

Reproducing line art electronically can be done in three basic ways. Either you can scan it, create it in a paint program, or create it in an illustration program. You might even choose a hybrid solution, i.e., scan it, and then use the scan as a template in an illustration program. To understand why you might choose any of the above strategies, it is important to understand some of the basics involved in electronic line art.

Electronic line art and halftones are governed by very different rules. This article deals almost entirely with line art. If you are interested in learning more about the scanning of halftones, please refer to the Linotype-Hell technical information piece entitled Scanned File Size, part number 3053. The Scanned File Size article also supplies some background information on file size concepts that apply to line art.

Line art

Line art is single color artwork without any tints. A line drawing, engraving or woodcut is a good example of line art. (See Figure 1.)

In scanning, line art refers to scanned data that contains one bit of information. Scans that are one bit deep define only two states: black and white. In process camera work, line art contains just black and white lines with no tints. No tints are included for the simple reason that re-photographing fine tints is difficult to do.

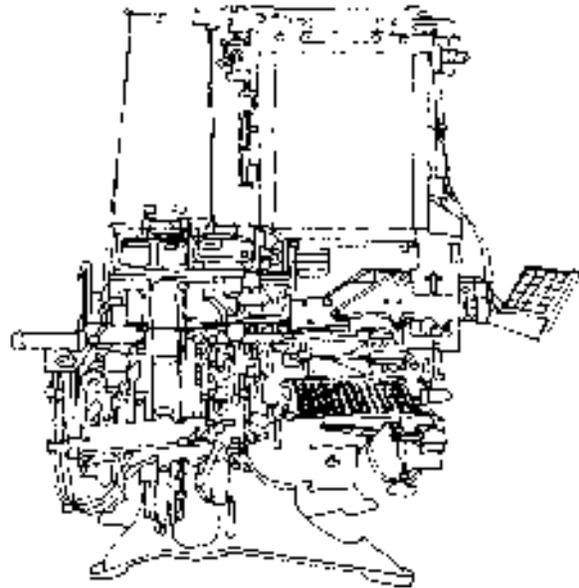


Figure 1 - This line drawing of a Linotype machine was done by Milton Glaser, and is used with his permission.

Vector versus raster

When line art is reproduced electronically it may come in one of two general types: raster or vector. Raster line art (often called paint or bitmapped) is line art that has either been created in a paint program or scanned. The data that makes up a piece of raster line art is in the form of rows and columns of scanned samples, i.e., a bitmap of black and white entries.

Vector line art (often referred to as draw or object-oriented) is line art that has been created in an illustration program. Instead of defining every single point, these illustration programs use mathematical representation of lines and shapes to create line art. For example, a vector line can be defined very

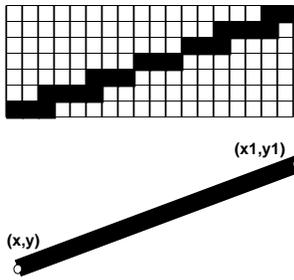


Figure 2 - Raster line (top), and vector line (bottom).

Input and output



Figure 3 - A 75 dpi line art scan output at 2540 dpi. Even though this file was output at a high addressability, it is still clearly a low resolution scan.

Interpolation

Device independence

simply if you know the two end points and the width of the line. To define a raster line you would need to know the location of the endpoints and every point in between. (See Figure 2.)

Vector line art has some distinct advantages over raster line art. Vector line art may be resized without affecting quality.¹ It also generally takes up less memory space than raster line art. The main disadvantage of vector line art is that you either have to draw it from scratch, or somehow find a way to convert a raster piece of line art into a vector format.

¹The stepping in raster line art is particularly noticeable when enlarged. Although it is also true that the flaws in a poorly-drawn piece of vector line art become more apparent when enlarged, a well-drawn vector line art enlarges with no quality degradation.

Scanner resolution and imagesetter addressability play an important role in quality. Scanner resolution refers to the amount of samples that a scanner 'sees' in a given distance, usually an inch or centimeter. Most commonly, scanner resolution is measured in dots per inch. For example, a common desktop scanner resolution is 300 dpi.

