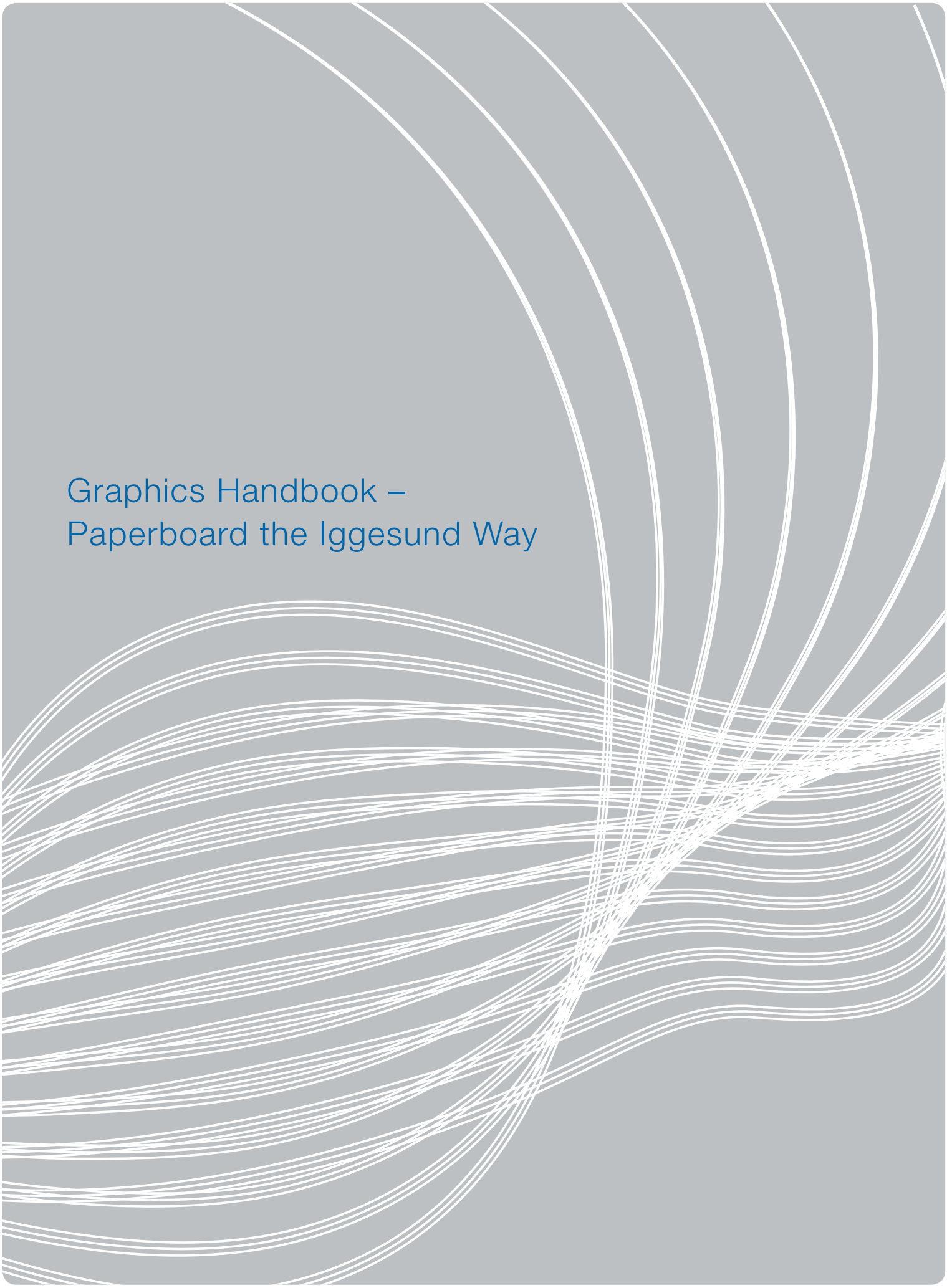
Graphics Handbook – Paperboard the Iggesund Way



Knowledge material

The **Graphics Handbook** is part of the **Iggesund Anchor Material**, a body of information material that consists of the following publications:

- Iggesund Reference Manual
- Iggesund Product Catalogue
- Paperboard – the Iggesund Way
- Graphics Handbook – Paperboard the Iggesund Way
- www.iggesund.com

Iggesund Paperboard has systematically compiled and made available this knowledge material – the Iggesund Anchor – in order to help increase the user's ability to make the best use of Invercote and Incada at all stages.

