

Substrate Guide

For HP Indigo Commercial digital presses





This guide is intended as an overview of the media offering and requirements for HP Indigo digital printing. HP Indigo digital printing makes it possible to provide your customers with a virtually endless choice of media. The HP Indigo family of presses prints on the industry's widest range of substrates for high-end digital color printing from standard papers, to synthetics, labels, canvas, and specialty papers.

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Paper types

Coated or uncoated?

Digital printing uses both coated and uncoated papers.

Coated paper offers superior smoothness, opacity, color, contrast and print definition. Single or double layers of coating may be applied on one or both sides of the paper. Single-coated paper tends to have greater bulk than double-coated paper, whilst double-coated paper can achieve higher brightness and opacity.

Uncoated papers offer a range of textures, shades and pleasing tactile contrast. Calendering allows uncoated paper to have a smooth, silky surface. Other processing during papermaking can result in the surface taking on embossed finishes like felt or linen. The use of uncoated papers and applications are increasing in digital printing.

Matt or glossy?

The terms matt and glossy describe the way in which light is reflected off a sheet of paper. Coated paper can have a matt or glossy finish. Gloss is achieved through calendering but only on a coated surface. Gloss increases with coat weight and the degree of calendering. Matt paper absorbs and diffuses light, making a non-reflective, easy-to-read surface. Glossy paper reflects light to give a shiny, lustrous appearance, which can enhance printed images.



Paper sizes

In many regions of the world, HP Indigo digital presses feed a range of paper formats including SRA3+ (330 x 482 mm), B2 (75 x 53 cm) and B1 (746 x 1120 mm). In the North American market, sizes are measured in inches. Typically 12 x 18 inch, 13 x 19 inch, and 20.8 x 29.5 inch formats are available for most certified substrates.

The A classification This is a series of standard trimmed sheet sizes in millimeters established by the International Organization for Standardization (ISO). The A series is commonly used in Europe for general printing purposes. The basic size, A0, is 841 x 1189 mm (i.e., 1m²). Each subsequent size is obtained by either doubling or halving the longer dimension, while the shorter dimension always stays in the same ratio to the longer dimension (1 to 1.414). The standard letterhead size, A4, is 210 x 297mm.

The B classification The B series paper sizes were created in order to provide paper sizes that weren't covered by the A series. An ISO standard of trimmed sheet sizes, with the same ratio of dimensions as the A series. It is intended for posters and wall charts, etc., and fills the gap between adjacent sizes in the A series.

Paper options for HP Indigo digital presses continue to expand along with the growth of digitally printed pages. They are precision cut to size, sold and supported by leading international and regional paper manufacturers.

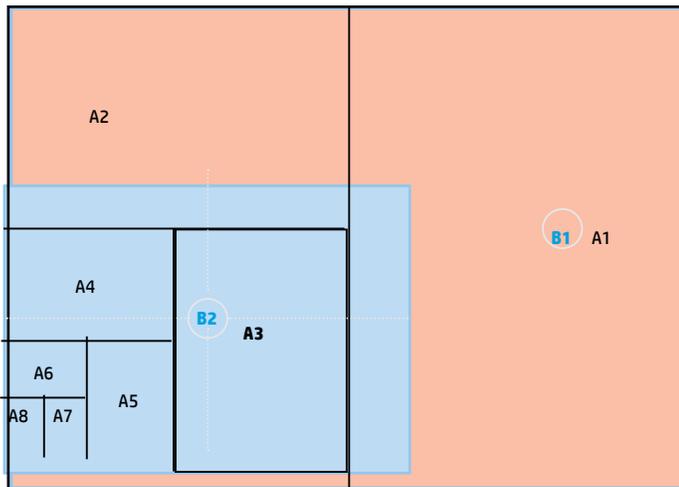
Surface optimization and treatment is an option, but finishes and well-known name brands have been developed and approved and backed by third party suppliers.

As HP Indigo's family of printing presses continue to grow in dimension, the substrate industry is keeping pace. Launching the new HP Indigo B2-sized platform on the HP Indigo 10000 Digital Press at drupa 2012 highlights the wide range and availability of HP Indigo media for all types of print applications, sizes, layouts, and end uses. drupa 2016 saw the unveiling of the oversized B1 commercial format on the HP Indigo 50000 Digital Press web-fed press.

