

Figure 1 – A polygon that might result when the flatness setting is set too high on a circle.

Flatness is a number which is used by the PostScript™ page description language to define how accurately curves are rendered by an output device. The flatness value represents the number of pixels that the resulting rendering may vary from a perfect rendering. Large flatness values will result in circles that look like polygons. (See Figure 1.)

The choice of a flatness value is a tradeoff between the accuracy of the rendering versus the length of time that it takes to calculate.

Flatness is both image and device dependent.

- A straight line is not affected by the flatness value but curves are affected in ways that are difficult to predict. (Don't use flatness to draw polygons! They will come out differently depending on the output device resolution.)
- A flatness value of 25 may produce miserable looking output on a 300 dot per inch (dpi) laser printer, but be quite acceptable at on an imagesetter at 3386 dpi. (See examples on the following page.)

In this article we will look at the story behind flatness and show examples of the effect that flatness has at different resolutions.

Line segments and curves

A curve may be approximated by a series of line segments. If the line segments are short enough, the individual line segments will not be visible. It is easier for a raster image processor (RIP) to calculate a series of short line segments than it is to create a perfect curve.

If the flatness is set too high, a curve will be made up of lengthy line segments that do not approximate the circle very well. On the other hand, if the flatness is set too low, the RIP may have to endure many more calculations than are necessary to produce a good-looking curve. The trick is to find a flatness value that works well at the resolution of the target output device.

