Technical Information

Calibration

Linotype-Hell

Calibration has a very specific meaning in the imagesetter world. It is the process of adjustment necessary to assure that the halftone dot percent value that you request is the dot percent value that you measure on your films. Calibration gives a repeatable level of consistency to the production of tints and halftones. There are three important factors in calibration:

- Maintaining your film processor
- Achieving an appropriate maximum density on film (and staying at it.)
- Linearizing dot percent with a transfer curve

This document will cover the last two issues as well as the calibration procedure for use with the Linotype Utility.* The issue of film processor maintenance will be covered in a separate technical information piece.

Halftone dot size

Laser imagesetters make marks on film. From these marks, different shapes can be formed: lines, characters, and halftone dots. The quality of each of these shapes is dependent on the underlying mark. The size of the mark that the laser makes on film is a function of the laser spot size, the laser intensity, the film material, and the film processing. If your processing varies, it can have an effect on the marks that the laser makes on film. This can actually cause the size of the halftone dot to vary and as a result, make images look lighter or darker. The purpose of calibration is to make sure that you get consistent, accurate reproduction of halftone dot size.

Film processing

Quality tint and halftone output requires an immersion bath film processor. An immersion bath film processor totally immerses the film material during processing, and as a result assures more even development. Other factors in film processing are the freshness of the chemicals, the temperature of the baths, and the time that each piece of film spends in the bath. Calibration is useless if the processor is not adequately maintained. Likewise, if temperature and speed vary, there is little sense in proceeding with calibration.

Density

Density is a measurement of the ability of light to pass through or reflect off of a material. The density of a solid black patch on a piece of film is called the maximum density or the dmax. The value of the dmax plays an important role in the accuracy of dot percentages. (See the Linotype-Hell technical information piece on Density and Dot Percent, part number 3074.) Measuring dmax requires a tool called a densitometer.

Linearization

If you were to make a graph of requested dot percent versus measured dot percent, and you found that what you requested was exactly equal to what you measured, the result would be the graph in Figure 1: a straight line going from 0 to 100% at a 45° angle. This is the ideal result.

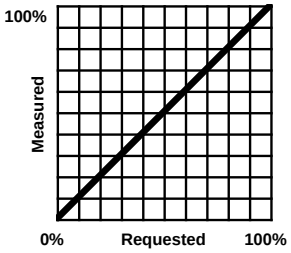

Figure 1 - Linear output

Linear output is what you expect after calibration. However before calibration, the measured value may vary from the requested value by any-

Requested	Measured
46	49
47	50
48	52
49	53
50	55
51	56
52	57

where from one to twenty percent. Calibration programs allow you to adjust for this. You input the values that you measured, and the program makes an adjustment so that you will get the value that you requested.

If you were to take measurements at 1% intervals on a gray scale, you might see something that looks like the chart to the left. In this example, where you requested a 50% dot, you actually measured a 55% dot. If you really wanted a 50% dot, you should have asked for a 47% dot. Calibration programs fool the imagesetter into doing this through the use of a transfer curve in the RIP (Raster Image Processor).

The transfer curve

Settransfer is the PostScript** operator that is used to create the transfer curve. What settransfer does is to create an array (i.e., a lookup table of numbers). By sending values through this array you can make requested values match measured values. Calibration programs create this type of array through the use of a feedback loop. You send down a test strip, measure the values, and input them into the calibration program. Using these values, the calibration programs sets up the appropriate array. Without this feedback loop there would be no way for the RIP to know how to make an adjustment.

The settransfer PostScript operator is described in the *PostScript Language Reference Manual* (2nd edition, Addison-Wesley, 1990) for those interested in investigating it. The book *Real World PostScrip*t (Addison-Wesley, 1988) also contains an informative section on settransfer (pp. 168-170).

Compressed gray levels

Calibration should not be overdone. Overcalibrating may lead to the loss of gray values in either the highlight or the shadow. This is insignificant when the correction is slight, but may be visible when gross corrections need to be made to bring a machine into calibration.

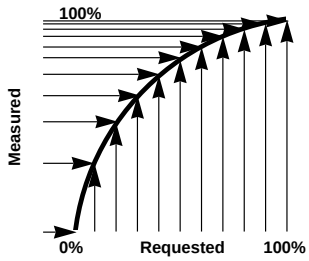

Figure 2 - The effect of a non-linear curve on measured values. Note how a set of evenly spaced requested values, when measured, can become compressed near 100%.

Imagine the situation where measured values differ greatly from requested values (see chart to right). To linearize this device, the transfer curve would need to apply a large correction. When the curve is shifted this much, many of the available gray values are compressed into one part of the curve. A bowed curve like the one in Figure 2 means that the dot percent values that you have to work with are concentrated in the shadows. This leaves less values to work with in the highlight.