Grain direction and stiffness

The direction in which the wood fibers lie (i.e., the grain) in a sheet of paper is significant. It affects the paper's stiffness and is determined by how the supplier cuts it into sheets. A sheet is stiffest in the direction of the grain and stiffness needs to be optimized for printing quality, runnability and finishing requirements such as folding. A typical A4 sheet is cut from the roll such that the grain runs in the direction of the long dimension from top to bottom (the long grain). The grain direction of a sheet is determined by how a paper is cut from the master roll. There is no single international standard for indicating whether a paper is long or short grain, and a number of local conventions exist. For more information, consult your paper merchant.

With regards to the HP Indigo 5900, 7900 and similar presses, for effective transport, long grain should be used when printing paper weights of 170 gsm or 65 lb cover and below, and short grain



above 170 gsm or 65 lb cover weights. For the HP Indigo 10000 Digital Press Series, the grain direction recommendations are reversed. For text weights we recommend short grain and for cover weights we recommend long grain.

There are a number of simple tests that can be carried out if grain direction needs to be determined.

The tear test: Tear a sheet of the paper both along its length and across its width. One result will be relatively straight, and the other more jagged. The straighter tear is in the grain direction.

The bend test: Bend a square test sheet in both directions. The bend of least resistance is along the direction of the grain.

The fold test: Fold a test sheet both lengthwise and across. The smoother fold is in the direction of the grain.

The nail test: Using the nail on your thumb and middle finger, score the test sheet across and down its length. The score along the grain is relatively straight, whilst the score across the grain is wavier.

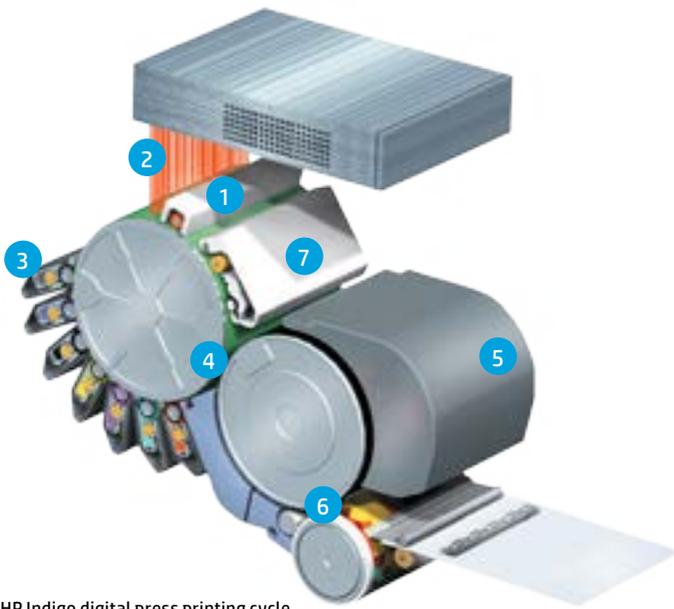
The moisture test: Sprinkle a few drops of water on the test sheet. After a moment, the wet area will pucker. The direction of the length of the pucker is the grain direction.

The HP Indigo digital printing process

HP Indigo's printing process is compatible with a wider variety of substrate types, surfaces and thickness than any other digital printing process. These include paper, paperboard, synthetics, canvas, plastic, and film. Only one formulation of HP Indigo ElectroInk is needed to print on any stock that the press can handle. This means that HP Indigo press users can rapidly switch between substrates without having to worry about changing inks. With conventional offset printing, different inks for papers and non-absorbing plastic films are required; particularly absorbent papers can also increase offset ink consumption by up to about 50%, which contrasts with ElectroInk where consumption has almost no dependence on the substrate properties.

Digital Offset

The HP Indigo Digital Offset process uses a heated blanket causing the specially shaped pigment-carrying particles within the ElectroInk to melt and blend into a smooth film. When it contacts the cooler substrate, the ElectroInk strongly adheres to the substrate, and immediately solidifies and transfers with almost no change in dimension or shape. Since the image is completely defined on the blanket, issues such as ink media interaction or ink-ink interaction which are common in nearly all other printing methods are virtually nonexistent. The result is an image with a true offset look and feel, accurately replicating the gloss and texture of the substrate on which it was placed.



