Many people are so excited about the ability to do color on the desktop that they neglect to learn about the fundamentals of black & white reproduction. But it should come as no surprise that most of the issues that demand attention to detail and quality in single-color work have even more importance in multi-color work. Therefore it is crucial to understand the foundations of black & white reproduction before you venture into color. The ultimate black & white application is the production of films. In the production of any film output (and particularly color separations), everything comes down to black marks on clear film. In this document we will look at how to judge the quality of either a single piece of film or a set of color separations.

Visual evaluation

You can tell a lot about a film by just looking at it on a light table. Visual evaluation is required to check for a number of things: the overall quality of the film itself, the registration accuracy, font usage, trapping, and moiré. Once the visual evaluation is complete, the film may be analyzed with tools like a densitometer, and a screen angle and ruling measurement tool.

Film Quality Checklist

- __ No streaking or scratches
- __ Base material is not fogged
- __ Tint/halftone quality is good
- __ Dmax in proper range
- __ Negative
- __ Emulsion down/right reading
- __ Crop/register marks line up
- __ Dimensions are correct
- __ Proper fonts used
- __ Traps properly executed
- __ Moiré evaluated
- __ Dot percents are accurate
- __ Proper screen angle/ruling

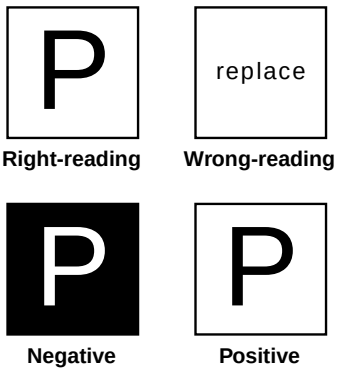

Figure 1 - The letter P shown as right-reading, wrong-reading, negative and positive

Overall quality One of the first things to look for is the overall quality of the processed film itself. It should be free of streaking or scratches which may be a result of film or processing conditions. The black areas should be solid enough so that light will not pass through them in the platemaking process. The non-image areas should be clear and not fogged. All tints and halftones should look consistent and smooth. Poor-looking tints and halftones may be a result of several factors, including: faulty film processing, or poor choice of screen angle and ruling (follow your manufacturer's recommendations for best results).

Maximum density (dmax) Density is a measure of the ability of the film to keep light from passing through it. A solid black area on a film is often referred to as the maximum density, or dmax. A densitometer measures density and will be able to give you a number value for the dmax (for a fuller explanation see the section on Density). A densitometer is an essential tool in determining film quality. However, if no densitometer is available there is a simple way to see if density has reached a reasonable level. Lay the film over a ruler (or some other opaque object) on a light table; if you can see the edge of the object through the black of the film, chances are the film's dmax is below 3.0 or so in density. If you can't see the edge, the dmax is most likely above 3.0. This is only a very vague estimation, but it can be helpful at times, particularly if you feel the dmax is too low. This test won't tell you if the dmax has run too high, however. And since maintaining a consistent dmax is very important in assuring good tint and halftone work, Linotype*-Hell recommends the use of a densitometer for quality control. (See the technical information piece called *Density and Dot Percent*, part number 136.)

Plate-ready films When a customer supplies plate-ready films, most printers prefer to receive emulsion-down, right-reading, and negative films. The description "emulsion-down, right-reading, negative films" means that the films are negative (the areas that will be inked are clear) and the type is readable (not mirrored) when the films are laid emulsion side down on a light table. The emulsion is the photo-sensitive material that the imagesetter exposes with the laser. The base is the clear plastic support for the emulsion.

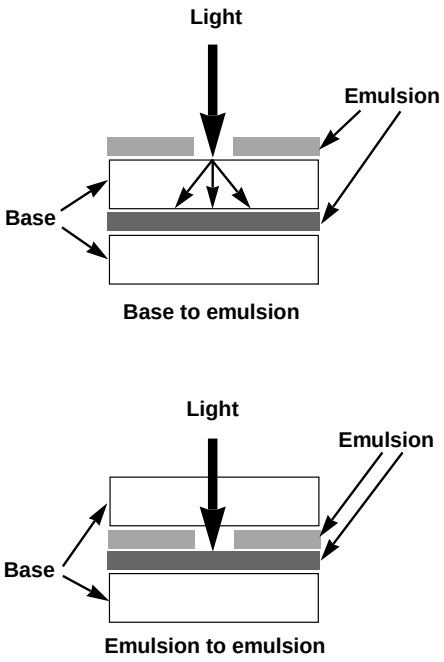

Figure 2 - Base-to-emulsion (top) and emulsion-to-emulsion (bottom) plate-making. Emulsion-to-emulsion results in a sharper image.

