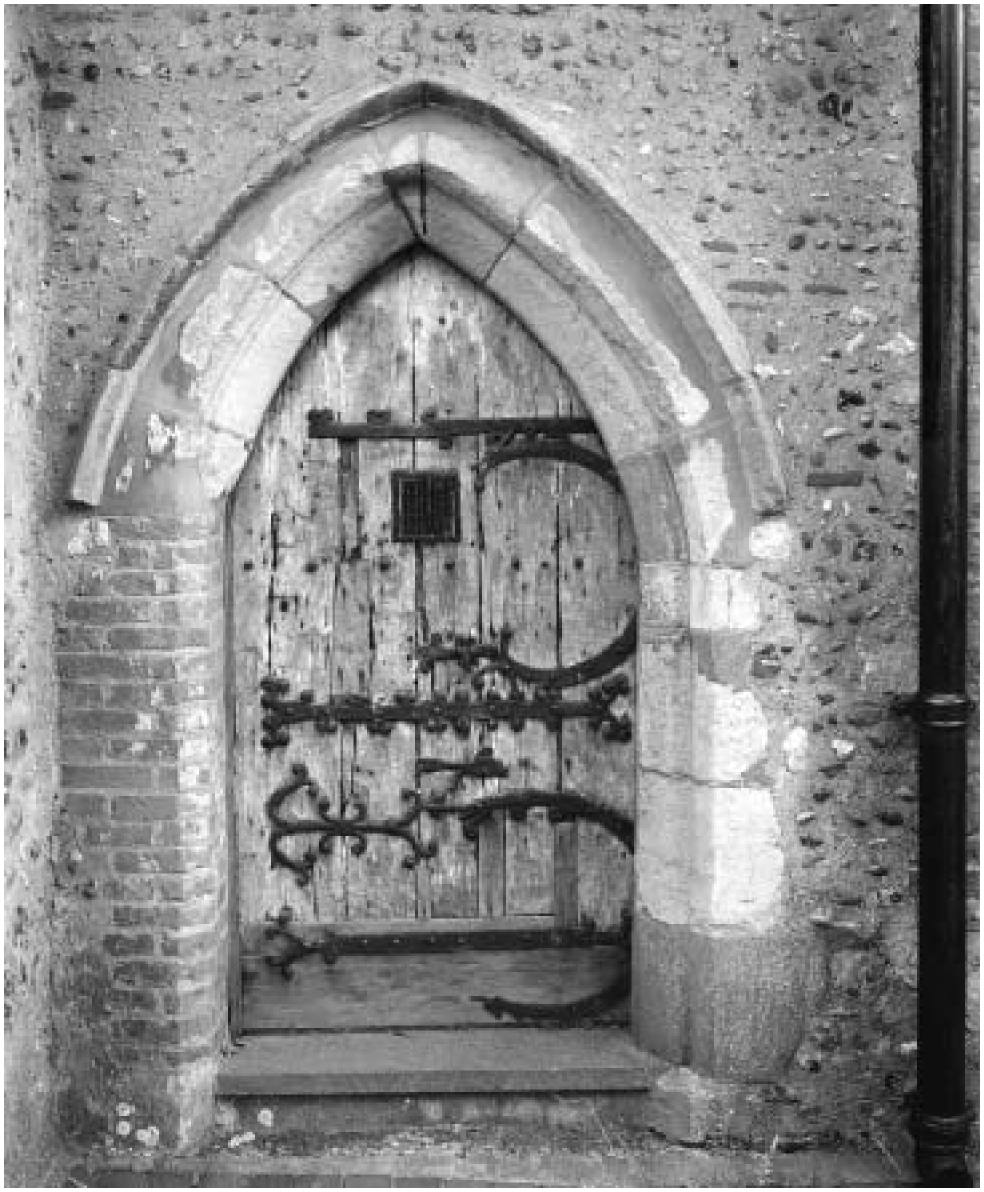
Unsharp Masking

Contrast control and increased sharpness in B&W

by Ralph W. Lambrecht



An unsharp mask is a faint positive, made by contact printing a negative. The unsharp mask and the negative are printed together after they have been precisely registered to a sandwich. There are two reasons to do this, the first being contrast control and the second being an increase in apparent sharpness.