1. Charging station
2. Laser exposure
3. Binary Ink Developer units (BIDs)
4. First transfer (PIP to blanket)
5. Blanket heating
6. Second transfer (blanket to substrate)
7. Photoconductor cleaning station

HP Indigo digital press printing cycle

The HP printing process takes place as follows:

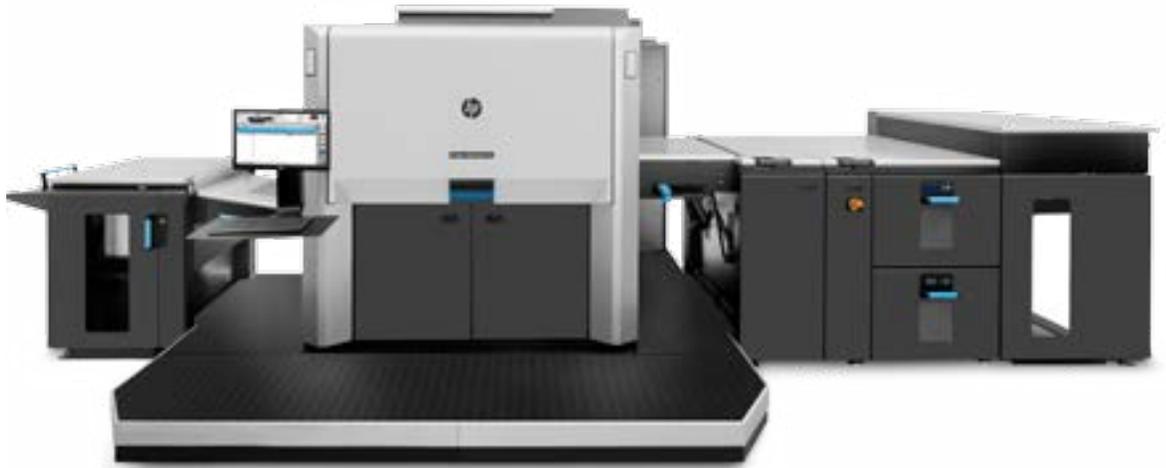
1. Electrostatic charging of the electrophotographic Photo Imaging Plate (PIP) which is mounted on the imaging cylinder.
2. Exposure of the PIP by a scanned array of laser diodes. These lasers are controlled by the raster image processor, which converts instructions from a digital file into 'on/off' instructions for the lasers.
3. Image development performed by the Binary Ink Developer (BID) units.
4. Transfer of the inked image to the blanket cylinder.
5. Removal of any residual ink and electrical charge from the PIP.
6. Heating of the inked image carried by the blanket.
7. Transfer of the heated inked image to the substrate held by the impression cylinder.

The above operations are repeated for every color separation in the image.

One shot, multi-shot printing mode

The transfer method to the substrate also differs according to printing mode. In Multi-Shot the substrate stays on the impression cylinder as it receives each separation from the blanket one after the other. As the final separation is printed, the substrate is either moved for duplex printing or delivered to the output tray. In One Shot mode, the PIP cylinder transfers a succession of separations to the blanket before they are transferred to the substrate in a single pass. One Shot is standard for Labels and Packaging presses, whereas most Commercial presses have the option for using either mode, depending on the substrate.





HP Indigo 12000 Digital Press

The second transfer method differs according to press models: HP Indigo webfed presses employ a One Shot printing process, as it is not possible to wrap the material around the impression cylinder for multiple passes.

Using the right paper

HP Indigo recommends the use of certified papers with the surface chemistry compatible to HP Indigo ElectroInk. Using non-approved media could encounter risks, such as paper jams, reduced blanket life on the press and poor ink adhesion. An inappropriate choice of paper can render the quality of commercial work unacceptable.

Paper surface chemistry is important for HP Indigo ElectroInk because the paper and the ink need to be attracted to each other. Incompatible paper chemistry will result in reduced HP Indigo ElectroInk transfer, poor ink adhesion, reduced productivity and quality of the output, and increased use of consumables. HP has taken the guesswork out of media selection and provides an approved list of substrates, suitable for every application.

If the substrate is successful, the media is approved and posted on the HP Indigo Media Solutions Locator section on www.hp.com/go/medialocator, an exclusive portal for HP Indigo customers, offering a comprehensive resource for the digital printing business.

The Media Locator is also available through the HP PrintOS app.

