

## Selecting a Printer for Metallograph® Guidelines

### Introduction...Printing as a System

Printing is a process where materials are merged by a machine in a precisely controlled manner, and where the product is defined all of the components. It is therefore a system, and considering it that is the best way to understand, optimize, utilize and extend it.

#### **The four primary components are:**

- Printer
- Substrate
- Ink
- Software.

**The printer is the hardware**, itself comprised of the machinery to move the substrate, the supply system for the ink, and the print engine itself – the part that controls the placement of the ink on the substrate. To create the image digital printers have electronically controlled printheads, while analog uses plates, dies or rollers. Speed, resolution, ink thickness and contact pressure are some device variables.

**Paper and polymeric films are the most common substrates**, but a great deal of printing is on labels, textiles, wood, glass, ceramics, rigid plastics and more.

Ink is obviously colored fluids and pastes, but here it also includes toners and solids already coated on ribbons, or colorless chemicals on the substrate which the printer causes to react.

**Software is ubiquitous** – not just for preparing the files but for controlling the printer actions, and with digital printers such as inkjet, thermal and toner, to actuate the dot forming mechanism.

As a system, thermal transfer is quite simple. Benchtop units have unwinds for rolls of ribbon (carrying thermoplastic ink), rolls of substrate (e.g., blank labels), an optional winder for printed products, a printhead over a driven rubber roller, which pulls the ribbon and substrate forward, all in a metal cabinet. The cabinet also contains the print engine – the electronic hardware, drive motors, control panel and the printhead. The latter is a set of thermal elements (nibs) closely spaced across the full width. In the nip between print bar and drive roll, the ribbon is next to the printhead with ink-side contacting the substrate. Momentary heating of an element softens the ink so it can adhere to the substrate, forming a dot representing a pixel in the image. The image may be generated in the printer, but more commonly comes from a separate computer. Print parameters, such as size, darkness and count, are optionally preprogrammed or selected using the print instructions on the computer.

A separate class of printers have been designed for graphic arts – most are wider and can multiple colors. Multi-color printing enables tight registration, multilayer circuitry to be printed by using conductive and dielectric ribbons.

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# Metallograph

Printable Electronics *Tech*

## **Printer Resolution and Print Feature Dimensions**

Image dimensions are critical with printed electronics. Dimensions are primarily defined by printer native resolution, and secondarily by dot gain. Native resolution is the number of dots (pixels) that can be printed in the machine (MD) and cross-machine (CD) directions. The common units are dots/inch (dpi) or dots/cm (dpcm). Thermal printers are available at nominal 200, 300 and 600 dpi. Resolution also predetermines pixel dimensions. Nominally 300 x 300 dpi represents a pixel 85 x 85  $\mu\text{m}$ , and solid areas are multiples of this. Actual printed pixels may be bigger or smaller depending on printing parameters. (The phenomenon in the industry is called dot gain.) This influences the edges of solids and the widths of lines. Similarly, gaps formed by non-printing pixels are nominally integers of the pixel dimensions, and again can be a little wider or narrower than nominal.

Single pixel structures print satisfactorily with resin inks. However, the continuous metal of the Metallograph(R) conductive ribbon has different characteristics so single pixel 300 dpi structures do not print, and there are limitations of when single pixel gaps are clean. The minimums for 600 dpi printers are 3 or 4 pixels wide. Other limitations are discussed as artifacts.

## **Printer widths:**

Standard benchtop label printers are nominal 4, 6 or 8 inches wide (although oversized by about a half inch). They can print with narrower ribbon and substrate for economy. Manufacturers include Zebra, Honeywell-Datamax Logopak, Avery-Dennison, Sato and others. The industrial versions are recommended as they are more robust and have more control over head pressure.

Two companies, AstroNova and MPrint, support the color label market, printing 4 the primary colors in sequence with separate print engines. As the registration is precise, multilayer circuits can be assembled at speed by printing conductor-insulator-conductor. These have print widths of 5 and ... inches respectively.

True graphic arts printers are wider yet, and can print fill color images of up to 8 colors (or circuit layers), again with tight registration. Gerber's Edge makes 300 mm wide

Print head design. Separation of ribbon from print is influenced by the print head design. Our recommendations consider this.

**\*Before purchase please contact us - we will provide guidance, samples from our tests, and your own design printed on one of our machines.**

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