Exposing the SONY Fs5

The factors that affect nominal exposure are:

1) **The sensitivity of the imaging medium to light aka ISO**

a) The higher the ISO, the more sensitive to light. There is a point of diminishing returns. At extreme ISOs, there can be an increase in noise, which can either add to or detract from the look you are going for. Test so that you know what to expect from your choices.

b) When shooting film, our film speed choices ASA now called ISO ranged from 25 to 800. With the SONY Fs5, the sensor is more sensitive, and depending on the picture profile you select, your ISO can range from 800 to 3200.

ISO	100	200	400	800	1600	3200

*Every doubling of the ISO represents a doubling of the sensor's sensitivity to light.

c) Digital cameras also have a feature that allows the user to increase the "gain" or the power to the sensor to boost it's sensitivity. This increase can result in an increase of noise. Usually a small boost is acceptable, whereas a significant boost becomes an aesthetic choice. Each increase of +6dB represents a full "stop" or a doubling of the sensitivity to light. A native 3200 iso, with a +6dB increase becomes effectively 6400 ISO

2) **The duration for which each frame exposed.** In a mechanical film camera this is a function of the number of **frames per second**, and the **shutter angle**. In a film camera, these two factors are mechanically linked. In a digital camera, they are not

a) In a mechanical film camera with a rotating shutter, at the "normal" frame rate of 24fps, with a "normal" shutter angle of 180^{o} , the duration of exposure is **$^{1}/_{48}{}^{th}{}_{sec}$** per frame:

$$^{1}/_{fps} \times {}^{\text{shutter angle}}/_{360^{o}} = {}^{1}/_{24} \times {}^{180}/_{360} = {}^{1}/_{24} \times ½ = \mathbf{{}^{1}/_{48\ sec}}$$

b) A shutter angle of 90^{o} would result in an exposure of 1/96 sec per frame.

c) In a digital camera, frame rate affects exposure, but the duration of exposure is not locked to the angle of a rotating shutter. It is possible with a digital camera to select the number of frames recorded each second, and at the same time to select the duration of exposure (effectively selecting a shutter angle). In the Fs5, you can set your display to show that setting as either degrees or as fractions of a second. When shooting the normal sync sound frame rate of 24 fps (23.976 fps) with a shutter speed of 1/48, it is understood that the shutter is the equivalent of a 180^{o}**.**

d) A shorter duration of exposure, whether achieved by shooting more frames per second, or with a more narrow shutter angle (faster shutter speed) will result in less motion blur, and shoot be tested. In extreme cases the movement presents as staccato instead of fluid, which can be used to great effect, as in the Omaha Beach sequence in "Saving Private Ryan". Conversely, a longer duration of exposure, achieved by shooting fewer frames per second or with a wider shutter angle, will result in more motion blur, and should be tested ensure you are achieving the desired effect.

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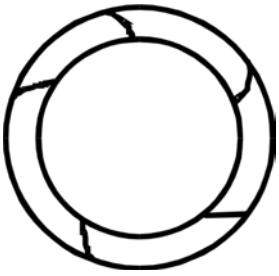
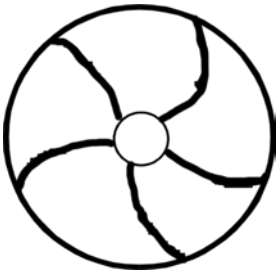
3) The amount of light that is able to reach the sensor is regulated in two ways: **the aperture and filtration**.

a) The **aperture** is the opening through which light passes, and it is adjusted through the iris. The size of the opening is called the fStop.

F-stops are typically divided into third stops. They are:

1.1 1.2 1.6 1.8 2.2 2.5 3.2 3.5 4.5 5 6.3 7 9 10 12 14 18 20
1 . . 1.4 . . 2 . . 2.8 . . 4 . . 5.6 . . 8 . . 11 . . 16 . . 22


f2


f 11

The smaller the number, the larger the opening and the more light is able to pass. This can get confusing, and so an easy way to remember that an f2 is wider than and f11, is to think of them as fractions. ½ is larger than $^1/_{11}$.

Adjusting the iris one full stop from an f2 to an f2.8 reduces the amount of light able to pass through the lens by ½. Adjusting the other direction, from an f2.8 to an f2, doubles the amount of light passing through the lens.

Changing from an f2.8 to an f4 is another full stop. You will notice that the numbers used are a logarithmic progression. Don't make the mistake of thinking that a doubling of the numerical value is a halving of the light.
Doubling the numerical value represents a 2 stop change (½ x ½ = $^1/_4$)

b) **Neutral Density** filters are used to reduce the light passing through the lens, without altering the color.

The built in **ND** filter wheel in the Fs5 allows the operator to preselect the ND values most useful for a given situation. It also offers a new technology called a variable ND, which allows for a smooth transition between neutral density values during a shot.

Although the base ISO of your camera is controlled by the picture profile, the effective ISO can be controlled through the use of ND filters. ND filters do nothing more than block visible light.

