

Suggested Procedure – QAI- 365

Procedure for calculating and applying a flatfield correction to scanned images of GAFCHROMIC[®] dosimetry films.

Rev 0.3

I. PURPOSE

For use when doing dosimetry on scanned images of GAFCHROMIC dosimetry films.

II. SCOPE

This QAI describes a procedure for calculating and applying a flatfield correction to scanned images of GAFCHROMIC[®] dosimetry films.

III. EQUIPMENT AND MATERIALS

1. Exposed sheets of GAFCHROMIC[®] dosimetry film – films should be the same size
2. An unexposed sheet of GAFCHROMIC[®] dosimetry film of the same size and from the same lot as the exposed films.
3. Film scanner – preferably 16-bit or greater response but no less than 12-bit capability in each measurement channel, e.g. greyscale, red, green, blue.
4. Scanner control software. This is usually supplied by the scanner manufacturer. Alternatively software such as ImageAcquisition (www.ispcorp.com) is especially useful with Epson and Microtek flatbed RGB color scanners.
5. Dosimetry or image analysis software, e.g. Picodose TA (Tecnologie Avanzate, Torino, Italy), FilmQA (www.3Cognition.com), Mira AP (www.axres.com), Photoshop (www.adobe.com), etc.

IV. PROCEDURE

1. The procedure that follows describes the use of an Epson Expression 1680 professional transparency film scanner and Epson Scan software. However, the procedure can easily be adapted to other scanners and software as well as to scanning done in reflection mode. Since it will be necessary to perform image arithmetic, it is best to produce a set of scanned images that are all the same size so that mathematic operations can be done on a pixel-by-pixel basis. For example, the pixel value in the first image is divided by the value of the corresponding pixel in the second image.
2. Confirm that the lot number and the size of all exposed and unexposed films are the same.
3. Determine the orientation of each film so that all films are scanned in the same orientation.
4. Looking at the scanner, the film is placed on a rectangular glass bed. The top and bottom edges are shorter than the sides. The scan starts at the top edge and finishes at the bottom edge. Note that on the Epson Expression 1680 Professional the maximum scan area is smaller than glass bed and is offset to the top right corner. Marks at the top left edge and near the bottom of the sides mark the maximum size of the scan area.
5. Place a film on the glass centered left-to-right in the scan area and at the top of the scan bed.

The following steps describe the set-up and operation of the Epson Scan software. The procedure provides for the disabling of image adjustment functions, the delineation of the scan area the saving of these settings so they can be recalled for future use.

6. Steps 7 to 11 describe the procedure for setting up the scanner options for the first time. If this has already been done, skip to Step 12.

7. With Epson scanners having a transparency adapter you will see window similar to that in Figure 1 when you scan for the first time. Set the menu options to:

“Professional Mode”

“Current Setting”

“Transparency”

“Positive Film”

“48-bit Color”

Then:

Enter the spatial resolution desired for scanning. Recommend 75 dpi.

Uncheck the options for “Unsharp Mask Filter” and “Descreening Filter”

In the dropdown menu by the side of “Preview” make sure to check “Normal”