Imagesetter or printer addressability refers to the amount of marks that an imagesetter or printer can make within a given distance, again usually an inch or centimeter. While this is often called resolution, addressability is the more accurate term. (For more information, please refer to the Linotype-Hell technical information piece entitled Addressability and Spot Size, part number 3071.) Addressability is usually measured in dots per inch.

The important concept to understand is how the relationship between input (scanner resolution) and output (imagesetter/printer addressability) affects quality. For line art, if the resolution of the scan falls below the addressability of the output device, you risk seeing output that may not look as good as what the printer is capable of achieving. (See Figure 3.) For example, a 75 dpi line art scan is never going to look any better than 75 dpi, even if it is printed to a device with a higher addressability.

If the resolution of the scan exceeds the addressability of the output device, then you may have more information that you actually need. For example, a 600 dpi line art scan output on a 300 dpi printer, will never look any better than 300 dpi. Therefore the quality ceiling, i.e., the limiting factor, may exist on either the input or the output side.

Note: In the case of halftones, the screen ruling of the halftone determines the optimum scanning resolution. Please refer to the Scanned File Size article.

Scanners can artificially increase the resolution of an image by inserting added data between pixels. This process is called interpolation. If a scanner is good at guessing where this data should go, then you have a better image. If not, you have a larger image that is not necessarily any better. Interpolation is a dicey business, so you should find out from your scanner manufacturer whether the scanner array actually scans for the specified resolution, or whether it uses some amount of interpolation to increase resolution.

Device independence refers to the ability of an image to be output on any device, and to print to the best of that device's ability. Vector images are innately device independent; raster images are not. Because a raster image has a resolution, it must map up to the addressability of the output device. That is why vector images are more flexible and print better over a wider range of devices. To make a raster image look good over the same range, it would be necessary to choose the highest common denominator, i.e., scan at the resolution that works for the output device with the highest addressability. Then the results would look good for all devices, but you would have much too much data for devices with low addressability.

Scanning versus creating

File Size	
(based on image size and scan resolution, see Scanned File Size article for full chart)	
300 dpi	
1" x 1"	11 KB
4" x 5"	220 KB
8" x 10"	879 KB
600 dpi	
1" x 1"	44 KB
4" x 5"	879 KB
8" x 10"	3.4 MB
1,000 dpi	
1" x 1"	122 KB
4" x 5"	2.4 MB
8" x 10"	9.5 MB

Note: Compression rates of 5:1 are possible with line art scans.

While you might like to simply scan images at resolutions that will take advantage of the addressability of your printer or imagesetter, you will soon find that this can create some pretty large files (see chart to left). However the most basic problem is that scanner resolution is expensive. Low-cost 300 dot per inch scanners abound, but a much greater investment is required to get true higher resolution.

The only way to know what scan resolution is suitable for your needs is to test with scans that are printed using the paper and press that you ultimately use. Figure 4 shows such a test. The same image is reproduced several times, the only difference between the images is the resolution of the scan.

As illustrated in Figure 4, one way to get better quality out of a low resolution scanner is to reduce the image after you scan it. Through this process you effectively increase the resolution of the file. This is useful when the images need to be reduced, but is not much help if you have a large line art image to reproduce. If your images are too large to reduce in this fashion (the bed size of the scanner would determine the largest image you could scan and then reduce), you have several options:

- Buy a high resolution scanner
- Create the images in vector format
- Convert a scanned image to vector format.

If you can't afford the scanner (and the storage that it will require for the large file sizes it produces), you may be interested in either creating the files in vector format, or converting raster images into vector format.

