

Lens and Camera Profiles

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Camera and Lens Profiles

Camera and lens profiles are used to apply corrections to raw images. Camera profiles adjust image colors and the tone curve. Lens profiles correct for barrel or pincushion distortion, light falloff in the corners of the frame and chromatic aberration. The process of creating profiles involves photographing different targets with a series of camera settings and then analyzing the resulting images. Increasingly, camera designers are taking advantage of the fact that images can be corrected in software to create innovative new lenses that are smaller, lighter, sharper and less expensive.

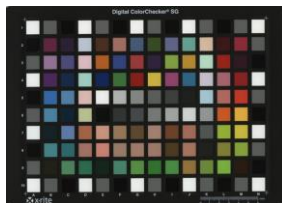
Creating Camera Profiles

Camera profiles are standard ICC color profiles that convert the colors in raw files to a standard color space. Camera profiles are created by photographing a test target that has a number of color patches whose color properties have been accurately measured and recorded in a reference file.

Picture Window supports several different types of commercially available test targets. Targets with more color patches produce more accurate profiles but are more sensitive to uneven illumination. The most commonly available target capable of creating profiles is the widely available 24-patch ColorChecker. The ColorChecker DC is now discontinued. The SpyderCheckr 24 and 48 patch targets are less expensive than the standard ColorChecker but appear to have quality control issues as patches in the copy I purchased did not accurately match its published reference file Lab values. The ColorChecker SG is currently the best available camera target, but it is fairly expensive. Other targets such as IT8s printed on film or on glossy paper are intended for calibrating scanners and do not work as well for camera calibration.



ColorChecker DC



ColorChecker SG



ColorChecker



SpyderCheckr 24 and 48

By comparing the color of each patch as captured by the camera with the corresponding color in the reference file, correction tables can be generated which are then stored as a standard ICC profile.

When photographing the target, try to observe the following precautions:

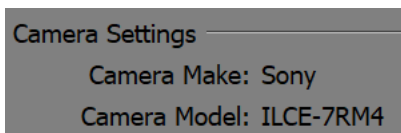
- 1) Make sure your camera sensor and the target are clean since dust or debris may cause slightly inaccurate results or cause problems processing the image files later.
- 2) The test target should be illuminated as evenly as possible, without glare or reflections, preferably by full mid-day sunlight incident at roughly a 45 degree angle. Make sure the camera white balance is set to Daylight.
- 3) You may wish to create additional camera profiles for different types of illumination such as overcast, tungsten or flash. Make sure the camera white balance setting corresponds to the type of illumination.
- 4) Do not use on-camera flash as this will cause reflections from the target – try to keep the illumination at a 45 degree angle.
- 5) Don't try to fill the entire frame with the target as this will cause brightness variations due to light falloff and the full camera resolution is overkill for measuring the color patches.
- 6) Take a bracketed series of exposures of the test target so you can select the one that makes the white patches as bright as possible without clipping.
- 7) Before creating a camera profile, create a lens profile for the lens you are using to photograph the target. Then use the Raw Develop transformation to apply the lens profile to the target image. This will correct for light falloff in the target image and make the profile you create more accurate.

For more details on creating profiles from a target image, see the Create Profile transformation.

If you want Picture Window to automatically select the camera profile when processing raw files, taken with a particular camera, save the profile with the following pathname:

My Documents\Picture Window Pro\Camera Profiles\xxx

where xxx is the camera make and model as displayed in the Image Info dialog box for images taken using the camera. For example, for a Sony A7RIV the Image Info dialog box displays the following in the Camera tab:



The corresponding camera profile filename to use is: Sony ILCE-7RM4.icc

White Balance

While the raw image data are unaffected by the camera white balance setting, the camera white balance setting selected at the time the photograph was captured is saved in the image metadata. When Picture Window opens raw files, it applies this saved white balance setting to the image data, changing the appearance of the image to reflect the “as shot” white balance setting. For this reason, a color profile created by photographing the test target in sunlight with the camera white balance set to Daylight should also work reasonably well for other lighting conditions as long as the camera white balance is set correctly.

