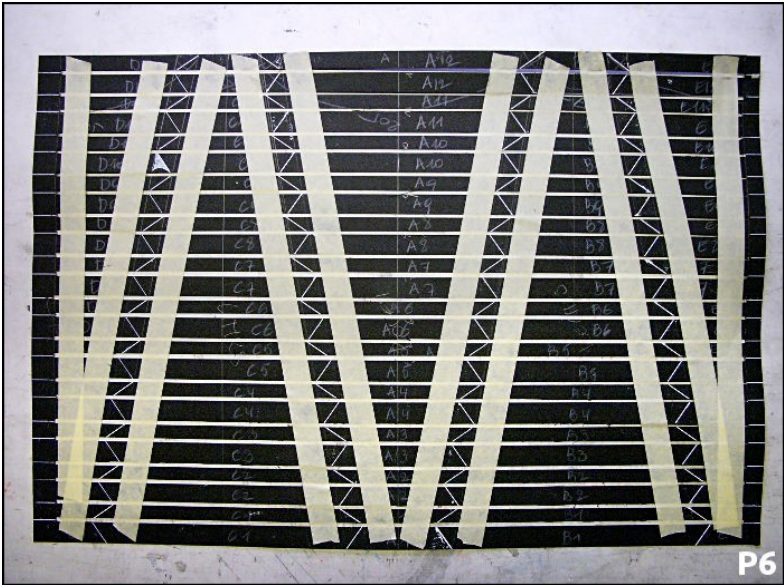
P3



P4



P5

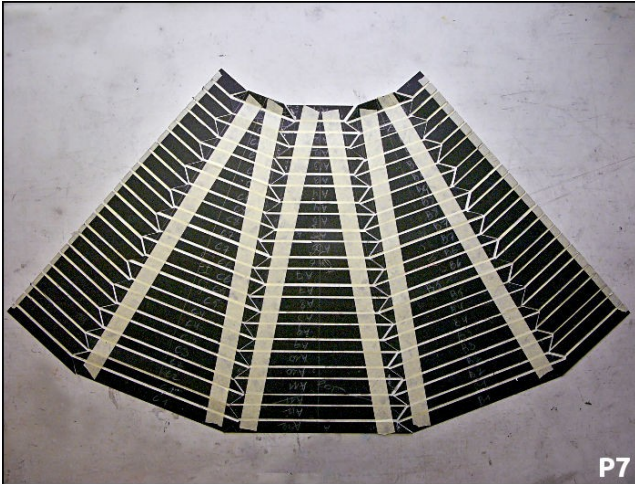


P6

In doing so, our future bellows is now subdivided into strips with alternating widths.

Before continuing our cuts, we fasten these strips with removable adhesive tape, placed along the 90° broken lines.

See picture P6.



We can now cut the 90° angled lines ; this allows to rearrange all faces in the same direction. You can see how the folds have alternate wide and narrow parts.

