

Thinking BIG

## A Buyer's Guide to Large Format Graphic Printers

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*A must-read guide for those looking to make the right investment in digital large format graphics printers.*

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# 1. INTRODUCTION

Large format digital inkjet printing presents an exciting and potentially highly profitable business opportunity.

The market for display graphics is enjoying exponential growth. Advances in digital print technology mean that bespoke large format displays can be produced quickly and cost effectively. At the same time, recognizing the visual impact of branded display materials, marketers are increasing their expenditure on signage and point-of-sale material.

There is no missing the scale of the opportunity. From billboard advertising to shop window graphics and branded vehicle wraps to promo banners at music festivals, there are large format display graphics wherever you look. Indeed, with the right technology, the opportunities presented by large format printing are limited only by imagination.

## Commercial display applications

### Outdoor Graphics

- Billboard advertising
- Backlit day/night adshells
- Building wraps and covers
- Branded vehicle wraps
- Bus wraps and side panels
- Taxi wraps and supersides

### Indoor Graphics

- Pop-up displays
- Hanging banners
- Restroom signage
- Shop window graphics
- Exhibition panels
- Theatre and TV backdrops
- Furniture
- Safety signs

### Point of Sale

- In-store banners
- Aisle-end advertising
- 3D pop-up displays
- Promotional packaging
- Shelf hangers
- Pop-up shops

### Manufacturing

- Bespoke wall coverings
- Mirrors and ceramic tiles
- Shower enclosures
- Novelty phone cases
- Table tops, doors and flooring
- Prototype packaging



*“The opportunities presented by large format printing are limited only by imagination.”*

If you are a print services provider considering entering the signage and display graphics market for the first time, you may find it useful to look at the opportunities for large format printing that already exist within your business. You should also consider the risks of not meeting your clients' current large format print requirements.

### Considerations

- Do I turn away any large format print work? (potential new business)
- Are my clients buying signage or display graphics from other vendors? (missed opportunities)
- Am I jeopardizing client loyalty by letting other vendors fulfill my clients' large format orders?
- Do I lose margin by outsourcing large format work on my clients' behalf?

Large format digital inkjet printers use either piezo electric printheads or thermal printheads to express tiny droplets of ink directly onto print media. The ink is cured (fixed to the substrate) using either a heater (solvent inks) or an ultraviolet light source (UV curable inks). Large format digital inkjet printers are available in different configurations, including flatbed roll-to-roll and hybrid.

This guide is designed to help you to understand the technology and make a more informed buying decision.



## 2. WHICH PLATFORM OFFERS THE BEST FIT?

Having considered the range of print applications you are likely to offer, you will need to determine which platform offers the best fit for your business.

Whilst manufacturers offer a wide variety of technologies, the first decision will be whether to purchase a roll-to-roll printer, a flatbed printer or a hybrid printer. The advantages of these platforms are explored below:

### Considerations:

- Will I be printing onto rigid substrates, rolls of flexible media or a mix of materials?
- Do I need to print onto thick or textured media?
- How important is registration? Will I perhaps be overprinting existing images?
- How much space have I got? Some systems are more compact than others

**Tip:** *These printers are BIG. When looking at production space, consider the printer's footprint, the end-to-end travel of the print table and allow space for handling.*



## Roll-to-roll printers

Roll-to-roll large format printers are used to print onto rolls of flexible print media. A roll of flexible material, such as paper, vinyl or film, is fed through a stationary print gantry and rewound, after printing, onto a take-up reel.



Roll-to-roll printers are ideal for printing posters, banners and window display graphics onto flexible substrates. Although primarily designed for printing onto flexible materials, some roll-to-roll devices can print onto rigid media.

### Advantages:

- Lowest capital cost
- Compact footprint
- Print onto roll-fed paper, vinyl and film
- Durable outdoor graphics
- Ideal for banners, pop-up, posters and car wraps

### Disadvantages:

- Requires special media
- Limited range of applications
- Doesn't support thick media
- Slow print speeds
- Solvent prints have long gassing off times
- Latex printers use excessive heat

## Flatbed printers

Flatbed large format printers are used for printing onto pre-cut flexible sheets and rigid substrates. A vacuum system holds the print media stationary on a flatbed table whilst the printhead gantry moves over the media, printing onto it.



