# Digital Basics for Printmaking
## DIGITAL & PHOTO PRINTMAKING

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.
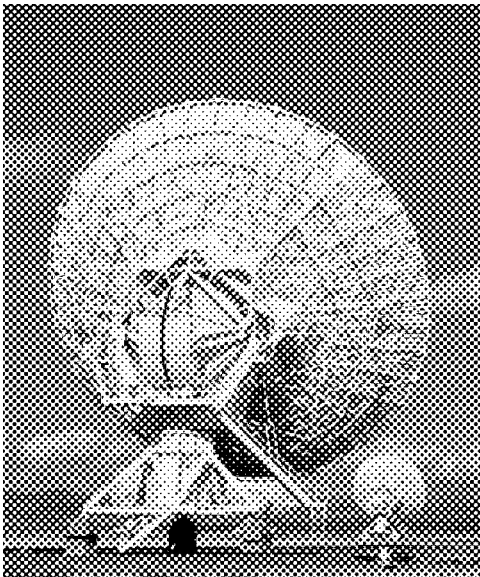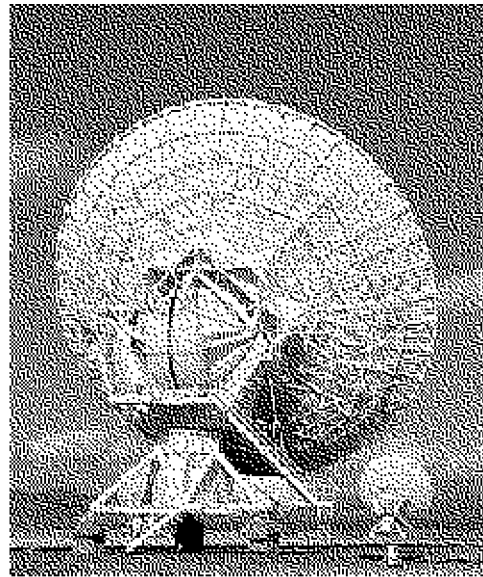
Halftone   Bitmap

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. If not correctly understood and utilized, improper setting of your resolution can create printing problems for you down the road.

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 72ppi. A medium sized image on screen may only be 450x300 pixels. A single frame of video is 640x480 pixels. Images printed

72ppi   36ppi   18ppi
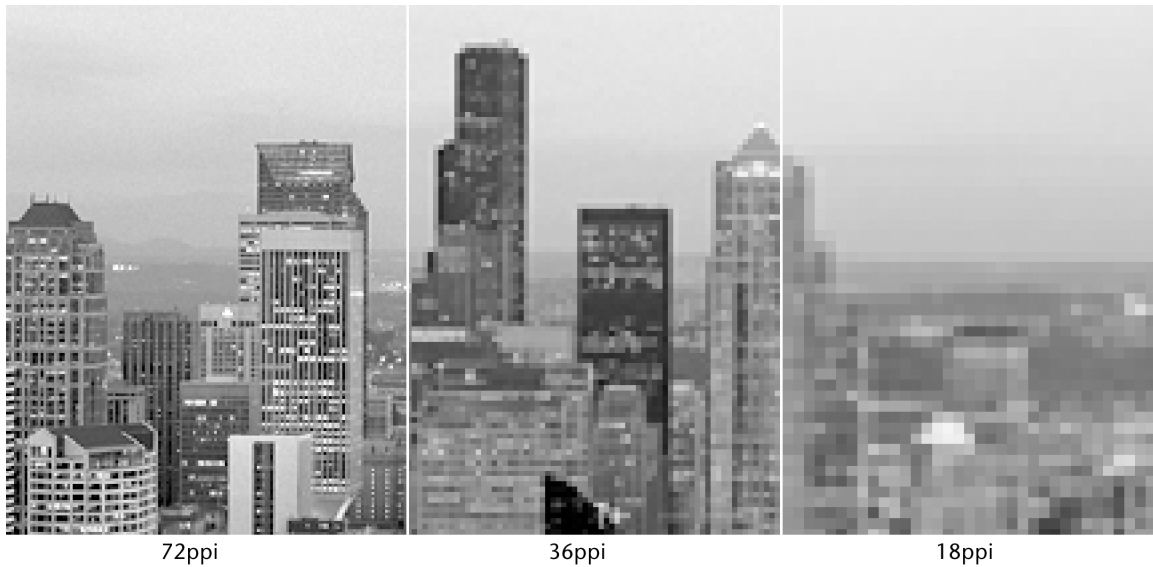
from laser printers and inkjet printers must be 150–240 pixels per inch to print at their best quality. An 8x10" image would have to be at least 1200x1500 pixels to be printed properly from one of these printers. Images printed in magazines and books usually range from 240-355ppi.