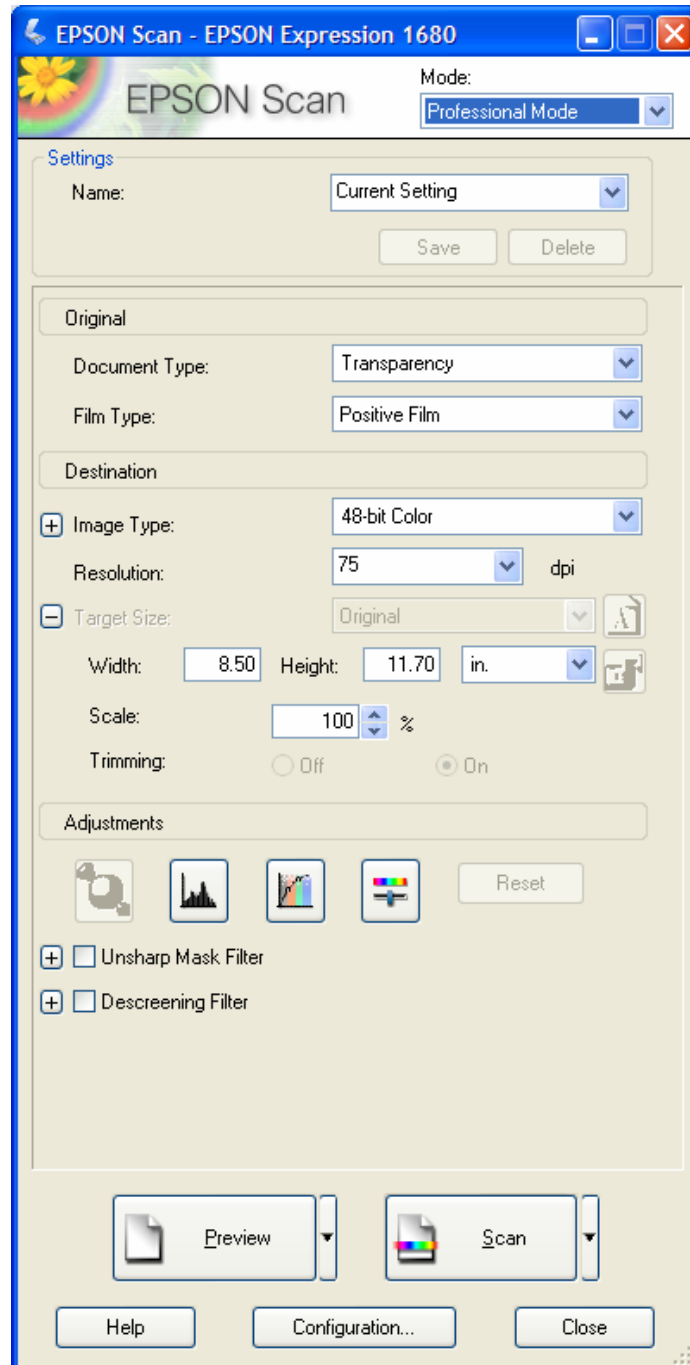


Figure 1

8. Open the “Configuration Window”.

Under the “Color” tab (Figure 2) check “**No color correction**”

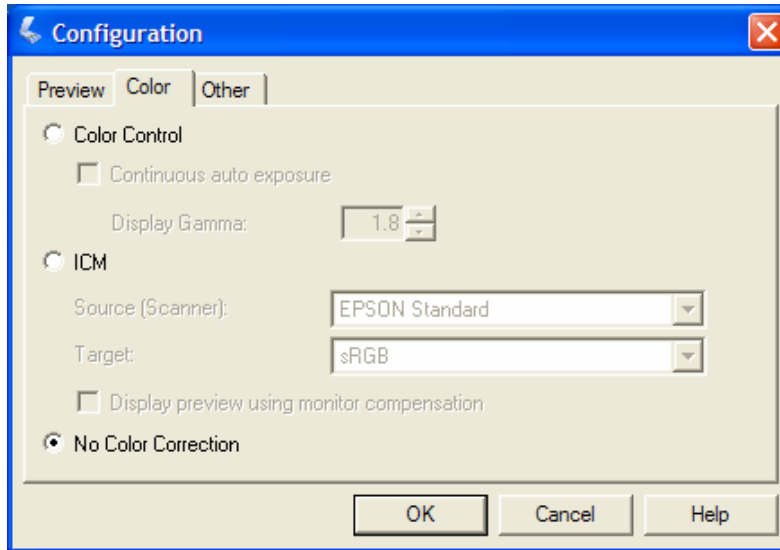


Figure 2

Under the “Other” tab (Figure 3) check “**Save settings**”

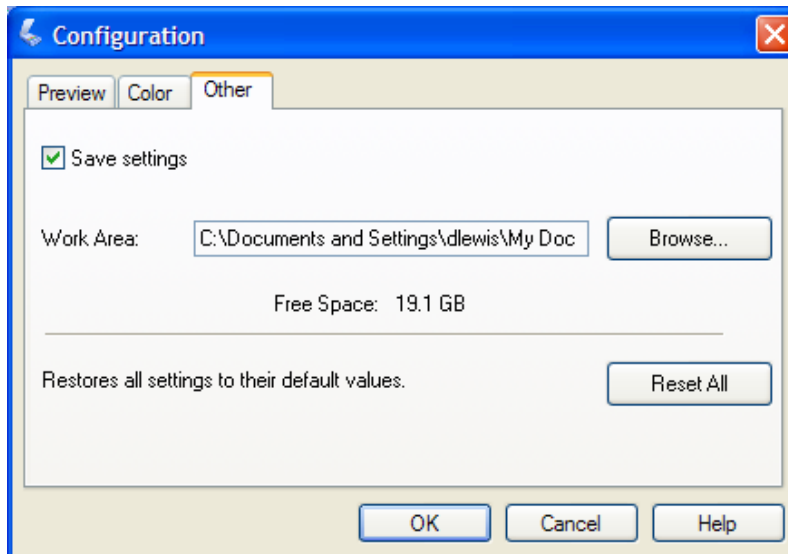


Figure 3

After closing the “Configuration Window” the “Scan Window” should look similar to Figure 4.

