Recording Data on Film

Recording data on film, whether text or images (or both), is a function that can be done by many devices. But what do your call these devices? Printers? Typesetters? Imagesetters? Recorders? Repro recorders? The answer to this question lies not only in specification sheets, but also in the history of the typesetting and scanning industries.

Scanning and recording

The earliest scanners had two functions. They scanned images, and they also recorded those images on film. To do this required two drums: a scanning drum and a recording drum. Scanning and recording occurred simultaneously, with both drums spinning. The drum on the left usually had the reading head and performed the scanning. Information was then passed to a writing head which recorded the data onto film. Halftoning was either performed on the data prior to recording, or, in some direct screening scanners, a halftone screen was laid directly over the film prior to exposure. Some devices included a third drum for masking. (See Figure 1.)

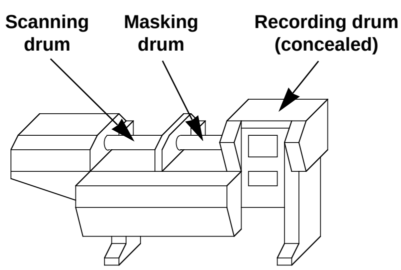

Figure 1 - Hell's DC 350 scanner contains not only scanning and recording drums, but also a drum used for masking.

Later, it became possible to scan an image without recording it at the same time. Once that development occurred there was no compelling reason to keep both functions in the same device. The scanning and recording functions could be housed in separate boxes.[1] A shop might choose to have several scanners but only one recorder. (There is no sense in having a recorder sit idle waiting for scans. Multiple scanners can supply the recorder with a steady flow of work.) This division of labor became even more pronounced with the introduction of mounting stations and other production-oriented devices. These devices assured that scanners would not sit idle waiting for jobs to be mounted.

Setting type

Through all of this, typographic elements were output separately and either scanned as line work, or stripped in at a later stage. This posed problems for editing text. Any changes in text meant that the new text would have to be re-scanned or restripped.

[1] This is comparable to punched paper tapes in typesetting. These tapes were used to store keystrokes and style commands. Produced on a terminal, they could be output on a typesetter at a later date.

Typesetters of the time worked only with text. No widely used methods were available for electronically merging text and images. With the introduction of the PostScript™ page description language in 1985, this situation began to change. Interesting and innovative solutions to the flow of electronic data (both text and images) came into more common use.

As PostScript became more popular, the term imagesetter was coined to describe typesetting machines which used a PostScript raster image processor (RIP). On the scanning side of the business, though some repro recorders can now also be driven by PostScript RIPs, these devices are rarely called imagesetters, even though the term is appropriate for them.

Terminology

From our perspective as a manufacturer of devices that output film, we use the following definitions:

- **Printers** are devices which output at low addressability[2] on plain paper. Examples: 300 and 600 dot per inch laser printers. Since many of these

[2] Addressability is the more accurate term for what is commonly described as resolution.

devices contain internal RIPs, they could be considered imagesetters, but the fact that they output on plain paper at lower addressabilities makes them printers rather than imagesetters.

- **Recorders** are devices which are used to record images on film.[3] These devices may be described as 'dumb' devices because they lack the intelligence supplied by a RIP. The term 'recorder' may be used to describe a range of devices from typesetters to high-end repro recorders. However, though some high-end repro recorders do not contain RIPs, they may contain intelligence of some other type, for example, a screening computer.

[3] For the purpose of this article, the film referred to is high contrast black and white film. There are devices called slide film recorders, which are used to image 35mm slides on color film, but they belong to a separate category of devices.

- An **imagesetter** describes a 'smart' recorder, in other words, a recorder with a RIP. The RIP and recorder are sometimes contained in the same unit, but more often than not the RIP and recorder are separate. Imagesetters usually output at high addressability to photographic film, photographic paper, or plate material.
- When laser **typesetters** were first introduced, their graphic capabilities were limited. Some of this was due to the typesetting languages that were used to drive them. Today, the term typesetter is used less frequently, and has been largely replaced by the term imagesetter.
- **Repro recorders** are devices which are used to output scans from high-end scanners. They may also be able to output pages if the pages are in a format that is native to the recorder. If these devices are driven by a RIP, then they can be considered imagesetters.

Exposing the film

The way that a Linotronic® 330 and a ChromaGraph® 3030 record film is fundamentally different even though both may be called recorders. One major difference lies in the number of laser beams used to expose the film. Most recorders, including many drum recorders, use a single beam that passes over the film repeatedly until it has exposed the entire image area. The optical paths may differ recorder to recorder, but the use of one beam is the general rule.[4] With devices like the ChromaGraph 3030, multiple, individually-modulated beams are used to expose the image.

