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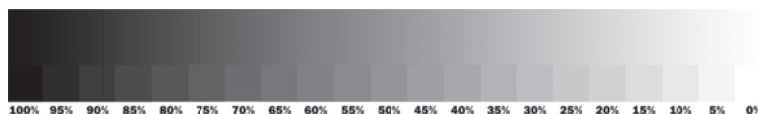
November 2010

Technical Newsletter

MURAKAMI SCREEN U.S.A., INC. 745 Monterey Pass Rd. Monterey Park, CA 91754 Tel 323.980.0662

Linearization of Halftones

The word 'linearization' seems confusing, it seems to have no association with screen printing and yet the process is often overlooked, but very crucial to halftone print quality. The truth is if you print halftones you need to understand how important linearization is in creating smooth tonal halftone prints. Linearization refers to adjusting a tonal ramp within a RIP program to produce accurate tonal values on film. Huh? Lets look at these terms in detail to understand what is going on.

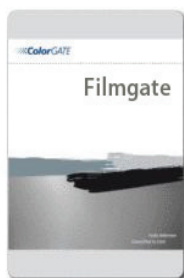


Tonal Ramp: Tonal values run from 0% (no tonal values or halftones) up to 100% which is a solid black image on your film. From 1% to 99% become halftones in the tonal ramp. Think of a gradation from white to solid black and all the shades of grey in between as shown in the example above. The more accurate your film halftone values are to the original art tonal values in Photoshop, the better the screen print reproduction. So just remember this, your film must have accurate tonal values, a 50% tonal value in the original art needs to be 50% on the film. (There are additional tonal adjustments due to *printed dot gain*, right now we need to control the film first.)

RIP Program: A high quality RIP program, (Raster Image Processing) reads the tonal values in the art and outputs halftones on film. Some RIP programs can be linearized, some can't. We sell Filmgate RIP which contains a linearization assistant to help control halftone values.

ColorGATE

Filmgate is produced by Colorgate a world leader in imaging software for film and digital print.



Epson 9880

The image setter of choice for film nowadays is an inkjet printer mainly because of cost. Epson, HP, and other manufacturers have ink jet printers capable of printing good quality film positives. However there are higher end image setters available using real film with very sharp halftone imaging that exceeds the quality of an ink jet imagesetter's halftone dot.

We have an Epson 9880 which produces very good positives using Filmgate RIP. The linearization process within Filmgate uses a target image tonal ramp that is assigned a halftone value (55 lpi for example) then printed on the inkjet printer and then measured with an X-rite Transmission Densitometer Model 331. The halftone measurements are entered into Filmgate's linearization assistant which uses the data to control future halftone output to be accurate, ie a 50% tonal value in an art program becomes a 50% halftone.

So here is what is needed to linearize the halftone output on an ink jet printer:

1. A good RIP Program, we use and sell Filmgate from Colorgate for it's top quality controls and ease of use.
2. A good ink jet printer like the Epson 4880 thru 11880 series with stock K3 Ink.
4. A Transmission Densitometer - we use X-rite's Eye One's Transmission Densitometer Model 331.

Next a look at common issues with inkjet printers before the linearization process.



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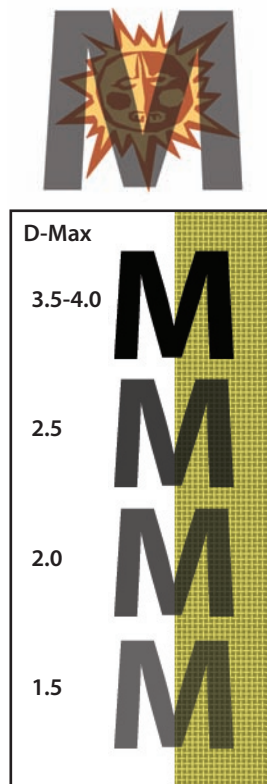
Common Ink Jet Issues

1. Weak UV Density: If you can see through the black area of the image your exposure lamp may expose emulsion through the black image. Notice that it 'may' expose since some transparent black areas can still have adequate UV Density to block light depending on ink, film brand, and ink jet manufacturer.

D-max refers to the optical density of a solid black image on the film as measured by a densitometer. Look at the example to the right. The M with a D-max of 1.5 may have weak UV density and allow exposure through the black image areas when exposing highly sensitive emulsions. A good solid black image with a D-max of 2.5 to 3.5 will have adequate UV density, which is crucial if you plan on printing waterbase, discharge inks, or simulated process. Generally with today's ink jet printers UV index is 1 point higher than optical density. If you have difficulty washing out the image, even with a pressure washer, your UV density is weak. Filmgate is calibrated to achieve 3.5 optical density assuring excellent UV Density.