Flatbed printers can print on to a variety of substrates, including wood, metal, glass, foam, plastic, vinyl, film and paper. They typically support media thicknesses up to 50 mm and textured or pre-formed materials with a variance in print depth of up to 25 mm.

A vacuum system is used to hold the media stationary. Some parts of the vacuum bed can usually be zoned off when not in use, reducing power consumption and noise. If, however, the media is smaller than the vacuum zone, it may be necessary to mask off the empty space, which can be laborious and time consuming process.

Despite having a large print bed, most flatbed printers have a relatively compact and well defined footprint. Because the print heads move over media that is fixed to a stationary platform, very little additional space is required around the printer.

### Advantages:

- Pre-cut flexible sheets and rigid substrate
- Support for thick media (up to 50 mm)
- Support for textured media (up to 25 mm variance in print depth)
- Full bleed (edge-to-edge) printing
- Tile displays over several boards
- Compact and static footprint (table doesn't move)

### Disadvantages:

- Highest capital cost
- Most flatbed printers do not support roll-to-roll printing
- Feed table requires masking (to maintain the vacuum)

## Hybrid printers

Like roll-to-roll printers, hybrid printers have a stationary print gantry. Depending upon its characteristics, the print media is either fixed to a moving table and passed through the print gantry or it is fed roll-to-roll. Because it takes very little time to switch from rigid to flexible materials, hybrid printers support cost-effective production of a wide array of graphics.



Hybrid large format printers offer greater flexibility than either flatbed or roll-to-roll printers as they can be used for printing onto pre-cut flexible sheets, rigid substrates and rolls of flexible material.

Custom-made jigs hold rigid media in place across the width of the printer, enabling multiple prints to be made and maximizing the productivity of the printer.

Because hybrid printers support both flexible and rigid media, it is much easier to produce mixed media work of consistent quality. This is less easy to achieve when using a flatbed printer for rigid media and a (different) roll-to-roll printer for flexible media.

Although hybrid printers may appear to be more compact than flatbed printers, it is important to recognize that space is required at the front and the back of printer for media moving through the print gantry. But, whilst hybrid printers do generally require a larger operational area than flatbed printers, they can save space when compared with operating standalone flatbed and roll-to-roll systems.

### Advantages:

- More versatile
- Quickly switch from rigid to flexible material
- Consistent colour quality on rigid and flexible media
- Pre-cut flexible and rigid media up to 50 mm thick
- No length restriction when printing onto rigid media
- Full bleed (edge-to-edge printing)
- No masking required
- Lower cost of acquisition (than flatbed)
- Faster return on investment

### Disadvantages:

- Larger workspace (space is required at the front and the back of the printer)
- May require a jig to hold multiple rigid media in place
- Less productive when printing onto multiple irregular sized media

### 3. WHAT DO I NEED TO KNOW ABOUT INK?

Most new large format flatbed and hybrid printers use UV curable ink. The print process is cleaner and faster than the solvent-based print process which was previously used for large format printing.

**Because existing users may be considering a move from solvent to either latex or UV curable technology, we will explore all three ink technologies.**

#### Solvent inks

Solvent inks comprise coloured pigments suspended in a petroleum-based solvent. Print is delivered wet and the solvents are dried or 'gassed off' using heaters. The evaporation process releases volatile organic compounds (VOCs) that can be harmful to the environment and which require venting.

Solvent inks produce vibrant colour images that are waterproof, fade resistant and flexible (elastic). Because the ink is flexible and adheres well to vinyl and film, solvent inks are (or were) commonly used to produce large format graphics for outdoor display.

Solvent inks can appear to cost less to buy than UV curable inks. Solvent inks typically have a lower cost per volume as purchased but, because the solvents evaporate during the gassing off process, a greater volume of ink is required to provide the same coverage.

