Off-Press Proofing and Printing of Stochastic Screen Separations

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Abstract

Process color separations output via stochastic screening exhibit enhanced sensitivity to dot transfer in each step of color reproduction from film to proof, plate and print. This paper reviews the variables for each step in the process reproduction of stochastic screening. The compensation tone curves required to achieve optimum proof to press visual simulation and the process control tools needed to monitor the reproduction process are discussed.

Introduction

Industry experience in successfully implementing a production process for reproduction of stochastic screening has been mixed. The small spot size (15 to 20 microns) of stochastic screening requires great care in transfer of the spots in the film, proofing, plating and printing reproduction steps. Fine highlight reproduction with some stochastic screening algorithms has been grainy and mottled. Compensation curves to adjust for excessive gain on press sometimes produce variable and unexpected results. Several negative off-press proofing systems in routine commercial use do not have the resolution to handle the 15 to 20 micron size stochastic screen spots. This paper discusses the variables that must be controlled to achieve routine process control for predictable printing when using stochastic screening.

Process Variables

The following is an outline of the basic process variables impacting consistent reproduction of stochastic screening.

Screening Algorithm:
- Spot size for consistent print reproduction
- Spot overlap on lay down across tonal scale
- Uniform and smooth highlights and flat tint areas
- Calibration process to compensate for dot gain

DuPont has recently introduced Crosfield® Lazel screening on Crosfield imagesetters. Lazel screening, using a 20 micron spot size, provides a screen that can be faithfully reproduced in printing. The software provides an automated two step process to linearize and compensate for dot gain and control the spot overlap on film for smooth reproduction results across the tone reproduction scale. Uniform and smooth highlights and tint areas are produced using a sophisticated error diffusion technique.

Film Dot Quality
- Quality of dot output from imagesetter
- Hardness of dot on imagesetter film

The Crosfield imagesetter in combination with DuPont HDB film produces a “hard dot” with a well defined sharp edge. This dot quality is essential for faithful transfer of dots on proofing and plating.

Off-Press Proofing
- Resolution of proofing system
- Balanced tone reproduction curves for neutral reproduction vs. press
- Simulation of dot gain across the tone reproduction curve vs. press

Many users of stochastic screening have found that off-press proofing is a weak link in the production process. Several commercial off-press proofing systems do not have the resolution to consistently proof 20 micon spot size stochastic films and therefore do not accurately predict print results. DuPont WaterProof® has the resolution to hold all the spots in stochastic screening. Figure 1 shows an example of WaterProof and print dot gain curves for 175 lpi, 300 lpi and Lazel 20 micron screened films. WaterProof does reproduce the tone curve equivalent to the press result for both dot gain and neutral balance. WaterProof can be used to set the calibration and compensation adjustments with any stochastic screening system to predict print results.

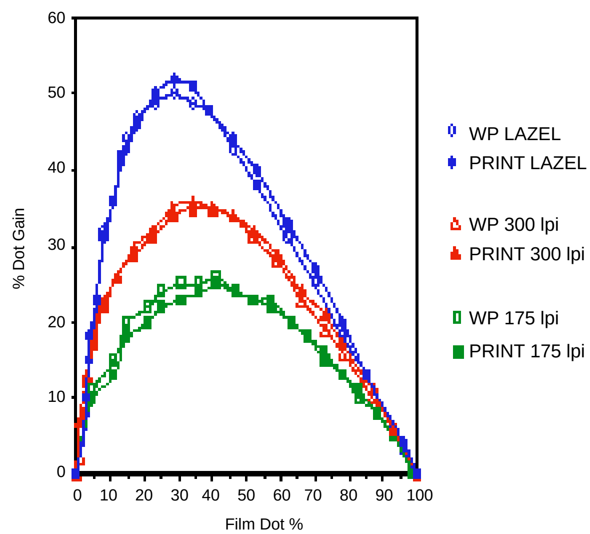

Figure 1. WaterProof and Print Dot Gain at 175 lpi, 300 lpi and Lazel 20 micron

Dot Gain in Stochastic Screening

The small spots used in stochastic screening lead to excessive dot gain in proofing and printing. A practical method to compensate for dot gain in stochastic is required to reduce the weight in the stochastic screen films. The following procedure was developed to compensate the stochastic curves to the same weight as conventional screening.