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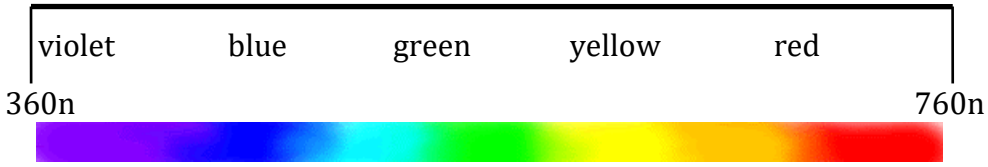
ISO	Internal ND	stops	Efective ISO		ISO	Cine ND	stops	Effective ISO
3200	1/2	1	1600		3200	0.3	1	1600
3200	1/4	2	800		3200	0.6	2	800
3200	1/8	3	400		3200	0.9	3	400
3200	1/16	4	200		3200	1.2	4	200
3200	1/32	5	100		3200	1.5	5	100
3200	1/64	6	50		3200	1.8	6	50
3200	1/128	7	25		3200	2.1	7	25
1600	1/2	1	800		1600	0.3	1	800
1600	1/4	2	400		1600	0.6	2	400
1600	1/8	3	200		1600	0.9	3	200
1600	1/16	4	100		1600	1.2	4	100
1600	1/32	5	50		1600	1.5	5	50
1600	1/64	6	25		1600	1.8	6	25
1600	1/128	7	12		1600	2.1	7	12
800	1/2	1	400		800	0.3	1	400
800	1/4	2	200		800	0.6	2	200
800	1/8	3	100		800	0.9	3	100
800	1/16	4	50		800	1.2	4	50
800	1/32	5	25		800	1.5	5	25
800	1/64	6	12		800	1.8	6	12
800	1/128	7	6		800	2.1	7	6

fStops	.7	1	1.4	2	2.8	4	5.6	8	11	16	22		
ISO	6	12	25	50	100	200	400	800	1600	3200	6400	12800	25000
Gain								0dB	+6dB	+12dB	+24dB		
										0dB	+6dB	+12dB	+24dB

The visible spectrum portion of the electromagnetic spectrum ranges from 360nm to 720nm (nm = Nanometers) (1nm = $^{1}/_{1,000,000,000meter}$)



Beyond 720nm is the portion of the spectrum that is infrared. The CMOS sensor is sensitive to IR. When using the iris to regulate the light that passes through the lens, the iris blocks equally, visible and IR wavelengths. A new breed of ND filters has been introduced, and are under continual development and improvement. These are IRND filters, they block both IR and visible light.

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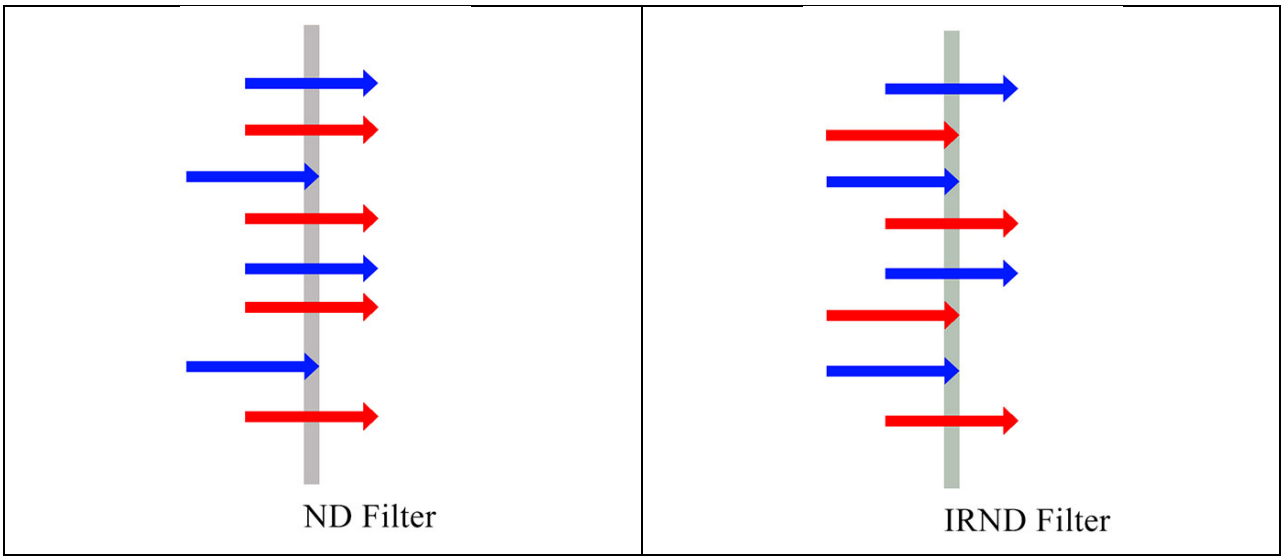
Using your camera's internal ND filter wheel, you should have no issues with IR. If you augment the internal ND filtration with externals filters, you may not have any issues at low levels of filtration, but as you increase the ND values, you may find it necessary to use IRNDs. Typically, ND.3, ND.6 do not reveal significant IR pollution. ND.9, ND1.2, ND 1.5, etc – do typically present IR pollution and so IRNDs are recommended.



IR pollution is not even across the spectrum and cannot be easily corrected during the color grading process. It is best to not introduce IR pollution to your image at all.

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No Filter f16

In looking closely at these three images, one can see that the first image has a neutral color cast, the black fleece looks black and the other colors present normally.

ND.9 f5.6

The second image using a traditional ND.9 required the iris to be opened 3 stops to compensate for the exposure. The black fleece is now reddish brown, as the wider aperture allows more IR to reach the sensor, while the ND filter blocks only visible light.

IRND.9 f5.6

The third image is neutral again, as the new IRND filter absorbs the IR wavelengths as well as visible wavelengths so the colors remain normal and match the unfiltered image.