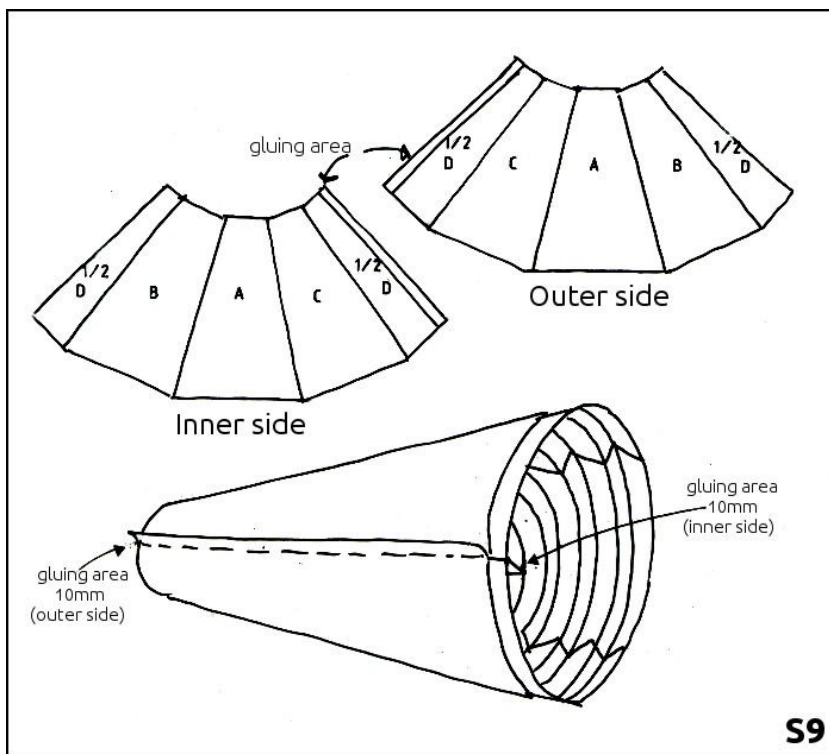
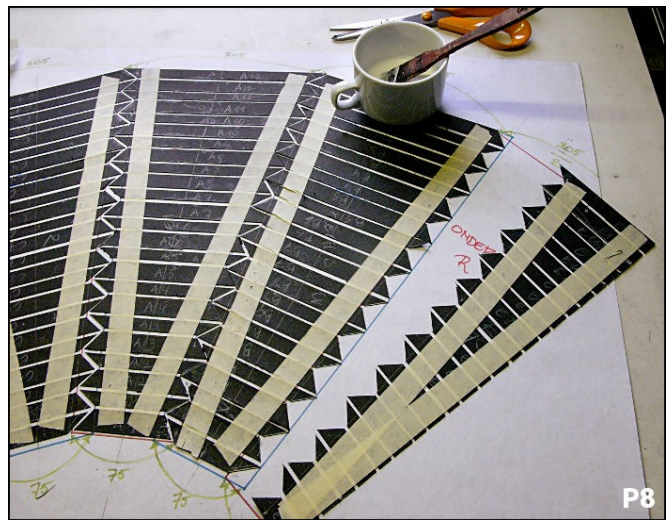
We have now what will form the backbone of our bellows.

See picture P7.

The pieces at the extremities can now be cut so as to form exactly both halves of the fourth panel (no gluing strip for this layer).

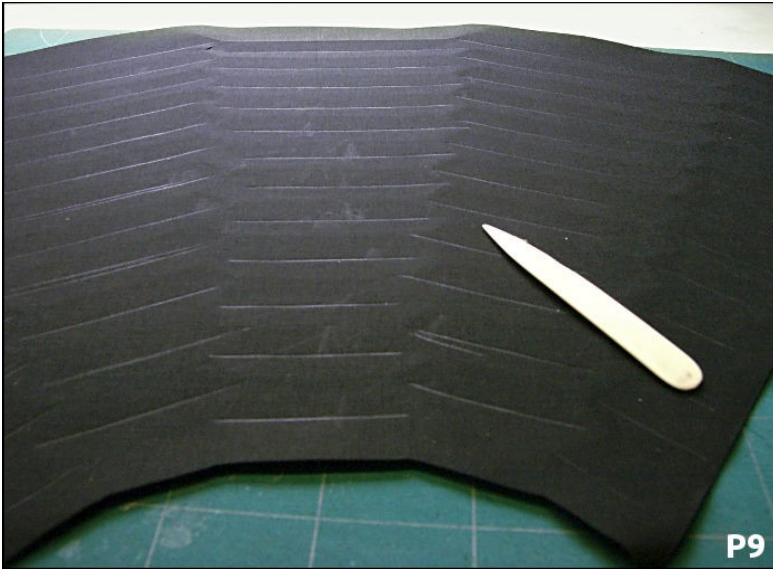
We paste now all these pieces on the paper side of our cloth, carefully following the drawing we made there.

See picture P8.



We can now adjust the cloth side by cutting what overtakes; we watch hereby to leave visible the cloth gluing edge allowing to join on the inside both extremities so as to form a cone.

See sketch S9.



**3-** It is time now to paste the outer layer (leather) on our sandwich, which is made from then on by three layers.

Do not paste yet the two half-faces forming the bottom of the bellows.

Please note that the leather layer also has a gluing strip on one side, which will allow to join both extremities of the leather part on the outside of the cone.