Graphics Handbook

Cover: Invercote Duo 610 g/m²
Index: Invercote Creato 260 g/m²
Insert: Arctic Silk 130 g/m²

Printing presses: KBA Rapida, Offset Litho
Inks: Flint Group Novastar
Lacquer: Novacoat
Rubber blankets: Day international Dura Zone 5000
Printing plates: Agfa Amigo

Production: Intellecta Infolog, Iggesund Paperboard AB,
Printer: Strokirk-Landström AB
Graphic Design: Schindler Parent, Intellecta Infolog
Graphic Illustrations: Nova Design/Elena Semenova
Photographs: Bildbolaget/ Rolf Andersson

Iggesund – Graphics Handbook

Inspiration

Production

Varnishing is only one way of enhancing the creative work. For more inspiration visit www. iggesund.com

Paperboard – the natural choice

Paperboard is a natural material with many applications. As a print medium, paperboard can withstand all the strains and stresses involved in the use of advanced finishing techniques. Paperboard is also highly durable, ensuring that printed materials will last for a long time. Typical graphical applications are book covers, cards, and CD and DVD covers. Paperboard packaging is a competitive method of transporting products from the manufacturer to the consumer while also being easy to recycle. In terms of graphic design, paperboard's excellent printing properties give brand owners great freedom to express their brand's individuality and thereby attract the consumer's attention.

Compared with other materials, paperboard made of virgin fibres has high performance and relatively low weight. It is safe for consumers to use because it contains known substances and is made in the same way every time. All paperboard products manufactured by Iggesund Paperboard conform to the relevant legislation and follow applicable product safety recommendations.

In most cases paperboard packaging remains folded or flat until the products are packed. Thanks to paperboard's small volume and low weight, large amounts of energy are saved in the transport chain. Paperboard cartons can be dimensioned to maximise the use of loading pallets, which leads to further significant energy savings in the distribution chain. When paperboard cartons have served their purpose they can be folded and compressed before being transported to a suitable recycling station. At every step of the way, paperboard packaging saves more energy and has lower environmental impact than most other packaging solutions.

Paperboard is made from timber, which is a renewable resource. Sunlight and water make the trees grow while they also bind carbon dioxide and give off the oxygen essential to life. The forest's closed ecological loop gives us the raw material for paperboard, while used cartons and printed matter have their own role to play in the recycling systems of a sustainable society.

Invercote & Incada

Invercote and Incada are Iggesund's two product families. Invercote is a solid bleached board and Incada is a folding box board. In both cases they have a wide range of applications, from graphical applications like brochures and covers for books and CDs to packaging. Which of our product families is most suitable for any particular application depends on the customer's requirements in each specific case.

When creased correctly paperboard can be folded and unfolded many times without cracking.

Varnishing can give the printed surface an extra lustre.

Iggesund Paperboard manufactures a range of paperboard products at Iggesund in Sweden and Workington in England as well as plastic extrusions and laminations for paperboard at Strömsbruk in Sweden. These facilities have been paperboard production units for the better part of a century, thereby helping to advance the craft, skill and tradition of paperboard manufacture.

The company

All sales of Iggesund Paperboard's products in Europe are coordinated at our sales office in Amsterdam. We also have sales offices in Singapore, Hong Kong and the United States, as well as in Iggesund. We have organised our technological systems and human resources to suit our customers' priorities and provide complete commercial and technical customer support. Customers' needs are constantly evolving and market conditions are ever changing. The service we provide is based on some simple principles:

- Locally based account managers and technical service managers. Account coordinators in the sales office in Amsterdam speak the local languages.
- Sheeting facilities close to our main markets, as well as at our mills, ensure the rapid delivery of small orders.
- Distribution centres close to our customers.
- Direct mill orders are supplemented by a wide network of selected merchants.