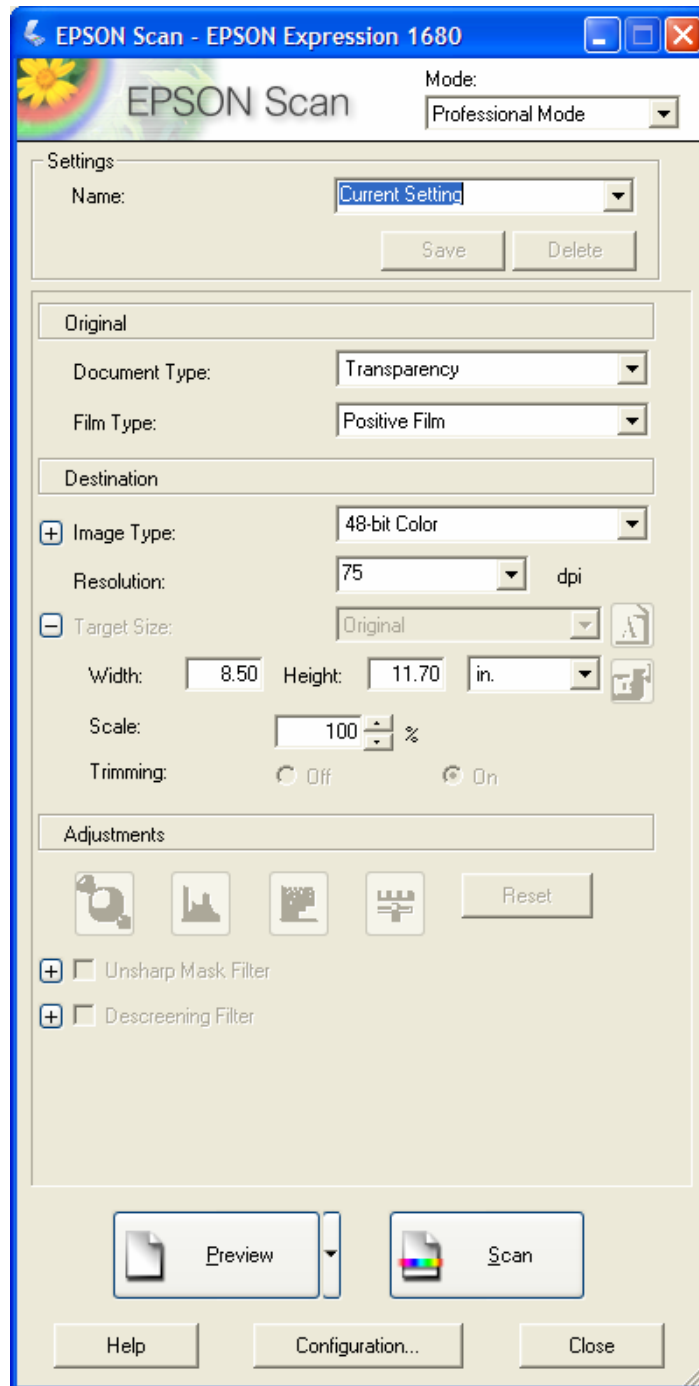


Figure 4

9. With an EBT film placed on the scanner at the top of the scan glass and centered left-to-right, make a “Preview” scan. The “Preview” window will open with the film image. If necessary adjust the position of the film left-to-right to center it and re-take the “Preview” image. In Figure 5 note that in the “Adjustments” area of the left hand window no buttons are activated. They were disabled by unchecking “Continuous auto exposure” and checking “No color correction” in Step 8, Figure 2. Color correction and auto-exposure are **undesirable** for dosimetry because they re-scale the scanner response for each image.