Testing and certification

Only paper that meets certain criteria can be expected to provide trouble-free performance in the digital printing press and produce high-quality results. Rigorous testing is essential to ensure that a paper product is suitable for digital printing.

A comprehensive testing and certification system means suppliers can establish a paper's compatibility quickly and easily.

Certification program

With thousands of media available worldwide, the HP Indigo family of presses prints on the industry's widest range of substrates for high-end digital color printing. Extensive facilities are available to test substrate compatibility for use on HP Indigo digital presses at the HP testing facilities in Singapore and the Rochester Institute of Technology (RIT) in North America.

The certification program continues to expand the number of media that provide excellent results on HP Indigo digital presses. Substrates for specialty printing include pearled papers, PVC, polyester and polycarbonate. This extensive selection enables HP customers to broaden their digital printing applications, differentiate themselves and add value to their services.

The qualification procedure for substrates comprises two parts. The first is a screening test to check fundamental compatibility. During the second test, the substrate is subjected to a more comprehensive evaluation and many parameters of the press-media interaction are checked.

The tests ensure the substrate can be used in duplex and collation modes. Upon completion of the various test procedures, a full, detailed report and printed samples for each substrate tested are provided to the supplier. If the substrate is successful, the media is approved and posted on the HP Indigo Media Solutions Locator section on www.hp.com/go/medialocator, an exclusive portal for HP Indigo customers, offering a comprehensive resource for the digital printing business.

The substrate qualification process involves a series of tests:

Runnability. How smoothly the substrate runs through the press. Ink transferability. The quality of ink transfer from the blanket to the substrate, demonstrated by highlight dots, thin lines, heavy images and image edge integrity.

Blanket-substrate compatibility. The meeting of substrate and blanket can leave a blanket memory effect, causing gloss differences between solids and background areas of the previously printed image.

Ink transfer and adhesion. Ink-substrate interaction, reflected in:

- The degree of ink fixing to the substrate
- Ink layer abrasion resistance (depends on application)
- Ink layer flaking, the degree of which determines the printed substrate's ability to withstand a variety of post press operations.

Optimizing your own substrate

In-house substrate priming is possible for those with unique media needs. HP Indigo's Commercial Substrate Priming Guide will guide you regarding available primers, and successfully applying and monitoring their performance. The use of primers can provide an acceptable printing surface, but it is not a substitute for certification or certified media. For rougher substrates, more primer may need to be applied to achieve good ink transfer and adhesion.

HP Indigo highly recommends using certified substrate or to use an HP Indigo authorized treatment center prior to attempting to optimize your own substrate.

Digital Ink Primer

If there is a need to print on standard offset papers including paperboard and specialty offset media, this can be achieved by the application of HP Indigo ElectroInk Digital Primer. The primer is contained in the ElectroInk and delivered during the printing process through an on-press ink station. As it is applied as an ink, the DFE simply creates an additional separation that selectively applies the ElectroInk Primer only in the areas with images.

Since the choice of paper is so vast, we may not have tested your particular paper for use with the HP Indigo ElectroInk Primer. Therefore we encourage you to first test the paper with our ink primer prior to commercial use. Please follow the below guidelines as you perform your evaluation.





Print applications

The HP Indigo digital family of presses prints on a broad range of substrates so they are suitable for an unusually wide range of applications.

If your HP Indigo digital press has just been installed and you are familiarizing yourself with its operation, it is strongly recommended that you use approved substrates, whose performance is backed and supported by the suppliers and manufacturers. Usually you will buy the substrates from a local paper merchant, who will offer a range of approved and/or optimized substrates. It is important to build a close working relationship with the supplier or merchant of approved and optimized substrates, in order to secure supplies. When your HP Indigo digital press was installed, you were given a user ID number and password to access the HP Indigo Media Solutions Locator, where you will find comprehensive information about the types of substrates available and relevant suppliers. The site is updated regularly so check it frequently.

