High Speed FP Flash

When conventional "one pop" flash is used on a digital single-lens-reflex (DSLR) camera this sequence of events occurs: shutter is pressed, mirror flips up, first curtain of shutter moves across the shorter dimension of the sensor, and when the sensor is fully revealed the flash fires. Then the second curtain of shutter closes to end the exposure. As shutter speeds increase a point is reached where second curtain begins to close and block the shutter before the first shutter is completely open. The fastest shutter speed where the lag between the two curtains completely reveals the sensor is called the "x-sync" speed. It is typically 1/200th or 1/250th of a second on most cameras with reflex mirrors and focal plane shutters.

> Why is called "X-sync"? I'm old enough to remember using flash bulb on my first cameras. Flash bulbs take so long to ignite the camera must sync the flash a few milliseconds before the shutter starts to open so by the time the shutter is fully open the flash bulb is at its brightest. Early cameras like my first SLR, a Nikon F have two sync settings: "F" for flash bulbs and "X" for strobes.

Conventional flash works fine indoors where ambient light levels are low, but outdoors in bright sunlight the x-sync limit forces a photographer to use very small apertures to correctly expose the background. For example an outdoor scene will always meter "Sunny 16" with is an rule-of-thumb which expresses the exposure at f/16 as always being a shutter speed of 1 / ISO speed. With an x-sync limit of 1/250th second that would require using one of following combinations at ISO 100 to balance a flash-lit foreground with a sun lit background: f/16 @ 1/125th or f/11 @ 1/250th. Both will produce wide depth of field and make the background distracting.

The camera makers created a clever workaround which allows shooting at wider apertures: pulsing the flash continuously as the two shutter curtains chase each other across the sensor. Freed from the x-sync limit a photographer can use any of these f-stop / shutter combinations to balance the sunlight:

f/8.0	@	1/500th
f/5.6	@	1/1000th
f/4.0	@	1/2000th
f/2.8	@	1/4000th
f/2.0	@	1/8000th

Wider apertures allow selective blurring of the background to provide subject / background contrast desirable in portraits. However the rapid pulsing of the flash reduces the range of the flash because the same amount of stored power is spread over more flashes. But as the aperture is increase the amount of flash power needed is also reduced so there is trade off.

A Test of Outdoor Backlight plus High Speed FP Flash Fill

I did a of High Speed flash in common outdoor portrait lighting scenario, putting the backs of a subject to the sun in front of a shaded background for rim-light then adding fill flash. With conventional flash the x-sync limit would limit aperture choice to f/11 creating a sharply focused distracting background. For this test I used f/2.8 to blur the background in Av mode where the camera "guessed" the correct shutter speed. I used a pair of light stands holding test targets. The foreground stand was

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10ft from the camera and fill flash, a typical shooting range for portraits to represent where the subject would be standing. The second stand was placed about 12ft further back to compare the effect flash fall-off and DOF.

Testing is alway more useful when compared to a baseline. For my baseline I wanted the color to be balanced to the sunlight and to take a reference shot in M mode based on an incident reading with my hand-held meter. So I started the test by setting custom WB from a gray card flat lit by the sun. Next I used a white towel in the same flat ambient light to compensate my Sekonic L-358 meter to my 20D camera. Those set-up tests are shown below as a screenshot from Bridge:

I shot the the WB test frame on the top left with the camera at the "Daylight" WB setting. The camera manual indicates the "daylight" preset is 5200K but when opened in ACR the WB was indicated as 5000K / tint = 0. The frame on the top right was shot after setting Custom WB using the shot on the left. It also read 5000K, but tint value had changed to +9 (towards magenta).

I wanted to use a manual shot in M mode metered with my Sekonic as a baseline, but first needed to compensate the meter to my camera. For that I use the trusty towel texture test. The shot on the left was the result when camera was set at the indicated meter reading in M mode. The highlight texture in the towel is blown. That is typical for Canon cameras because their actual ISO speeds are about 20% faster than ANSI standards. I shot frames at 1/3 and 2/3 stops under the meter reading and used 1/3 stop as the meter compensation factor.

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With the meter calibrated I set up the targets so they were back-lit. The sun was about 135 degrees from the camera axis to the right, behind the target. I took an incident reading facing the sun and then set the camera in M mode at the indicated reading at f/2.8 the aperture used for all the tests. This is the resulting file:

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Some might think its under-exposed, but what determines correct exposure with digital in the technical sense is whether or not the highlights are exposed correctly, not how the mid-tones and shadows look. In that shot the highlights are just below the point of clipping. When the RAW file is viewed in ACR if the exposure slider is increased at all the detail in the sun-lit side of the towel starts to clip. So that shot, while dark overall, has highlights which are optimally exposed. The problem with the exposure of the mid-tones and shadows is the fact the DR of the sensor can't correctly reproduce the detail of the scene as I saw it by eye, which of course is why fill flash is necessary. This shot, and the test which follows, show the difference between what we might perceive as correct exposure by looking at the entire photo range, and what is nominally correct exposure per the highlight detail.

