What is Scanner Resolution?

Scanner Resolution is a representation of the scanner’s enlargement capability. Scanner Resolution is the measurement of the resolving power of the scanner’s optics and is expressed as dots per inch, but it is more accurately described as pixels per inch. A scanner’s sensor takes an analog image and digitizes it line by line. The more pixels per inch of the image that are captured, the larger the image can be reproduced by spreading those pixels out over a larger area.

Does Scanner Resolution equal image quality?

No. Since scanners are input devices, the optical resolution of the sensor is only part of the equation when it comes to image quality. The resolution is a representation of its enlargement capability. The image quality of a scanner depends greatly on the sensor and lenses used within the scanner’s optical system and how well those reproduce color, tonality and gradations with little to no mechanical image noise. These qualities can be measured by the specification called Optical Density.

What is Optical Density?

Optical Density, also called dynamic range, is a scanner’s ability to detect and reproduce the tonal range of the images being scanned. Optical density is usually measured on a scale from white at 0.0 to black at 4.0, with the higher end of that scale important for scanning transmissive items like film.

A scanner with an optical density of 2.0 to 3.0 will lose details in highlights and shadows. A scanner with a higher optical density of 3.2 to 4.0 will show a greater range of detail in highlights and shadows. In the images shown, the scanner on the left has an optical density of 3.2 while the scanner on the right does not state an optical density in its specifications.
A Scanner with Both Good Optical Resolution and Optical Density is the Best Choice

With scanner resolution being a measurement of enlargement capability and not the sole factor of image quality, choosing a scanner should be based on color reproduction, tonality, gradation and little to no mechanical image noise.

In the samples below, the same slide is scanned at 6,400 dpi/ppi. The scanner on the left has an Optical Resolution of 6,400 dpi/ppi with a 3.4 Optical Density, while the scanner on the right has an Optical Resolution of 9,600 dpi/ppi with no listed optical density. Note the level of detail and clarity in each of the blown up areas.

* Source: 35mm positive slide. Images scanned at 4,800 dpi/ppi using default settings.
** Source: 35mm positive slide. Images scanned at 6,400 dpi/ppi using default settings
More Information About Scanner Resolution

Which resolution number is the most important on a scanner?

Most scanners will list three resolutions: optical, hardware and interpolated. The Optical Resolution is the measure of the scanner’s sensor. Hardware Resolution is a combination of the sensor Optical Resolution and the movement of the stepping motor. Interpolated Resolution is Hardware Resolution with added pixels determined by an algorithm. Both Hardware and Interpolated Resolution can go very high, but as Optical Resolution is a measurement of the sensor directly, it is best to keep most scans within the optical range.

A scanner with a high very high Optical Resolution of 9,600 dpi/px may produce a very large image from a 35mm slide, but the quality of that image will be determined by the quality of the sensor, its lenses and the Optical Density.

How much resolution do I need?

The amount of resolution needed is usually determined by where the scanned image is going to be used. An image for the web or e-mail does not require a lot of resolution because it will only be seen on a monitor. Usually, 72-150 dpi/px is more than enough.

For printing purposes, to reproduce a photo in 1:1 scale, a resolution of 300-360 dpi/px is enough resolution. This 300-360 dpi/px range is also good to know for enlargements because it can help determine the resolution needed to get enough pixels from the scan. If your image does not have enough pixels at the printing size you are trying to enlarge it to, the image will be blocky and pixilated instead of smooth.

You can use this simple formula for determining enlargement pixels needed:

Short side of output size ÷ Short side of original image x 300 (or 360) dpi/px

Thus, to get an 8” x 10” print from a 4” x 6” original, you would need to scan at 600 or 720 dpi/px.

8 ÷ 4 = 2, 2 x 300 (or 2 x 360) = 600 or 720 dpi/px

The formula also works for very small items, like 35mm slides. Given that the average 35mm image area is 0.94” x 1.42”, to make a 16” x 20” print your formula would read:

16 ÷ 0.94 = 17.02, 17 x 300 (or 17 x 360) = 5,100 or 6,120 dpi/px