The following are key applications for HP Indigo digital presses:

A3 posters	Educational manuals	Pocket folders
Agendas and badges	Folding cartons	Point of sale materials
Books	Greeting cards	Postcards
Brochures	Invitations	Posters
Business cards	Labels	Product datasheets
Calendars	Lay-flat books	Sales materials
Car manuals	Leaflets	Six-page brochures
Conference materials	Manuals	Stationery
Corporate Identity	Menus	Signage
Coupons	Personalized catalogs	Tent cards
Direct marketing and mail materials	Photobooks	Transactional printing

Printing on special substrates

From coated and uncoated papers to transparencies, labels and synthetic substrates, the HP Indigo family of digital presses prints on a wide variety of substrates compared to other digital printing processes. The extensive substrate range allows HP customers to broaden their digital printing applications capability and time to market, adding value to the services they offer. Only one formulation of HP Indigo ElectroInk is needed to print on any substrate that is compatible with the press. This allows rapid switching between substrates. Some surfaces need a simple treatment to ensure the image binds to the surface properly and can withstand handling and conversion.

Storage and handling

Paper reams should be kept in their moisture resistant packaging until required, as this minimizes the exchange of moisture between the paper and its storage environment. Ideally paper should be stored in humidity- and temperature-controlled conditions. Direct sunlight and extremes of temperature should be avoided, so keep paper away from radiators and air conditioning units. Always store according to the first-in, first-out principle, and store boxes and reams on a pallet rather than directly on the floor, in order to avoid damage.

Paper producers will specify ideal storage conditions but 50% relative humidity between 19° C and 23°C is typically recommended. Where there is no automatic climate control, winter will be the time of year when the risk of problems is greatest. Ideally, an air conditioning unit should be used to maintain the right level of humidity all year round. Paper sheets should be allowed to settle at the print room temperature in their wrappers before use. The time this takes depends on the amount of paper in the reel or ream and the temperature difference between the paper and the print room. Allow up to 24 hours. Partly used reams and reels should be returned to their moisture-proof wrapping.

Print recyclability and deinking

HP Indigo maintains an active print recyclability research program. Research has focused on deinking, a key step in print recycling process in which ink is separated from the fibers. Good deinking results are particularly important when it is intended that the pulp produced in the deinking process be turned back into graphic papers, rather than being used for alternative applications such as cardboard.

HP collaborates with industry partners on deinking research, including several leading paper manufacturers with substantial paper recycling operations. HP invested considerable resources in developing a fundamental understanding of the key factors affecting deinkability and in new deinking chemistries. These findings have been shared with the deinking community at various scientific and industry forums. Collaboration is being discussed with various paper companies and paper institutes to explore opportunities for exploiting HP's research on an industrial scale.

In addition, every month, more than 100 tons of HP Indigo prints produced with HP Indigo ElectroInk in HP Indigo facilities are collected and sold for a variety of recycling applications.

Successful mill-scale and pilot deinking trials

In June 2013, Voith Paper, a leading supplier of deinking equipment, and the Paper Technology Department of PMV Darmstadt, a leading German technical institute, conducted two pilot-scale trials with five percent and 10 percent HP Indigo feed. The research found that even with 10 percent HP Indigo feed, the pulp produced in the trials was suitable for standard and higher New generation ink tube made quality recycled graphic paper grades.

The trials were held at the Voith Paper Fiber Systems Technology Center in Ravensburg, Germany to take advantage of near-mill-scale equipment, creating a realistic simulation of a standard graphic paper deinking mill, including drum pulping, two flotations and one disperger.

Finishing

Effective finishing adds value to any job and greatly enhances quality printing. Equally, perfect paper and perfect printing can be rendered worthless by poor finishing. If lamination is inadequate, cracking may appear at folds and the overall finish can be prone to scratches, abrasion, rub-off and other damage. These defects will be seen by the customer, whatever the standard of printing. Most finishing for digital presses takes place off-line.

Folding

Folding transforms the flat sheet into a variety of formats, each of which suits particular end-uses. Common formats include single-fold, letter, and double parallel, gate, foldout, cross and zigzag. Folding is affected by a number of variants, including size, weight, bulk, grain direction and surface coating. Factors such as humidity, curl, toner/ink coverage, static and the time elapsed since printing will all affect folding. The most basic fold, which is the halving of one sheet to make four pages, is a simple one-fold operation. But as soon as another fold is involved to make eight pages, a closed edge will need to be slit and trimmed and the sheets glued or stitched to keep them together. For a very small run, folding can be undertaken by hand but high-speed folding machines are recommended for quantities of 100 or more. The two main types of folder are the knife and buckle folder.

