Plate Measurement Questions and Answers

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Q. Can I use my X-Rite densitometer to verify dot area on printing plates before going to press?

A. Yes. Your densitometer can be used to measure, correct, and control your plate imaging process. To get the most out of using your densitometer in this way, consider the following factors.

The Densitometer's Forte

The first thing to keep in mind is that, color reflection densitometers are designed to read the amount of incident light absorbed by a photograph, press sheet or off-press proof. As a result, these densitometers are designed to accurately measure Black, Cyan, Magenta, and Yellow colorants on a substrate like paper.

YES YOU CAN!

X-Rite has successfully measured dot area from exposed and processed lithographic offset plates – conventional and digital alike. In addition, comparisons made by leading plate manufacturers have found X-Rite densitometers to be doubly useful. In addition to measuring a variety of plate materials with consistent and reliable results, these manufacturers have used the same instruments to also measure their proofs and press sheets.

Offset lithographic plates, however, do not usually have cyan, magenta, yellow, or black images on a white substrate. Instead, the plate material is usually brushed aluminum with a gray color. The color of the image area varies with the plate type and manufacturer; typical colors include green, pink, brown, black and blue. Polyester-based digital plates are nearly the inverse of ink on paper—a near-white image on a flat black substrate.
These color properties introduce unique issues that arise when the plates are evaluated using densitometers.

Contrast

As a result of plate color properties, the contrast between the image and non-image areas of the plate may be less than ideal. Plate contrast is typically less than half that of ink on paper. In fact, some plate materials do not exhibit enough color difference between image and non-image areas. As a result, the densitometer may not be able to calculate the exact dot area imaged.

Aperture Size
The size of the densitometer aperture, or measuring window, is another important factor when reading dots on a plate. You should use the largest aperture possible (3.4mm on X-Rite 400-series instruments) given the aperture is not larger than the image area. This effectively averages a larger measured sample, and minimizes the effect of random plate patterns and imaged screening methods.

Instrument Response
The ISO and ANSI standards for Graphic Arts reflection densitometry specify Status T among the densitometric responses for ink on paper measurements. X Rite recommends Status T in these applications because it is the response most used by North American printers. In addition, the wide-band characteristics are sensitive to process and non-process colors alike. For this reason, Status T response densitometers can be useful in measuring the varied image and media colors found on lithographic printing plates.

Some densitometers may contain polarization filters. Because there is no standard type or color of polarization filter, adding these filters to a known status response densitometer fundamentally alters its performance. For this reason, X-Rite does not recommend using polarization filters under any circumstance.

Screening Techniques
The type of screening utilized on you printing plates will also affect the measurements you make using a densitometer. For instance, as the line screen ruling imaged to a plate increases, the corresponding measured dot area will also likely increase. The same is true of press sheets or proofs, higher lines-per-inch (LPI) means increased dot gain. Although digitally-exposed plates are susceptible to this phenomenon, it is often exaggerated with (negative working) conventional plates due to variances in film to plate contact and vacuum draw-down during exposure.

If you use FM or Stochastic screening techniques in plate-making and printing processes, the small image element sizes will also result in slightly higher dot area values than their halftone (AM) counterparts. This occurs because there are more image parameters per inch, so there is more edge area or “shoreline” around the elements. This results in light scattering and absorption effects that increase the apparent dot area.

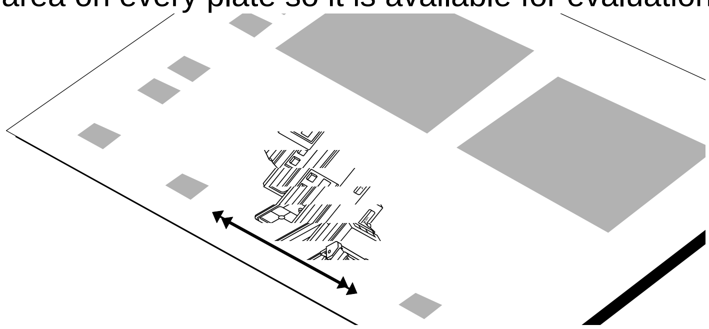
***Q**. How will these factors affect using my color reflection densitometer to measure plates?*

***A*.** The process you use to measure printing plates will be different than measuring proofs or press sheets, but the results will allow you to control your plate imaging process. This process focuses on getting consistent and accurate plate measurement results.