The emulsion side looks duller than the base side. (Your reflection will appear in focus on the base side.) The difference will be easier to see if you curl over one corner of the film to get a side by side comparison of the back and front. If you still have trouble telling which side is the emulsion side, take a sharp object and try to scrape some of the black from a piece of scrap film. You will be able to do this on the emulsion side, but you will only scratch the base on the base side. Lastly, imagesetter film, because it comes in rolls that are wound emulsion-side-in, tends to curl slightly toward the emulsion side.

Emulsion-down, right-reading, negative films are needed for two reasons[†]:

1. In creating a printing plate it is important that the plate maintain as much of the detail as possible from the film. This is made easier when the emulsion of the film and the emulsion of the plate are directly touching when the plate is exposed (see Figure 2). If the base of the film were between the two emulsions, some light would scatter, unwanted areas would be exposed, and the plate would not be as good as possible.

2. The printing plates for offset lithography need to be right-reading when the emulsion is down because of the way that the ink is transferred from the plate to an intermediary drum (called the blanket cylinder), and finally to the paper. If you viewed the image on the blanket cylinder, it would be wrong-reading, but when it is transferred to the paper it becomes right-reading again (see Figure 3). This offsetting of the image onto the blanket cylinder is why the term *offset* is used to describe the most common type of lithography.

[†] If you intend to supply plate-ready films, check first with your printer. Screen, flexography, and gravure printing have different requirements than offset lithography.

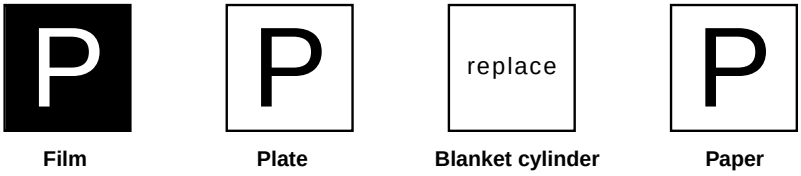

Figure 3 - The clear areas on the film correspond to the exposed areas on the plate. The exposed areas of the plate hold ink which is then transferred to the blanket cylinder before being applied to the paper.

Registration Registration can be best checked by laying the films on top of each other on a light table. To check dimensional accuracy you should measure each film individually with a ruler. (It is best to pick a standard tool for measurement in your shop. Variations may occur between different rulers.) You may want to measure films on a drafting table with a T-square if you have concerns about skewing. (Improperly loaded film may shift from side to side in the imagesetter. This skewing may cause the crop marks within a page to shift or curve in relation to each other.)

Fonts In the rush to check some very subtle detail, it is easy to overlook some larger issues. Keep an eye out for incorrectly substituted fonts, particularly Courier (which may be used when the chosen font can't be found) or bitmapped output (which may occur when the outline printer font can't be found). Font ID issues are discussed in greater detail in a soon to be released technical information piece called *Using PostScript Fonts*.

Trapping Trapping has been an important issue for printers for a long time, and is now being addressed in the electronic publishing field. (See the technical information piece called *Trapping*, part number 3057.) It is important to look to see that any traps you created are really there. Do not rely on a proof to tell you if the trap is successful. A properly aligned proof will tell you very little because it doesn't account for variations in press registration.

Many traps are as small as one quarter of a point; as a result it can be very difficult to see them. As traps increase in size, up to one point or so, they

Figure 4 - General appearance of trap lines when viewed on a light table. No trap (top), .25 point trap (middle), and 1 point trap (bottom).

start to become much easier to discern. The best way to view a trap is to overlay the films on a light table. Align the films and tape them to the light table. Look closely at the areas you expect to trap.

Traps on negative films appear as a clear or tinted area between the two objects[††] (see Figure 4). Exercise care, because untrapped objects may appear to have a very slight trap line when viewed as a negative on a light table. An actual trap is much more visible.

[††] The opposite is true on a positive (i.e. the trap is an overlay of two black or tinted areas). This makes checking for a trap more difficult on a positive film since the underlying black will not show through if the dmax is high enough.

Moiré Moiré is another subtle effect that is not always revealed in a proof. Moiré may not be noticeable at all in an overlay proof[†††], and sometimes subtle moiré effects won't even show up in a laminated proof[†††]. Therefore it is best to do some checks on the films before you go to proof. Viewing the films on a light table gives you an idea of what the absolute worst-case moiré would be. The actual moiré in a piece will never be this bad because the individual ink colors are not as dark as the black in each layer of a color separation. Since yellow is the lightest color, it contributes the least to moiré; however, because of its common placement only 15 degrees from other colors, it may cause problems in light greens and pinks.