#### Advantages:

- Low perceived ink cost (by volume)

#### Disadvantages:

- Wet ink is easily smudged
- Curing process increases lead time
- Noxious and potentially harmful fumes
- Industrial ventilation is required
- High energy costs (dryers and ventilation system)
- Additional space is required (for dryers and work in progress)
- Special range of substrates required



## Latex Inks

Latex inks are used in roll-to-roll devices just like solvent printers but work in a different way.

Latex ink contains specific type of polymers which surround and suspend the ink pigments in water. This liquid is jetted onto the media through print heads to form the image. Heat is used in two ways. It first evaporates the water away leaving the polymer pigment behind. The heat is then used to activate the polymers to bind the pigments to the media. The prints come out dry and can be used straight away, improving productivity.

Unlike solvent inks, the latex ink has low-VOC emissions. No special ventilation is required for operating the printer. Low odour latex inks make it ideal for high quality indoor signage, wallpaper etc., and very durable outdoor uses such as vehicle wraps.

### Advantages:

- Low smell and VOC emissions
- No drying time, straight to secondary processing
- No ventilation required
- Wide range of media
- Faster print speeds
- Can be used in sensitive environments where odour has to be low

### Disadvantages:

- Requires a lot of heat to fix and dry prints
- Energy consumption
- Prints can be subject to scratching if mishandled



## UV curable inks

UV curable inks comprise coloured pigments and a photo initiator suspended in an acrylic polymer (plastic) emulsion. Instead of heat, the ink is cured by exposing it to ultra violet (UV) light. Exposure to UV light causes the photo initiator to react with the acrylic polymer, instantly hardening it and fixing it to the print media.

Like solvent inks, UV curable inks produce vibrant colour images that are waterproof, fade resistant and flexible (elastic).

Since no secondary finishing processes, such as mounting or laminating are necessary, printing directly onto rigid substrates using UV ink, reduces cost and increases productivity. And, because the print media is not subjected to heat, more delicate media can be used, including plastic carrier bags and even laptops.

The UV curing process offers numerous advantages. The ink cures instantly,

increasing throughput speed, reducing job turnaround times and increasing production capacity. No dryers are required, saving space and reducing energy consumption. And, because the ink does not evaporate, less ink is used and venting isn't usually required.

### Advantages

- Wider range of substrates
- Shorter lead times (ink dry on delivery)
- More productive (faster throughput)
- Energy and space savings (no ventilation or dryers)
- Easier to maintain (UV inks do not evaporate and are less prone to clogging)

### Disadvantages

- Higher initial cost of acquisition



## 4. UNDERSTANDING THE UV CURING PROCESS

High intensity ultra violet light is required to cure or fix UV curable ink. Exposure to a UV light source causes the photo initiator in the ink to react with the acrylic polymer, hardening it and fixing it to the print media.

UV curable inks are formulated to cure under very specific lighting conditions. The ink formulation and characteristics differ from manufacturer to manufacturer and UV curable inks and UV light sources are not interchangeable.

There are two UV light source technologies to consider when purchasing a large format digital inkjet printer: traditional mercury vapour lamps and newer UV LED curing systems.

### Mercury vapour lamps

Mercury vapour lamps are the most commonly used light source in UV curable print technology. High intensity ultraviolet light is created by passing electricity through vaporized mercury in a high-pressure tube. Mechanical shutters open and close to expose the lamps during printing. The high energy light source ensures that ink is fully cured.

Although the technology is well established, mercury vapour lamps are not considered eco-friendly. The lamps take time to warm up, they consume a lot of electricity and they generate heat, which can affect heat sensitive media. The lamps also lose efficiency over time and need to be replaced after 1,000 or so hours of use.

Mercury vapour systems generally costs less to buy than UV LED systems but have higher maintenance costs and consume more energy.