Sustainability

Packaging in general and paperboard and paperboard-making processes in particular are all subject to environmental scrutiny. As a paperboard supplier Iggesund takes responsibility for the environmental impact of our products from the sourcing of our raw materials through our manufacturing processes.

Environmental management systems are in place at all our mills (ISO 14001). The Holmen Group's forest management routines are approved in accordance with the FSC and PEFC standards as well as certified in accordance with the ISO 14001 standard. Both our mills hold chain of custody certifications (CoC) in accordance with FSC and Iggesunds Bruk also holds CoC certification with PEFC. This enables our certified customers to be part of the certification chain.

Our aim is that our processes will meet environmental requirements with good margins to spare and we ensure that our products are safe for handling and use. Both mills operate in accordance with the energy management system standard SS 62 77 50.

Sustainable forest management ensures both continued access to raw materials and biodiversity.

Packaging waste and associated landfill issues are a major concern in some countries. For a long time used paper and paperboard have proven to be easy to recover – both as a raw material for recycled fibre products and increasingly for energy recovery. Iggesund's energy use is based on biofuels and we have initiated programmes to further reduce the use of fossil fuels, thereby reducing fossil carbon dioxide emissions.

Paperboard has a low carbon footprint compared to other packaging materials. The raw material, timber, is harvested from managed forests that absorb carbon dioxide and emit oxygen. Because no uniform methods of measuring carbon footprint exist, we refrain from making any specific claims.

You can read more about environmental issues in **Paperboard – the Iggesund Way** and in **Holmen and its World** at www.holmen.com.

One tonne — knowledge included

To achieve the best results in the printing process or in packaging manufacture, you need not only a high-quality base material but also knowledge about how to use that material in the best possible way.

For a number of decades Iggesund Paperboard has systematically compiled and made available to its customers an extensive body of knowledge material — the **Iggesund Anchor Material** — in order to help increase the user's ability to make the best use of Invercote and Incada at all stages.

The **Iggesund Anchor Material** is intended to assist people involved in specifying, selecting, printing, converting or using paperboard.

Iggesund Paperboard's **Graphics Handbook** is the part of our paperboard information package that deals with printing and finishing from the viewpoint of our graphics customers. The **Graphics Handbook** gives both the designer and printer basic knowledge about paperboard and its possibilities, and about the differences between using paperboard and paper as the base material for graphical production.

The inspirational section of the **Graphics Handbook** contains examples of creative solutions and the more production-oriented section provides advice and support to transform your creative ideas into efficient production.

The **Product Catalogue** gives you

- facts and figures about the properties of Invercote and Incada
- product specifications
- general technical information about paperboard handling, quality assurance, product safety regulations, sustainability and paperboard terminology.

The **Paperboard Reference Manual** contains information about:

- basic paperboard facts
- paperboard appearance and performance properties, and how they are related
- paperboard conversion methods and the requirements they place on paperboard properties.

Paperboard – the Iggesund Way contains basic facts about Invercote and Incada and the paperboard manufacturing process. It also describes the customer benefits available through Iggesund Paperboard's mills and paperboard manufacturing processes, customer support and service. **Paperboard – the Iggesund Way** is available as an e-magazine and in pdf format.

More information is available at **www.iggesund.com.** If you have further questions, please contact your Iggesund Paperboard representative.

Inspiration and know-how

Discover the creative aspects of paperboard — and the strengths beneath its smooth white surface.

In this book we describe what you can achieve with paperboard. You will find information about various printing and finishing techniques and the paperboard features that are crucial for obtaining excellent results. Use these features to help transform your design ideas into reality. For further know-how about the production aspects of paperboard please refer to the section “The production aspects”.

