SCANNING AND SCANNERS

Resolution:

Although the concept can be confusing, resolution is just a measurement of how many pixels a scanner can sample in a given image. Resolution is measured by a grid. Think of a chessboard, with eight squares along each side. The resolution of that chessboard would be 8 x 8. If the chessboard had 300 squares along each side, its resolution would be 300 x 300 -- the typical resolution of an inexpensive desktop scanner today. That scanner samples a grid of 300 x 300 pixels for every square inch of the image, and sends a total of 90,000 readings per square inch back to the computer. With a higher resolution, you get more readings; with a lower resolution, fewer readings. Generally, higher resolution scanners cost more and produce better results. Unfortunately, things aren't that straightforward in the real world. There are actually two ways of measuring resolution, and manufacturers occasionally confuse them in the hope of selling more product. Here's what you need to know about both:

Optical Resolution. A scanner's optical resolution is determined by how many pixels it can actually see. For example, a typical flatbed scanner will use a scanning head with 300 sensors per inch, so it can sample 300 dots per inch (dpi) in one direction. To scan in the other direction, it will move the scanning head along the page, stopping 300 times per inch, so it can scan 300 dpi in the other direction as well. This scanner would have an optical resolution of 300 x 300 dpi. Some manufacturers stop the scanning head more frequently as it moves down the page, so their machines have resolutions of 300 x 600 dpi or 300x1200 dpi. Don't be fooled; what really counts is the smallest number in the grid. You can't get more detail by scanning more frequently in only one direction.

Interpolated Resolution. The other thing to watch out for is claims about interpolated (or enhanced) resolution. Unlike optical resolution, which measures how many pixels the scanner can see, interpolated resolution measures how many pixels the scanner can guess at. Through a process called interpolation, the scanner turns a 300 x 300 dpi scan into a 600 x 600 dpi scan by inserting new pixels in between the old ones, and guessing at what light reading it would have sampled in that spot had it been there. This process almost always diminishes the quality of the scan, and should therefore be avoided. It can also be accomplished by almost any image editing software, so it doesn't really add to the value of the scanner. Unless you plan to scan line art at very high resolutions (more on that later), ignore claims of interpolated resolution.

How much do you need? Although resolution is somewhat difficult to understand, there are several useful rules of thumb to help determine how much resolution to pay for. First, figure out how the scanned image will be used. Scans that will appear in books or magazines need higher resolution than those that will appear in desktop printouts or in multimedia projects or web pages, and there is a separate rule of thumb for images you will be converting to text. In all cases, you should scan at the lowest resolution that will provide the quality you want. Extra resolution only slows the process down and wastes disk space.

Photos that will be printed on a traditional printing press should be scanned at approximately twice the linescreen of the printed piece. For example, most magazines are printed at 133 lines per inch, so an image destined for their pages would be best scanned at 266 dpi. (In practice you can get away with 1.5 times the lpi, but 2.0 times will give you better quality results.) This is because continuous tone images like photographs are converted to halftones before printing, and this process requires at least two pixels for each halftone dot.

Line art illustrations that will be printed on a traditional press should be scanned at the highest resolution possible, or at least 1200 dpi. These images are not converted to halftones before printing, the way photos are, so the higher the resolution used for scanning, the smoother these illustrations will be.

Images that will be printed on desktop laser or color printers are less demanding, because the output resolution of those devices is usually only 300 dpi or 600 dpi (compared to the 2540 dpi output resolution used by magazines and books). These printers use a linescreen of 50-100 lpi, so images should be scanned at 100-200 dpi for best results.

Photos and ***line art*** being scanned for on-screen viewing, such as a web page, require even less resolution because most screens can only display 72-80 dpi. Scanning at a higher resolution only creates extra information that the screen display will ignore and slows down the displaying of the images while creating a larger file than necessary.

Images that will be converted to text should be scanned at 300 dpi or 400 dpi. Most optical character recognition (OCR) programs will accept either. At 300 dpi, your scanning will be done faster, but at 400 dpi, you may get better results, especially on small type. If you will be primarily using text from your scanned images (by way of OCR or document management applications), a 300 dpi scanner will suit you fine.

