Digital Basics for Printmaking

A Halftone and a Bitmap.

A small image from a website may only be 180 x 125 pixels at 72 ppi such as the one above. Printed directly from the website the image is 2.5" across. For quality inkjet printing an image should be about 300 ppi, which would make the above image only .6" x .4" inches.

DEFINITIONS

Halftone

A continuous tone image, such as a black and white photograph, must be translated into varying sized dots to give the illusion or approximation of tonal transitions and gradations when printed. These are known as halftones. The use of the word halftone may refer to an image that has been converted into one, or the actual dots in the image. Halftones used to be created by exposing an image through sheets of film with a grid dots that were clear in the center and increasingly opaque towards the edges. Depending on how much light passed through the screen varying sized dots would be created.

Bitmap

An image that has been digitally converted into a grid of either black or white pixels. Tonality is approximated through the frequency of information.

Resolution

There are many types of resolution. Resolution is used to measure the amount of information an image has. Resolution is specific to the technology being used and there can be several different resolutions operating simultaneously. For example, some inkjet printer can print at a resolution of 2880 dots of ink per inch, but you may only have it set to print at 1440 dots of ink per inch, while the resolution of your file is 300 pixel per inch. If not correctly understood and utilized, incorrect resolution settings could create printing problems for you down the road.

Typical Resolutions

Images from the Web/On-Screen = 72 ppi

Color or B&W Photo to be printed on an Inkjet Printer = 300ppi

Hand Lithography = 240+ ppi for halftones

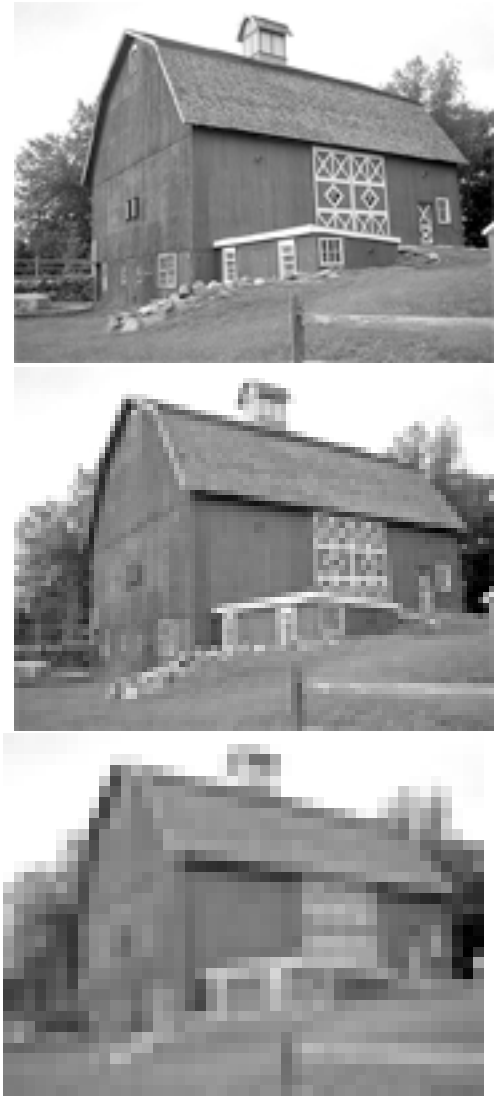
Screenprinting = 150 ppi (depends on screen mesh)

PPI

The resolution of a digital image is measured in pixels per inch. Pixel is short for picture element. Images viewed on-line or from video have a resolution of 72 ppi. A medium sized image on screen may only be 450x300 pixels. A single frame of HD video is 1920 x 10800 pixels. Images printed from laser printers and inkjet printers must be around 240 pixels per inch to print at their best quality. An 8x10" image would have to be at least 1200 x 1500 pixels to be printed properly from one of these printers. Images printed in magazines and books usually range from 300 ppi and higher.

Image Mode / Pixel Depth

The amount of information a pixel contains, is determined by the number of bits ascribed to it. A bit is the fundamental unit of measurement on a computer and is either a zero or a one. A bitmap image has only one bit per pixel, so it can only be



Resolution: 180 x 135 @ 72 ppi, 90 x 68 @ 36 ppi, 45 x 35 @ 18 ppi.

made up of black or white pixels. A grayscale image has 8 bits per pixel for a total of 256 values from white to black. RGB color images have 24 bits per pixel; 8 for each channel of Red, Green and Blue elements that make up an image on a computer screen. CMYK image mode is particular to commercial printing, and is the acronym for Cyan, Magenta, Yellow an Black, the four colors used to reproduce images through printing. This image mode is only used when printing color separations or sending files to a commercial printer. Images printed on ink-jet printers do not need to be converted to CMYK although they often print with those colors.