Creating Lens Profiles

Creating a lens profile takes more time than creating camera profile since you need to photograph two different test targets using the full range of focal lengths and f stops for each lens you want to profile. A copy stand is very helpful for holding the camera in position as you vary the target distance, but if you don't have one you can tape your target to the wall or place it on the floor or on a table and use a tripod instead.

While it is possible to correct lens distortion in fisheye lenses, this defeats the purpose of the lens and produces heavily cropped images with blurry corners. Consequently, creating lens profiles for fisheye lenses is not recommended.



Lens profiles are specific to a camera body make and model, so if you have two or more camera body types that use the same lenses, you will need to profile each lens separately for each body. This is necessary to avoid various issues, for example, with crop sensor and full frame sensor bodies that share lenses.

If you are sure two or more camera bodies are equivalent, you can make copies of the lens profiles and rename them instead of creating a new set of lens profiles. Once you make copies, use a text editor to open the lens profiles and change the camera and lens names at the beginning of each one.

Photographing Light Falloff Targets

Light falloff (vignetting) is measured by photographing a uniform white field. You can use a light box or your computer monitor via Picture Window's File/White Screen command. While neither light source is completely uniform, placing a sheet of matte drafting film or ground glass between the camera and the light source helps even out the light and reduces reflections.

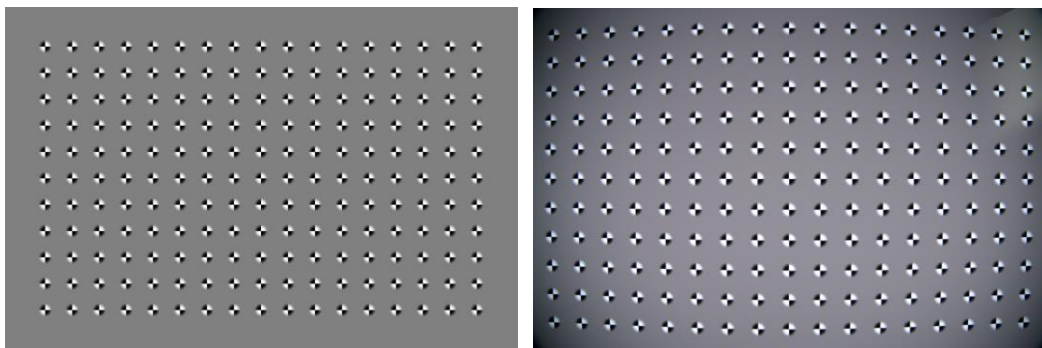
When photographing the target, try to observe the following precautions:

- 1) Place the camera very close to the light source to reduce ambient light entering the lens.
- 2) Expose images so the lightest parts are as bright as possible without clipping.
- 3) Make sure the light box or screen surface is clean.
- 4) Do not try focus the lens on the target as this will just exaggerate any non-uniformities.

Photograph the white target at a range of focal lengths, if you are profiling a zoom lens, and at a range of f-stops (for example every full stop over the range of the lens). Light falloff is greater for wide angle lenses, and for wide angle zooms it can vary quite a bit with focal length, so make sure you sample enough different focal length settings especially at the wide end. Aperture also affects light falloff, but typically not as much as focal length. Telephoto lenses usually have much less light falloff so you may not need to sample quite as many different focal lengths or apertures.

Photographing Distortion Targets

Measuring lens distortion and chromatic aberration involves photographing a test target created using the Lens Profile Target transformation (under Test Patterns). This target image consists of a grid of registration points on a gray background. Print a copy of the image, preferably on matte paper to reduce reflections.



Lens Profile Target

Raw Target Image

The Lens Profile Target transformation lets you create a target image that matches the proportions of your sensor so the target can fill the entire frame.

For wide angle lenses, you may need to print out a larger version of the target if a smaller one is closer than the minimum focusing distance of the lens when you get close enough to fill the frame. For telephoto lenses you may need to print a smaller target if your setup limits how far away from the target you can position the camera. Targets between 5 and 20 inches wide suffice for most lenses.

When photographing the target:

- 1) Make sure your camera sensor and target are clean since dust or debris may cause slightly inaccurate results or cause problems processing the image files later.
- 2) Tape or weight down the corners of the target to keep it flat (but do not let the tape or weights be part of the images).
- 3) Center the target in the frame as accurately as possible. Set your camera grid to show diagonals so you can accurately align the center of the frame with the center of the target. The lens distortion target always has one grid point dead center. If the target image is not centered, Picture Window may not be able to process the image.