Unsharp masks have been used for some time to control the contrast in prints made from slide film. They can also be used for B&W prints when the negative has an excessively high contrast due to overdevelopment. The mask has typically no density in the highlights, but has some density and detail in the shadows. Fig.9 shows how the sums of the densities result in a lower overall contrast when the mask is sandwiched with the negative.

However, this chapter is not about using an unsharp mask to rescue an overdeveloped negative, but rather to utilize this technique to increase the apparent sharpness of the print. A word of warning may be appropriate at this point. This is not for every negative, but more importantly, it is not for every photographer. It is a labor-intensive task to prepare a mask, and some printers may not be willing to spend the time involved to create one.

The technique is very similar to a feature called 'Unsharp Mask' in the popular image software Adobe Photoshop, but usually takes several hours to execute in the darkroom. The masks need to be carefully planned and exposed with the enlarger light, then developed and dried. Then it needs to be registered with the negative to a sandwich and printed. Batch processing several masks together cuts down on the time involved. Despite the workload, I would not be surprised if once you have seen the dramatic difference it can make, you never print an important image without a mask again. Many fine art photographers make masks for all their important images, and some do not ever print them straight anymore, because few images look better printed without an unsharp mask. You may be less committed, but I hope this chapter will encourage you to try it out.

How it is done

We start with the selection of an appropriate film to generate a mask. Specially dedicated masking film is either not available anymore, hard to come by or very expensive. For this reason, I now propose using either Ilford's Ortho Plus in Europe, or Kodak's TMax in the USA. Other film will probably do fine, but I have not tested them. Ortho Plus from Ilford has the advantage of being able to be handled under a strong red safelight, but it is unfortunately, sometimes hard to find in the USA. I use 4x5 inch sheets exclusively to make masks for all film formats and see little reason to store masking film in different sizes. For me, it is easier to handle and store larger rather than the smaller film sizes.

The enlarger should be set up to allow for an even illumination to the entire baseboard with an empty negative carrier in place. A copy frame is helpful to hold the negative and the mask. Mine is made of plastic and has a gray foam backing with a hinged glass cover. A piece of 1/8 inch glass will do however, if no copy frame is available. Place the mask film, supported by a piece of black cardboard, into the middle of the open copy frame, making sure that the emulsion side of the masking film is facing up, as in fig. 1. Place the negative on top of the masking film, again with the emulsion side facing up. Close the cover or hold the sandwich down with the glass.

The precise exposure may require some testing, but I have given you a starting point, for the two films mentioned, at the end of this chapter. Fig. 1 also shows how, during the exposure, the light passes through the emulsion of the negative first and then through the base of the negative to reach the emulsion of the mask. This base has a typical thickness of about 0.18 mm (0.007 inch) and it also diffuses the light slightly. This effect is responsible for the creation of a slightly unsharp mask. The thicker the base, the more the light is diffused and the mask becomes increasingly unsharp. Ironically, the unsharp mask is responsible for the sharper image when printed later as a sandwich. It is common practice to use clear plastic spacers, available from art supply stores, between the negative and the mask to increase the effect, but I find that it looks unnatural. Therefore, I do not use spacers anymore. However, you may want to experiment with clear plastic sheets of 0.1 - 0.2 mm (0.004 - 0.008 inch) thickness, to find the effect you prefer.

After the exposure, process the mask as you would any other film. The developing times mentioned at the end of this chapter are starting points and they

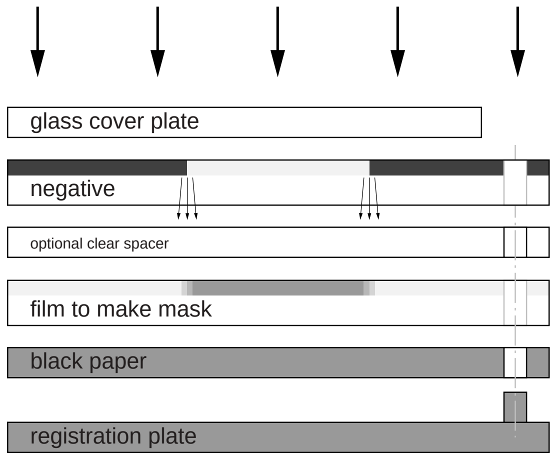


fig.1 Negative and unexposed masking film are placed, emulsion side up, on top of the baseboard. The carefully planned exposure creates a faint and slightly unsharp positive, called the unsharp mask. An optional plastic spacer may control the degree of sharpness.