Requested	Measured
0	0
10	35
20	52
30	67
40	78
50	82
60	87
70	91
80	95
90	97
100	100

Note: Results like this are unlikely unless the dmax is extremely high.

In situations where you are already working with a limited number of gray values, (for example where a high screen ruling is output at a low resolution), this type of shifting can be critical. The best way to avoid overcalibration is to be sure that your dmax is not too high. Also, be sure that your imagesetter resolution setting is appropriate for the screen ruling that you have chosen. (For more information on the relationship between gray levels, screen ruling, and imagesetter resolution, see the Linotype-Hell technical article on Resolution and Screen Ruling, part number 3050.)

Calibration procedure

The Linotype Utility includes a calibration program for the Linotronic line of imagesetters. This process has two parts: setting the density and calibrating for dot percent. A description of the calibration procedure follows.

1. Setting the density

- Choose a resolution setting. (Keep in mind that calibration is necessary for each resolution setting that you intend to use.)
- Set the imagesetter for negative output when calibrating for negative film, or positive output when calibrating for positive film. Linotype-Hell recommends that you select positive or negative at the imagesetter, rather than

through the page setup portion of your application.[1] If you want to calibrate to imagesetter paper rather than film, refer to the Linotype-Hell technical information piece on Calibrating on Imagesetter Paper, part number 3076.

[1]Although the calibration dialog box has a selection called negative print, this is for use only if you also select negative from the application (which is not recommended).

- With Chooser, select the output device, then launch the Linotype Utility. (If the output device to be calibrated is selected after the utility is launched, you will need to pull down the *Various* menu and select *Query Printer*.)
- Under *Imagesetter* select *Set Density*. The *Density Dialog* dialog box allows you to choose the range over which tests will be output as well as the frequency. For example, if you know the density setting from a previous day, you may choose to pick a narrow range around that value and to do tests in increments of ten units. See Figure 3.
- Select *Test Print* to output the density test to the imagesetter. Process the tests and measure the density of the solid black areas. (See Figure 4.) You may get results that look like the chart to the left.

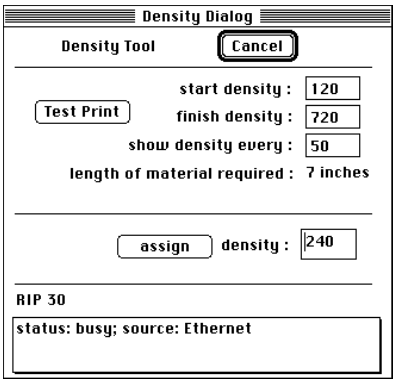

Figure 3 - Dialog box from the density portion of the Linotype Utility.

Density setting	Solid density (dmax)
200	2.82
210	3.10
220	3.24
230	3.46
240	3.57
250	3.78
260	3.90

Set the density setting on the imagesetter to the value that corresponds to the solid density value that you require. Linotype-Hell recommends that you aim for a dmax reading around 3.5, so in this case a 230 density setting[2] would be appropriate.

[2]Don't confuse the *density setting* on the imagesetter with the actual *measured density*. The density setting controls the laser intensity. The density value that you measure will depend on the film and film processing as well as the laser intensity.

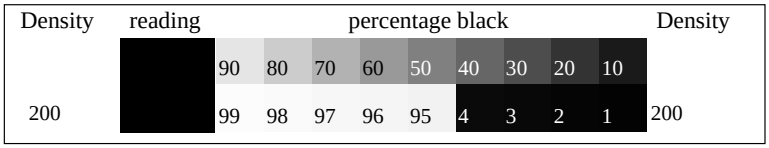

Figure 4 - Negative output of the density test. Do not be concerned with the tint blocks, dot percent is measured later. The test also includes type from 6 to 25 points.

2. Calibrating for dot percent:

- Under *Imagesetter* select *Calibrate*.
- The *Calibrate Imagesetter* dialog box (see Figure 5) shows a series of dot percent values. If you want to calibrate for a particular screen ruling,[3] select *Custom Screen* and change the default value as desired. When you are ready, select *Print Gray Scale* to send the test to the imagesetter.[4]

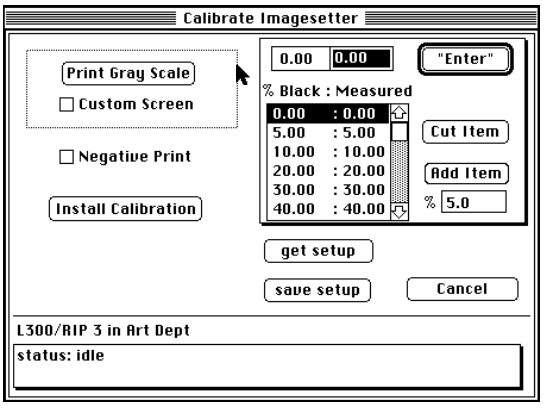

Figure 5 - The calibration portion of the Linotype Utility.