[4] Some recorders do split a laser beam into two parts for the purpose of testing the strength of the beam, and a few do write with dual beams, but the majority use only one.

Imagesetters/recorders	Description	Laser optics
Linotronic 260	Capstan	Single beam
Linotronic 330	Capstan	Single beam
Linotronic 560	Capstan	Single beam
Linotronic 630	Internal drum	Single beam
Herkules™, Herkules M	Internal drum	Single beam
Linotronic 830/930	External drum	Multiple beam
ChromaGraph 3020/3030	External drum	Multiple beam

In the Linotype-Hell product line, six parallel beams[5] are commonly used by repro recorders, with each one controlled by an electro-optical modulator (EOM). Devices which use a single beam as opposed to multiple beams are shown in the chart above.

[5] Eight beams are used with the DC 3000 series on directly recorded output.

Addressability

This multiple beam approach makes it a little more difficult to calculate the addressability of a device like the ChromaGraph 3030. Most single beam recorders have a number of different addressability settings. Any number of screen rulings may be output at these addressability settings. With a multiple beam device like the ChromaGraph 3030, the addressability setting is closely tied to the screen ruling in the following manner:

- Before output, a screen ruling is chosen. The multiple beams of the laser are focused with a zoom lens so that they will expose the proper screen ruling. (See Figure 2.) The multiple beam is then used to 'paint' halftone dots, usually in two passes where one half is painted on the first pass, and

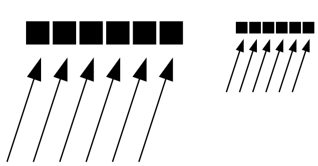

Figure 2 - Two possible zoom settings which would produce two different screen rulings.

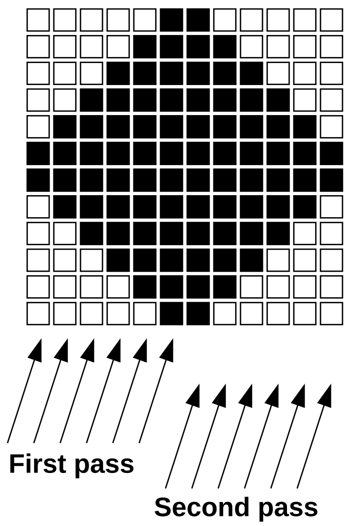

Figure 3 - A recorder may use six beams to paint a halftone dot in anywhere from two to four passes.

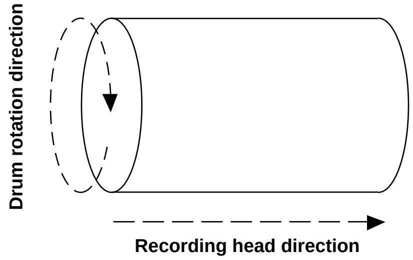

Figure 4 - Diagram showing the two different directions for addressability.

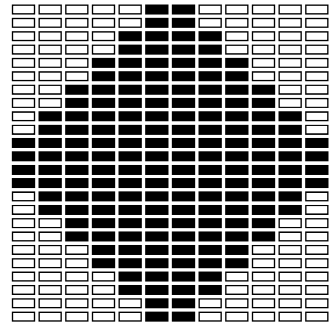

Figure 5 - In this example, the addressability is higher in the drum rotation direction.

the other is painted on the second pass. (See Figure 3.) Though multiple beams are used during each pass, each beam is controlled separately from the others.

- Depending on the chosen screen ruling and the amount that the device has been zoomed, the distance from the center of one halftone dot to the next may vary anywhere from 1/75th to 1/400th of an inch. If two passes of the six beams paint a halftone dot every 1/400th of an inch, that means that there are 12 laser marks in each 1/400th of an inch. Based on this, the addressability setting works out to be around 4800 dots per inch (dpi). For the 1/75th inch example, the addressability setting would work out to much less, closer to 900 dpi.
- With drum recorders like the ChromaGraph 3030, the addressability along the axis in which the recording head moves, may not be the same as the addressability in the direction of the rotation of the drum. (See Figure 4.) This can result in a situation like that shown in Figure 5. The addressability in the drum rotation direction may be as much as four times that of the recording head direction.

With devices like the Linotronic 330, the screen ruling and the addressability setting determine the number of gray levels that the chosen screen ruling/addressability combination will produce. With devices like the ChromaGraph 3030, the number of gray levels is constant for each screen ruling and it is the addressability that varies.