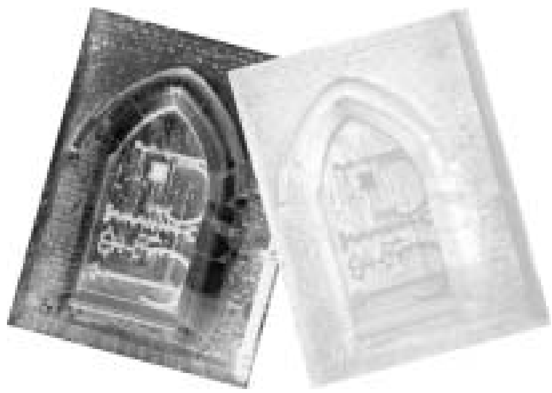


fig.2 Negative and unsharp mask will be printed together as a precisely registered sandwich. This reduces the overall contrast of the negative, but increases edge sharpness and local contrast of the print.

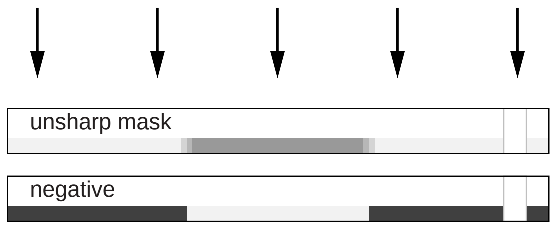


fig.3 The registered sandwich is placed into the negative carrier and printed together with the emulsion side down. The increase in required paper contrast and the 'edge effect' create a sharper image.

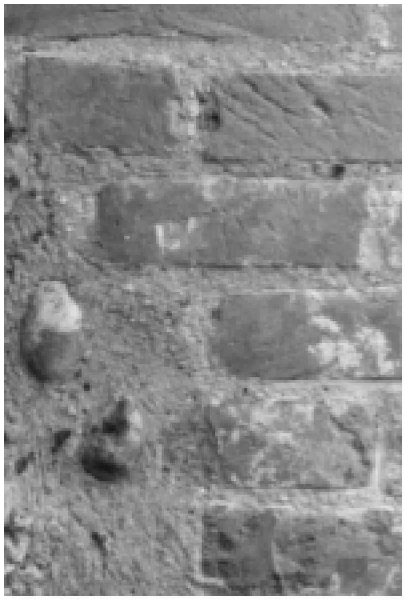



fig.4a-b These two examples show a detail of the brick work to the left of the door. Fig.4a (above) was printed with the negative alone, and fig.4b (above right) was printed with the negative and the mask registered to a sandwich. The increase in local contrast and edge sharpness is minute, but clearly visible. Paper grade 2.5 was used for fig.4a and increased to grade 4.5 for fig.4b to compensate for the reduced contrast of the sandwich.

work well for me. I use a Jobo processor with constant agitation, but your times may differ if you use a different method. Fig.2 shows the negative and the mask for the cover photo.

The negative and the mask are sandwiched, as shown in fig. 3, in order to print them together. Relatively expensive pin registration equipment is available from several sources to do so, but I have never used any of them. Aligning the negative and the mask manually on a light table, with a bit of tape and a loupe, works well with a bit of patience and I suggest you try it first. You may decide that masking is the way to go and then the purchase of such equipment may be a wise investment.

What a difference

The lead image shows the north door of St. Mary of Buttsbury in Essex, one of my favorite English churches. The original negative density required a paper grade of 2.5 and, being taken with a 4x5 camera, produced a rather sharp image. The image reproduced in this chapter was printed including the mask and it reduced the contrast of the sandwich to the point that a paper grade of 4.5 was necessary. The result is significantly sharper then the print from the negative alone. The enlarged details of fig. 4 and 5 demonstrate the difference well. You can probably guess that figures 4b and 5b were printed with the mask.