Invercote’s strength and resilience make it highly suitable for deep and crisp embossing.

The creative aspects

The very special features of paperboard derive partly from the use of carefully selected virgin fibres as raw material and partly from the multi-ply construction. Unlike paper, multi-ply paperboard consists of several layers with different characteristics. The surface and structural features can therefore be tailored to suit a great variety of creative effects and demanding functional designs. You could say that the multi-ply construction adds a third, creative dimension to the two-dimensional sheet.

Long-lasting appearance

You have more design options and a base material which helps you to successfully implement your intentions. Besides excellent graphical presentation, you gain features such as strength, stiffness, stability and elasticity. Let your creativity play. Whether you wish to convey an exclusive impression of beauty or create a very special creative shape, paperboard adds value to your design.

Beauty is not everything. There is also user friendliness in everyday life to consider. In order to prevent deterioration from aging or frequent use, you must have a light-stable and durable material that retains its good appearance and function. When you design graphical products to be used in demanding environments, paperboard adds usability and durability to your design. A service or safety manual, for example, requires folds that will not crack despite frequent opening and closing. To remain in good condition, the cover also needs to be resistant to thumb marks, stains and spots. Since the printed information needs to stay clear and legible, it is also important to avoid yellowing.

Paperboard features

Thanks to its multi-ply construction, paperboard offers a rich variety of design options. Paperboard’s many features are all derived from the use of carefully selected virgin fibres and closely managed production processes. Combined in the wet state, the pure, strong and flexible virgin fibres form an interlaced network, in which each layer can be given its own special characteristics depending on the features desired.

White, smooth, and carefully finished

To provide excellent graphical presentation, the paperboard has to be white, smooth and carefully finished. To achieve a very smooth and well finished surface, the fibres in the surface layers are normally somewhat shorter and softer than the fibres selected for the inner layers. Chemically processed virgin fibres give the required whiteness and light stability, which are further enhanced by carefully designed coatings.

Strong, tough, and beautiful

The choice and processing of the fibres used for the inner layers depend on the structural features required. To create the elasticity, strength and sense of quality found in a dense paperboard we use a greater proportion of long fibres in the middle layers. When stiffness is desired, the fibres should be shorter and stiffer. Usually a combination of stiffness and elasticity is preferred. Skilfully achieved compositions are therefore needed in order to obtain a strong, resilient and beautiful paperboard that gives optimal performance in printing, finishing and use.

Stable, durable, and adaptable

Whether you need to create two- or three-dimensional shapes, produce sophisticated decorative effects or reproduce demanding images, paperboard is a perfect choice. The multi-ply construction provides a stable and durable material, which benefits creasing and folding and also is wonderfully adaptable for long-lasting embossing.

Complex construction designs with moving parts require paperboard that does not crack along the creases, especially when you are printing colours across folds.

Embossing, hot foil stamping and die cutting make any printed material stand out from the crowd.

Uniform material properties

The basic properties of paperboard are whiteness, smoothness, strength and elasticity. Together these properties offer the best possible image reproduction. They also benefit creasing, folding and embossing, besides providing the base for excellent results from such techniques as metallic film lamination. A high degree of uniformity in material properties is the hallmark of a high performance paperboard.

Total cost efficiency

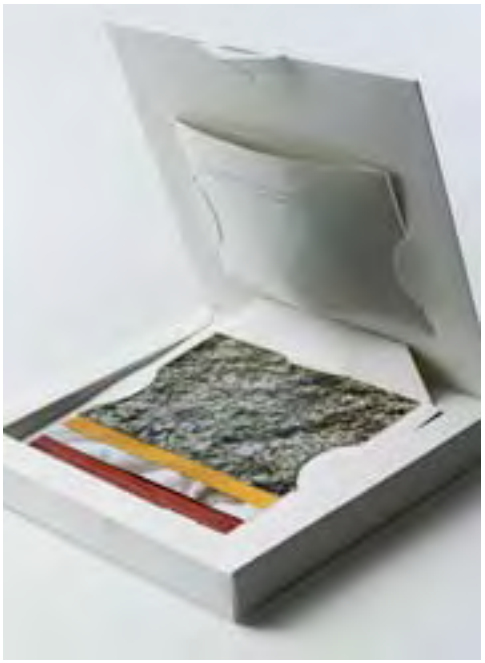
When the quality of the end result is your first priority, your choice of base material is easier and less limited than when your first priority is just to have a low purchase price. With paperboard you can achieve effects that are almost impossible with other base materials. But besides the many aesthetic and functional advantages of paperboard, let's also look at the economics. The cost of something can be assessed – and reduced – in many ways. What price do you put on having reliable printing and finishing processes? Or on not wasting your valuable time and materials? Paperboard offers crucial benefits – not only to the design result but also to your total cost efficiency.

