PUT YOUR DESKTOP SCANNER ON A DIET

Desktop scanners may just be the most misunderstood tools in the entire printing industry. Most people acknowledge that these scanners are inexpensive compared to many process cameras, and certainly compared to any of the full size drum devices. But few understand *what* production work they are capable of or *how* to produce that work efficiently.

The common assumption is that desktop scanners are capable of good comps and FPOs, but only the very highest resolution models can produce marketable halftones and line work (the jury is still out on color). To those who would shout "Amen!" to this summation, I propose that this type of broad-brush interpretation is robbing you of a guaranteed profit center. The assumption that all production scanning requires high resolution must be challenged, and examined in the light of evidence.

There's plenty of proof that line art and halftones produced with these "low-end" scanners can easily eclipse work produced on top-rated horizontal cameras, and most side-by-side tests produce desktop "believers." As with all tools, the skill level of the operator is the determining factor. There are however, some that hold an unswerving belief that all litho work requires high resolution scans. This supposition will extract a high price in production time and profit margins.

Much of our society, as a whole, believes that every issue can be resolved by overkill, and scanning is no exception! When in doubt, overdo it. Nothing succeeds like excess. Supporting evidence is everywhere in our culture. I counted my neckties this morning… I have twenty-seven. But I am quite sure that my life would improve significantly if I owned just one more.

I call this deadly attitude “the spirit of gluttony.”

In the area of desktop scanning for printing, excessive resolution doesn't produce better results, nor does it deliver more detail. As a matter of fact, too much resolution can actually destroy the very detail we hope to capture. More is not better, it is simply more.

Resolution in excess of the amount needed to produce accurate halftone dots is not only wasteful in terms of storage space, file transfer time and maneuverability, it also causes the RIP (Raster Image Processor) of an Imagesetter to perform millions of calculations needlessly.

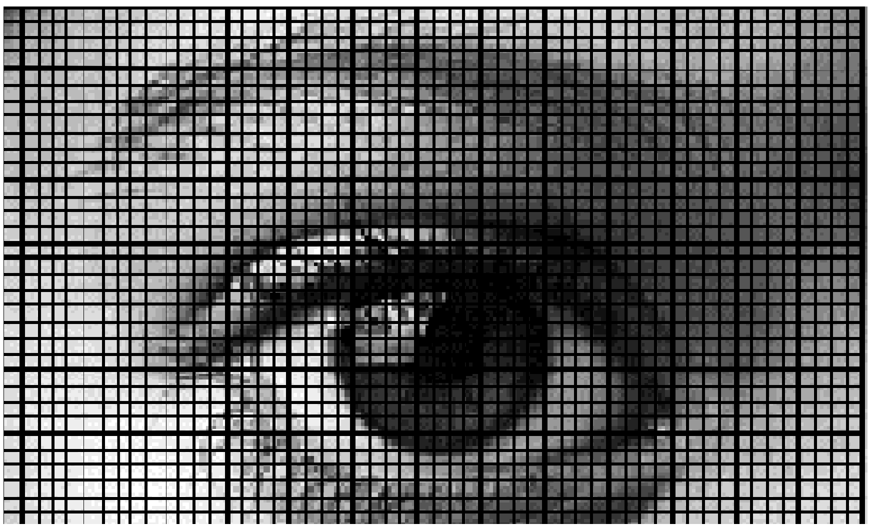
So before you produce your next halftone, there are a couple of things you should know about scanning. Range and Resolution. Once you know what each does and what part it plays in the scanning process, I guarantee you'll start saving money and producing better halftones.

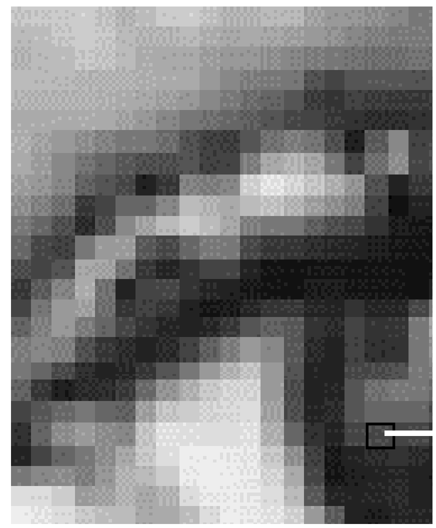
Range, in this context, describes the number of gray tones between black and white. Resolution has to do with the number of pixels (computer jargon contraction of "picture elements") counted within a given measure (usually an inch), and is expressed in DPI (dots per inch).