In order to be fair to the original image and not to generate unrealistic expectations, it must to noted that the difference is much more obvious when the two techniques are compared side to side. The original print is very sharp in its regular size of 11x14 inches, but the masked negative produced a print of increased local contrast, clarity and apparent sharpness.

Why it works

It might interest you why unsharp masks work, now that we know how it is done and what a difference it can make. I am aware of two governing phenomena for unsharp masks to increase sharpness.

You have probably noticed the first phenomenon during regular darkroom work already. A print just looks sharper when printed on a higher contrast paper. Figures 6 and 7 demonstrate this effect in form of an example and a diagram. In both cases, the same negative was printed onto paper of different contrast range. The same effect can be observed when the highlights are printed darker. This is similar to using a higher contrast paper, because the increased exposure

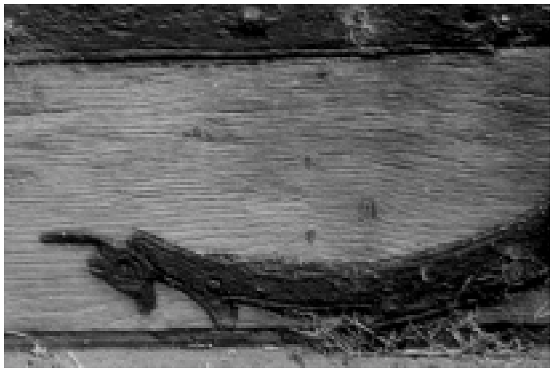



fig.5a-b These two examples show a detail of the lower right hand side of the door. Here the difference in sharpness is clearly visible between negative fig.5a (left) and sandwich fig.5b (far left).

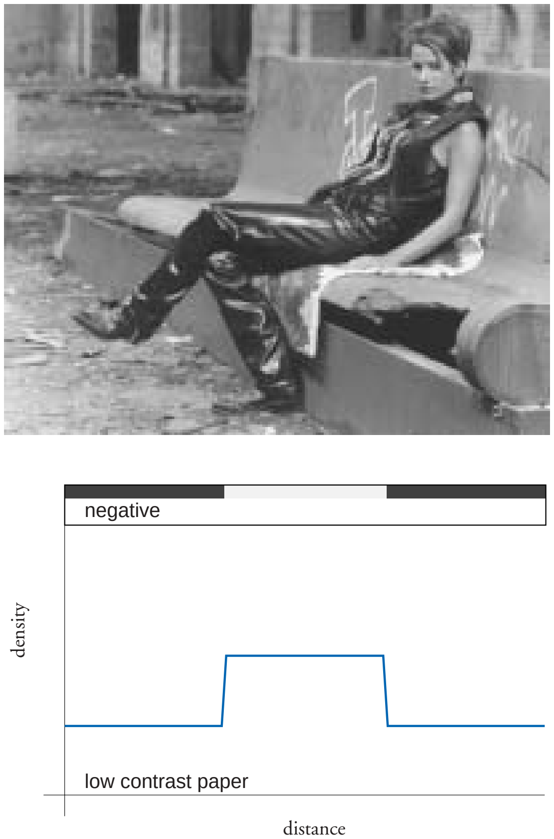


fig.6 A negative printed onto low-contrast paper creates a modest difference in density between shadows and highlights.

