

## Filters and Long-Exposure Photography

This involves using a long-duration shutter speed to sharply capture the stationary elements of images while blurring, smearing, or obscuring the moving elements.

1. Long exposures are easiest to accomplish in low-light conditions, but can be done in brighter light using neutral density filters. A neutral density filter should block out light without leaving a colour cast on the resulting image. Each ‘stop’ of an ND filter reduces the amount of light entering the camera by a factor of 2, i.e.: 2-stop filter (often referred to as ‘ND4’) reduces the amount of light hitting the sensor by a factor of 4. A 3-stop (‘ND8’) filter by a factor of 8 and so on, until you get to 10-stops, when the light is being reduced by a factor of 1024, meaning that the shutter needs to be open for over 1000x longer than without the filter.

No filter	With 2 stop ND (ND4)	With 3 stop ND (ND8)	With 4 stop ND (ND16)	With 10 stop ND
	4 times	8 times	16 times	1000 times
1/500 sec	1/125 sec	1/60 sec	1/30 sec	2 secs
1/250 sec	1/60 sec	1/30 sec	1/15 sec	4 secs
1/125 sec	1/30 sec	1/15 sec	1/8 sec	8 secs
1/60 sec	1/15 sec	1/8 sec	1/4 sec	16 secs
1/30 sec	1/8 sec	1/4 sec	1/2 sec	32 secs
1/15 sec	1/4 sec	1/2 sec	1 second	1 m 8secs
1/8 sec	1/2 sec	1 second	2 seconds	2 m 8secs
1/4 sec	1 second	2 seconds	4 seconds	4 m 16 secs
1/2 sec	2 seconds	4 seconds	8 seconds	8 m 32 secs
1 second	4 seconds	8 seconds	16 seconds	17 mins
2 seconds	8 seconds	16 seconds	32 seconds	34 mins
3 seconds	16 seconds	32 seconds	1 minute	c55 mins
4 seconds	32 seconds	1 minute	2 minutes	c. 1hour 8 mins

2. Tripod is essential for very long exposures, ensuring that the legs are stood on firm ground, the centre column is not extended and the strap is secured so not to catch the wind.

3. For many cameras, it is best to compose and focus your shot without the filter, switch to manual focus and then carefully attach the filter. Many mirrorless cameras with Preview Exposure turned off will allow you to see the view through the filter and focus

4. Close the viewfinder shutter or cover viewfinder to prevent stray light from sneaking in during the exposure.

5. For exposures longer than 30 seconds, use ‘BULB’ mode of your camera and use a remote shutter release cable (if not use 10-second timer to give camera time to settle). Calculate how long to leave the shutter open for (see table above) or use a phone app (such as NDCalc for android/iOS).

6. Even at low ISO, super long exposures can result in hot pixels (bright red/green/blue pixels in your image). To eliminate these take an exposure of identical length, at the same ISO, with the lens cap on. The hot pixels will be identical so you will generate an entirely black image, with the same hot pixels, to subtract away from your image during post-processing.

7. Some brands of filter result in a colour cast on the final image so shoot in RAW to be able to correct during post-processing.

8. Try Exposure Blending to improve your final image: either by using two different shutterspeeds to remove motion from some parts of the images or using several long exposure images to increase the blurring effect on water/clouds etc – **see separate sheet.**