The knife folder

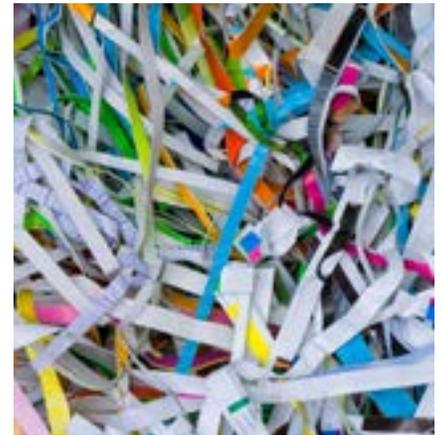
The knife folder is used by in-line finishers and comprises a knife blade which is controlled by a cam which times the folding action and drives the paper between the two counter-rotating fold rollers. The folded product is carried to the next station between straps and the process repeated as necessary.

Buckle folder

The buckle folder is a stand-alone machine for offline applications. It consists of two rollers which push the sheet between the fold plate (two metal plates) until it hits a preset stop. The rollers continue to push the sheet so it buckles downwards until it is caught between two counter rotating rollers which pull it down and create the fold.

Cracking

Cracking is usually a problem associated with dry toner rather than HP Indigo ElectroInk, which



is flexible. Cracking is mainly the result of paper fibers that break during folding, but certain factors increase its likelihood. Dry paper, folding against the grain, heavier coatings and higher paper weights all make cracking more likely. HP Indigo's continuous improvements in ink and paper technology are regularly extending the performance of processes and materials. The correct choice of folding machine and various production techniques can help reduce the risk of cracking. Solutions include wet scoring and lamination. Reduced machine speed can help, too. Scoring before folding is recommended for papers above 150 gsm.

Lamination/encapsulation

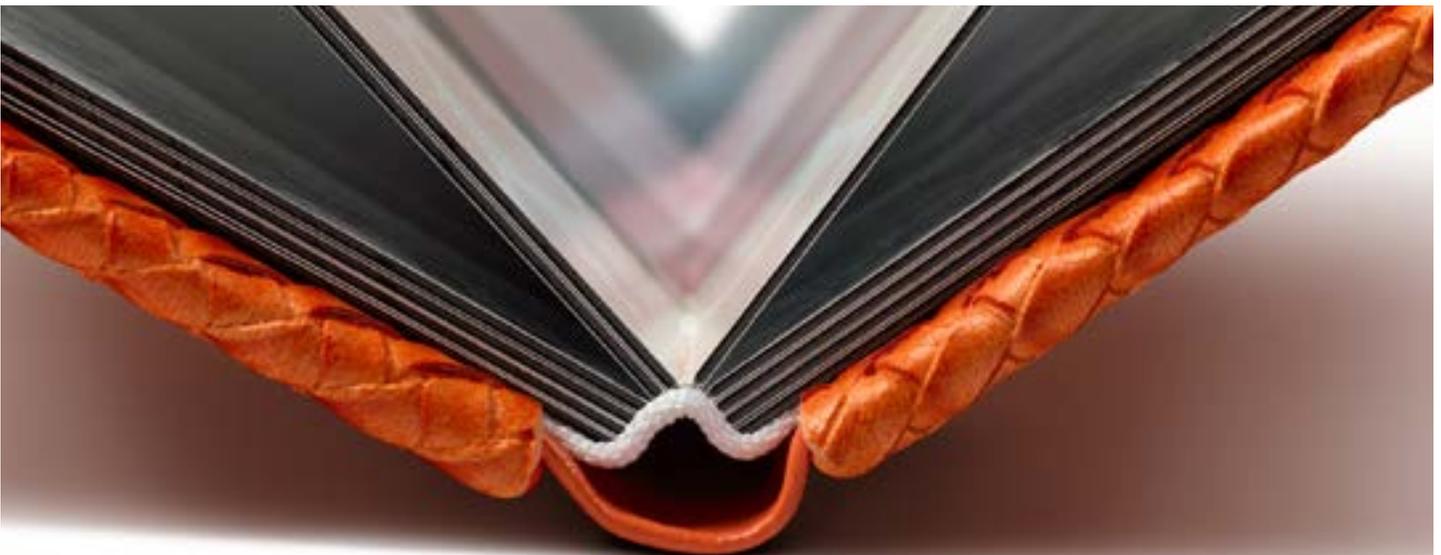
Lamination and encapsulation help protect a product and improve appearance. Lamination/encapsulation consists of a sheet of clear film applied to the printed matter, which preserves the print and gives it an attractive finish.

