THE CURRENT STATE OF DTS (DIRECT TO SCREEN) AND CTS (COMPUTER TO SCREEN)

Larry Cope describes using ink-jet printing screens for textile and promotional product printers

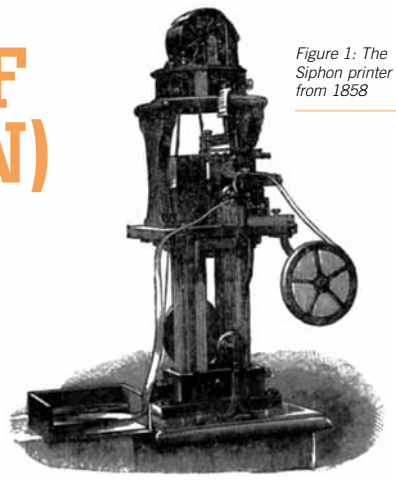

Figure 1: The Siphon printer from 1858

Both DtS and CtS names signify the same basic principle of applying a UV resistive stencil directly to the screen which is then exposed and washed out to make a print ready screen. Two other methods include Laser and DLP (digital light projection); these types of systems bypass the need to expose the screen but the cost is significantly (ten to 20 times) higher, and are seldom found in textile printing shops.

There are two basic methods to apply the stencil to the screen, thermal ribbon and piezo ink-jet. Thermal ribbon machines comprise only about 2 to 3% of the market. The cost of a thermal ribbon machine can be much less than ink-jet machines but the cost of the ribbon is much higher and thermal ribbon machines need to be in a relative clean environment printing on a nearly perfectly uniform emulsion coating. The chart below showing materials' costs was compiled by calling several manufactures and using figures they supplied to calculate costs to print a 457 x 457mm [18 x 18 inches] image on a 584.2 x 787.4mm [23 x 31 inches] screen. Prices could vary from country to country; local distributor prices could also impact these prices.

- Wax resin ribbon thermal method65 cents/ square foot — $1.46 per image
- Hot melt (Phase change) ink$60.00/100 gram block of ink — .45 per image
- Liquid UV resistive ink $200.00/litre bottle — .22 per image

Wax resin ribbon costs were easy to calculate because the amount of ribbon used is not image dependent. Hot melt ink has only one manufacturer to my knowledge and prices I was quoted were consistent. Liquid was most difficult because there are many manufactures and wide variations in price. I chose to use the price of a very high quality dye ink specifically made to stencil screens and made in the USA. The prices for hot melt and liquid inks will vary depending on image density, DPI and line count of the stencil image.

PRINTING DIRECT-TO-SCREEN

The balance of this article will cover ink-jet printing direct to screen. Many people think that ink-jet printing is a relative new technology but this is not true. The first ink-jet printing device was the Siphon recorder, patented in 1858 (UK Patent 2147/1867) by William Thomson and used to record telegraph messages. [Figure 1] The first piezo DOD (drop on demand) the current technology was not Epson or Exon as many people think. In the late 1940s RCA corporation was developing the first piezo drop-on-demand printer which was patented in 1950 (US Patent 2,512,743) but was never developed into a commercial product. From 1973 to 1985 four types of piezo actuators were patented and, in 1977, the Siemens PT-80 was the first piezo ink-jet printer to reach the market.

You may be asking if all this history is necessary, but understanding industry history helps to understand where we are at today and where we could be tomorrow.

Below are four types of ink-jet piezo actuators and some of the current companies associated with each.

1. Squeeze tube
Siemens
2. Bender
Epson, Tektronix, Dimatix
MEMS technology print heads
3. Push or bump
Ricoh, Hitachi
4. Shear mode
(shared wall and roof actuator)
Shared wall, SII Printek, Xaar, Konica Minolta, Toshiba, Brother
Roof actuator, Dimatix (Spectra Gen 2)

Note on Shear mode: Shared wall print-heads can only fire every third jet at the same time; the piezos share a common centre wall so you cannot fire all jets simultaneously. Roof actuator is possibly the most costly but holds advantages over other types of print-heads and may be the best way forward for direct-to-screen printing.

Ejected drop velocity is from 15 feet/second to over 30 feet/second. Never, and I repeat never, hold your hand in front of an ink-jet print-head while it is jetting ink. At this velocity the small particles of ink will penetrate your skin which can cause blood poisoning.

THE EARLY YEARS

The first years of the 1990s saw the first direct-to-screen printing units from Gerber. These used thermal bubble jet water-based inks to produce the stencil directly on the screen emulsion. They did reduce costs and increase profits but they were, basically, flood jets that flooded the screen with a heavy liquid mask which would spread as soon as printed. This made image quality only fair.