#### Advantages:

- Lower initial cost of acquisition
- Proven technology produces high quality results

#### Disadvantages:

- Lamps need to warm up before use, reducing productivity
- Lamps need to cool down before relighting, reducing productivity
- Heat can cause sensitive media to warp, reducing the range of applications
- Lamps degrade and need replacement, increasing maintenance costs
- High energy consumption increases overheads
- Lamps contain mercury and metal halides that are potentially harmful to the environment

## UV LED lamps

Some newer systems use LED lamps to create ultraviolet light. UV LED lamps do not need to warm up, they consume less electricity than mercury vapour lamps and have a much lower operating temperature. UV LED lamps also have a longer lifespan - some systems are rated at 20,000 working hours - and generally do not need replacing during the lifespan of the printer.

**Tip:** *LED technology may cost more to buy (higher initial investment cost) but can save money over the working life of the printer.*

Because UV LED lamps emit a narrower spectrum of UV light (UV-A rays versus UV-A, UV-B and UV-C rays), the inks need to be more finely calibrated than those used in mercury vapour lamp systems. Some vendors - those selling mercury vapour technology - argue that this results in a smaller colour gamut (range of colours).

### Advantages:

- Low voltage LED technology reduces energy consumption by more than 50%
- Low operating temperature means that it is possible to print into heat sensitive media
- Instant on/off switching eliminates the need for mechanical shutters, improving productivity
- UV LED lamps have a long lifespan and should not need replacing during the lifespan of the printer

### Disadvantages:

- Higher initial cost of acquisition
- Smaller colour gamut (according to some vendors)

### Considerations:

- Will I be printing onto heat sensitive print media?
- What is the quoted lifespan of the UV light source?
- Will I need to replace UV lamps and, if so, what is the ongoing replacement cost?
- What is the printer's energy consumption and what impact does that have on costs?



## 5. PRINT QUALITY AND PERFORMANCE

Printhead technology has an impact on print quality and print speed. Print quality is generally measured in dots per inch (dpi) but the relative size of the ink dots and the number of printhead passes required to print an image will affect both print quality and throughput speed.

**Tip:** Consider how the print will be viewed. For work viewed at close quarters, such as fine art, it is important to select a device that produces high resolution output but for display graphics that will be viewed from a distance, resolution is less important.

Large format digital inkjet printers use either piezo electric printheads or thermal printheads to express tiny droplets of ink directly onto print media. The first piezo printheads (binary printheads) could only express droplets of a fixed size and, using a four colour (CMYK) print process, the resulting print output could appear grainy, with poor tonal gradation and muted highlights.

To improve image quality, inkjet manufacturers introduced a six colour process (super CMYK). The addition of light cyan and light magenta inks to the binary print process allowed lighter colours to be substituted in highlights and mid tones. The six colour process used more ink but delivered print output with smoother tonal gradation and more vibrant highlights.

### Considerations:

- Can the printer produce greyscale images of near photographic quality?
- Do I need to use light cyan and light magenta ink or just standard colours?
- What is the throughput speed when printing greyscale images?
- Can it print in different resolutions for different applications?

### Variable drop binary printheads

Variable drop binary printheads are a relatively new innovation. They enhance print quality by expressing ink droplets of different sizes, however, the binary technology only allows one size of droplet to be printed in each pass of the printhead.

Whilst inkjet printers with variable drop binary printheads can produce vibrant, high resolution output without the need for additional colours (light cyan and light magenta), multiple passes of the printhead are required to produce greyscale images, significantly reducing productivity.

#### Advantages

- High 'native' resolution
- Print variable drop sizes
- No need for light cyan and light magenta ink

#### Disadvantages:

- Can only print one drop size per pass
- Multiple passes required to simulate greyscale printing, reducing productivity

## Variable drop greyscale printheads

Variable drop greyscale printheads can express ink droplets of variable size in the same pass. This enables high resolution graphics and dense solids to be printed in a single pass, significantly improving productivity. The process also uses considerably less ink, reducing production costs.

Whilst variable drop binary printheads can deliver print output with a seemingly higher 'native' resolution, variable drop greyscale printheads can achieve the same 'effective' resolution using lower resolution printheads and in fewer head passes.