The procedure given in this paper for compensation of stochastic screening is based on using DuPont WaterProof to generate the compensation curves. This procedure works with any of the commercial stochastic screening algorithms.

A large amount of commercial printing is done at 175 lpi and many presses are setup to print in balance to this reproduction condition. The data shown in this paper compares stochastic screening to 175 lpi, however, the same procedure can be used to compensate stochastic screening to any conventional line screen ruling.

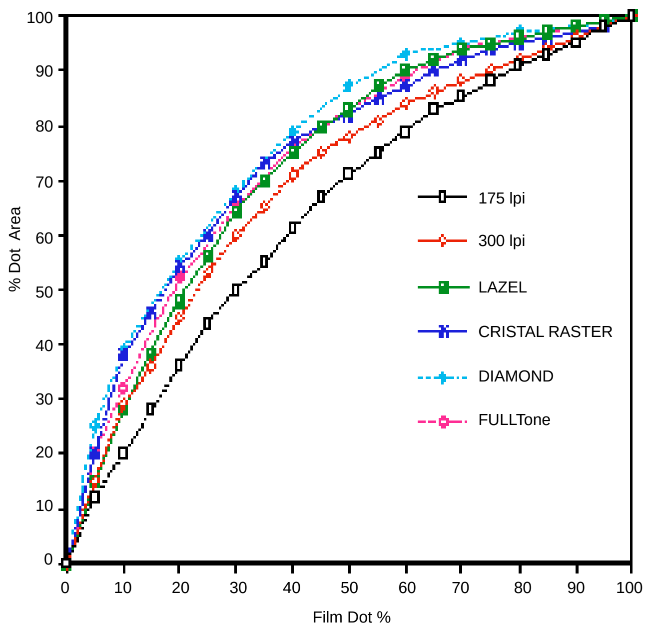

Figure 2. % Dot Area Curves for Commercial Stochastic Screen Algorithms

Figure 2 shows average tone reproduction curves for several commercial stochastic screening products. A 20 step tone scale (5% steps) was generated off the linearized image setter for each screening product. Film output was supplied from: conventional 175 lpi and 300 lpi (Crosfield Magnasetter), Crosfield Lazel, Agfa Cristal Raster, Lino-Hell Diamond, and Scitex Fulltone. All of the stochastic screening was output at a nominal 20 micron spot size. All films were proofed on DuPont WaterProof on the magenta layer. Figure 2 shows the percent dot area plot of the reflection density measurements against the original % film value.

Note that the various types of stochastic screening produce similar dot gain weights but curve shape varies across the tonal scale depending on the screening algorithm. All stochastic results had significant gain compared to the 175 lpi and 300 lpi conventional screening.

Compensation for Dot Gain

A general procedure to compensate stochastic screening to the tone reproduction "weight" of conventional printing was developed and includes the following steps:

- Establish a printing condition for 175 lpi screening with dot gain values at the mid-tone in the range of 22% to 25%. The chromatic colors (Y, M, C) must be within 4% to maintain a balanced condition.
- Off-press proofing must produce similar dot gain and balance to the 175 lpi result to achieve a visual match to press conditions. This is the case when using DuPont WaterProof.
- Compensate the stochastic screen curves so that the dot gain curves match the 175 lpi conventional curves.
- Print the stochastic screen films to the balanced print condition for 175 lpi to produce a close match for the stochastic screening to the 175 lpi and the WaterProof result.

Compensation Calculation

The calculation for dot gain can be done using Figure 3 as a guide. The example shown is for Lazel screening showing the calculation for the 25%, 50% and 75% tint values. In actual application, all points allowed by the image setter calibration would be plotted.

- Draw a vertical line from any of the original dot % values on the horizontal axis to the % dot value of the 175 lpi curve.
- Draw a horizontal line from the point of intersection on the 175 lpi curve to the vertical axis.
- Where the horizontal line intersects the stochastic % dot area curve, draw a vertical line back to the film dot % axis.
- The film dot % value where the vertical line intersects the axis is the compensation value necessary to output a stochastic film with a similar tone curve shape to 175 lpi.

