

SCANNING & RESOLUTION *continued*

Resolution

Printing can produce **solid** images such as:

this black square



this line

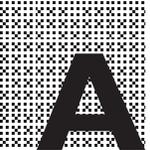


this letter

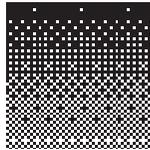


It can also produce **tonal** images such as:

this grey square



this gradient



this photograph



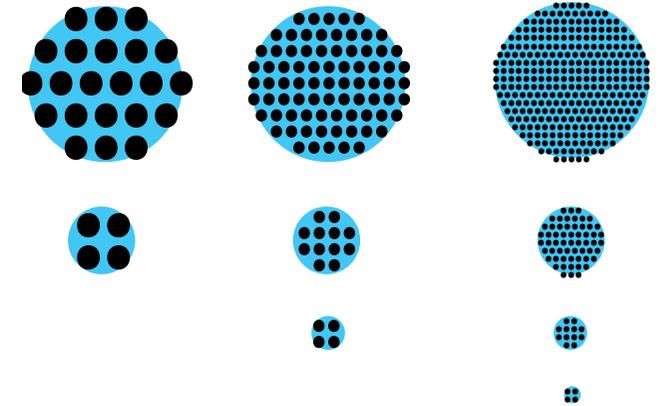
You will notice that the tonal images are made up of little dots. This is because a printing press is incapable of producing an even tone or gradient. All printed material is made up of solid shapes or a series of small solid dots. These small dots are referred to as a Halftone screen. The process of rendering tonal images into small printing dots is called screening.

LPI (lines per inch) refers to screen frequency. A halftone screen is a method by which different tones are rendered as variable-sized dots in order to be printed. Screen frequency is measured by the number of rows of dots per inch of screen. Halftone dots are present only when colour, a tone or a gradient is being printed. A higher screen frequency produces better resolution in images as well as smoother gradients, tones, shades and blends.



DPI (dots per inch) refers to the output resolution of the laser printer or imagesetter. The imagesetter makes tiny dots and combines them to make up everything you see in the output. These are called machine dots.

Machine dots (shown in Black) make up halftone dots (shown in Blue). The higher the Dpi the sharper the halftone dots. This allows finer dots to be produced which in turn allows a higher screen frequency.



PPI (pixels per inch) refers to the amount of information in a scanned image. It is often incorrectly termed dots per inch. The correct PPI for printing requirements:

PPI = 2 X LPI X amount of enlargement

These pixels are a notional measurement of an amount of information. They exist as electrical impulses and have no real physical dimension - they are referred to, in their stored state, as file size measured in bits of information.

Pixel dimensions

The number of pixels along the height and width of a bitmap image. Pixel dimensions are important when preparing an image for online display (for example, a Web page that will be viewed on a variety of monitors), because your image may be viewed on a 15-inch monitor, you may want to limit the size of your image to 800-by-600 pixels to allow room for the Web browser window controls. Print-based graphic artists use millimeters or centimeters to measure images.

The display size of an image on-screen is determined by the pixel dimensions of the image plus the size and setting of the monitor. For example, a 15-inch monitor typically displays 800 pixels horizontally and 600 vertically. An image with dimensions of 800 pixels by 600 pixels would fill this small screen. On a larger monitor with an 800-by-600-pixel setting, the same image (with 800-by-600-pixel dimensions) would still fill the screen, but each pixel would appear larger. Changing the setting of this larger monitor to 1024-by-768 pixels would display the image at a smaller size, occupying only part of the screen.

Image resolution

The number of pixels displayed per unit of printed length in an image, usually measured in pixels per inch (ppi). In Photoshop, image resolution and pixel dimensions are interdependent. The amount of detail in an image depends on its pixel dimensions, while the image resolution controls how much space the pixels are printed over. For example, you can modify an image's resolution without changing the actual pixel data in the image – all you change is the printed size of the image. However, if you want to maintain the same output dimensions, changing the image's resolution requires a change in the total number of pixels.