Many insist that two pixels are needed to produce a single halftone dot. The popular current assumption is that scan resolution should be "two times the line screen." I'm not sure where this assumption came from, but the scanning majority have certainly bought into it in force. And their image files are typically about the size of New Jersey. Is this "2 X LPI" amount necessary? Is there logic behind the assumption? Let's take a look at some facts about scanners and halftones that might shed some light on the issue.

Range.

When a picture is scanned, the image captured is displayed on a computer monitor as a *gray map* (a checkerboard type grid made up of thousands of square pixels). Each of these pixels is filled with a gray shade represented by a single number (between 0-255). Black = 0, and White = 255. Darker pixels have lower numbers and lighter pixels have higher numbers.





One of the functions (the Spot function) of the RIP is to build halftone dots from gray map information. The gray "values" of these pixels are what the imagesetter uses to calculate and create proper-sized halftone dots for any screen ruling. The higher the number is, the smaller the dot will be. The lower the number the larger the dot. Dark pixels have low numbers and therefore produce larger dots. Light pixels have higher numbers and therefore produce smaller dots.

This next statement will probably violate the beliefs and convictions of some, but it is none-the-less, absolutely true. *Each halftone dot requires but a single pixel to determine its size. That single number is all the information the imagesetter needs to produce each dot.*

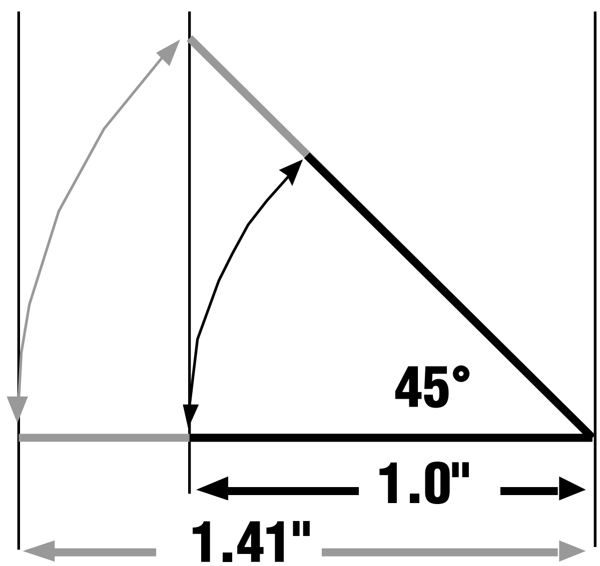
That's right… one! Just one pixel delivers all the information needed to produce one halftone dot. What happens when excess resolution is sent to the RIP? Do we get twice the detail when two pixels are used? Not hardly. The truth is, when the imagesetter sees two pixels where it expects only one, it simply adds the two numbers together and divides the sum by two. *The RIP can only use one number to determine the size of a single halftone dot, and it will do whatever necessary to derive at one!* So what is gained by setting the resolution to "2 X LPI"? …more processing time on the imagesetter! The sad truth is that none of that extra calculating ever improves the halftone.

But don't start scanning pictures at 150 DPI for 150 LPI halftones just yet, there's more to be considered.

Resolution.

Scanner resolution is measured by counting *horizontal* pixels, and halftone dots are measured by counting *diagonal* dots. Obviously, there is not a simple "linear" relationship here. Halftones are printed at a 45° angle and scans are recorded on a 0° angle. The first issue, therefore, to realize is that pixels and halftone dots are measured on different angles.

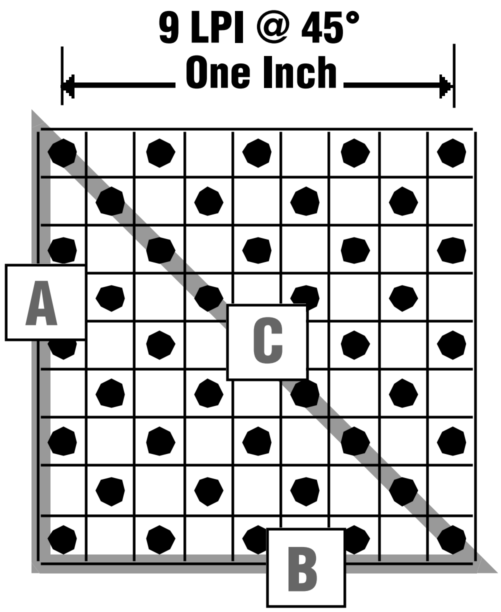
When contact screens are manufactured, the dots are imaged horizontally… parallel to the edge of the screen substrate. A 100 LPI contact screen starts out life actually measuring 100 dots *horizontally*. But, then the screens are trimmed *diagonally* to facilitate the 45° angle used for halftones. Simple geometry reveals that when a horizontal line of a known length is rotated 45°, the *horizontal* real estate covered is seriously diminished.