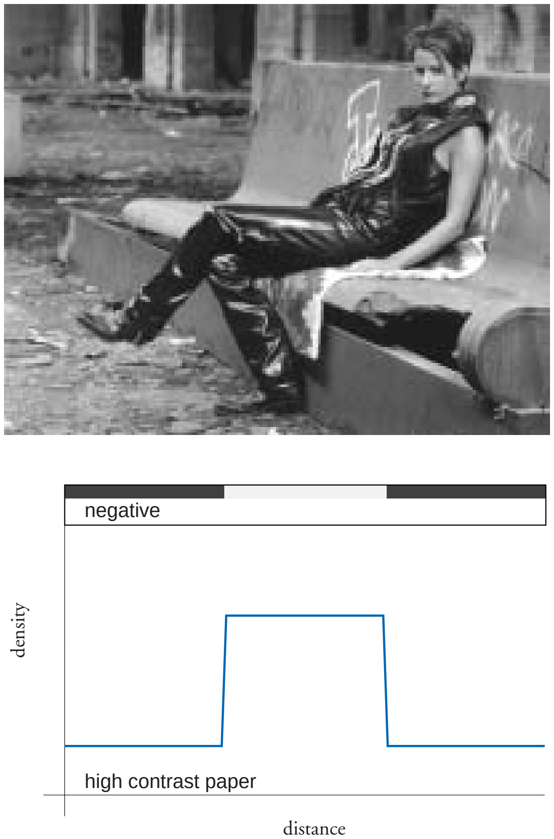


fig.7 A negative printed onto high-contrast paper creates an increased difference in density between shadows and highlights. The increase in contrast makes the image appear to look sharper.

causes the density in the darker highlights (Zone VII) to increase more quickly than in the brighter highlights (Zone VIII), due to their relative location on the toe of the characteristic curve. In either case, the result is either a local or an overall contrast increase.

The second phenomenon is explained in fig.8 and I like to refer to it simply as the 'edge effect'. You see the negative and the mask sandwiched together. Looking at the sandwich density and reading from left to right, there is a relatively high density up to point 1, responsible for a relative low density in the print. At point 1 this changes, because the fuzzy edge in the mask causes the sandwich density to increase up to point 2, while the print density is lower than the adjacent highlights. Of course, at point 2 things change again, because the sharp negative edge is now switching to

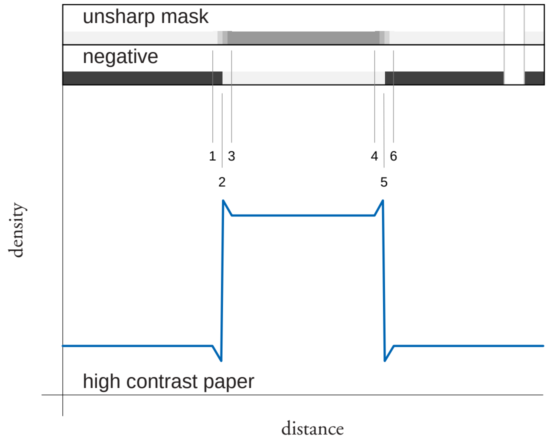
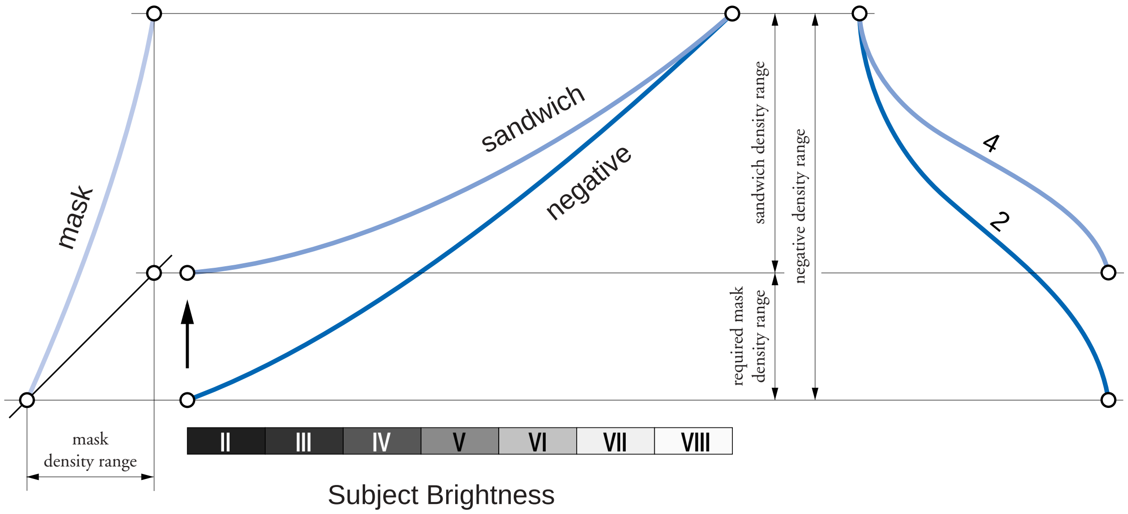


fig.8 A higher contrast paper is required when the negative is printed with the mask. Additionally, the 'fuzzy' edges of the unsharp mask increase the density difference and create an 'edge effect'.