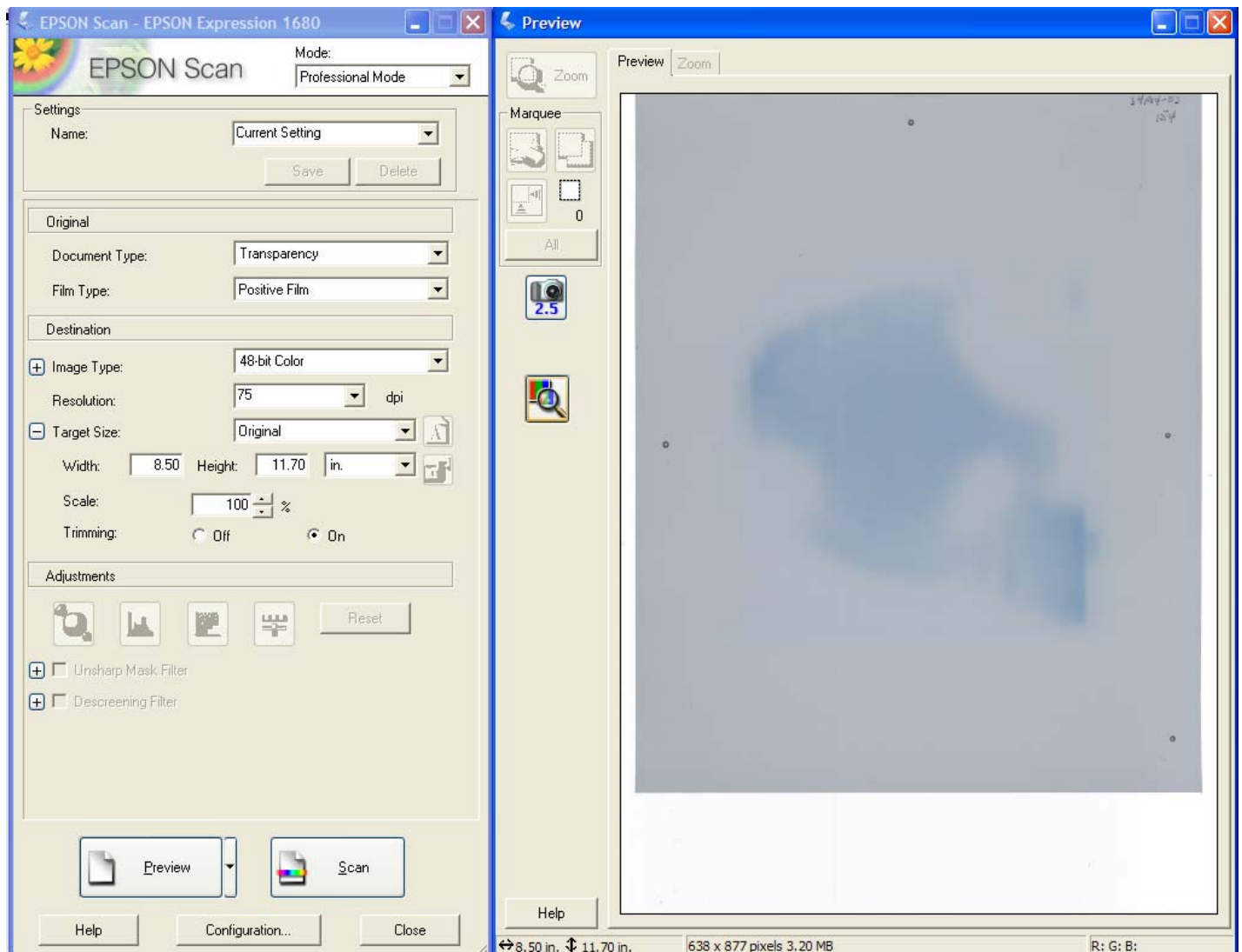


Figure 5

Useful tip: Once the film has been centered, it will help in positioning subsequent films if you mark the border of the scan window to indicate the location of the film edges.

10. Place the cursor in the “Preview” window and draw an area of interest at the border of the film image as shown in the right hand window of Figure 6.