Indeed, according to FESPA (the Federation of European Screen Printers Associations), a 360 dpi print from a variable drop greyscale printhead has the same 'effective' resolution (real world appearance) as a 1,000 dpi print produced using a variable drop binary printhead.<sup>1</sup>

<sup>1</sup>.(fespa.com/en/news-media/features/the-ultimate-guide-for-printhead-technologies)

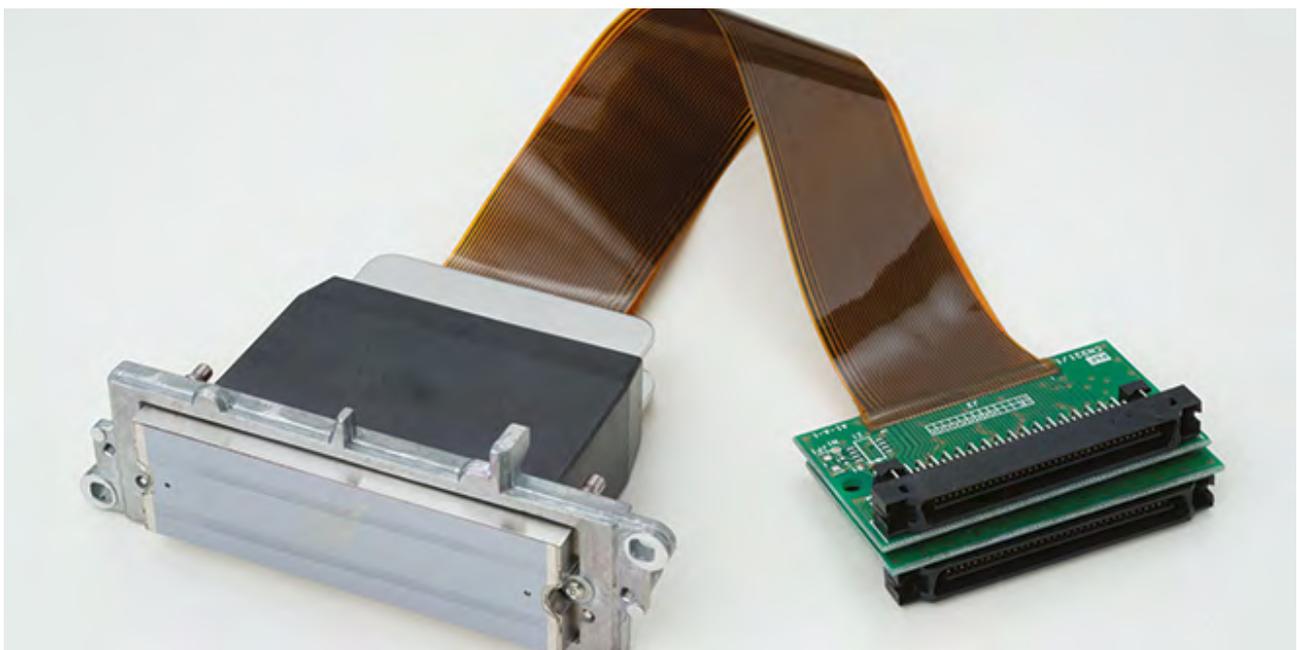
### Advantages:

- High 'effective' resolution
- Print variable drop sizes in one pass
- More productive for greyscale printing
- No need for light cyan and light magenta ink
- Uses less ink than binary or variable drop binary printheads

### Disadvantages:

- Higher initial cost of acquisition

**Tip:** *Manufacturers quote a range of different print speeds. Compare speeds on a like-for-like basis at a level of quality which meets the majority of your customers' expectations.*



## 6. WHAT IS THE ADVANTAGE OF WHITE INK?

White ink expands the range of potential print applications. It can be used as a base layer when printing onto coloured media and transparent film. The white layer eliminates show through and ensures colour integrity. White ink can even be used to add texture, such as a snakeskin effect, to the print media.