fig.9 A typical negative has a high density range and requires a paper grade 2 to print well. A mask can reduce the shadow density while not affecting the highlight density. The resulting sandwich prints well on a higher paper grade while raising local contrast and sharpness.



the shadow area and the print density increases sharply. However, the fuzzy mask does not reach its highest density until point 3 where the print density finally settles. The reverse effect can be observed from point 4 to point 6, at which the print reaches the final highlight density again.

In summary, when using an unsharp mask, a higher paper grade is required, due to the contrast reducing effect of the mask, which creates an 'edge effect' at the boundaries of highlights and shadows. Both phenomena work together to increase the apparent sharpness of the print.

Planning a mask

This section of the chapter is aimed to guide you in the successful planning of the exposure and development of the masking film. I made a special effort to consider photographers, who are fortunate enough to own a densitometer, as well as the more traditional darkroom enthusiast, who is more familiar with paper grades. In both cases, we will determine the original negative characteristics, and then design a mask to change it to a desired sandwich characteristic. Fig.9 and fig.10 will work in combination with each other to help with the understanding of the process, the evaluation of the negative and the design of the mask.

We will begin with the evaluation of the overall density range of the negative to be printed. If you have a densitometer, take a density reading of the important highlights and shadows and calculate the difference. Fig.10 suggests a negative density range, if you know the paper grade at which the negative printed well. For example, let's assume that you determined a negative density range of 1.05, which is equivalent to a paper grade 2 as shown in the table. Now estimate how much the local contrast needs to be raised. This depends on the image itself, your intent for the image and your personal taste, but raising the paper contrast by two grades is usual. To continue our example, you want to raise paper contrast from grade 2 to 4, which requires a mask density range of 0.35 as shown in the table.

The graphs in fig.11 will help you with the exposure and the development of the masking film. The development times are starting points, which were tested with my Jobo processor and constant agitation in my darkroom. We will use the previously determined negative and mask density ranges to find

negative density range	paper grade	sandwich paper grade				
		1	2	3	4	5
1.55	0	0.25	0.50	0.70	0.85	1.00
1.30	1		0.25	0.45	0.60	0.75
1.05	2			0.20	0.35	0.50
0.85	3				0.15	0.30
0.70	4					0.15
0.55	5	mask density range				

fig.10 Negative density range and paper grades have a defined relationship. A target paper grade for the sandwich will determine the required mask density range.

the appropriate development time. The negative density range is on the vertical axis and the mask density ranges are plotted as individual curves from 0.3 to 0.7 in 0.1 intervals. In our example, assuming Kodak's TMax-400 for a moment, picture a horizontal line at 1.05 negative density. Then, interpolate a curve between 0.3 and 0.4 to represent a desired mask density of 0.35 and estimate the intersection with that horizontal line. This gives a development time of about 7.5 minutes. The exposure index changes with the development time and the table to the right recommends an EI of 160 for a 7.5-minute development time.

The exposure times for both films are assumed to be 1/4 of a second given an illumination of EV of -3.0 on the baseboard. I have used a Durst color head with a halogen light source, no filtration, and again your conditions may vary, but it should be a good starting point. The other assumption is a negative highlight density of 1.37, my standard density for Zone VIII•5, and the exposure must be changed to reflect the highlight density of the target negative. This is easy, using a densitometer, since a density of 0.3 is equivalent to 1 stop of exposure. Bracketing the exposure is advisable without the use of such a tool.