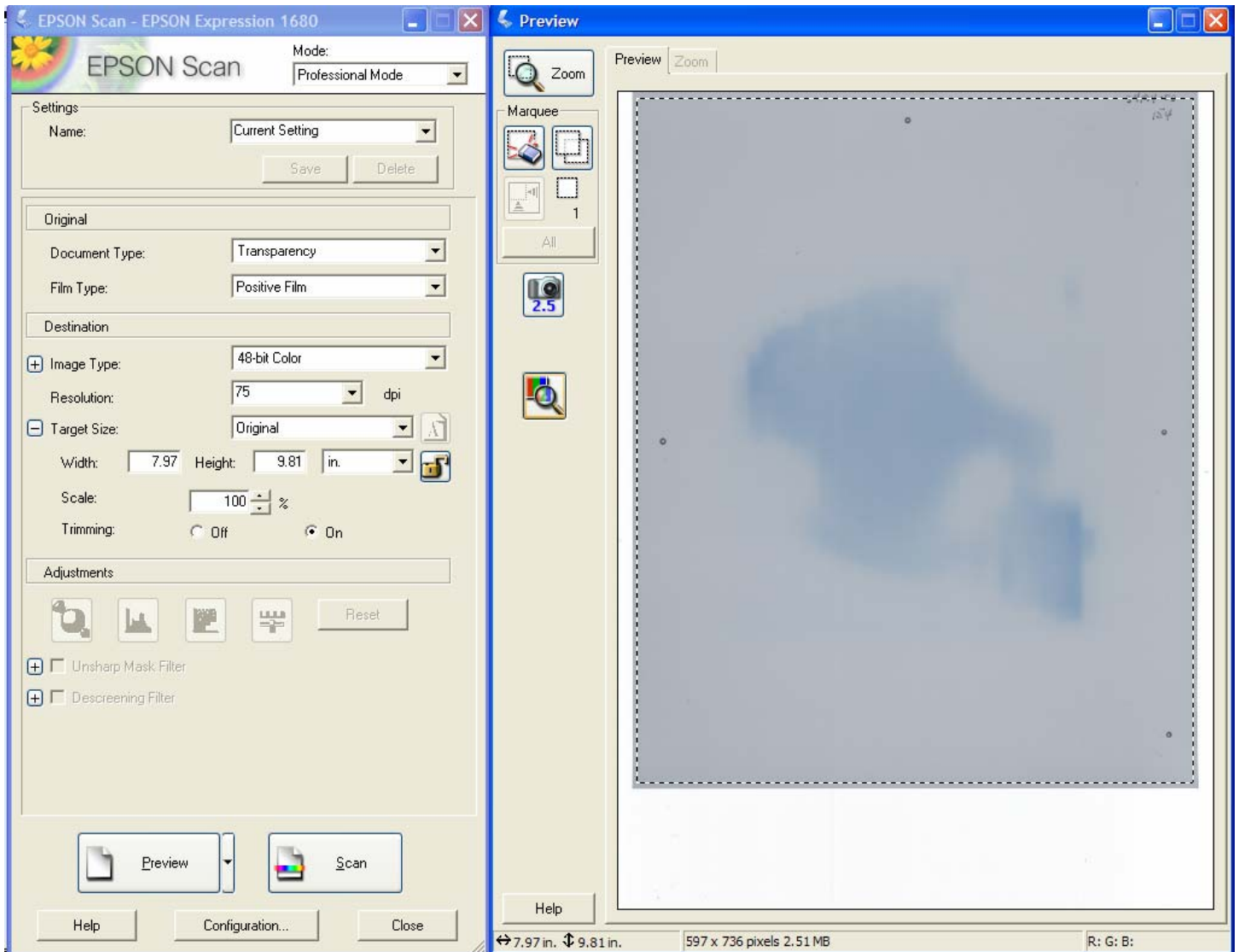


Figure 6

11. Now highlight the “Settings” dialog box – Figure 7. Type in the new settings name, e.g. EBT Film, and save. In future when you select EBT film under “Settings” you will return to all the values/options selected as well as the selected scan area. You are ready to scan your image set.