DPI

dpi is the acronym for dots per inch and is specific to a particular device, specifically a printer. This is not the same as ppi, but does effect what ppi you will need for any given image. The term dpi generally refers to the resolution a printer can print at. Laser printers are set to print at 600, 800, or a maximum of 1200 dpi. Ink-jet printers generally print at 360, 720, 1440 or 2880 dpi. Dpi is device specific (ie: the GCC Elite XL), and is the one of the most important factors in determining proper ppi and lpi.

LPI

Lines per inch pertains to halftone images only. It is a measurement of how many lines of halftone dots occur per inch. Lpi is separate but related to ppi and dpi. Lpi varies depending on how an image is printed. The grid of halftone dots is also set to a specific angle. A 45º angle is the least noticeable and is used for printing images in black or a single color. Other angles are reserved for color printing.

Typical LPI

Magazine = 133 lpi

Newspaper = 85 lpi

Hand Lithography = 65-75 lpi

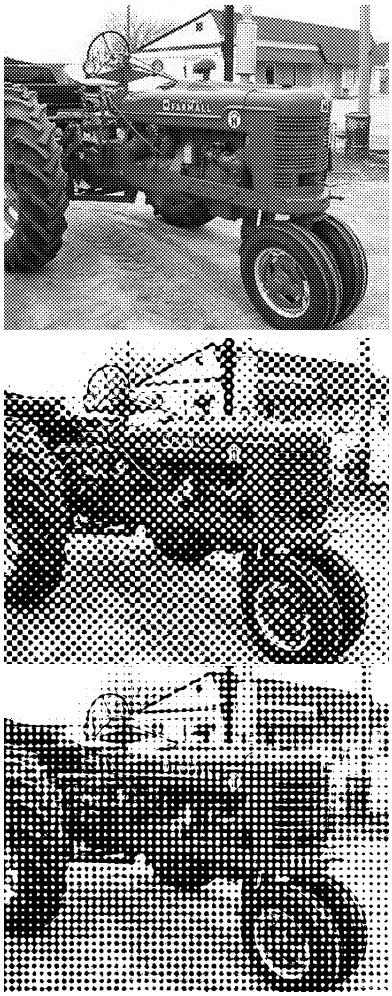
Screenprinting = 45 lpi (depends on screen mesh)

Laser Printers

Black and white laser printers create images on paper by fusing toner, a fine plastic powder, onto paper. By default they print grayscale images with a halftone screen. Our HP5000 and GCC Elite XL in the computer labs print at 1200 dpi with a halftone screen over 120 lpi. Only media labeled for use on a laser printer may be used. Improper materials can melt around the heating element ruining the printer. *This means no Iron-on Transfer Sheets!*

Inkjet Printers

These color printers spray liquid dyes or pigments in very fine droplets onto the paper and are essentially like watercolors. When set to their maximum printing resolution of 1440–2880 dpi they can rival the quality of chemical based photographs. By default, they render images with stochastic dithering rather than applying a halftone screen (frequency as opposed to amplitude). Although they print with the four process colors (Cyan, Magenta, Yellow, Black), or a variation of them (Cyan, Light Cyan, Magenta, Light Magenta, Yellow, Black, Light Black) digital files may be left in RGB mode since the software for the printer will automatically translate the files to be printed appropriately. Be aware that many of these printers may not use archival pigment-based inks, meaning they could drastically fade in direct sunlight in a matter of weeks. If media (paper and film) specifically for inkjet printers is not used, the printer can be permanently ruined.



75 lpi, 25 lpi at 45° angle, 25 lpi at 0° angle.

General Formulas for Determining PPI, DPI AND LPI

Remember that these are not fixed rules. Experiment! Try it the way you want it or just ignore this info altogether!/

ppi = 2 x lpi
A photo-litho will print easily at 75 lpi, so the ppi should be set to at least 150ppi.

optimal lpi = dpi ÷ 16
A laser printer set to 1200 dpi will print 75 lpi most accurately which is also optimal for lithography.

optimal lpi for screenprinting = screen mesh ÷ 5
A 230 mesh screen will generally not print an image above 45 lpi as accurately regardless of higher dpi or ppi.

optimal dpi for screenprinted bitmaps = screen mesh ÷ ~2.5

DPI, LPI and Number of Gray Levels

The formulas listed above are important because they determine not only optimal qualities for hand printing your images, they also determine the image quality and the number of grays your image can contain. Most important is the dpi (the resolution of your output device) in relation to your lpi. This determines how many dots will make up one halftone dot. If you divide the dpi by 16, this means you will have a 16x16 halftone dot made up of a total of 255 dots. This provides 256 possible grays, that conveniently also matches the number of grays in a standard grayscale file with 8 bits per pixel. Although this is an optimal setting, you do not need to follow this formula as a hard and fast rule.