Resizing & Resolution: All these tips assume that you will be printing an image at its original size. It's important to remember that you will need more resolution if you will be enlarging an image, and less if you will be reducing it. For example, if you are going to print your image at 200% of its size on a desktop color printer, and want it to have 200 dpi resolution, you will need to scan the image at 400 dpi. Alternatively, if you will be printing at 50% of its size, you only need to scan at 100 dpi. Take this into account when deciding how much resolution you will need.

The Bottom Line: If you do the math, you'll probably end up arriving at the following general conclusions:

- If you will be printing on a traditional printing press, and will be working with originals in a variety of sizes, get the highest resolution scanner you can afford. In most cases, this means a 600 dpi scanner.

- If you will be printing on a desktop color printer, decide whether you will need to enlarge items frequently. Usually a 400 dpi or 600 dpi scanner is the right choice, though a 300 dpi scanner will do well without breaking the bank.

- If you will be displaying images primarily on-screen, chances are a 300 dpi scanner will give you all the resolution you require.

Bit Depth:

When a scanner converts something into digital form, it looks at the image pixel by pixel and records what it sees. That part of the process is simple enough, but different scanners record different amounts of information about each pixel. How much information a given scanner records may be measured by its bit depth. The simplest kind of scanner only records black and white, and is sometimes known as a 1-bit scanner because each bit can only express two values, on and off. In order to see the many tones in between black and white, a scanner needs to be at least 4-bit (for up to 16 tones) or 8-bit (for up to 256 tones). The higher the bit depth for the scanner, the more accurately it can describe what it sees when it looks at a given pixel. This, in turn, makes for a higher quality scan.

Most color scanners today are at least 24-bit, meaning that they collect 8 bits of information about each of the primary scanning colors: red, blue, andgreen. A 24-bit unit can theoretically capture over 16 million different colors, though in practice the number is usually quite smaller. This is near-photographic quality, and is therefore commonly referred to as "true color" scanning.

An increasing number of manufacturers are offering 30-bit and 36-bit scanners, which can theoretically capture billions of colors. The only problem is that very few graphics software packages can handle anything larger than a 24-bit scan, because of limitations in the design of personal computers. Still, those extra bits are worth having. When a software program opens a 30-bit or 36-bit image, it can use the extra data to correct for noise in the scanning process and other problems that hurt the quality of the scan. As a result, scanners with higher bit depths tend to produce better color images.

One warning: not all monitors can display a 24-bit, true-color image. Many monitors (especially older ones) display only 8-bit images, with just 256 colors. If an image looks patchy or distorted on screen, it may be the fault of the monitor, not the scanner.

Dynamic Range:

Another important criteria for evaluating a scanner is the unit's dynamic range, which is somewhat similar to bit depth in that it measures how wide a range of tones the scanner can record. Dynamic range is measured on scale from 0.0 (perfect white) to 4.0 (perfect black), and the single number given for a particular scanner tells how much of that range the unit can distinguish.

Most color flatbeds have difficulty perceiving the subtle differences between the dark and light colors at either end of the range, and tend to have a dynamic range of about 2.4. That's fairly limited, but it's usually sufficient for projects where perfect color isn't a concern.

For greater dynamic range, the next step up is a top-quality color flatbed scanner with extra bit depth and improved optics. These high-end units are usually capable of a dynamic range between 2.8 and 3.2, and are well-suited to more demanding tasks like standard color prepress.

For the ultimate in dynamic range, the only choice is a drum scanner. These units frequently have a dynamic range of 3.0 to 3.8, and deliver all the color quality one could ask of a desktop scanner. Although they are overkill for most projects, drum scanners do offer high quality in exchange for their high price.

While a high dynamic range is no guarantee of good scanning results (many other factors come into play), it is generally an indication that the scanner manufacturer is striving to please educated buyers by producing a higher-quality product. All other things being equal go with the scanner that offers the higher dynamic range.