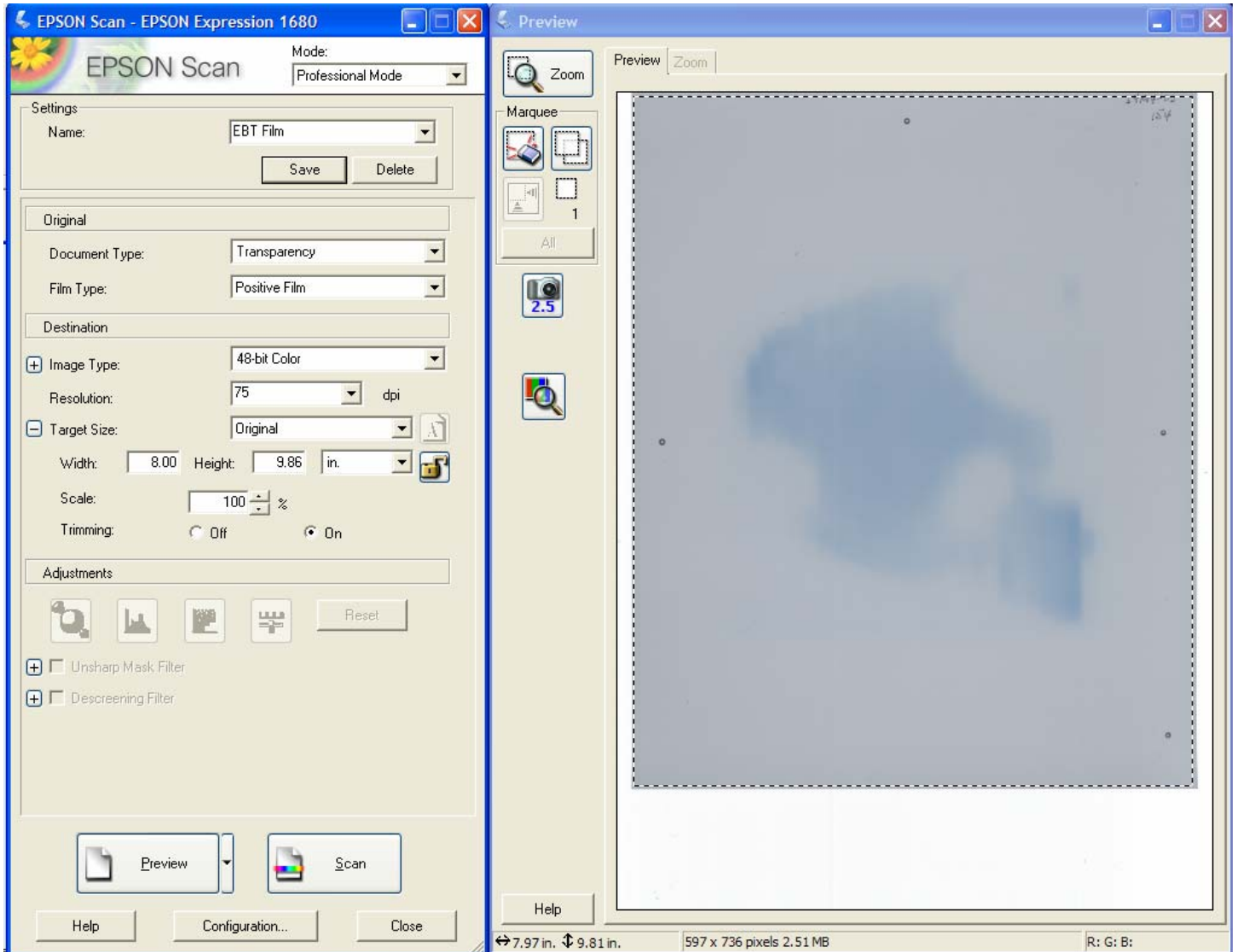


Figure 7

12. Having set up the Options and Selections settings in Steps 7-11 you are prepared for scanning. A window similar to Figure 8 will appear after you activate the “Scan” button. Go to the “Settings” box and select the setting from the drop-down menu. In this case it is “EBT Film”

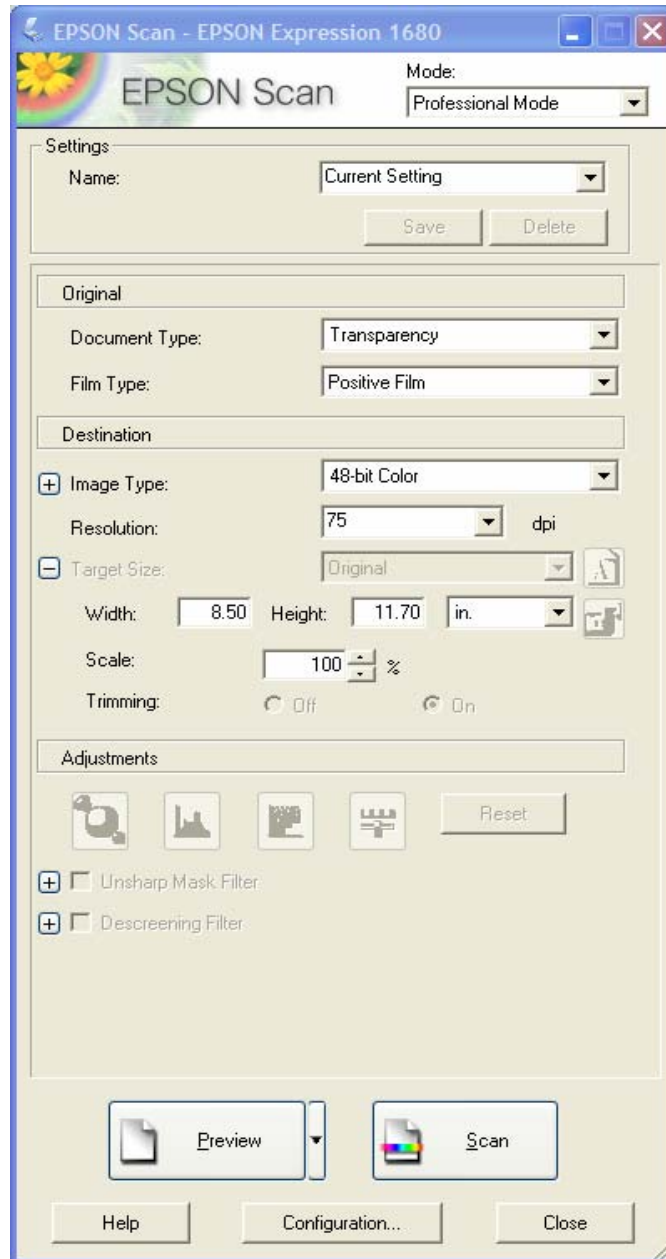


Figure 8

The "Preview" window opens with the scan area highlighted as shown in Figure 9.