As you may have noticed, I have chosen to use rather short exposure times, below 1 second, to stay within the reciprocity window of the film. Therefore, I mount one of my large format taking lenses to my enlarger. This assembly allows me to use the shutter to get any of the typical exposure times between 1/500 and 1 second. Typical enlarger timers do not allow precise timing in this range, and I suggest using longer times of several seconds if you cannot utilize a large format taking-lens. Modify the illumination by changing the aperture of your enlarging lens, and perform your own tests to get the right exposure and contrast of the mask. Be aware that the reciprocity failure of conventional films may generate an increase in contrast if the film is exposed longer than 1 second. Modern films, like TMax, Delta and FP4 are less sensitive to this effect.

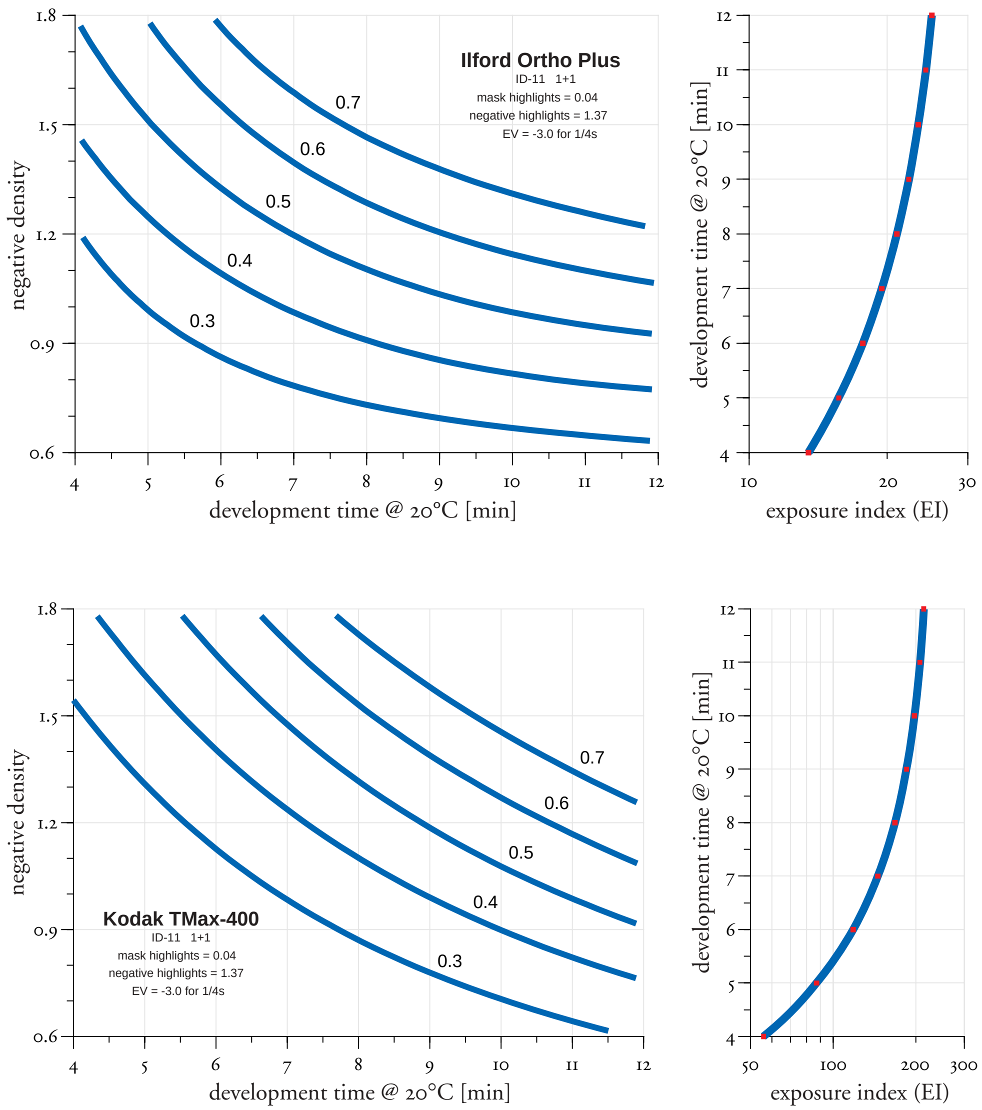


fig.11 Planning a mask is easier with starting point values for development time and exposure index for two films. The input variables are negative and mask density ranges.