Encapsulation refers to lamination that is performed on both sides of a sheet, though lamination is often used to describe this, too. If the product needs to be protected and readability is a priority, then matt lamination is the answer. Gloss lamination provides a very attractive appearance but can make a printed job hard to read. There is a wide choice of laminates available so most requirements can be met. Cellulose acetate provides a very high gloss, for example, whilst orientated polypropylene (OPP) is formulated to allow folding without cracking.

Binding

The main binding methods are:

- **Saddle stitching.** Saddle stitching is one of the simplest binding techniques. It is also the most widely used. Folded signatures are placed over a "saddle" and then stapled along the spine. This style of binding is excellent for booklets, brochures, newsletters, pamphlets, direct mailers and catalogues. Page numbers have to be in multiples of four to make the folded booklet. As few as eight pages with cover can be used, or up to 64 with self-cover.
- **Perfect binding.** Perfect binding is a method of bookbinding where a flexible adhesive attaches a paper cover to the spine of the assembled signatures. Paperback novels are an example of perfect binding.
- **Spiral, Wire-O and plastic comb.** These are all a type of mechanical binding which uses a series of double wire loops formed from a single continuous wire run through punched holes on the binding edge. These techniques allow the document to be opened completely flat so are suitable to bind printed matter which requires constant reference, such as instruction manuals. These techniques are relatively cheap and fast so they suit short runs.
- **Drilling.** Produces holes in those documents that are intended for presentation in loose-leaf binders, ring binders, etc. Drilling allows thicker document piles to be processed in a single operation than punching.





Frequently asked questions

1. Why does HP recommend approved media? Paper that meets our compatibility criteria provides optimum performance in the digital printing press and produces high quality results. Non-approved papers can adversely affect productivity, causing increased paper jams, reduced blanket life, and may lead to quality problems, such as reduced ink adhesion and service risks.

2. How do I find out which media are approved? The HP Indigo Media Solution Locator is part of the 'My HP Indigo' portal at www.hp.com/go/medialocator. It is a searchable database and is the main source of information on approved substrates for HP Indigo customers. Media Locator provides a list of thousands of certified substrates. Media lists are segmented per country.

The Media Locator provides a selection per geographic region of media with basis weight, grade (coated gloss, matt, silk, etc.) and supplier names, in addition to links to suppliers' home pages for local contact details. The majority of media is supplied and supported by independent manufacturers. HP does not guarantee the continued availability of any of the media listed or that the manufacturer will not alter product composition or a production process which may change the media printing characteristics.

3. How is a substrate tested for compatibility? The qualification procedure for substrates comprises two parts—the initial phase evaluates basic compatibility, ink adhesion and transportability, whilst the second phase evaluates all the parameters for optimum performance and press productivity. The tests check substrates for:

- Runnability of the substrate, i.e. how smoothly it runs through the press
- Ink transferability and adhesion-quality of the ink transfer from the blanket to the substrate, as reflected in highlight dots, thin lines, heavy lines and image edge integrity
- Blanket-substrate compatibility-the meeting of substrate and blanket can leave a blanket memory effect, causing gloss differences between solids and background areas of the previously printed image.

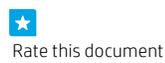
4. Can papers outside the weight specification of the press be printed? The recommended paperweight specification per press is based on lab testing and field experience. Papers outside of this may perform in certain aspects adequately, however, they may require more handling, interrupt workflow, impact on productivity due to jams or ultimately affect the integrity of the printed output. For this reason quality, the press specifications and use of approved and recommended media is the proper way to ensure press performance.

5. Can HP Indigo digital presses print on offset media? Many coated and uncoated offset grades are used and approved for use on HP Indigo commercial presses. The majority of the current approved solutions are supplier supported, off-the-shelf products, with no special handling required. In addition, the use of HP Indigo ElectroInk Primer on supported presses enables selective priming for printing on an extended range of standard offset papers.

6. Can synthetic media be printed on HP Indigo commercial digital presses? Several HP Indigo digital presses support printing on optimized synthetics using One Shot technology. You can find on the approved list per press in the Media Locator. Since synthetic products are sensitive to heat, certain products might not be stable enough for a digital printing process. Therefore, only approved substrates should be used.

Learn more at
www.hp.com/go/medialocator

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