- The test strip includes two gray scales (see Figure 6). Before you enter any new values, the top scale is uncalibrated. The bottom scale reflects the curve that is currently set in the RIP. If no curve is resident in the RIP, like values in both the top and bottom curves should match. To calibrate, take

[3]A calibration for 150 lpi may also work well for 133 lpi but not for 60 lpi. For the greatest accuracy you should calibrate for each screen ruling.

[4]The Linotype Utility allows you to add steps to the gray scale, however, adding steps does not significantly improve calibration, and can even cause problems, particularly when they are done in 1% step increments.

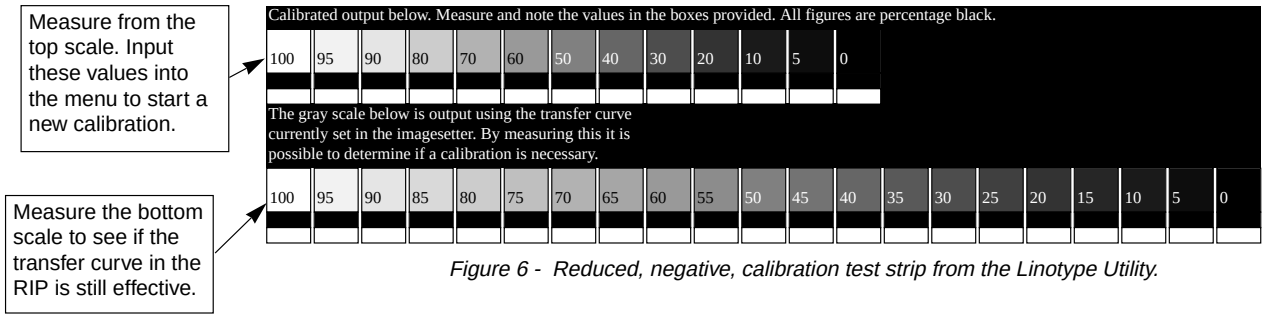

Figure 6 - Reduced, negative, calibration test strip from the Linotype Utility.

dot percent readings from the top row of gray scale boxes. Enter these values in the right hand column of the *Calibrate Imagesetter* menu.

- Send another test strip by selecting *Print Gray Scale*. Measure the top scale of the resulting test strip. The values should match much more accurately (within a percent or two). If you are satisfied with the results, download the transfer curve to the RIP by clicking on *Install Calibration*. If you are not satisfied you may either doublecheck your entries to see if any mistakes were made, or re-output an unadjusted gray scale and start again.
- When you click on *Install Calibration* a new transfer curve is written to the RIP's hard disk. (The file is called Lino/Start.Calibration.) If there was a previous Lino/Start.Calibration file already resident on the disk, it will be overwritten. Only one transfer curve can be resident on the hard disk at any time. Rather than deleting a curve that is resident on the hard disk of the RIP, it is easier to simply install a new curve.
- If you are having trouble with calibration, you may benefit from deleting the existing curve. This can be done by choosing *RIP*, then *Delete File(s)*, and *Calibration*.You should then reset the RIP, and start from scratch.

Note: If you are measuring from film negatives, you should set your densitometer to read negative values. (A densitometer reading negative will read solid areas as 0% and clear areas as 100%.) Most densitometers allow you to measure either as positive or negative. If your densitometer can't read negative, you will have to subtract the values that you get from 100 to be able to key them into the menu.

Densitometers

It is important that you use your densitometer correctly if you want to get accurate measurements. Calibrating a densitometer is a separate procedure that will help assure consistent measuring. Check your densitometer manual for more information. The procedure for actually measuring dot percent should be consistently done. When measuring dot percent you must zero the densitometer to a clear portion of film. This tells the densitometer where a positive 0% lies. You should also zero to film when measuring density.[5]

[5]With density measurements whether you zero to film or to air gives you two slightly different readings. If you zero to air (in other words press the reading head down with no material), all measured values give an exact reading of how difficult it is for light to pass through the film. If you zero to film, the clear portion of the film becomes your baseline. Your dmax values will ready slightly lower if you zero to film. (In essence, the density of the clear film will be subtracted out of all other measurements.)

Conclusion

Keep in mind the three important factors in calibration: film processing, maximum density, and the transfer curve. If you pay attention to these factors you can expect consistent reproduction of halftone dot percentages.

Acknowledgements

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Comments

Please direct any questions or comments to:

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