Underexposing emulsion to compensate for a low D-max results in early screen breakdown, pinholes, and press stoppage which affect production yields and the profitability of the company.

2. Dot Gain - Ink Jet printers are prone to dot gain, often by as much as 20%. A 50% value in the original art can become 70% on film. Linearization fixes dot gain during film output. Filmgate has a simple tool that allows very accurate control of halftone values.



The linearization Process:

1. Filmgate is our starting point. We sell this software because in our tests as well as independent tests Colorgate software has won top honors for accuracy of color management and ease of use.

Filmgate has a great linearization tool included in the software. One thing to know about linearization is that it is an iterative process. You can repeat the process to fine tune the accuracy of the linearization.

Filmgate linearization uses the following areas along with our specific values we chose for our linearization example, (you can adjust for your shop's needs):

1. Printer Resolution.....2880x2880
2. Halftone Lines Per Inch.....55 Lines per inch
3. Halftone Angle.....22.5 Degree Angle
4. Halftone Dot Type.....Default Round

Also Filmgate uses a 'MIM' file to capture print specifics. A MIM file is an abbreviation for: **Media, Ink, and Metamode**

Media: Not all film is the same. Some may dot gain worse than others so noting the specific source of the film identifies the exact film you are using during the linearization process.

Ink: in this case we used K3 inks from Epson. Using bulk ink supplies may give different results than K3 inks from Epson.

Metamode: refers to the printer resolution, halftone lpi, and angle.

Naming the linearization file is important since you need to know which one to select among many that will be created over time. I used the following file name for the linearization test:

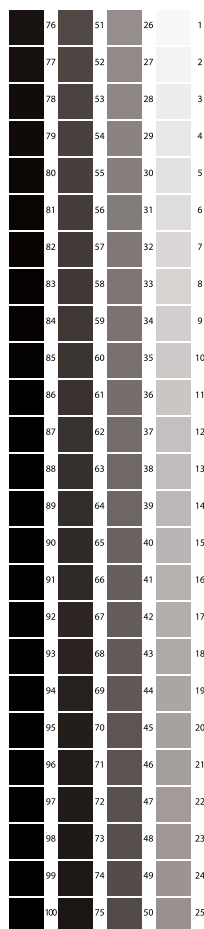
55lpi_22.5_2880x2880_BCFilm

This file name gives me the information I need to know when selecting a linearization to output film for a specific job. I use this same file naming structure for all linearizations so that they are easy to find in the list that Filmgate generates from available linearizations.

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Filmgate
Linearization
Target

This is the test target within the Filmgate software. Once a linearization file name is established Filmgate saves all data to the file to begin building adjustment curves that will control halftone output.

In this linearization example Filmgate prints out 4 Targets for CYMK. You can choose to output all at the same angle, or it will output the target at typical lithography angles for four color process printing, great for 4/C graphics, and four color printing on white T's. For screen printing add 7.5 degrees to the default litho angles to prevent moire.

Once the film is printed and dried for 30 minutes we can test the squares for halftone values with the X-rite Transmission Densitometer Model 331. This model has a 'dot' button used to measure only halftones which it will display as a percentage.

It is not necessary to measure all 100 squares. Simply measure squares 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 100 and enter the dot percentage into Filmgate's linearization assistant.



X-rite Densitometer Model 331

Repeating the measurements for all CYMK targets provides Filmgate the data necessary to adjust halftone outputs to be accurate. Quite often the first linearization achieves a 2% +/- accuracy. Another set of targets can be printed again using the just created linearization and printed and measured once more to achieve very precise halftone values.



Accurate Linearization
Solid Blacks, Fine Details Preserved
Good control of quarter tones

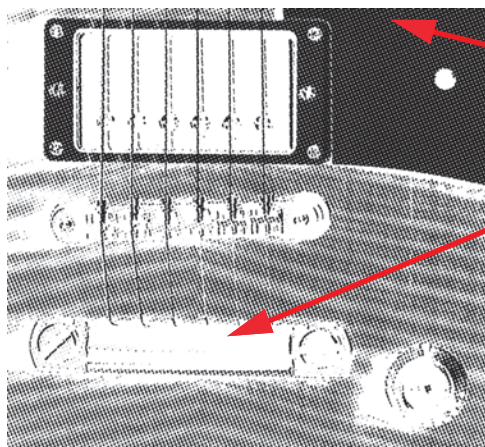


Unlinearized Film Output
Too much Dot Gain
Loss of 60%+ Halftones



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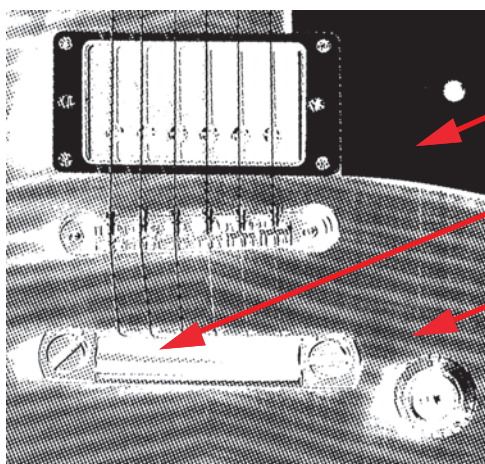