When everything is completely dry, we press on the cloth of the internal layer with a bone folder or a paper knife, so as to have the folds' crests penetrating into the 2mm slits..

See picture P9

Stick now the bellows together to form some kind of cone.

For that purpose, you coat the 10 mm cloth strip with some contact glue, and you do the same on a corresponding width on the other side.

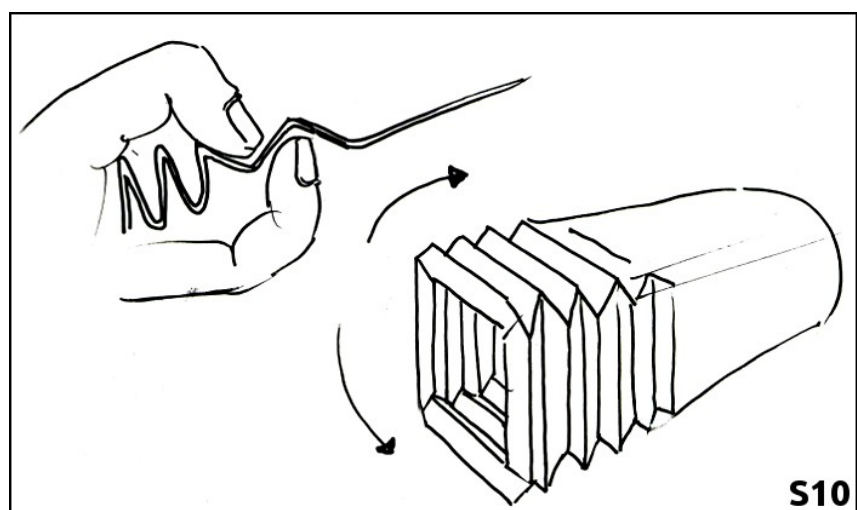
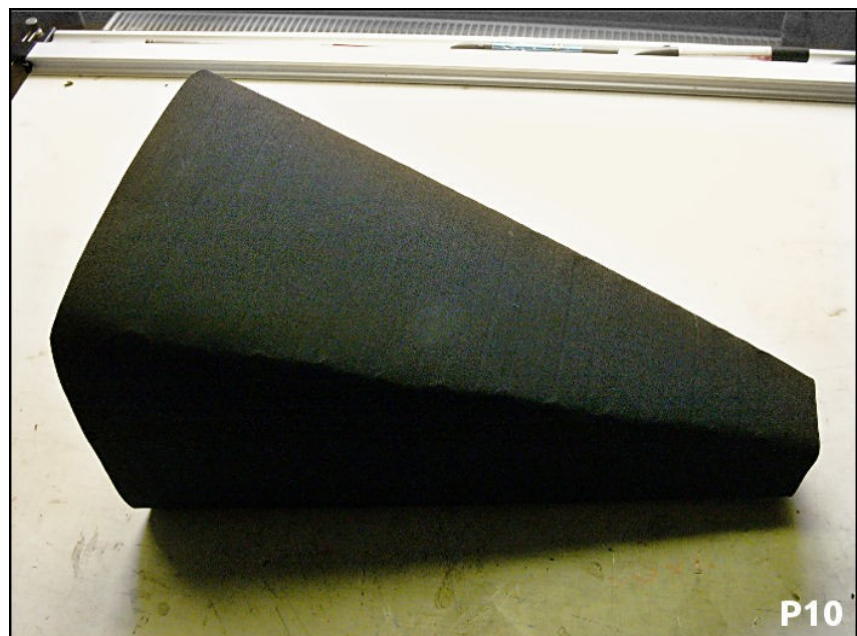
Press firmly both glued strips on each other, making sure that the folds coincide correctly on both sides.

Coat now the leather strips remaining to be glued together and press firmly. When everything is dry, you can begin with folding the bellows.

