TOBIAS ASSOCIATES, INC.
50 Industrial Drive, P.O. Box 2699, Ivyland, PA 18974-0347 USA
Tel: 215/322-1500 Toll-free: 800/877-3367 Fax: 215/322-1504
E-mail: tobias@densitometer.com • www.densitometer.com

Why Use a Densitometer?

Any printing process from the most simple black and white work to complex color work will benefit from the use of a **densitometer**. You might manage without one, but your printed product will never have the consistency and quality that you would get through the use of densitometry. The densitometer provides the element of control, providing you with information that will guide the decisions that you make as you print a job.

So what is a densitometer, anyway? There are two types, transmission and reflection. A transmission densitometer measures the amount of light passing through film or any other transparent medium. A reflection densitometer measures the light reflected from a surface, usually paper. In both cases, there are special conditions for the measurement process to ensure consistency between different densitometer models. The reading you get from a densitometer when you measure a sample is given as a **density value**. This is a ratio comparing the light from a sample to a null or zero value.

The densitometer measures the amount of light received from a sample and displays the result using a logarithmic output. This has several consequences. One is that the numbers that you get from a densitometer appear to match approximately what you see – equal increases in density readings of a sample look like equal steps of increasing darkness. Also, density numbers are much easier to use; typical reflection densities of 1.10, 1.35, 1.50 found in printing, would be 7.94, 4.47 and 3.16 if percentage reflectivity were used. Another important consequence, especially for the reflection densitometer, is that the density value of an ink sample is approximately proportional to the physical thickness of the ink or, in other words, the **ink film thickness**. Using these density readings, other elements of the printing process such as **dot area** can also be derived. This is true for either transmission or reflection densitometry.

The printing process consists of trying to reproduce the infinite palette of the real world around us within the limited framework of ink on paper. The modern reproduction process converts the continuous tones of photographs into varying dot patterns to represent the lightness and darkness of the original. These same patterns of dots are found all the way through the reproduction process. They appear in film used to make plates, in the plates and on the printed sheet. For quality control it is essential to monitor these dots throughout the whole reproduction process.

Transmission densitometers are most commonly used in the prepress area for controlling the quality and processing of film material. Transmission densitometry is used to measure the amount of light that passes through the film. This will give you readings for D_{min}, the clear or unexposed film area, and D_{max}, the darkest exposed black area of the film. These, with measurements between the two extremes, assure that correct exposure times were used, as well as good chemical processing. Usually a stepped density wedge is used as the test image for these measurements.

During film inspection, the densitometer may be used to verify that halftone screens or film tints are correct. Is an intended 50% tint on an imagesetter output in fact 50%? Today, software programs are available to automate imagesetter calibrations using data from the densitometer. This **linearization** of the imagesetter output is of extreme importance. Failure to daily monitor output will result in missing highlights, clogged shadows and poor reproduction.

Reflection densitometers are most often used in the pressroom area. Their primary function is to measure the **SID** or **Solid Ink Densities** of the inks being used. All other measurements and the

quality of the print job can be traced back to the proper control of the SID. The most practical way to make these measurements is to use a **colorbar, (**see sample below). This is an image that is printed across the press sheet, usually on the trailing edge, that contains targets to provide measurement areas for the solid ink densities, dot measurements and other control elements. These colorbars are provided as film and exposed onto the plates along with the image or they may be digitally derived in CTP (computer to plate) systems. If you are using film, never, ever duplicate the film as this will distort the dot area test patches and render them useless. A colorbar has a repeating sequence of measurement areas and will usually try to repeat the sequence every one or two key zones. The values that you measure in a colorbar at a particular key zone are generally indicative of the printing in that area.

The densitometer, then, is used to measure the density values of the solid areas of the process colors. What values should you expect? Well, that is up to you. Typically, and this depends on the ink and paper that you are using, the Black would run 1.50 – 1.70, Cyan 1.35, Magenta 1.30 and Yellow 1.00. It is important to find out what works for you and to stick with those acceptable values. Try to run even densities for each color across the press sheet, within a tolerance that you have established, say 0.08, and create a standard set of density values that you stay with from job to job. The tolerances that you establish should not be too tight since there is a natural variation in density values as the job is run. A good demonstration of this variation is to measure the same color swatches on a colorbar on ten press sheets, pulled at one-minute intervals, and to record their density values. This will show how density varies with no adjustments to the ink keys, water control or the speed of the press. Remember, solid ink densities are proportional to the ink film thickness. So, in a very direct way you are controlling the amount of ink that you are putting on the paper.

Having controlled the densities of the solid ink, what's next? Well, by controlling these you have also, to some extent, controlled the dot reproduction since the dot value is dependant on solid density. As the dot is reproduced through the process, it tends to enlarge. This is called **dot gain**. A 50% dot on original colorbar film may, in fact, print as a 65% dot. In the pressroom, measuring dot gain at 25% highlight, 50% mid-tone and 75% shadow for each color is a good indication of tone reproduction quality. In printing, the balance of dot gain between the process colors, cyan, magenta and yellow, is critical. The actual value is of less importance than the fact that the dot gain be within about two percent of each other in order to maintain a good **gray balance**. Gray balance is another of those useful targets included in a colorbar.

What this all means is that the reproduction process has to be monitored and measured from beginning to end. You simply cannot look at a piece of film from an imagesetter and guess at the dot sizes. You cannot make a plate from a piece of film and be certain that the exposure was correct or that the dots were reproduced properly. And you cannot print color consistently without densitometric assistance. Modern electronic layout puts the power of tone management in the prepress area where color editing firmly belongs. Your goal is to make the press a printing device, not a color editor. Using densitometers help you control your process from beginning to end and result in improved quality and consistency, while reducing costs. You simply can not afford ***not*** to use them.

Sample Colorbar