What has actually happened is that the horizontal distance once covered by the line when it was in a horizontal position, has been "shortened" now that it has rotated 45°. The line would have to be extended along the diagonal axis to have it cross the original horizontal axis. So what does that have to do with scanning, you say? Everything.

Right in the middle of that paragraph is an eye-opening truth that will set you free from pixel gluttony. You will experience a genuine "A-HA," that will save you both time and money. The simple solution to correct resolution lies in the difference/relationship between the "horizontal lengths" of the two lines. Hang in there with me and you'll see what I mean.

Halftones are printed at 45° and scanners record pixels at 0°, the relationship between the two angles is the critical key to scanner resolution. When we discover the ratio between the two line lengths, we'll know exactly how much resolution is needed to correctly reproduce any halftone or color separation in any LPI.



High School Geometry to the Rescue

The illustration above demonstrates the relationship between scanning gray map and halftone cell. Look closely and you will see a right triangle formed by the horizontal line (scanner CCD array), the vertical line (scanner CCD travel), and the diagonal line (the halftone dot direction).

If you think back to high school geometry, you'll remember hearing… "The sum of the squares of the sides of a right triangle are equal to the square of the hypotenuse." The more common way to express this equation is "$A^2 \text{ x } B^2 = C^2$" Basically, each of these equations is stating that the diagonal line is 1.41 times longer than either the horizontal or the vertical line.

That's the answer we've been looking for. Do you see it? The resolution of the scanned image must be at least 1.41 times the number of halftone dots. If you use a 150 LPI screen ruling, the image (scaled to final size) should ideally contain 212 DPI of resolution. To make calculating a little easier, we'll use 1.5 as a "factor."

The input (scanning) resolution calculation then is:

Input Resolution = (LPI x Scale) x 1.5

Example: If we want to scan an 8" x 10" photo and produce a 4" x 5" halftone at 150 LPI, then figure:

IR= (150 x .5) x 1.5
IR= 75 x 1.5
IR= 112.5

NOTE: If you are using a 300 DPI scanner, always scan using **either**: 300 DPI, 150 DPI, 100 DPI, or 75 DPI

In the case of this example, use the next highest DPI from 112.5, or 150 DPI.

Of course, this is only the *input* half of the story. Getting the correct input is to be followed by re-sizing the image and resetting the resolution for *output* to film. If using Adobe Photoshop, open the "Image Size…" dialog and re-size the image to the scaled (50%) size of 4" x 5" and reset the resolution as follows. Here the 1.41 factor is more important.

Output Resolution = LPI x 1.41
OR= 150 x 1.41
OR= 212 DPI

As we can see, the concept that the best resolution for high-quality scans should be 2 x LPI is erroneous. The misconception is an honest one, even a somewhat logical one. Since high-end color separation houses with the six-figure scanners have scanned at very high resolutions for years. It's only logical that the fledgling desktop industry would follow the same formula! Every time we port a scan over to the desktop from a DS, Hell or Crosfield Scanner we see that their scans exceed 300 DPI.

What must be realized is that there is a fundamental difference between the two technologies. High-end scanners process much more resolution than PostScript Imagesetters *need*.

Finally, while the difference between 300 DPI and 212 DPI seems insignificant, in actual disk and processing size, the difference is anything but insignificant. Thirty (30) megabyte files at 300 DPI reduce to fifteen (15) megabytes at 212 DPI. That's significant.

The word "desktop" has a natural, perhaps warranted stigma attached to it largely because of the work produced by inexperienced desktop publishers. But don't throw the baby out with the bath water! Do not assume that desktop scanners are incapable of litho-grade results. In the hands of experienced craftsmen, there are few limitations to what these devices are able to produce.

Learn the facts. Put your desktop scanner on a diet and watch your bottom line grow. Scan smart... because a megabyte is a terrible thing to waste!

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