Making Your Plate Measurements Consistent
You may measure the same area of the same plate and get differing readings. If you do, this may be due to the **contrast** of the plate, your **measurement** approach, or plate **processing** factors. The following sections will discuss each of these variation sources, and suggest methods to make your plate measurements consistent.

Contrast
Some plates have minimal contrast between the plate and image areas. This can make the plate difficult to evaluate with a densitometer. One thing to check, is the response of your densitometer. If it is not a Status T instrument you may consider replacing it with a Status T instrument, which will typically be more sensitive to plate and coating colors than other densitometer responses. In some cases, there may simply be inadequate plate and image contrast. If this is the case, it is unlikely that any densitometer (including a so-called *plate meter*) will read your plates consistently.

In this case, you are better off using a contact plate control wedge from either RIT or UGRA for conventional plates. These tools use visual comparators that allow you to determine dot gain and plate exposure without the aid of an instrument. For digital plates, you can use a similar digital test image, a loupe and a comparative sample to make an evaluation of the imaged plate characteristics. You can easily locate this test image in the plate bend or gap area on every plate so it is available for evaluation but will not print.



Measurement Method
Another way to improve the consistency of plate measurements is to use a consistent approach. Here is why.

Both conventional and digitally imaged plates are imaged on the same types of materials—usually aluminum sheets, which are either mechanically or electrochemically grained. The graining of the plates is necessary, prior to applying the light sensitive coatings, in order for the coatings to adhere to the plates properly. They may utilize the same basic materials, but when looking at a micro analysis of these two surface types at 2500X and 5000X, there is a considerable texture difference between them.

These textures have the ability to scatter light differently, so in order to receive consistent dot values when reading the plates with a densitometer, you must be consistent when taking the readings. One way to maximize consistency in measuring printing plates is to always align the shoe of your densitometer with the gripper-edge (or the same edge) of the plate. A common orientation will help you achieve more consistent dot area measurement results.
Likewise, it is important that when you zero your densitometer on the plate (or make any of the readings, for that matter) you utilize the same spot each time. Reading different spots on the plate, when zeroing, or reading different areas when setting the 100% dot area, will introduce variation into your measured dot values. Most plate test images contain labeled areas for

setting the 0% and 100% values. Put these to use in assuring you achieve consistent measurement results.

Processing
Another source of variability that can affect the consistency of your measured dot area values is the processing step in plate preparation. One of these sources is as simple as the amount of desensitizing solution (gum-arabic) left on the plate. Variations in the thickness of this thin film can result in measurement variations from plate to plate. Similarly, if the plate is wet, both the image and non-image areas might appear darker to the densitometer, resulting in measurement inconsistency. Finally, factors such as varying exposure times, voltage fluctuations, processor brush pressure and developing chemical strength or activity can also lead to variation in measured dot sizes on the plate.

So, to minimize measurement variation, make sure your plates are gummed, cleaned, processed and dried properly. Ensure they are measured using consistent methods, and utilize the proper densitometer response in recognizing your plate's inherent contrast.

Making Your Plate Measurements Accurate
The next section describes how it is possible to alter the dot area formula of a densitometer so that the resulting measurement is equivalent to the expected value. Even though you can use these methods to change the way your densitometer measures dot area, X-Rite recommends that you maintain a consistent dot area formula, and change instead your absolute expectations of the plate imaging process. Please read on to see why we recommend this approach.

Dot Area Formulas

Murray Davies Dot Area

$$\frac{1-10^{-Dt}}{1-10^{-Ds}} \times 100$$

D_t = Density of the tint, minus substrate
D_s = Density of the solid, minus substrate

The most common calculation used to convert density measurements into dot area is called the Murray-Davies formula for apparent dot area. By measuring the density of three image areas, the equation yields a percentage between 0 and 100. The formula was chosen because of the linear relationship between reflectance and percent dot, while accounting for solid ink density.
Recall that screening methods, including the line screen ruling, can effect your dot area measurements. When densitometers (or *plate* meters) use the Murray-Davies dot area formula, they will report slightly higher dot area values on the higher line-screen of two otherwise equivalently imaged plates. To compensate for this phenomenon, most densitometers allow you to change the dot area function using something called the *n-factor*.

The N Factor

A variation of the Murray-Davies calculation introduces an adjustment to the exponent.[1] This adjustment is called the *n-factor* and has the effect of changing the calculated dot area, although the underlying densities are the same. As the *n-factor* is increased, the calculated dot area decreases, and vice versa. Setting the *n-factor* to 1 has no effect on the Murray-Davies formula described earlier.

