Linotype-Hell

Technical Information

Addressability and Spot Size

Within the imagesetter industry, there is some confusion as to the true meaning of the word resolution. To understand resolution, we'll have to look at the meanings of the following terms: addressability and spot size.

Addressability and resolution

Resolution is the ability with which an imagesetter can render detail. This is a combination of a number of factors. Addressability and laser spot size are of the most importance, but film type, film processing, and imagesetter accuracy must also be taken into account. The terms addressability and resolution have often been used interchangeably, but actually addressability has a slightly different meaning. **Addressability** is a measure of how many marks an imagesetter can make within a linear inch. Unfortunately, the industry convention has been to use the term resolution instead of addressability. For example, the 2540 dpi (dot per inch) 'resolution' of an imagesetter is actually it's addressability. To truly determine resolution you would have to run a test that shows whether an imagesetter can hold extremely fine detail.

Spot size

The smallest mark that an imagesetter can make on film is called a laser spot. The laser spot is the result of film being exposed by a laser and later developed in a film processor. Most imagesetter manufacturers put spot size information on their specification sheets. This spot size is measured with special optical equipment under laboratory conditions using a static (motionless) laser at a specific laser intensity. For example, the specification sheet for the Linotronic 330 lists the spot size as 20 microns. This measurement of the profile of the static laser gives a general idea of the size of a laser spot. However the actual spot size depends on film and film processing conditions.

Laser intensity

Film and film processing are not the only factors that affect the spot size on film. Another variable is the laser intensity (also known as the density setting). For example, the Linotronic 330 imagesetter has many resolution settings (from a proof mode at 635 dpi all the way up 3386 dpi). At 635 dpi, you would not even be able to create a solid black with a 20 micron spot. The neighboring laser spots simply wouldn't overlap. (See Figure 1). By increasing the laser intensity, you effectively increase the size of the spot that the laser makes on the film. Therefore, it is the laser intensity (i.e., density setting) that allows you to image a solid black at 635 dpi.

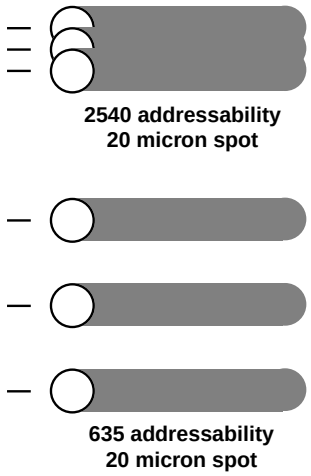

Figure 1 - Overlap for a 20 micron laser spot at 2540 dpi (top), and at 635 dpi (bottom).

Laser intensity gives you the ability to control the amount of exposure that the film material receives. This allows you to control the density of a solid area, and as a result paint a solid black at low resolution settings. Conversely, laser intensity can be decreased at higher

addressabilities. Does this amount to changing the spot size? In effect, yes, but this is different than true variable spot size. Variable spot size imagesetters adjust the opening (or iris) through which the laser passes. As a result, spot size may be changed for two or more addressabilities.

Optimum spot size

Variable spot size allows an imagesetter to better match the size of the laser spot to a specific addressability. However, not everyone agrees upon what exactly is the optimum spot size. Some have claimed that spot size should be the inverse of the addressability, so that there would be no overlap at all between neighboring rows. (See chart below and Figure 2.) Others say that the proper spot size should be smaller than two times the inverse of the addressability, but larger than the square root of two times the inverse of the addressability. (This would allow a certain amount of overlap.) To avoid excessive overlap, spot size should probably be no more than three times the inverse of the addressability.

Note: A micron is equal to .002835 points or .0003937 inches. A point is equal to 352.78 microns or .0139 in.

Addressability	1/Addressability	$\sqrt{2}$/Addressability	2/Addressability	3/Addressability
635 dpi	40 microns	57 microns	80 microns	120 microns
1270 dpi	20 microns	28 microns	40 microns	60 microns
2540 dpi	10 microns	14 microns	20 microns	30 microns
3386 dpi	7.5 microns	11 microns	15 microns	22.5 microns

As mentioned earlier, the actual spot size depends on film and film processing conditions. In addition, other factors besides spot size play a role in the quality of an image on film. But what is the effect of spot size alone?

Too large? Too small?

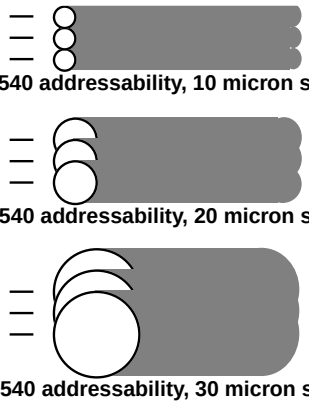

Figure 2 - Overlap of neighboring laser spots at 2450 addressability.

What are the drawbacks of too large a spot size? Too large a spot size may create such a large overlap between neighboring laser spots that gray values could be lost in halftones, particularly in the highlight and shadow areas of an image. Also, no line can be drawn that is finer than the spot size.

What are the drawbacks of too small a spot size? If the actual laser spot on film is less than the inverse of the addressability, streaks may appear in dark tint areas, and you may not be able to create a solid black. You might also see a ragged edge along fine lines or solids. (Note the scalloped appearance of the right edge of the top example in Figure 2.) It all comes down to this:

- What is the finest line that you need to be able to draw? Remember that 10 microns is 3/100 of a point or 4/10,000 of an inch.
- Will too large a spot size cause you to lose gray values? This can only be determined through testing with the film and processing that you intend to use. Remember that the smallest halftone dot that many printing presses can reliably reproduce is between 3 to 7%. A 3% halftone dot at a screen ruling of 200 lpi (lines per inch) is about 25 microns in diameter. At 150 lpi a 3% dot is about 33 microns in diameter. Conversely, a 20 micron spot is the same size as a 2% 200 lpi halftone dot or a 1% 150 lpi halftone dot.

Conclusion

Spot size is not a clear-cut issue; neither is quality. Quality depends on many factors: addressability, spot size, film, film processing, and imagesetter optics to name a few. But in the long run, it is the quality of the image on the film that is the most important issue because it is the film that will be used to make the printing plates that will run the job.

Comments

Please direct any questions or comments to:

Jim Hamilton, Marketing Department
Linotype-Hell Company
425 Oser Avenue
Hauppauge, NY 11788 (516) 434-2712

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