Av mode is typically used outdoors to automatically compensate for any fluctuations in the ambient light. When I did the test the sun was in and out of the clouds. The first thing needed when shooting in Av mode is to determine how much, if any EC correction is needed to get the camera metering to correctly expose the scene, per the highlight detail. In the sequence below I started with the camera set to the default EC = 0, then decreased EC until the highlights in the towel in the foreground stopped clipping in the over-exposure warning of the playback:

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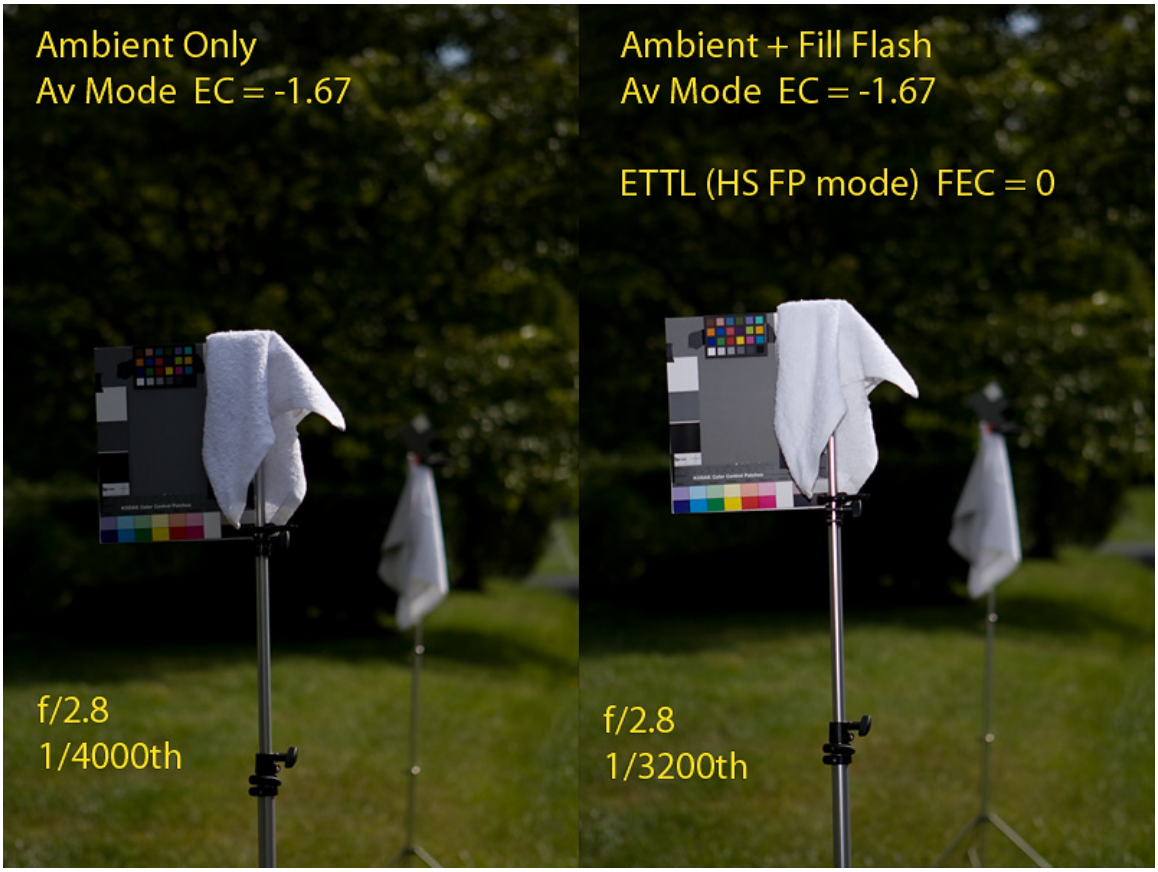
The predominantly dark background and small highlights fooled the automatic metering and at EC=0 the highlights were grossly overexposed. It required - 1-2/3 stops of EC to eliminate the clipping of the highlights.

The test to find the amount of EC adjustment necessary to correctly expose the highlight detail reveals that while perceptually the first or second shots might be perceived as being better looking, they are in fact overexposed per the highlight detail.

Once I determined minus 1-2/3 stops EC was needed to correctly expose the highlights in the towel with only the ambient light I turned on the flash which was set in ETTL mode, with High Speed FP enabled and FEC at the default 0 setting.



The highlights in the shot with High Speed flash fill are actually better exposed than in the ambient only shot on the left and the tonal range on the card in the foreground is reproduced accurately!