Some densitometer manufacturers have recently re-marketed standard densitometers as special *plate meters*. For the most part, these meters are ordinary densitometers that utilize an adjustment to the dot area *n-factor* which changes the resulting dot area readings. Unfortunately, they do not overcome the physical low-contrast properties of printing plates, and may be *less* sensitive to the variety of colors used in plate coatings. This is evidenced in a recent study by the Graphic Arts Technical Foundation (GATF) where an ordinary Status T densitometer (X-Rite 418G) utilizing the Murray-Davies formula was found to be useful in the measurement and control of both conventional, and digital plating processes.[2]

To simplify the plate control process, X-Rite recommends that you set the n-factor equal to 1.00 in your densitometer (yielding the Murray-Davies equation). This is the factory default for most graphic arts densitometers (however, *plate meters* may have an unspecified *n-factor* set in the instrument).

To control your plating process, take steps to minimize the *variability* of your plate measurements. You should look for consistency in measured dot area for a given plate imaging path. For instance, you may consistently generate dot area readings of 54% on a 50% tint for a given plate/processor combination, utilizing a specified set of imaging parameters.[3] If this the case, given the plate prints correctly on press, you should seek to obtain the same values on future plates of this type by utilizing a consistent approach to measuring dot area. You can monitor and control this process like any other process in your facility. Apply knowledge of SPC and statistics to recommend process control criteria. If a future measurement does not meet your measurement criteria, then you can seek to find the source of the variation, and correct it.

***Q**. What procedure do you recommend for measuring plates with a densitometer?*

A. We turned to the experts on this question. One plate manufacturer recommended the following procedure to produce the most accurate results when measuring printing plate dot values.

Plate Measurement Procedure

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[1] The introduction of an *n-factor* other than one into the Murray-Davies apparent dot area formula results in the Yule-Nielsen formula.

[2] See the March/April, 1995 issue of GATF World (Volume 7, Number 2) for a summary of this study.

[3] These parameters would include the plate manufacturer, specific plate type, plate processing, line screen ruling, screening method, film and chemistry (if applicable), imaging program, imagesetter or plate-setter calibration software settings, imaging software and workstation hardware.

Perform step-off exposures using an UGRA scale, continuous tone scale and a FOGRA scale to determine desired exposure and maximum vacuum draw-down benefits
Ensure processing conditions are at optimum efficiency; machine processing is desired to reduce variability. The desensitizing solution (gum) or finisher layer should be removed with warm water and plate should be completely buffed dry leaving no water marks or streaks in the areas to be measured (fingerprints or water spots can affect accuracy)
Use the dot area function of the densitometer

Zero the densitometer in cleanest non-image area and darkest solid areas (areas *within* the scale to be measured are desirable)

Take readings from center of each target area

If more than one reading of the same scale is required for repeatability, accuracy or SPC, try to zero the densitometer in the same location before each reading
When reading different plates and coatings you must zero the densitometer to the non-image area of the new plate and re-read the 100% patch

It is important that you work with your plate manufacturer in maintaining the recommended procedures for plate exposure and processing in order to achieve optimal results. Practicing a stable and consistent plate procedure will allow you to have better control of your printing processes.

In conclusion, X-Rite's densitometers have proven to be accurate and very consistent in tests with plates of different coatings and grain structures, but almost any densitometer will give you acceptable measurement results. Just remember; the densitometer is only as accurate and consistent as the measurement methods and control processes used.
If you are wondering whether your densitometer can read plates, the answer is YES!

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References

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2. Anthony P. Stanton, Graphic Arts Technical Foundation, "Reproduction Characteristics of Computer-to-Plate Imaging Systems," TAGA Proceedings, 1995, p. 1-28.
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4. Eastman Kodak Co., Jim Scritchfield, Plate Mfg. Division, 9952 Eastman Park Drive, Windsor, CO 80551, (800)548-4635.
5. Eastman Kodak Co., John Horan, Response Center, 1901 West 22nd St., Oak Brook, IL 60521, (800)833-2772.
6. Graphic Arts Technical Foundation, 4615 Forbes Avenue, Pittsburgh, PA 15213, (412)621-6941.

7. X-Rite, Incorporated, 3100 44th St., Grandville, MI 49418, (616)534-7663.