Use your imagination and know-how

As a designer you use your imagination and know-how to create an attractive and alluring design that will fulfil a specific function. Your customers, their target groups, your printer and possibly many other stakeholders all have an interest in your work. The more you know about their individual needs and requirements, the more expert your choice of design effects and base material will be.

Your design determines what printing and finishing techniques will be used, as well as how the user will experience the finished product. As part of your design process, you must therefore also consider issues like cost-efficient printing and finishing, as well as how the end product will be used. Together with a skilled printer the choice of correct paperboard for the intended task will transform your creative and functional intentions into reality.

The concave Diamond Pack was developed to showcase the possibilities offered by Invercote. It took 112 creases to produce this shape.



By combining effect varnishes with embossing, you can create a surface that feels like stone, wood or silk. Only your imagination sets the limits!

Changing times

The process of graphical production and its various applications are both undergoing rapid change. Digital pre-press production, the digital distribution of files, print on demand, and cross-media production (i.e. the simultaneous use of electronic and conventional graphic media) are all becoming increasingly common.

Knowledge and wise foresight

It is important to meet technological changes with knowledge and wise foresight. How will these changes affect your own work? If your design is to be distributed in digital format for local printing and finishing in a variety of places, then you need to take special precautions by specifying the job very thoroughly. This is because you will not have the same opportunity to personally check the art work as when you are working with a printer near you.

Whether your design is for a brochure, book cover, CD cover or set of displays, you and your customer expect the quality of the finished product to meet your expectations regardless of where it is physically produced. This quality doesn't happen by itself. To achieve your intended result you must specify the substrate to be used. It is not enough just to specify the general type and grammage. Different products behave in different ways, so you must specify exactly which paperboard product you want to use. Then the binding and all the other finishing techniques must also be specified. Although digital pre-press technology and the digital distribution of files can lead to gains in cost efficiency and time savings, printing and finishing remain in many respects hands-on crafts.

Covers of today and tomorrow

What about covers? Who will need them in the future? Well, oddly enough, CDs (for example) are now being sold more than ever before – thanks to the electronic distribution of music rather than despite it. CD covers are therefore needed more than ever, both to provide protection for their fragile contents and to support sales of the music. A powerful visual impression combined with paperboard characteristics such as sturdiness and a smooth, dust-free, pure surface on the reverse side makes paperboard the perfect material to cover the hits of both today and tomorrow.

As for books, the ability to read an electronic version on screen or to print your own copy at home can sometimes be very useful. But there is a lot more to a book than just its contents: visual appearance and tactile feel are also highly valued by book lovers everywhere. The kind of books people want to remember and keep will remain "IRL" (in real life).

Many leading designers believe that the design of covers will become even more important in the future. When cross-media publishing is used, for example in advertising, the various media are supposed to support each other. The graphic design then becomes even more crucial as a means of creating a very clear, shared context. In the case of CDs, games and books, their covers add context even though their contents may also be available online. This added value goes beyond decoration and protection: it encapsulates and preserves the very soul of music and literature.

You can create subtle effects by embossing at various depths or heights and experimenting with different glossy varnishes.