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 made up of black or white pixels. A greyscale 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 phosphors that make up an image on a computer screen. CMYK image mode is particular to 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. 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 2880dpi. 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. Generally, newspaper images are printed at 85lpi, whereas magazines are set to 133lpi. Lpi is different for printing by hand and will vary from 35-55lpi for screenprinting or 65-85 for lithography. 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.
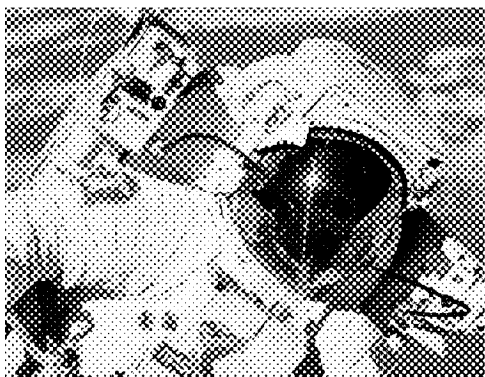
LASERPRINTERS

Black and white laserprinters create images on paper by heat setting powdered toner onto paper. By default they print greyscale images with a halftone screen. Our HP5000 and GCC Elite XL in the computer labs print at 1200dpi with a halftone screen over 130lpi. 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!
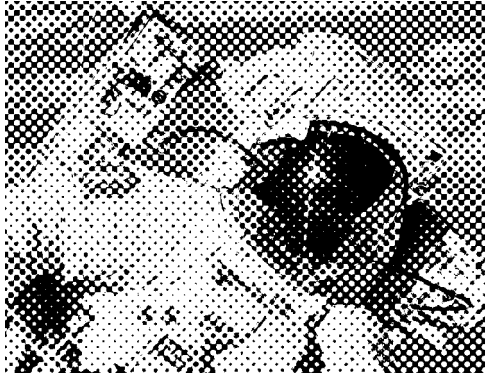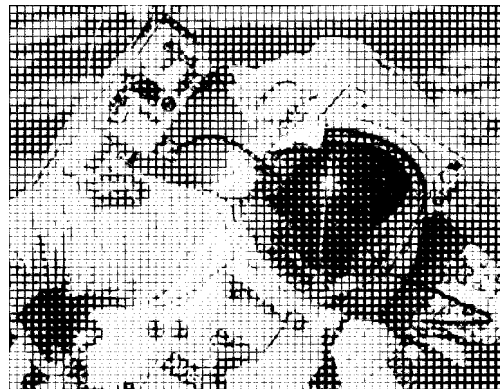
24lpi
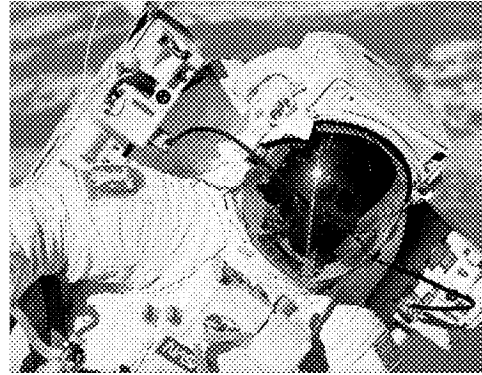
48lpi

36lpi / 45 degree angle

36lpi / 0 degree angle

line instead of round dot

cross instead of round dot

INKJETPRINTERS

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 1440–2880dpi they can rival the quality of 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) 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.

FORMULAS FOR ACCURATE PPI, DPI AND LPI

Formula	Example
ppi = 2 x lpi	A photo-litho will print easily at 75lpi, so the ppi should be set to 150. Anything above 150 will be wasting space on your disk.
optimal lpi = dpi ÷ 16	A laser printer set to 1200dpi will print 75lpi most accurately
optimal lpi for hand printed photo-litho = 65- 85lpi	If your lpi is above 85 you may have trouble with darker areas filling in or maintaining a full tonal range.
optimal lpi for screenprinting = screen mesh ÷ 3.5	A 195 mesh screen cannot print above 55lpi regardless of higher dpi or ppi
optimal dpi for screenprinted bitmaps = screen mesh ÷ 1.5	A 130-150dpi bitmap will be printed most accurately on a 200 mesh screen.

Remember that these are not fixed rules: Experiment! Try it the way you want it!

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.

3-by-3 cell
10 possible gray levels

8-by-8 cell
65 possible gray levels

16-by-16 cell
257 possible gray levels