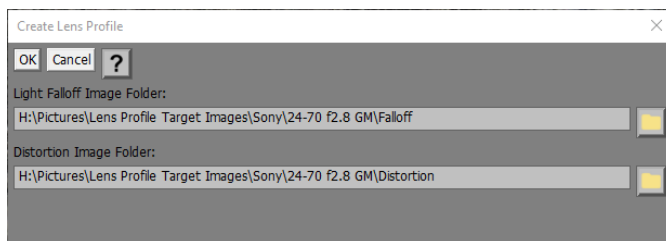
- 4) Make sure the camera is perpendicular to the target. One way to do this is to replace the target with a small mirror and then center the reflection of the camera lens in the frame. This is not as critical as centering the target.
- 5) The target is the same upside down or right side up, but make sure it is photographed with the long side of the target matching the long side of the frame.
- 6) Adjust the distance between the camera and the target so the grid of registration points fills the entire frame as much as possible without cutting any points off (as in the example above).
- 7) Adjust the exposure so the lightest parts of the target are as bright as possible without clipping by checking the histogram. This increases the contrast of the images and makes it possible to locate the registration points more accurately.
- 8) Accurately focus the camera on the target using the widest available lens aperture. It is very important that the distortion target be as sharp as possible.
- 9) Set the camera white balance to match the type of light illuminating the target.

Photograph the target at a range of focal lengths if it is a zoom lens. You also need to photograph the target at a range of f-stops for each focal length. Zoom lenses that span a wide range of focal lengths often have barrel distortion at one end of the range and pincushion distortion at the other end, so you need to sample enough different focal lengths to accurately model the lens distortion characteristics.

Building the lens profile

Once you have taken all the target photographs, you are ready to process them to create a lens profile. Copy all the raw files of the light falloff target to one folder and the raw distortion files to another folder. Do not place any other files in these two folders.

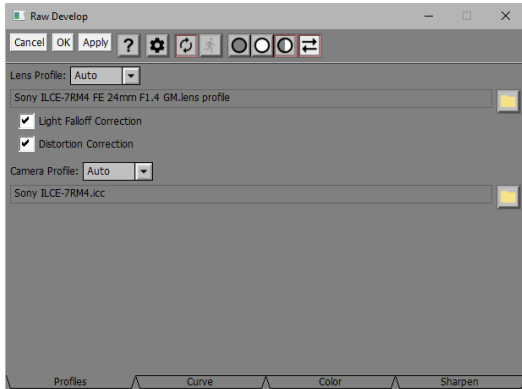
Next, select the File/Create Lens Profile command. Identify the locations of the two folders and click OK.



Picture Window will then process the two sets of raw images, create a lens profile and store it in My Documents\Picture Window Pro folder\Lens Profiles. The name of the profile is derived from the Camera Make, Camera Model and Lens Model metadata tags from the raw files. Depending on the number and size of the raw files in the two folders, this can be a lengthy process. You can track the progress via status information displayed at the bottom of the dialog box as each file is processed.

Using Camera and Lens Profiles

To apply a camera and/or lens profile to a raw image, use the Raw Develop transformation. This transformation is designed to be used immediately following the File Open transformation that opens the raw file before any other operations are performed on the image. The Profiles tab of the Raw Develop transformation lets you select the camera and lens profile you want to use – these settings are automatically filled in based on the image’s metadata, if available, but you can change them if you need to.



If you select a lens profile, the correction settings derived from the calibration image that best matches the focal length and f-stop of the raw image are selected and applied. Depending on the amount of lens distortion, the edges of the raw image will be automatically cropped to keep the image rectangular.

If you select a camera profile, the profile is first assigned to the raw image. Next, the image is converted to the current working color space. If you specify both a lens and camera profile, the lens profile is always applied first.

Camera Profile or Lens Profile is set to None or if the profile setting is blank, the corresponding operation is not performed.

After applying camera and lens profiles, you can move on to the remaining tabs to adjust the brightness curve, color balance and saturation, and sharpness of the image.