Set-up procedures

A great deal can be learned about the difference between a Linotronic 330 and a ChromaGraph 3030 by looking at their set-up procedures. This process, usually called calibration or linearization, accomplishes the same goals for the two devices, but is done in a somewhat different manner.

Calibration involves two steps: assuring that the exposure of the laser on the film produces an acceptable dmax (maximum density) in areas that are solidly exposed, and, assuring that the halftone dot percentage that you request is the halftone dot percentage that you get.

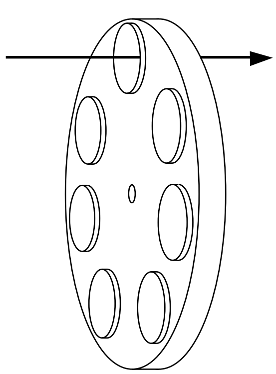

Figure 6 - The intensity of the laser in a Linotronic 330 recorder is adjusted via a filter wheel for the coarse setting and modulators (not shown) for the fine setting.

Linotronic 330 – For a Linotronic 330, the first step in the process is to set the dmax on film. The amount of exposure that the laser delivers to the film can be changed through what are known as laser intensity or density settings. These settings are achieved through modulators and filters. For most Linotronic devices, a three digit number determines the setting of these modulators and filters. This number may be set from the recorder panel or through the Linotype-Hell Utility software. The first digit of the three digit number represents a coarse filter setting and the second two digits amount to fine modulator settings. (See Figure 6.)

With a Linotronic 330, this number is called the density setting (even though it only affects the density in conjunction with the sensitivity of the film material and conditions in the film processor.) When the film processor is running consistently, the density of a solid black dmax area can be controlled with this setting for a given film material. Once the desired dmax is set, halftone dot percent accuracy can be adjusted through the use of a calibration program. A sample set of halftone dot tints is output, measured, and then that data is used to create a transfer curve which assures that the requested halftone dot percent matches the measured halftone dot percent. The Linotype-Hell Utility allows you to create calibration curves.[6]

ChromaGraph 3030 – The process for calibrating repro recorders like the Chromagraph 3030 involves four steps: focus, light, zoom, and linearization. The first four steps parallel the dmax setting portion of the recorder calibration procedure, but in fact, even more is adjusted than just the dmax.[7]

- **Focus** – The focus setting accounts for film thickness and simply refers to focusing the laser beams accurately on the film plane. This setting is valid for any screen ruling.
- **Light** – The light setting corresponds best to the laser intensity (or density setting) of an recorder. It must be done for every screen ruling. (With recorders, the laser intensity setting must be done for each addressability setting.) The light setting is done with a knob in the power supply or through keyboard commands.
- **Zoom** – The zoom setting is used to set the screen ruling, and at the same time the addressability of the recorder. By zooming in and out, the six beams of the recorder are able to reproduce a variety of screen rulings. The zoom setting must be done for every screen ruling used.
- **Linearization** – Dot percent is linearized using a 21 step gray scale. A non-linearized version of the gray scale is output and measured. The results are then fed back into the linearization program and form the basis for getting accurate halftone dot percent values.

The Linotronic 330 and the ChromaGraph 3030 have been chosen as examples of single and multiple beam devices. The calibration procedures for other recorders in the product line may differ somewhat.

[6] For more information on calibration, please refer to the Linotype-Hell Technical Information articles entitled Density and Dot Percent, Calibration, Calibrating on Imagesetter Paper, and Automatic Calibration.

[7] Some older recorders in the Linotype-Hell product line (like the DC 350) had one additional step: the filter setting. The filter setting is required for these devices because the laser beam is split into multiple parts which must be balanced to achieve uniform exposure. This setting does not need to be done often, but is critical for good output. In newer devices like the ChromaGraph 3030, this adjustment is handled automatically.

Conclusion

Both the Linotronic 330 and the ChromaGraph 3030 may be considered to be recorders. But if these devices are connected to a RIP, then they are properly called imagesetters.

Acknowledgements

Many thanks to Gus Barbuto, Jack Bruger, Ron Duff, Phil Hunt, Vickie Matus, Kimberly Meyers, Steve Neveroski, Dennis Ryan, and Walter Ullrich of Linotype-Hell Company for their help in producing this document.

Please direct any questions or comments to: Jim Hamilton, Marketing Department, Linotype-Hell Company, 425 Oser Avenue, Hauppauge, NY 11788
(For subscription information on the Linotype-Hell technical information series, please call 1-800-842-9721.)

September 1993, Part Number 7019