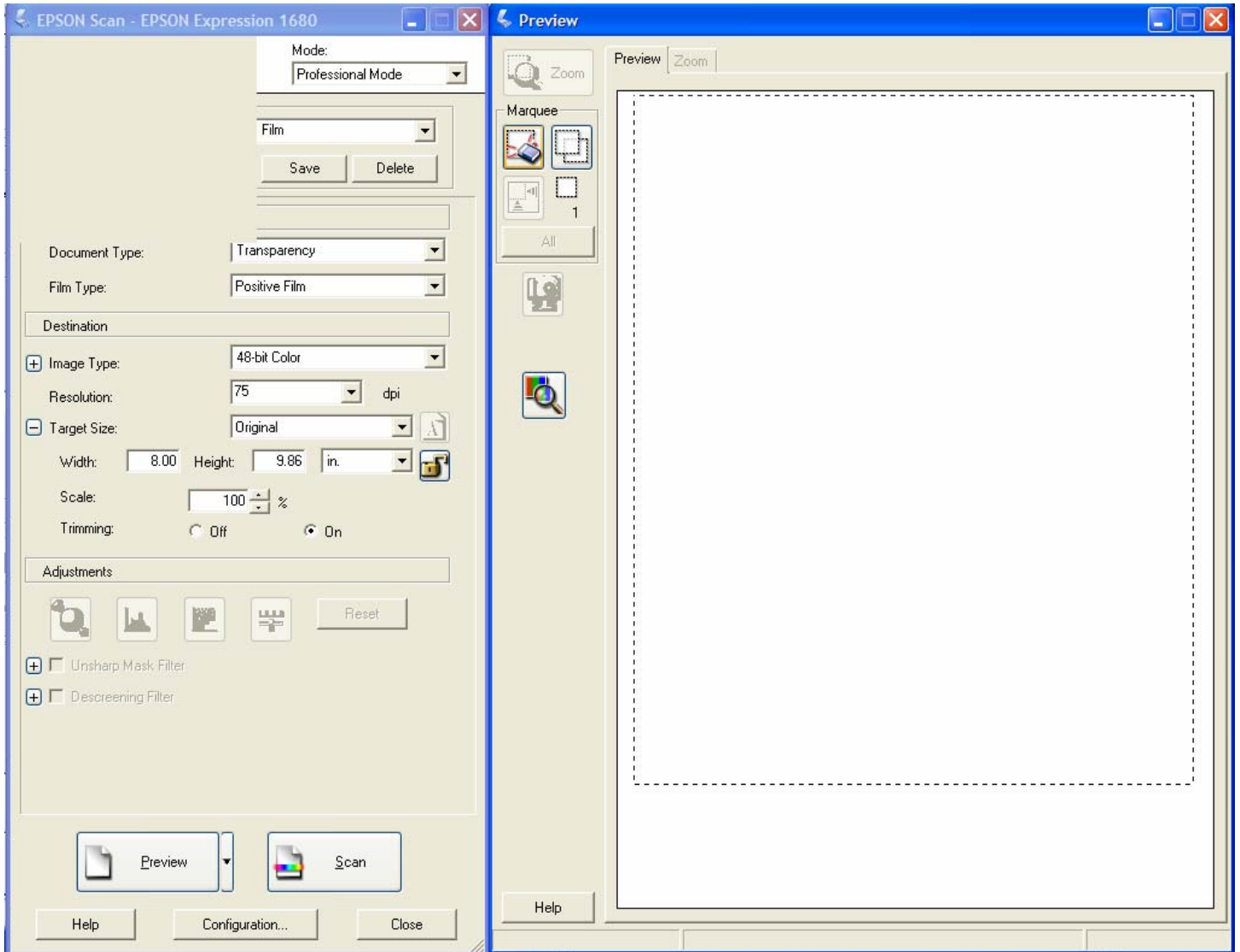


Figure 9

13. Place a film on the scanner and center it. Select “Preview” and obtain a scan. The image should appear within the outlined area in the preview window as shown in Figure 10. Once you are satisfied with the positioning you can close the “Preview” window and proceed to scan the set of exposed films as well as the unexposed films.