When printed, an image with a high resolution contains more, and therefore smaller, pixels than an image with a low resolution. For example, a 1-by-1-inch image with a resolution of 72 ppi contains a total of 5184 pixels (72 pixels wide x 72 pixels high = 5184). The same 1-by-1-inch image with a resolution of 300 ppi contains a total of 90,000 pixels. Higher-resolution images usually reproduce more detail and subtler color transitions than lower-resolution images. However, increasing the resolution of a low-resolution image only spreads the original pixel information across a greater number of pixels; it rarely improves image quality.

Using too low a resolution for a printed image results in pixelation – output with large, coarse-looking pixels. Using too high a resolution (pixels smaller than the output device

can produce) increases the file size and slows the printing of the image; furthermore, the device will be unable to reproduce the extra detail provided by the higher resolution image.

Resampling

Resampling refers to changing the pixel dimensions (and therefore display size) of an image. When you downsample (or decrease the number of pixels), information is deleted from the image. When you resample up (or increase the number of pixels), new pixels are added based on color values of existing pixels. You specify an interpolation method to determine how pixels are added or deleted.

Keep in mind that resampling can result in poorer image quality. For example, when you resample an image to larger pixel dimensions, the image will lose some detail and sharpness. Applying the Unsharp Mask filter to a resampled image can help refocus the image's details.

You can avoid the need for resampling by scanning or creating the image at a high enough resolution. If you want to preview the effects of changing pixel dimensions on-screen or print proofs at different resolutions, resample a duplicate of your file.

File size

The digital size of an image, measured in kilobytes (K), megabytes (MB), or gigabytes (GB). File size is proportional to the pixel dimensions of the image. Images with more pixels may produce more detail at a given printed size, but they require more disk space to store and may be slower to edit and print. For instance, a 1-by-1-inch, 200-ppi image contains four times as many pixels as a 1-by-1-inch, 100-ppi image and so has four times the file size. Image resolution thus becomes a compromise between image quality (capturing all the data you need) and file size.

Another factor that affects file size is file format – due to varying compression methods used by GIF, JPEG, and PNG file formats, file sizes can vary considerably for the same pixel dimensions. Similarly, color bit-depth and the number of layers and channels in an image affect file size.

Photoshop supports a maximum file size of 2 GB and maximum pixel dimensions of 30,000 by 30,000 pixels per image. This restriction places limits on the print size and resolution available to an image.

Monitor resolution

The number of pixels or dots displayed per unit of length on the monitor, usually measured in dots per inch (dpi). Monitor resolution depends on the size of the monitor plus its pixel setting. Most new monitors have a resolution of about 96 dpi, while older Mac OS monitors have a resolution of 72 dpi.

Understanding monitor resolution helps explain why the display size of an image on-screen often differs from its printed size. Image pixels are translated directly into monitor pixels. This means that when the image resolution is higher than the monitor resolution, the image appears larger on-screen than its specified print dimensions. For example, when you display a 1-by-1 inch, 144-ppi image on a 72-dpi monitor, it appears in a 2-by-2 inch area on-screen. Because the monitor can display only 72 pixels per inch, it needs 2 inches to display the 144 pixels that make up one edge of the image.

Printer resolution

The number of ink dots per inch (dpi) produced by all laser printers, including imagesetters. Most desktop laser printers have a resolution of 600 dpi, and imagesetters have a resolution of 1200 dpi or higher. Ink jet printers produce a microscopic spray of ink, not actual dots; however, most ink jet printers have an approximate resolution of 300 to 720 dpi. To determine your printer's optimal resolution, check your printer documentation.

Screen frequency

The number of printer dots or halftone cells per inch used to print grayscale images or color separations. Also known as screen ruling or line screen, screen frequency is measured in lines per inch (lpi) – or lines of cells per inch in a halftone screen.

The relationship between image resolution and screen frequency determines the quality of detail in the printed image. To produce a halftone image of the highest quality, you generally use an image resolution that is from 1.5 to at most 2 times the screen frequency. But with some images and output devices, a lower resolution can produce good results. To determine your printer's screen frequency, check your printer documentation or consult your service provider.

Note: Some imagesetters and 600-dpi laser printers use screening technologies other than halftoning. If you are printing an image on a nonhalftone printer, consult your service provider or your printer documentation for the recommended image resolutions.