Non Linearized Film Output
Scanned Image of actual film

Non Linearized Film Output (Light)

1. Note halftone in Pickguard, should be solid black to allow tan spot color to print over solid and avoid halftone.
2. Loss of reflection detail in tailpiece of guitar in lower tonal values.

Zoom in to examine these scans, the difference is very noticeable when zoomed in. Without linearization the image is uncontrolled. Dot values can be below needed values (light image), or above (dark image below)) depending on how the file is set up in the RIP program. Using a linearization file to control output assures the important tonal values are present in the final print.



Linearized Film Output
Scanned Image of actual film

Linearized Film Output

1. With linearization solid 100% black areas remain solid black, which helps the final print have strong spot color areas.
2. Important halftones in the quarter tone values of 25% in the metal reflections and 75% in the wood pattern are preserved.
3. Stripes in the figured maple top have good light to dark and were separated to use the black shirt.

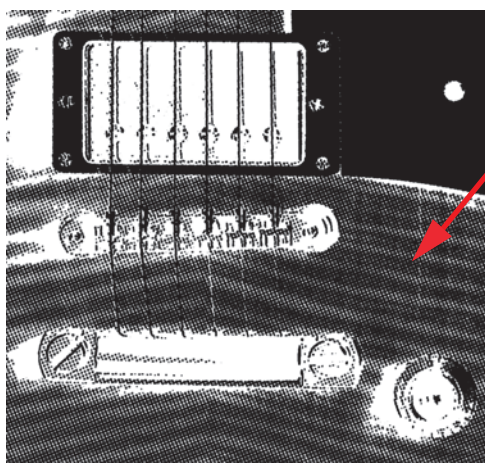
With a RIP linearization all halftone values on film are predictable and print results improved.

Non Linearized Film Output (Dark)

1. Stripes in figured maple top are lost due to dot gain on film. Important dark stripes in the baseplate will fill in during printing and prevent the design from using black shirt color as a shading element.
2. Any print dot gain will cause additional tonal values to be lost in the wood and lose design details.

Smooth tonal values over the 4-100% range determine the visual appeal of a sim process print. Why 4% and not 0%? Generally vignette moire occurs in tonal values below 4%, Filmgate allows you to eliminate these tonal values or use them depending on your art and the mesh count selected.

(Actual Film output on an Epson 9880. Center image was linearized within Filmgate to achieve accurate tonal values that matched values seen in Photoshop.)



Non Linearized Film Output
Scanned Image of actual film

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Summary

Once linearization of the film is complete it is possible to apply print dot gain adjustments. Print dot gain can also be as high as 20%. A lot depends on mesh selection, squeegee durometer, angle, speed, pressure, edge sharpness, ink viscosity, and off contact. Establishing the best halftone press set up and standardizing or documenting the variables mentioned above is recommended before applying any print dot gain adjustments. This is a subjective area depending on the design. For the print to the right we didn't use any adjustments to the linearization. After analysis of the print I would like about 5% taken off the 50%-90% halftone values. . In most cases little adjustment is needed, but for saturated prints with lots of halftones above 50% adjusting the linearizations helps bring out detail and clarity to areas that can be muddy. More on curve adjustments in an upcoming article.

Your shop's quality is determined by the quality of art you offer. You can only print what your software and imagesetter capture, the better the film generation, the better the final print.

Special Offer for our Newsletter readers and their friends: 15% off of Filmgate RIP.

Filmgate for 'S' Category Printers: 1190.00
(Larger Imagesetters slightly more)
1 Free Linearization (a \$200.00 Value)

 **ColorGATE**



Actual 5 color print. Film output with Filmgate on an Epson 9880 using a 55 lpi Linearization.

To order or discuss the Filmgate RIP program contact Alan at the following number listed below. We offer a 30 day demo version of Filmgate for your appraisal.

Alan Buffington
323-980-0662 ext 118
800.562.3534

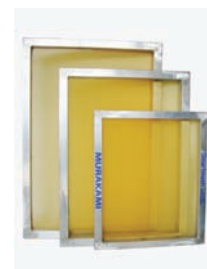
Walt or Bob can also advise you on selecting Murakami Products for Textile, Graphics, or Electronic Screen Printing.

Bob Wellen
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916-343-0018

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