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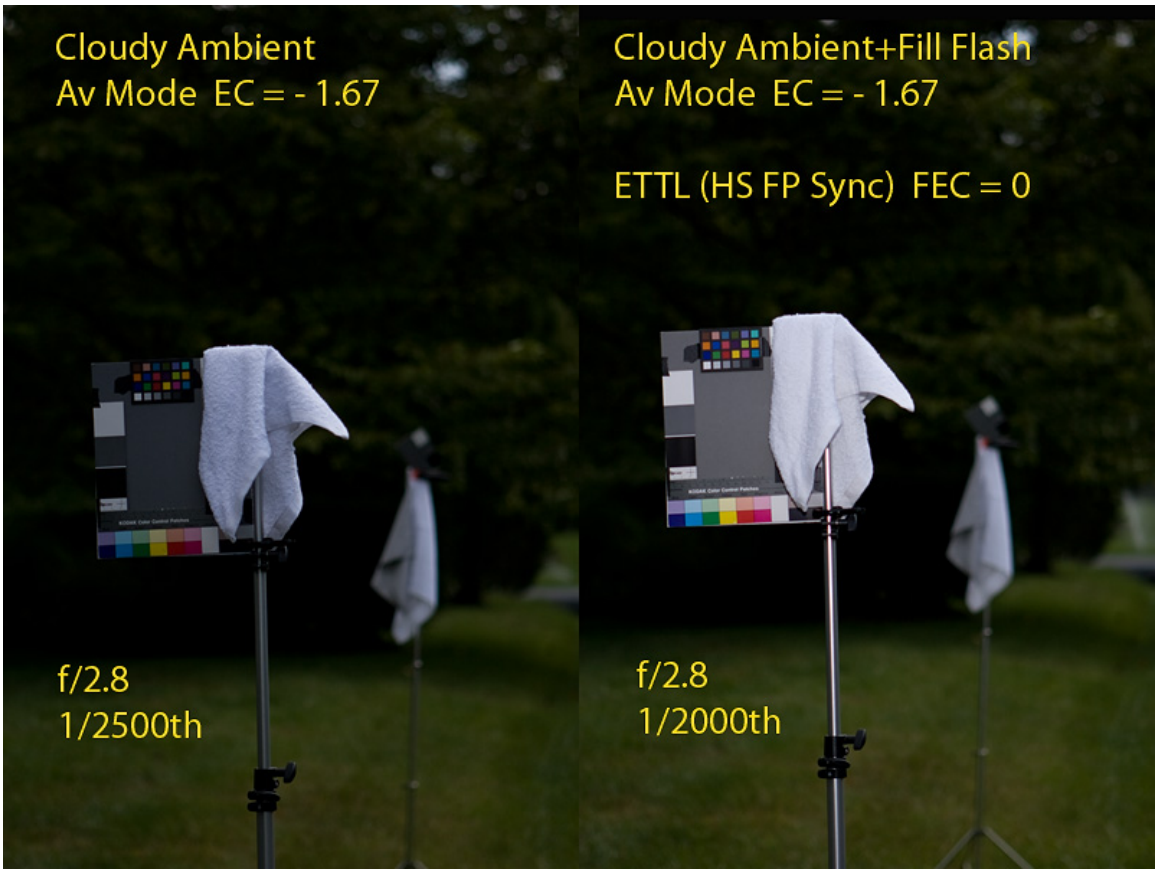
As mentioned the sun was darting in and out of clouds. I shot another ambient / ambient+flash comparison when the sun was partially behind the clouds. I left the EC set to - 1-2/3 stop and the flash at FEC = 0:



Both shots above are about 2/3 stops underexposed, per evaluation in ACR. That is to say an adjustment in exposure of about .6 stops was needed in the editor before the highlights in the towel started to clip. This second shot with fill flash, while under-exposed is easily corrected in ACR.

Conclusions:

1) The test to find the amount of EC needed to correctly expose the white textured highlights in the towel using the "black out" feed back from the over-exposure warning reveals that a back-lit ambient only scene that looks correctly exposed in the regular playback at EC = 0 may in fact be severely clipping the small highlights which are difficult to see. It validates my contention that the simple flashing over-exposure warning in the info playback mode is the most accurate way to gauge exposure.

2) When the ambient exposure is set correctly parts of a photo outdoors will look under-exposed. That simply reflects the fact the an average sun-lit scene like the

test shot has at least a 10 stop range of illumination between highlight and shadow detail and most digital cameras can only record about 6 stops. So when the highlights are exposed correctly the mid-tones and shadows will be much darker than perceived by eye.

3) When the ambient exposure is set correctly per the highlight detail the flash does a very good job of balancing the fill. Frankly I was a bit surprised at this because in most situations its necessary to bump up the FEC above the default 0 level.

4) When flash is added to the foreground the background stays darker than normal, for the reasons explained in #2 above. I consider this a positive thing for portraiture because a darker than normal background will make a normally filled face in the foreground contrast more.

5) The difference in result between the shot in direct sun vs. the one where the sun was behind the clouds reveals is the need to monitor and adjust EC as the contrast of the ambient lighting changes to get the ambient lit highlights correctly exposed. But the fact the exposure errs in the direction of being under-exposed makes it possible to easily correct it in Photoshop.

6) High Speed FP flash mode works quite well in combination with wide apertures, which require much less flash power vs. conventional flash at the same distance. A conventional flash shot would have been limited by x-sync to f/11 @ 1/250th. Opening the lens to f/2.8 (4 full f/stops) requires 1/16 the amount of flash power to create the same exposure. So when shooting in High Speed FP sync mode keep in mind the effective shooting distance will increase as the aperture selected becomes wider.