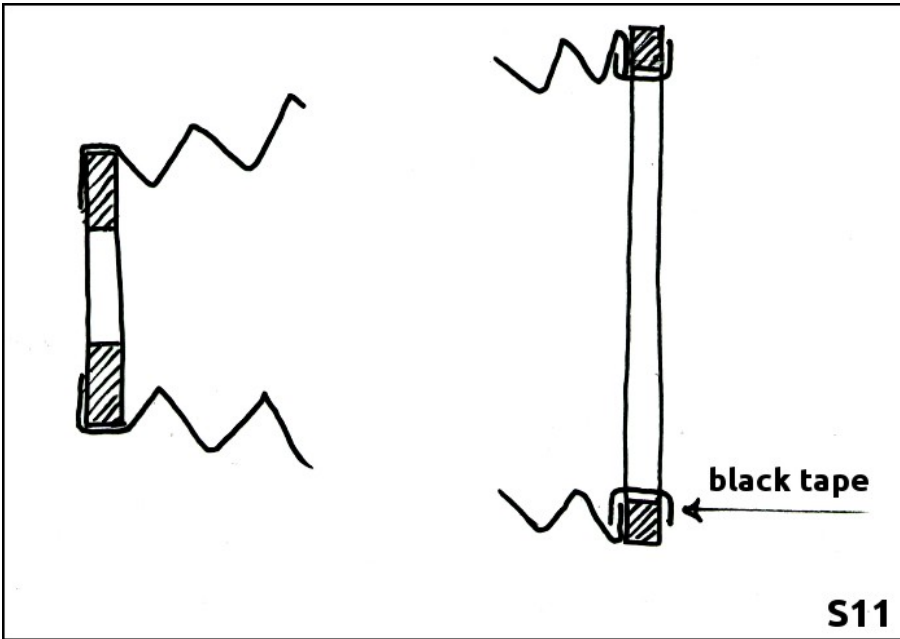
Start from the largest opening, by pushing with some fingers the crest of the fold towards the outside, while pushing inward the low part of the fold with your thumb.

Once the 45° angle is obtained, do the same, but the other way around, with the fold of the next face – and so on until making a complete tour. Do this for all the folds.

See sketch & picture 10







Thanks to the internal cardboard strips, the folds will take automatically their correct shape.

All the folds being made, correct with the bone folder the shape of those less than perfectly set up.

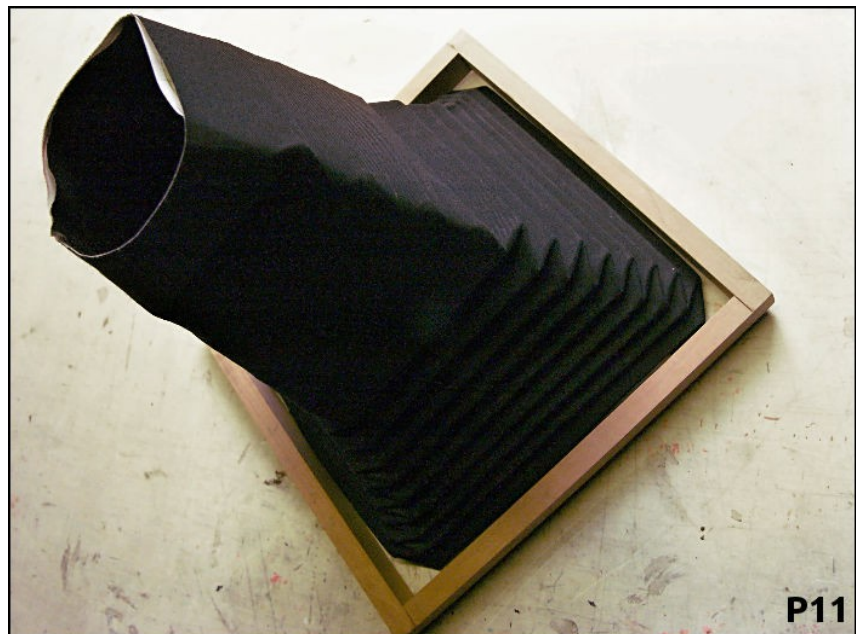
Next task is to paste the bellows to its wooden frames and to apply black adhesive tape on the glued edges of the bellows and the wood, the tape passing through the opening of the frame.

See sketch S11

**S11**

The bellows is now ready to be attached to the body, first on the front standard from inside, then on the rear standard from outside.