Displays — today and tomorrow

Paperboard is a highly suitable base for large displays, whether you prefer screen print, offset lithography (in special machines you can print displays as large as 220 x 180 cm), or digital printing (ink jet). The last-mentioned technique is developing very rapidly, both in terms of print quality thanks to new types of oil-based inks, and when it comes to cost-efficient production.

One innovation on the way to becoming a reality is displays printed with ink that remains invisible until it is "turned on" electronically. The basis of this technique is the Nobel Prize-winning discovery that plastics are able to conduct electric current. The special ink forms a plastic foil when dried and the colours can be activated by a very weak current. Four colours can be used to produce large displays, which can be refreshed with different motifs – even animated ones. All the possible motifs remain invisible until one of them is lit up. This method is being developed by the Swedish research institute Acreo in co-operation with stakeholders such as the leading paper and paperboard industries in Sweden and Finland. When this "electronic paper" technology becomes commercially available, it will be a most remarkable case of cross-fertilisation between the world's oldest graphic medium and its newest one.

Conveying meaning

Times change, but not always in the way we think – or rather, almost never in the way we think. It was long thought that the Internet, with its e-mail and video conferences, would replace the need to travel. In fact, the opposite has happened: people now travel more than ever. Once, people thought that the telegraph would reduce the need to travel. But it didn't, as we all know. Nor did the telephone. New means of communication have always increased the use of existing ones. In the same way, despite the increased use of electronic media, both paper and paperboard will continue to carry and convey meaning. It would seem that the dematerialisation of information also requires its rematerialisation in order to carry and convey meaning at any deep level. As human beings we need to use all our senses to understand the world.

The desire to create remains!

Humankind has an inborn desire to create, refine, develop and improve. These urges make us seek out base materials that can be designed to offer new functions and associations. In the hands of the designer, paperboard is an exciting and experimentally formable material. From here on we will introduce you to its creative dimensions, both for traditional applications and for ones you may never have seen before.

Laser cutting can create effects that are even more complex than those made by embossing. But the paperboard's strength is an important factor to keep in mind.

The paperboard's ability to spring back is crucial to all pop-up constructions.

Graphical presentation

Paperboard can do for you whatever paper can and so much more. The clean, white sheet with its smooth surface is the starting point for achieving excellent graphic presentation of photographic images, decorative designs in soft pastel shades, or strong bold colours in large solid areas. By choosing the right paperboard you can also gain high light stability so that your creation will retain its whiteness for a long time.

Another factor which makes paperboard superior to paper is its stiffness, even at lower grammages. This is extremely rewarding because it creates a tactile sense of quality in applications such as brochure and book covers, cards, displays and menus. There are also times when you need the reverse side to have a different surface finish. You can easily achieve this feature with paperboard thanks to its multi-ply construction.

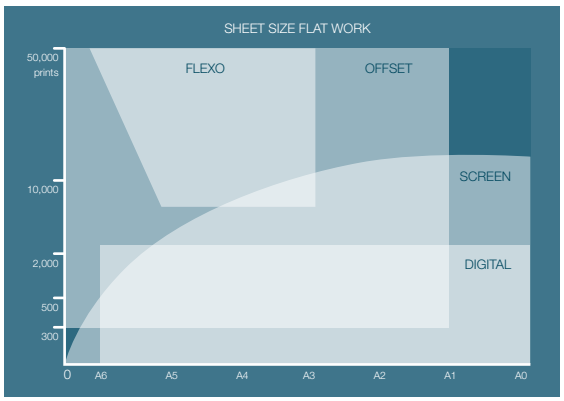
The whiteness makes it possible to achieve excellent graphical presentation in true colours and with perfect contrast between illustrations and unprinted areas.