The late 1990s saw the development of phase change (wax) print-heads from Data

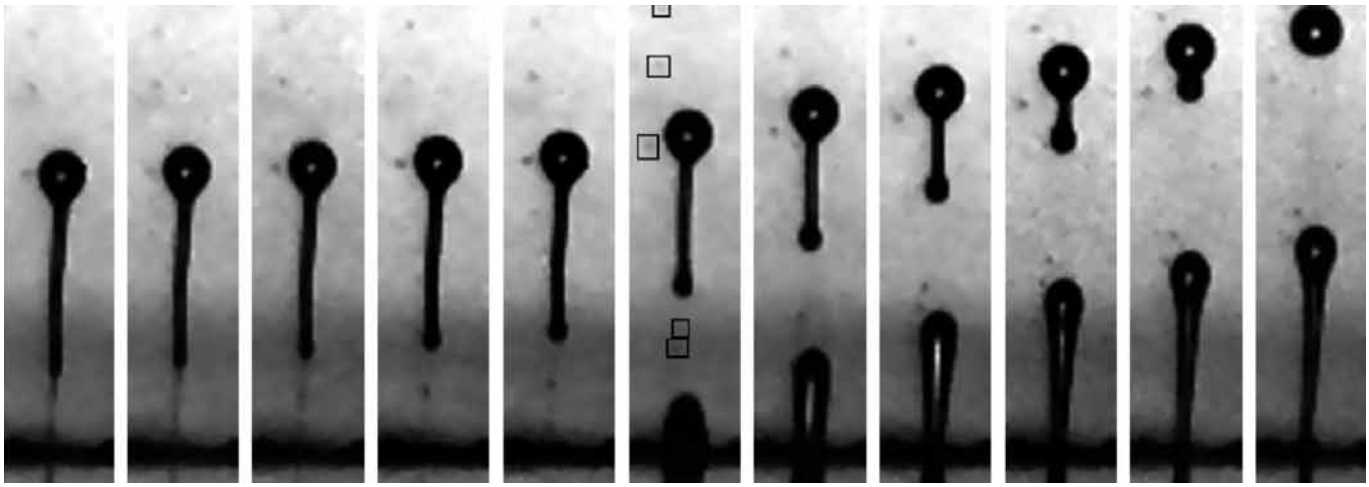

Figure 2: Two dots being ejected from one nozzle in sequence filmed at one million frames/second

Products (now Ricoh) and Spectra (now Fujifilm Dimatix). These heads used the latest developments in piezo technology and were a large step forward in print quality. The ink did not spread and image quality was better controlled. There was the problem of thermal attraction as one heated dot on the page tries to draw the next dot to it, so image distortion can occur. Also, the electronics near the print-head are subject to very high temperature as these print heads operate at 125 degrees C (257 degrees F). The heads are costly and tend to have a short life span of the nozzle plate. Wax print-head development is very static at this time, meaning the head you purchased in 1999 is basically the same head you purchase today.

The 2000s saw huge investment in piezo liquid print-head development and also ink development. If you think back to the late nineties and the printer on your desk, you could only dream of printing photo quality images with water-based liquid inks; not so today. We have very robust print-heads with long life spans 30,000 to 70,000 screen images or more produced with the same print-head. Water-based UV resist dye inks that don't spread out are dry to the touch within seconds and image quality is superior to wax (phase change) heads today. Wax printers are still viable but you are limited due to large dot size and a maximum of 256 jets per print-head.

One of the difficulties with ink-jet printing is that dots in round form are not ejected from the print-head [Figure 2]; a very small mass of ink is ejected with a long tail following. As the drop travels forward the tail pinches off and then catches up to the main drop. In theory this is what we want to happen in the real world; at differing air temperatures, humidity and ink viscosities strange things happen. The tail can break off from the main drop causing many small dots to form. The tail speed can be too fast and crash into the main drop causing many small dots to land on the media. This lowers the resolution of the stencil image on the screen.

CONSISTENT RESULTS

Different inks all have various results. When DtS/CtS manufacturers suggest temperature ranges and humidity levels they are trying to help you with consistent results that will achieve higher throughput and lead to better profit margins. Temperature and humidity control of the DtS/CtS printing room are a must for consistent high quality stencil production.

All shops are unique but a simple general rule for productivity and quality in a garment printer's screen room using DtS/CtS technology would be to produce your direct-to-screens at no more than 55 lines/inch using a binary or GS 30 to 50 picolitre (dot volume/size) print-head at 600/800dpi round dots. This combination would produce good half-tones and sharp line art and text down to 14 point size. On press the screens would easily allow the passage of the correct volume of ink to produce a high quality graphic on most fabrics. The next step up would be to use 55 to 65 lpi at 600/800dpi but each dot would be elliptical and formed using six or eight very small dots to produce one larger dot on the stencil. A true 1200dpi image at 85 lines on a 320 mesh screen will not allow much ink to pass through on a carousel press, and will usually not look as good as a lower resolution screen image.

Print quality is better when several very small dots at a high resolution are used to produce printable on-screen dots at lower resolutions. Finer details can be represented and also the graininess of the print is much less with this process. For water-based inks the lower amount of ink with smaller drops results in shorter drying time – another reason to move towards smaller drops. There is and always will be a trade-off between print speed and print quality using ink-jet printers to produce screen stencils.

Screen shops are different and have unique needs. Therefore, at Acti Cameras we produce our direct-to-screen equipment using print-head technology from Dimatix (greyscale and binary), SII Printek, a subsidiary company of Seiko Instruments, (greyscale) and Epson (greyscale). We currently offer printers in several sizes from 23 x 31 to 64 x 60 inches. ■

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