See picture P11



**P11**

**On the following page, you can see the result of my research and bellows construction efforts...**



**René Smets**

**September 2014**

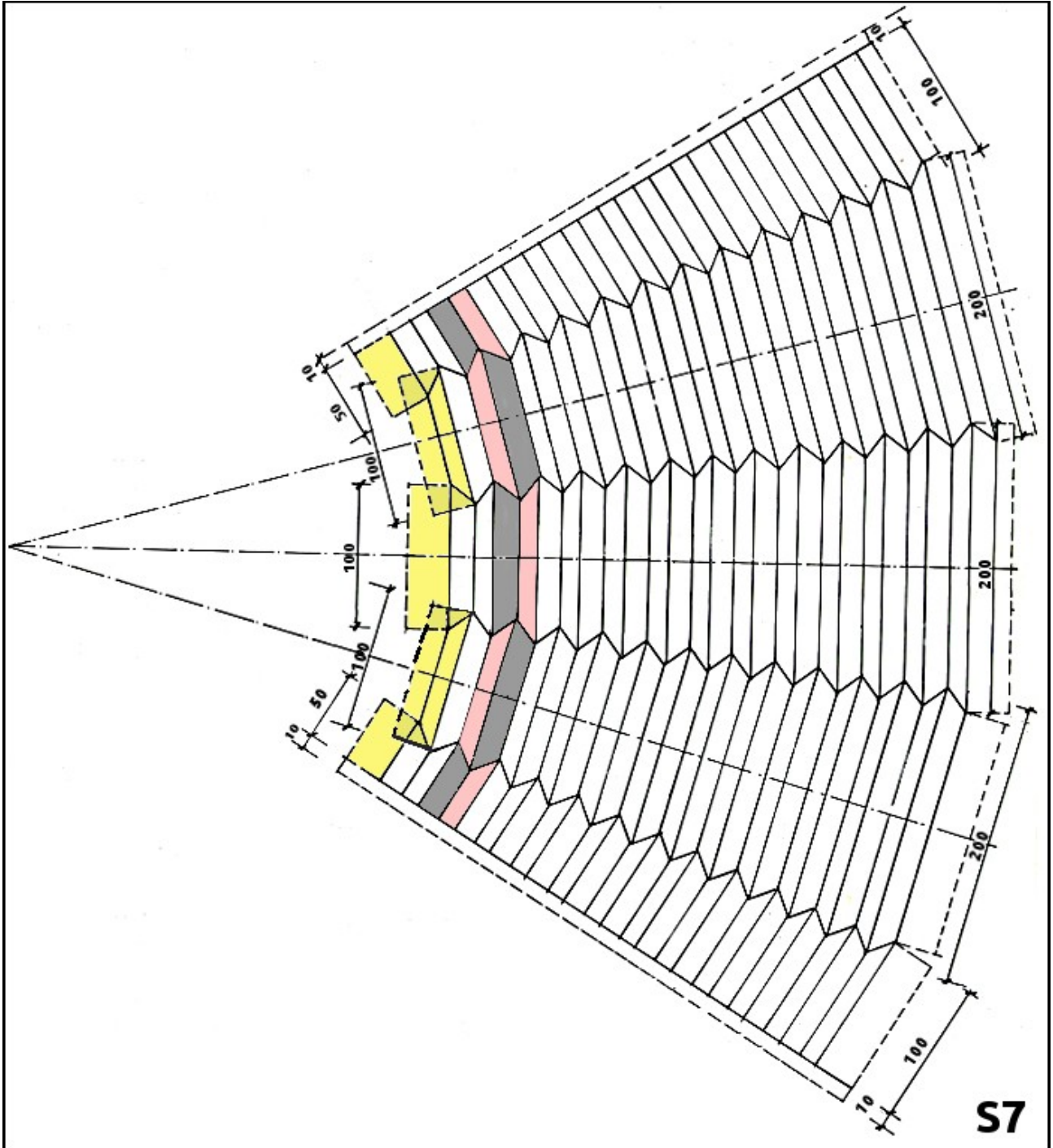
*(translation: Jacques Kevers)*

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Annex 1: sketch 7



Annex 2: sketch 8