The best way to check for moiré is to take the cyan, magenta, and black films and align them carefully on a light table (it helps if you can tape them down individually so that you can lift them up and compare two and three color combinations.) Temper what you see with the knowledge that this is the worst case, particularly when you overlay the yellow film. (A soon to be released technical information piece will cover moiré in greater detail.)

[†††] An overlay proof is made up of several layers of acetate that each represent one of the process ink colors. Cromacheck** and Color-Key** are DuPont and 3M's trademarks for overlay proofs. In a laminated proof, each of the process colors are applied and merged to a single piece of material. Cromalin** and Matchprint** are DuPont and 3M's trademarks for laminated proofs.

Evaluation with tools

Once a visual evaluation is completed, it is important to check certain characteristics of film using a variety of tools, particularly a densitometer and a screen angle and ruling measurement tool.

Density A densitometer that measures density as well as dot percent is a must in any shop that produces films. All employees who use the densitometer should understand the proper procedure for taking measurements.

The laser's effect on the film material, in combination with the effect of the processor on the film material, are two critical factors in developing a good solid black (ie., maximum density or dmax) on film. Changing the intensity of the imagesetter laser will change the dmax. Changing processing conditions (such as processor speed or the chemicals) will change the dmax as well.

Films need to have a dmax of at least 3.00 or so to prevent significant amounts of light from passing through the black portions of a film. However there is no benefit from having densities much higher than 4.00, and there may in fact be some detriment (see Linotype-Hell technical information piece on *Density and Dot Percent*, part number 136). The most common values for maximum density fall between 3.00 and 4.00. Values approaching 4.00 may be necessary for films that need further work by the printer, including duplication and stripping into other pages. Discuss your printer's dmax needs to see if they have any special requirements.

Dot Percent For any work involving tints or halftones, the measurement of dot percent is an important step. Because of variations in processing that affect the maximum density, there may also be variations that affect the size of the halftone dot, and as a result the gray or color that those halftone dots

create. The first step in assuring that dot percents remain accurate is to see that the dmax stays constant. The second step is calibration, which will not be discussed here except to say that Linotype-Hell offers a calibration program as part of the Linotype Utility.

It is useful to have a gray scale on each film that you output so that dot percent accuracy can be measured at a later date. Some software applications include a gray scale along with the crop marks. If the gray scale isn't labeled with requested dot percent values you can make the following assumptions:

- An 11 step scale from clear (white) to black means that each step increments by 10% (0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100).
- An 17 step scale from clear to black means that each step increments by 6.25% (0, 6.25, 12.5, 18.75, 25, 31.25, 37.5, 43.75, 50, 56.25, 62.5, 68.75, 75, 81.25, 87.5, 93.75, 100)

Note: For other lengths, count the number of steps, subtract one for the clear step if it exists and divide 100 by this number. Determine each step's value from the result.

Screen angle and ruling Screen ruling needs to be chosen appropriately for the paper and printing press that will be used to print the job. In color work, screen ruling and angle play an important role in moiré. Therefore, a quality control check of the films should include measuring screen angle and ruling. A screen angle and ruling tool (printed on paper) is included in the technical information piece called *Measuring Screen Angle and Ruling*, part number 3055. To get a film version of this tool send a self-addressed, stamped (three first-class stamps), 9" x12" envelope to the address below.

Proofing

Evaluating a proof is too complex a subject to cover in this forum. But briefly, different types of proofs provide different levels of color accuracy:

- Color printer output may be used as a rough comp or for placement, but not to make decisions on color.
- Overlay proofs may be used for placement, color decisions for some applications, and to see the progressive effect of each color.
- Laminated proofs are used for color decisions for many applications.
- Press proofs are used for color decisions that require the highest accuracy.

Remember that not all proofing methods will show moiré. Dot gain† may not appear in a proof either. Only experience will tell you what you can expect from certain types of proofing methods, because only then will you be able to compare the completed piece with the proof.

† The tendency of a halftone dot to become larger as a result of the ink bleeding into the paper. Dot gain tends to darken an image.

Conclusion

In producing plate-ready films you are taking over a set of tasks that was commonly handled by the printer, therefore it is of the utmost importance that you communicate your intentions beforehand with your printer. They will need to lay out their requirements as well. Good lines of communication will facilitate the entire procedure.

Comments

Please direct any questions or comments to:

Jim Hamilton, Marketing Department
Linotype-Hell Company
425 Oser Avenue
Hauppauge, NY 11788 (516) 434-2717

Part Number 3062, 2/91