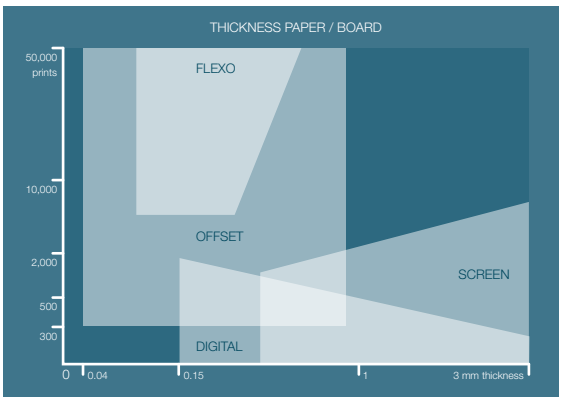
The smooth surface permits a high-quality graphical presentation. Good rub and abrasion resistance preserves the presentation and prevents deterioration.

Overview of printing methods

With paperboard you are free to use all available printing techniques. The main conventional methods for graphical applications are offset litho and screen print but digital printing is developing rapidly. Each technique offers different characteristics, thus giving you vast opportunities to choose the right paperboard for your design.

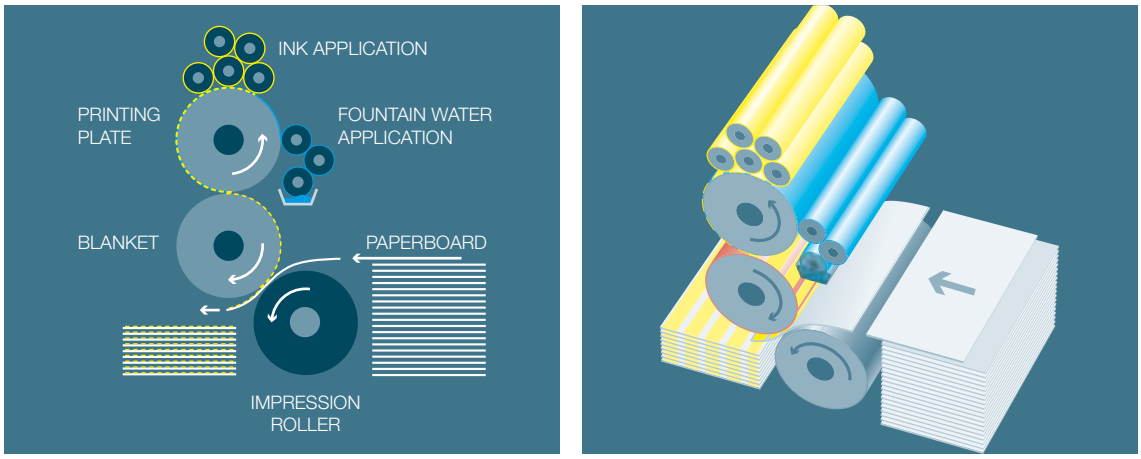
As always, you need to take into account the specific purpose for which your design is intended. Is it to be short lived or long lived, exposed to outdoor changes of weather or designed to attract attention on a shop shelf? What kind of impression do you want to create, how many colours will there be, and which finishing techniques will be applied before completion? With paperboard – as with paper – there are always some major decisions to make before going into production.





Each printing technique is limited not only by efficiency but often also by sheet size and thickness.

Offset litho printing



Principle of offset printing (sheet fed).

Offset lithography is widely used for graphical applications. The method is different from other printing techniques because it is indirect. The ink is transferred to the paperboard via a compressible rubber blanket, which adapts to the surface structure, enabling good contact and ink application. With its relatively low pre-press costs, fast make-ready, and high production speed, this process is commercially attractive for a wide range of run lengths.

The two main types of lithographic inks are based on conventional drying oils and UV drying respectively. To finish the printed surface, varnish is often used. Since there are three different types of varnishes for inline or offline applications, the possible combinations enable a large number of printing and varnishing options. To avoid problems and achieve the best result it is always important to consider the interplay between ink, varnish and paperboard surface. The most suitable combination should be chosen in consultation with a skilled printer.

Pros and cons of offset litho printing

Pros:

- achieves the highest screen ruling of all printing methods
- reproduces the largest colour gamut
- gives superior colour matching in multi-colour presses
- enables superior register between different colours
- is economically viable in a great span of run lengths (about 300 to 60,000 impressions)
- most presses can print a wide range of paperboard grades (from about 0.08 mm to 1 mm thick)
- special presses can handle thick paperboard grades and also large formats (up to 220 x 180 cm).