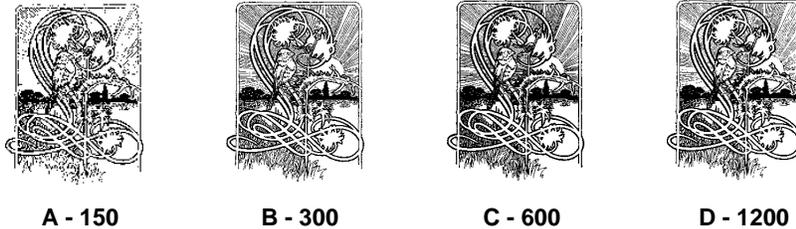


Figure 4 - Image A was scanned at 75 dpi and reduce by 50% to give a final effective resolution of 150 dpi. Image B was scanned at 150 dpi and reduce by 50% to give a final effective resolution of 300 dpi. Image C was scanned at 300 dpi and reduce by 50% to give a final effective resolution of 600 dpi. Image D was scanned at 600 dpi and reduce by 50% to give a final effective resolution of 1200 dpi. All images were then printed via offset lithography on an 80 pound paper.

Converting into vector format

The advantages of working in a vector format are: smaller file size, greater flexibility with sizing, and potentially faster printer output times.² There are several ways to get an image into a vector format:

- Create it in an illustration program like MacDraw**, Adobe Illustrator**, Aldus FreeHand**, Arts & Letters**, Corel Draw**, or Cricket Draw**.
- If you have an original drawing already, some programs allow you to use a scanned version of the original as a template to draw over. The programs may also have some ability to do automatic tracing.
- Use a program that converts a scanned image into a vector format. Adobe Streamline** is the best known product of this type. (Adobe recommends that scans used for conversion by Adobe Streamline be at least 300 dpi. This is to assure that stairstepping in the scan is not converted into detail.)

²It is difficult to make generalizations about output time of vector images that have been converted from a raster format. This is because vector images, though generally smaller in file size, may still contain elements (i.e. numerous lines or complex shapes) that may be difficult to compute and print.

Often, after an image has been converted an artist may need to fine tune it. Because of this, it makes sense to do this type of conversion only with images that you intend to reuse frequently.

Converting logos

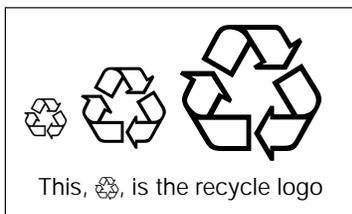


Figure 5 - The recycle logo shown at 18, 36, and 60 points, and also included in 10 point text.

Corporate logos require particular attention to detail because of the image that they project for a company. To meet the need for quality logos, Linotype-Hell offers a service for companies that want their logos converted into a PostScript** format. Font experts at Linotype-Hell work from a high-quality original that you supply, scan it at high resolution, convert it into a vector format and ultimately make a font out of it. Each logo can then be keyboard accessed, just as you might do with any other character in a font.

Linotype-Hell's special attention to detail, combined with years of experience in the type industry, means that the logo will look good at a range of sizes. In addition, if the logo is ever meant to be incorporated into text, it can be done in a manner that addresses the spacing of the characters around it.

Figure 5 shows an example of a logo that has been converted in this manner. For more information on this service, please contact either your type sales representative or myself at the address below.

Clip art

Clip art books have been around for a long time, but now they exist in electronic data formats. This makes it easier for designers to have access to line art that they can use without fear of infringing on an artist's copyright.

As there are many different companies who supply these products, and the images come in a number of different file formats, it is important to know if you are getting raster or vector line art, and whether it is in a form that you can easily use. Very often the promotional literature will only mention that the artwork is in Macintosh** or PC format. If it says that they can be edited in a paint program, you know the files are raster (probably MacPaint**, TIFF, or .PCX).³ If it says they can be edited in an illustration program, you know the files are vector (probably EPS, MacDraw, or PICT.)

³Ask about the resolution of the scans. If the scans are done at 72 dpi, they may only be suitable for printing to a dot matrix printer.

Conclusion

Whatever path you choose, your decision should be tightly dependent on the quality level that you require (based on the printing process and paper that you use), the budget that you have, and other factors like existing equipment or libraries of images that you have in a certain format.

Comments

Please direct any questions or comments to:

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