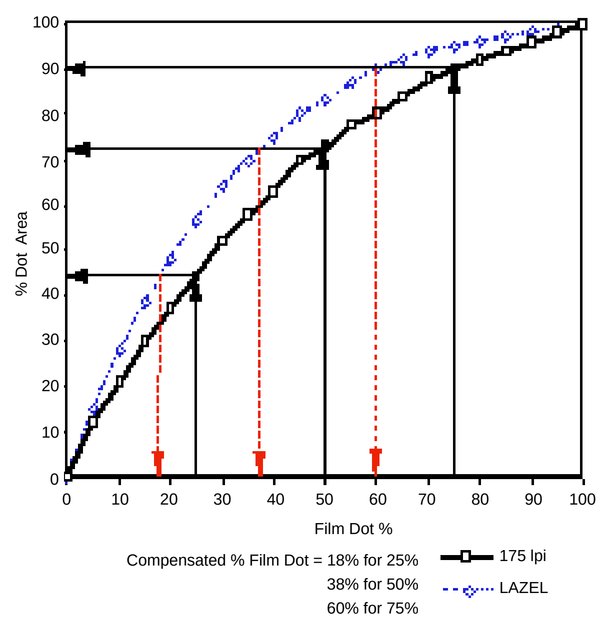

Figure 3. Dot Gain Compensation for Stochastic Screening

The dot gain curve result after compensation comparing Lazel 20 micron to 175 lpi for WaterProof and the printed result is shown on Figure 4. Note that the weight of the Lazel proof and print has been adjusted to match the conventional screening.

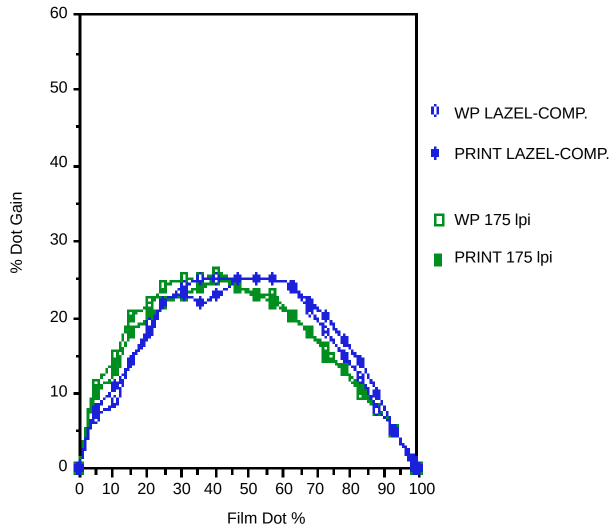

Figure 4. Compensated Lazel 20 screening curve

Plating

- resolution of plate system
- dot gain on press

Plates with sufficient resolution to hold the small dots are required. DuPont Howson™ HPN plates have the broad latitude and resolution for consistent reproduction of stochastic screening.

Printing

- tone scale balance
- dot gain
- solid density

Successful printing of stochastic screening requires printing in balance in all colors. Printing a conventional 175 lpi control bar to mid-tone dot gain of 22-25% with all colors within 4% will reproduce stochastic screening in balance and match WaterProof. Some printers have experienced the ability to increase solid density on the inks using stochastic screening, however, the tone curves must be reduced to compensate for the higher ink film thickness. The color balance of the chromatic colors must be maintained while increasing solid ink density.

Process Control

- control bars

Process control is achieved using a control bar with stochastic screen tint values of 10%, 35% and 75%, representing the quarter-tone, mid-tone and shadow areas of the reproduction curve. Table 1 provides typical print results for Crosfield Lazel screening measured with a reflection densitometer. Other stochastic screening algorithms will produce similar results. Monitoring the dot gain on all colors using these tint patches provides print control for setting the inking keys. The dot gain read on these tint patches must be maintained within 4% for all colors to sustain color balance on the stochastic screening and match the proof result.

Table 1. Lazel Screening EDA & Dot Gain Values

Tint Value	EDA Value (Y, M, C, K)	Dot Gain Value (Y, M, C, K)
10%	40% - 45%	35% - 40%
35%	80% - 85%	45% - 50%
75%	95% - 100%	20% - 25%

Note: Output is *linear* tint values; not compensated

Conclusions

The small spots used in stochastic screening may increase the process variability. The major sources of variability have been noted.

A straight forward process for building dot gain compensation for stochastic screening is given. The DuPont WaterProof proofing system can be used to set compensation for stochastic screening and accurately predict printing results.

Print process control can be done using conventional and/or stochastic screen production control bars.

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