File Formats & Resolution: Mixing & Matching

This article explains the principles of resolution and introduces several guidelines for successful input and output and resolution manipulation.

"But it looks fine on the screen!?!?..."

Images on computer monitors are made up of squares of light. Images on a printed piece of paper are made up of hexagonal dots of ink. The kind of information needed for each is different. While all file formats will display on the monitor and print, some are oriented toward one purpose or the other. Thus, a file saved primarily for display will look fine and print to a desktop printer and yet return from the print shop distorted. It is critical to know what file formats are for, how to use them and how to set the correct resolution.

The problem begins with saving space. The Postscript language which turns image information into dots for print needs more information than the screen does. Files oriented toward screen resolution can save space by not including all the details printers need. Thus file for print can be reduced for screen only, but once thrown away, information is gone and is not restored because the format is changed back to one suitable for print. This can be an issue with many digital cameras. To save space and download quickly pictures are saved as JPG.

It is not necessary to know the history of how or why all the different file formats came to be. The successful desktop publisher should simply know that there are two formats that are acceptable for standard high resolution output: TIFF & EPS. JPG (J-Peg) and GIF (Jif or Gif) are the most common file formats for screen only—the web, multimedia or presentation graphics. Though it is possible to print a GIF or JPG, both formats save space by throwing away information a high resolution printer needs to produce high quality image.

Almost any file can be saved in a variety of formats. It is possible to save a TIFF as a GIF, but in doing so information will be thrown out to make the file smaller. The GIF will still print, but results will vary. GIF and JPG are not generally used for high resolution output. Changing a GIF back to TIFF will make the file large again because space will be created to store the printer information in the file again. But the information that should be stored in that space is gone.

How does screen resolution relate to print?

Typically computer screen resolution is 72 pixels per inch which roughly relates to dots per inch on paper. The difference is that it takes less light to fool your eye than ink dots. So while 72 tiny squares of light per inch look like a clear image, 72 dots of ink on a page look distorted. Professional print output starts at 1200 dots per inch and goes to 2400 or more on four color lithography. However, a file should never have a resolution of 1200 unless an image is being drastically enlarged.

The third component of understanding resolution is file resolution. The screen is measured in square pixels, printed page in hexagonal dots and the file in the computer in bits of information per dot. In other words, when an image is scanned and converted into a digital file, each dot is described by a series of digits (bits). Depending on how many bits are recorded per dot, the computer can generate more or less printed dots per scanned dot.

In practical application let's take the industry standard image editing and preparation software: Adobe Photoshop. This software stores 8 pieces of information for each dot of an image: 8-bit. A standard TIFF image saved by Photoshop will have 8 bits per dot. When the file is then converted back into dots to print, each bit can become a dot. The following equation is the primary guideline in determining minimum resolution:

$$\text{file dpi} \times \text{bits} = \text{maximum output}$$

A 300 dpi file saved by Photoshop at 8-bit will produce 2400 printed dots per inch. 300 is the industry standard for high resolution output.

This equation can help us determine the file resolution and save space. In most print plants professional black and white seldom requires more than 1600 dpi. So, a file saved as a TIFF or EPS and set to an image resolution of 200 will produce the best possible result. Additional information in the file (higher dpi) is wasted.

Back when print shops turned photos into dot patterns using photography, they determined the size and shape of dots by using mesh screens and measured resolution in lines per inch. Printers still refer to resolution of a printed page in lines per inch and frequently advise desktop published to double the line screen (lpi) in order to calculate dots per inch (dpi). This is usually safe, but there is no direct coloration.

How to Get Excellent Results:

Scan at 300 dpi or higher. Most desktop scanners will record most accurately at 300. Higher scan resolutions are helpful for enlarging. The idea is that if the scanners eye brakes each dot down into more than it needs, the image can be stretched without losing resolution.

Once an image is scanned save it as a TIFF or EPS. If the scanner software doesn't support either of these PICT is passable. Then open the file in Photoshop in order to adjust contrast, set size and edit minor blemishes.

NOTE: Since desktop scanners are looking at pictures through glass all scans will be distorted and need adjustment no matter how good the scanner. On close inspection one might also note that dust or scratches are visible on the computer that were not noticed on the picture. Such minor details will only get worse throughout the production cycle. So, the dust might show up as white specs in the dark area of a photo when printed. Depending on the use of the image it is usually worth inspecting and fixing a scan.

Once the image is fixed change it to the correct color mode and check the file resolution. If the picture will be black and white and is sized correctly, 200-250 dpi are fine. A little extra never hurts and may allow some size variation in layout.

I find that TIFFs behave better than EPSs. The advantage of TIFF is that they can be screened and have special effects applied right in most page layout programs. They also tend to be smaller than EPS files. EPS files can be changed to TIFFs in Photoshop, but it isn't necessary to do so. Many popular graphics products use EPS for features specific to those programs. EPS files can contain embedded Fonts which can be tricky. Be careful if you find yourself with EPS files. Clip art created in Illustrator, Freehand or Corel will more than likely end up needing to be exported as EPS in order to be used in PageMaker, Quark or InDesign.

Drag & Drop Design

Most graphical operating systems like Mac OS, Windows and NT support the ability to drag text and images from one program to another. This is fine for text, but graphics won't work. What is being dragged is the screen image information which is then stored in the destination document. The page layout files will not be linked to the printer information in the image file. For presentation graphics, web design, and rough layouts that won't print to high resolution, dragging and dropping makes moving between software products easy. But, for anything that will be output to print, the image or graphic must be imported or placed using the page layout products function for creating links. Then, the image and art files must go with the page layout files. There is no magic, the information has to be there or final results will be poor.

72 dpi   vs.   300 dpi
(file resolution when printed to 2400 dpi)

Digital Cameras

The best results in desktop publishing are still achieved with scanners. However, many digital cameras set on their highest quality setting can record enough information to support professional reproduction.

Be aware that many digital cameras are specifically made for consumers to have fun with digital pictures—not lithography. All digital cameras and scanners come with software. Note that if the camera has a high resolution setting and the software lets the user save TIFF images, the camera may produce an acceptable, printable image. If the camera only saves JPG images it may print to an ink jet, but it won't print directly to an image setter. Be very careful with digital camera images.

There are many models that can provide useful images. But at this point in the development of digital camera technology, professional level cameras still cost $20,000. and up. $500. to $1,000. cameras are just starting to be useful to yearbook staffs and school publications.

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