**Tip:** *White ink expands the range of print applications. It can be used to print an opaque layer on coloured and transparent media or to add a texture, such as snakeskin or leather.*

Some systems include a dedicated channel for white ink whilst others require the use of an existing colour channel. It is not advisable to change colours once a machine has been configured as it is necessary to flush out the original colour, taking the system offline and wasting ink.

It is important to understand the costs of white ink printing. A comparatively large volume of white ink is required to create a white base layer and productivity can be reduced by as much as 50% if the printhead needs to make an additional pass.

### Considerations:

- If printing solely onto white substrates, white ink may not be required.
- Is white ink available on demand (dedicated channel) or do I need to use a colour channel?
- If I have to change colours, how long does it take and how much ink is wasted?
- Can I print white ink at the same time as other colours or does it require a separate pass?

## 7. WHAT DOES THE PRINT CONTROLLER DO?

The print process is managed by a print controller, sometimes referred to as a print server or RIP (raster image processor).

The controller extracts and processes compressed print files, sending data to the printer in a format that it understands. Each pixel or vector coordinate is translated by the RIP and printed as a finely measured droplet of ink.

Some systems have a dedicated controller, whilst others can be configured with a third party controller. Both have their advantages. Dedicated RIPs are developed specifically for the printer and can offer control over a wider range of printer functions. Third party RIPs are developed to work with a variety of systems and can offer a common workflow across different platforms.

Because large format graphic files are data rich, you should look for a controller with a fast processor and plenty of memory (RAM). Whilst specifying a powerful controller may increase the initial system cost, it will improve productivity and reduce the risk of bottlenecks when the workload increases.

The print controller also provides support for colour management. Good colour management is essential when producing customer-facing print as it ensures that the colours output by the printer are accurate and consistent. A good colour management system will allow you to create output based on ISO, SWOP and Japan Color print standards.

Other features that support good colour management include colour calibration (or profiling), PANTONE® matching and trapping (or overprinting). Colour calibration enables output to be matched across multiple devices, PANTONE® support ensures that logo colours are accurately reproduced, and trapping enables one colour (black text, for example) to be printed over another.

### Considerations:

- Am I happy to use a manufacturer's dedicated printer-specific RIP?
- Is there a third party controller that offers a common platform with other printers?
- Does the RIP offer ICC colour management and PANTONE® support?
- Does it allow jobs to be edited (resized, cropped, tiled etc) prior to printing?

## 8. SERVICE AND SUPPORT

When selecting new equipment, performance is likely to be a key selection criteria. We touched upon productivity when looking at printhead technology but there is more to productivity than just throughput speed.

Because time is money, you will want to select a system that streamlines the production process, offers reliable around-the-clock performance and is well supported by the equipment vendor. Considerations will include:

### Job set up and interchange time

Consider how much time will be spent setting up print jobs. Is the operator interface easy to navigate? How long does it take to switch from one print media to another? Will I need to spend time masking off the print table? Can I save time by tiling multiple images onto one board?

### Reliable around-the-clock performance

It is not always easy to gauge reliability but there are some telling clues. Consider the manufacturer's reputation and look at the breadth of their large format product range. Ask about the printer's target volume, peak volume rating and its service parameters.

### Service support

One of the biggest time stealers in a production environment is downtime related to machine failure and, for that reason, it is important to understand whether the manufacturer's suppliers service strategy provides the right level of support.

**Tip:** *Don't be shy to ask for references. Satisfied customers are usually happy to talk and can give you invaluable feedback on both the technology and the manufacturer's support.*

Whilst a two-hour response may be considered acceptable, it is of little value if an engineer is not able to quickly resolve your technical issues.

It is important to look behind the standard SLAs and ask the manufacturer/supplier some pertinent questions about their service support.

- Can they monitor the printer and remotely diagnose service issues?
- Do they use their own technicians or do they outsource service to a third party?
- How many trained service technicians do they have in your area?
- Are the service technicians trained and certified by the manufacturer?
- Do their engineers carry spare parts and, if so, what percentage of problems do they resolve at first visit?



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