Linotype-Hell

Technical Information

Measuring Screen Angle and Ruling

One of the primary considerations in tint and halftone work is the choice of the screen angle and ruling. **Screen angle** is a measure of the orientation of the halftone screen, and becomes particularly important in color work. **Screen ruling** is a measure of the fineness of a halftone screen, and must be appropriate for the paper and press being used. Choosing screen angle and ruling using the PostScript** page description language can be frustrating until you understand some of the basics involved in digital halftoning.

Do you get what you ask for?

PostScript operates in a theoretical world. It creates descriptions of pages that can be printed on any number of devices. It is the job of the RIP (Raster Image Processor) to bring the page back to reality and print it at a particular resolution on a given device. Screen angle and ruling are very much dependent on the resolution setting of the output device. Just as the number of grays that an imagesetter can produce increases with an increase in resolution, so does the achievable set of screen angles and rulings. This means that the screen angle and ruling which you request (either using a software program or PostScript code), may not be the angle and ruling which the imagesetter actually outputs. PostScript will get as close as it can, but just how close it gets depends on the resolution of the imagesetter, the angle and ruling requested, and the type of halftoning involved.

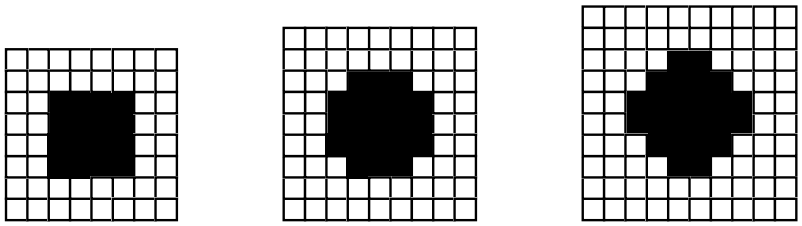
Screening algorithms

Linotype-Hell has been instrumental in the development and implementation of halftone screening algorithms. Two of these algorithms: HQS Screening* and RT Screening*, are discussed in greater detail in the Linotype-Hell technical information piece called Moiré, part number 3063. The next two sections in this document give an overview of the way that RT Screening produces screen angle and ruling.

Screen ruling

Screen ruling is determined by a relationship between the resolution of the output device, and the length of the side of the halftone cell. (The halftone cell is the imaginary bounding box of a digital halftone dot.) The length of the side of the halftone cell must fit on the grid made up by the resolution setting of the imagesetter. As an example, Figure 1 shows some halftone cells that are possible at a 0° angle and 1270 dot per inch resolution. Note that the

Note to Figure 1:
A single halftone cell is shown for each screen ruling. The halftone dot in each cell is approximately a 25% dot. The smaller the cell, the higher the screen ruling (because more cells will fit in an inch). The larger the cell the greater the number of grays that that halftone can produce. The number of grays is equal to the number of pixels in the halftone cell plus one.



1270/8 = 158.75 lpi **1270/9 = 141.11 lpi** **1270/10 = 127.00 lpi**

Figure 1 - A selection of halftone cells at 0° and 1270 resolution. 0° is chosen for this illustration because of the simplicity of the halftone cell. As the cell is rotated to other angles the principle becomes much more difficult to visualize.

length of the halftone cell must be a whole number, in this case 8, 9, or 10. Dividing the resolution by the length of the side of the cell gives you the screen ruling. In this case, 1270/8 = 158.75, 1270/9 = 141.11, and 1270/10 = 127.00. So for this combination of factors (0° and 1270 resolution) if you were to ask for a 133 line per inch screen ruling, the RT Screening in the PostScript RIP would make a choice and pick the closest one: 127.00 lines per inch. In a practical sense, there is little difference between a 133 line per inch screen and a 127 line per inch screen. The higher the resolution of the imagesetter, however, the greater the number of choices, and the closer the selection comes to the requested ruling.

Screen Angle

For screen angle, a similar choice must be made. Imagine trying to draw a line between two points on a grid. (See Figure 2) The length and angle of any line you draw are dependent on the grid. It is easy to draw a horizontal or vertical line on a grid. A 45° diagonal is also easy. However in either of these cases you might have to settle for a length that is not exactly what you intended. If you wanted to draw a 3 1/4" line at a 15° angle, you would have to choose from the closest options available (none of which, in Figure 2, are exactly 15°.) If you imagine that the length of the line is the same as the length of the side of the halftone cell (see Figure 3,) then this is what happens when you select screen angle and ruling at a certain resolution.

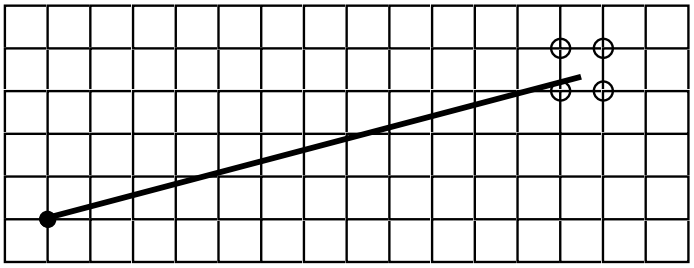


Figure 2 - The open circles indicate the options available for a line of approximately 3 1/4" in length and a 15° angle drawn on a grid of 1/4" squares.

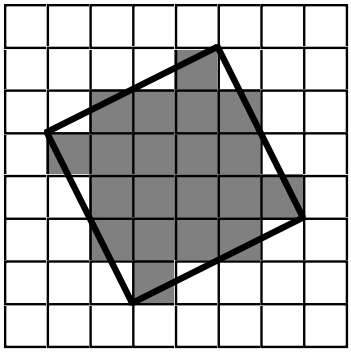


Figure 3 - Halftone cell at a 26.57 degree angle. The shaded areas denote the pixels that fall within the cell.

What this all means is that any requested angle will only occur at certain screen rulings. For example, for black and white work, a 45° screen angle is most commonly used. This angle can be achieved exactly in PostScript regardless of screen ruling, however, the screen ruling is limited to a number of discrete values.

In some cases, as with the 15° and 75° angles commonly used for color separation, both the screen ruling and angle may vary slightly. Again, this will depend not only on the resolution of the output device, but also on the type of halftoning being used. The crucial advantage of Linotype-Hell's HQS Screening is that it is able to produce screen angle and ruling much more accurately than has been previously possible with the PostScript page description language.

Conclusion

Visual observation is not enough to determine if the screen angle and ruling are correct. To help you measure it, Linotype-Hell has developed an analyzing tool that is specifically designed for PostScript halftones.

The Linotype-Hell measuring tool provides a quick and easy way of determining the screen angle and ruling of a halftone or tint. The printed version shown here will allow you to measure screen angle and ruling on film. If you would like a film version of the tool for measuring halftones on paper as well as on film, send a self-addressed, stamped (four first class stamps), 9" x 12", envelope to the author at the address on the back of this document.

Replace this page with supplied film

Comments

Please direct any questions or comments to:

Jim Hamilton, Marketing Department
Linotype-Hell Company
425 Oser Avenue
Hauppauge, NY 11788
(516) 434-2717

Part Number 3055, 7/91