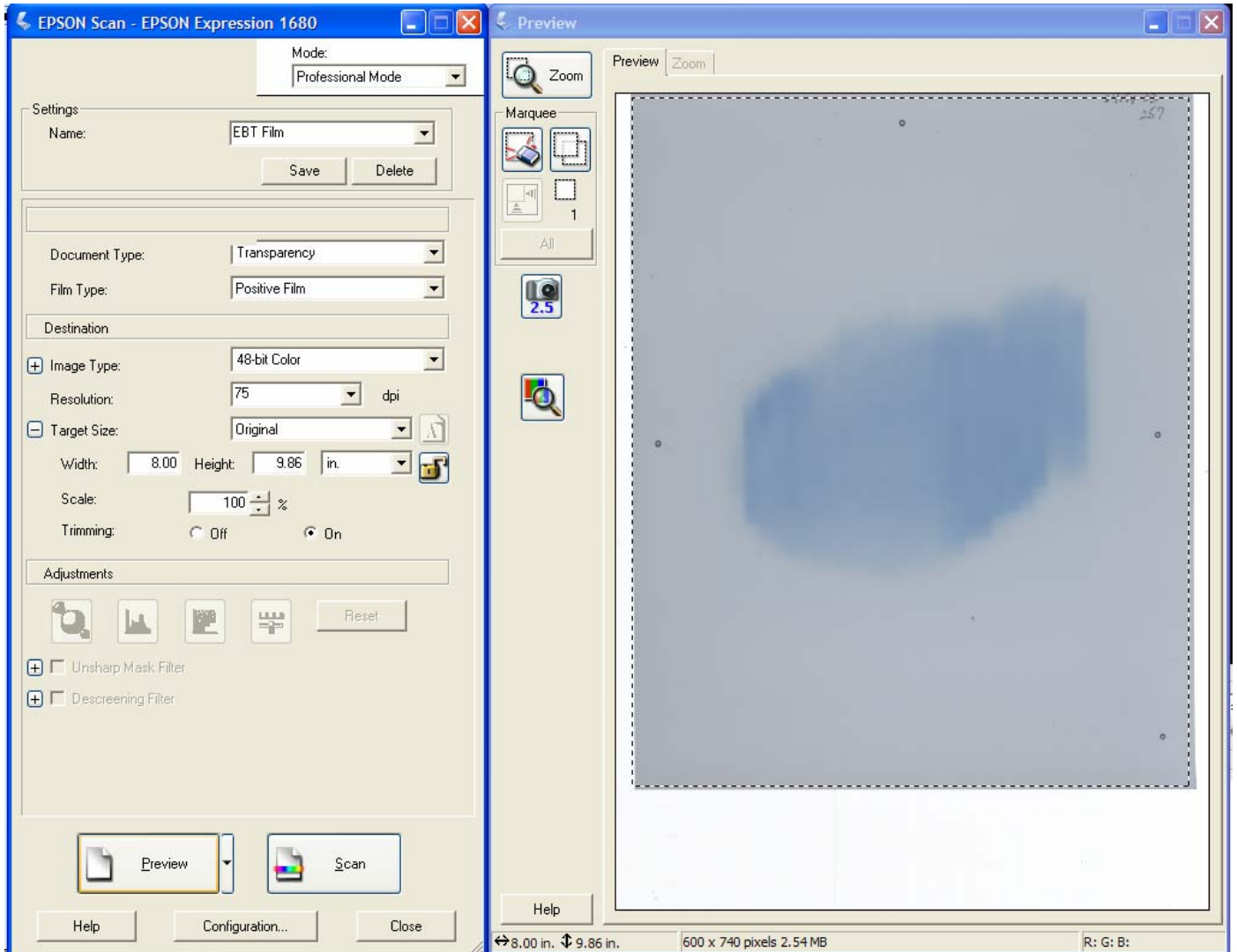


Figure 10

The following steps describe the extraction of image data for the red color channel from the RGB image. The procedure assumes the use of software (e.g. Picodose TA, Matlab, Photoshop) that can perform this separation.

14. Since GAFCHROMIC dosimetry film produces blue images the greatest response is obtained in the red color channel. Scan data obtained in RGB mode can now be split into individual channels to extract the data for the red channel. The following describes the use of Picodose TA to accomplish this. The RGB data can be split by other software such as Photoshop and Matlab.
15. Open Picodose TA.
16. Click IMAGES on the menu bar.
17. Select "Import" and click "RGB acquisition options..."
18. In the "RGB acquisition options" window check "Red only" and click "Confirm"
19. Select IMAGES on the menu bar. Select "Import" and on the drop-down menu select "File tiff RGB 24/48 bit"
20. Select and import the RGB image.
21. A window will open containing the R (red) image. Save the red image.
22. Import the other images and extract and save the red color channel data.

The following steps describe the generation of the Flattening Correction image. The procedure assumes the use of software (e.g. Picodose TA, Mira AP, Matlab) that can perform pixel-by-pixel arithmetic operations.

23. Open the image of the unexposed film.
24. Choose an area of interest that covers all, or almost the entire image and measure the mean scanner response value. Scanner response value is also referred to as pixel value (PV). The mean value for the unexposed film image is PV_u .
25. Divide each pixel value in the unexposed film image by PV_u .
26. Save this image and call it "Flattening Correction"
27. It is recommended to smooth, or filter the Flattening Correction image to minimize the effect of anomalies caused by dust, scratches, etc. The choice of filter is left to the user, but it has been found that a 12x12 median filter gives satisfactory results.

The following steps describe operations to flatten exposed film images using the Flattening Correction image. The procedure assumes the use of software (e.g. Picodose TA, Mira AP, Matlab) that can perform pixel-by-pixel image arithmetic operations.

28. Open an exposed film image to be corrected, or flattened.
29. Open the Flattening Correction image.
30. Use the image arithmetic function in the software to divide the PV of the pixels in the exposed film image by the PV of the corresponding pixel in the Flattening Correction image.
31. Save the flattened version of the exposed film image.
32. Repeat the process for each exposed film image.

VII. DEFINITIONS

VIII. AFFECTED DEPARTMENTS

Effects all operating departments.

IX. REVISIONS TRACKING

Revision 0.3 - This is a newly documented procedure.

The information contained in this document are intended for use only by persons having technical skills and at their own discretion and risk after they have performed necessary technical investigations, tests and evaluation of this particular protocol. While the information herein is believed to be reliable, we do not guarantee its accuracy and the user must make its own determination about the validity of this protocol. Neither ISP nor its affiliates shall be responsible for the use of this information, methods, formulation or apparatus described in this document. WE MAKE NO WARRANTY< EXPRESS OR IMPLIED< OF MERCHANTABILITY OR FITNESS OF ANY PRODUCT FOR A PARTICULAR USE OR PURPOSE. We also make no warranty against infringement of any patent by reason of user's use of any information, product, method or apparatus described in this document.