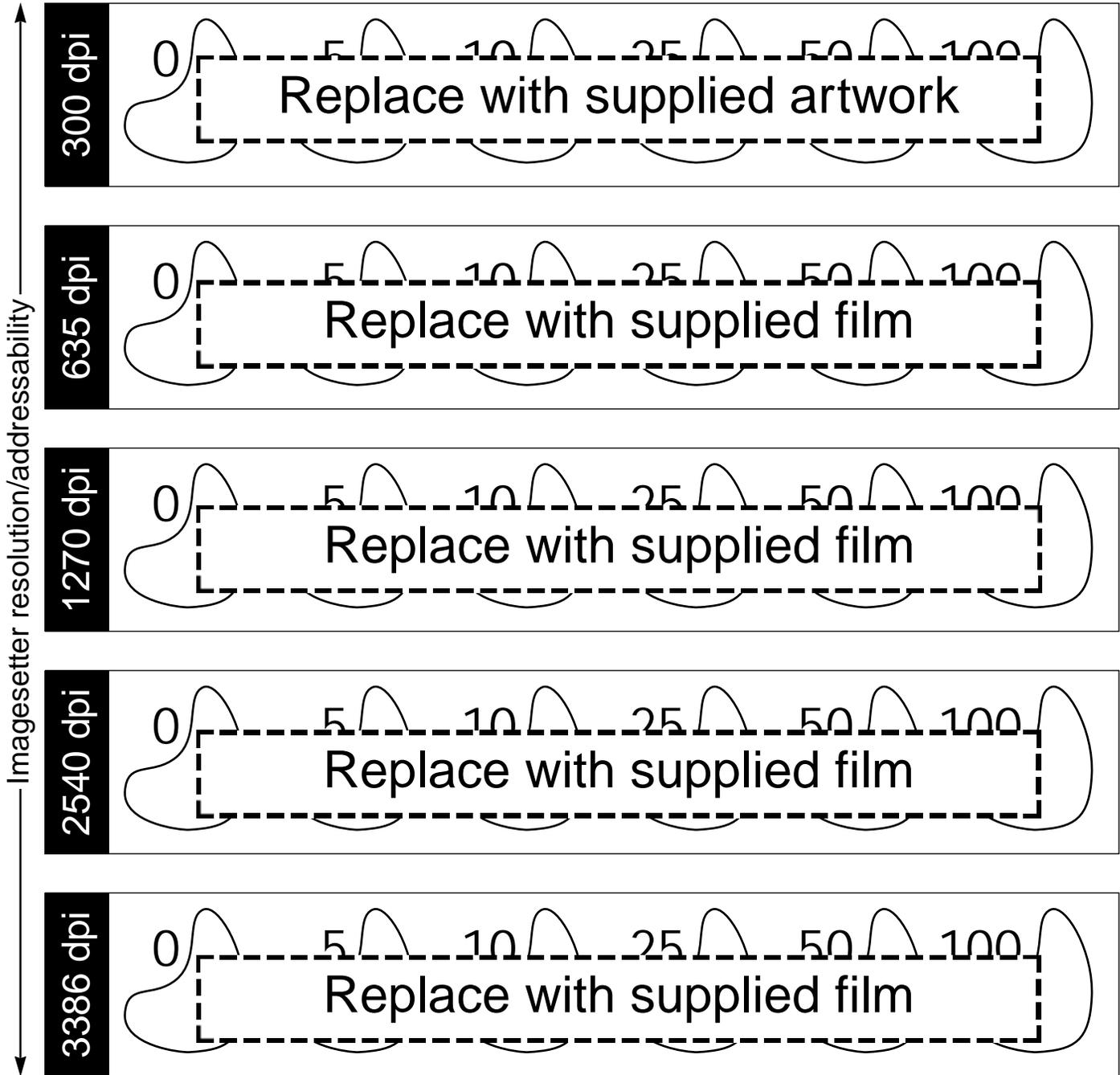
Adobe Illustrator 5.0

Most people know flatness from the Style dialog box in Adobe Illustrator™ (any version below 5.0). With Illustrator 5.0, Adobe changed the way that it assigned flatness. It developed a definition of flatness based on the printing device resolution and a user-chosen output resolution setting. (See chart to left.) The output resolution setting is found in the Attributes dialog box.

Adobe undoubtedly changed this because of problems caused by having the default flatness value set to zero. This made illustrations much more complex than they needed to be when output at high device resolutions. It created a cycle that worked like this: a user would be able to print a file on a 300 dpi laser printer, but would have trouble outputting the file at high resolution on an imagesetter. The solution: increase the flatness setting.

By setting flatness via the output resolution setting, Illustrator 5.0 guarantees that the flatness value will be no less than one, and probably not high enough to produce clunky curves. Whereas flatness was device specific, Adobe's output resolution setting is device appropriate. The test on page 16 provides insight on setting either flatness alone or flatness based on Adobe's output resolution setting (not to be confused with the printing device resolution).

$\text{Flatness} = \frac{\text{PDR}^1}{\text{ORS}^2}$				
¹ Printing Device Resolution ² Output Resolution Setting				
Flatness				
	PDR			
	300	1270	2540	
100	3.00	12.70	25.40	
ORS 800	.38 ³	1.59	3.18	
9600	.03 ³	.13 ³	.26 ³	
³ Values below 1 are rounded up to 1. Output resolution settings must be between 100 and 9600. 800 is the default value.				



Flatness test

To help predict the effect of flatness, the test above shows the same shape at a number of different imagesetter resolution and flatness settings. The shape in the test was chosen to demonstrate how some curves are affected more drastically than others. Flatness values from zero to 100 are shown. (This is the range of acceptable values for versions of Illustrator prior to 5.0).

Acknowledgements

Many thanks to Rebecca Hauser and Erik Gibson of Adobe Systems Inc., and Kevin Simms of Linotype-Hell for their help in producing this document.

Please direct any questions or comments to:

Jim Hamilton, Marketing Department, Linotype-Hell Company, 425 Oser Avenue, Hauppauge, NY 11788
(For subscription information on the Linotype-Hell technical information series, please call 1-800-842-9721.)

April 1994, Part Number 7029

© 1994 Linotype-Hell Company. All rights reserved.

- Linotype and Hell are registered trademarks of Linotype-Hell AG and/or its subsidiaries.
- Adobe, Illustrator, and PostScript are trademarks of Adobe Systems Incorporated which may be registered in certain jurisdictions.

All other company and product names are trademarks or registered trademarks of their respective owners.