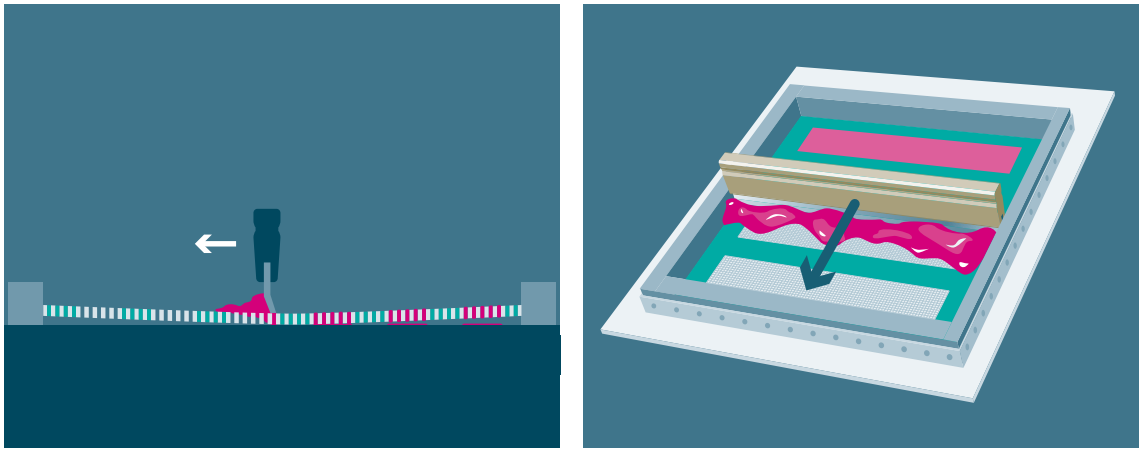
Cons:

- reproduces less brilliant metallic colours than e.g. flexography
- consumes more paper waste during start-up when setting the ink moisture balance
- gives a thin ink layer which often has to be varnished to achieve rub resistance
- the process is sensitive to temperature fluctuations (this can be prevented using a press with temperature controlled rolls).

Key paperboard features

Whiteness, smoothness and surface finish are the most crucial paperboard features for achieving excellent colour reproduction. The exceptional stability of multi-ply paperboard is also important for doing high quality offset printing. So is the flatness of the paperboard, especially when running at high speeds. Compared to other printing methods, offset inks are tackier and therefore demand somewhat higher surface strength.

Screen printing



Principle of screen printing.

Screen printing is best described as a stencil method. It is used to print on very stiff substrates that other presses cannot handle. Some screen presses are also capable of handling large formats. These two factors make screen printing on paperboard ideal for display materials.

The basis of the screen printing system is a frame that is covered with a fine net called the mesh. On this mesh a photosensitive film is applied. The image – the stencil – is put on top of the film and after that the whole frame is exposed to a light source. Where the film is exposed to light – i.e. in the non-image areas – it hardens and seals the holes in the mesh. In the developing stage the film is removed from the image areas. The ink is allowed to penetrate the mesh and thus reproduces the image.

The ink is applied at one end of the frame and is then raked over the mesh with a squeegee applied on the flood bar. The thickness of the mesh and stencil determines the thickness of the ink layer. The hardness and angle of the rubber squeegee determine things like dot gain. In comparison to other printing methods, screen printing produces a much thicker layer of ink, making it more resistant to scratches. The ink is also less sensitive to sunlight compared to other printing methods.

Pros and cons of screen printing

Pros:

- suitable for printing on substrates thicker than 1 mm
- more suitable than other methods for formats larger than 720 x 1020 mm
- small editions (as small as 1 to 50) can be printed at reasonable cost
- light-resistant ink layer that does not deteriorate from sunshine
- ink and varnish layers are extra resistant to wear
- little or no waste of paperboard

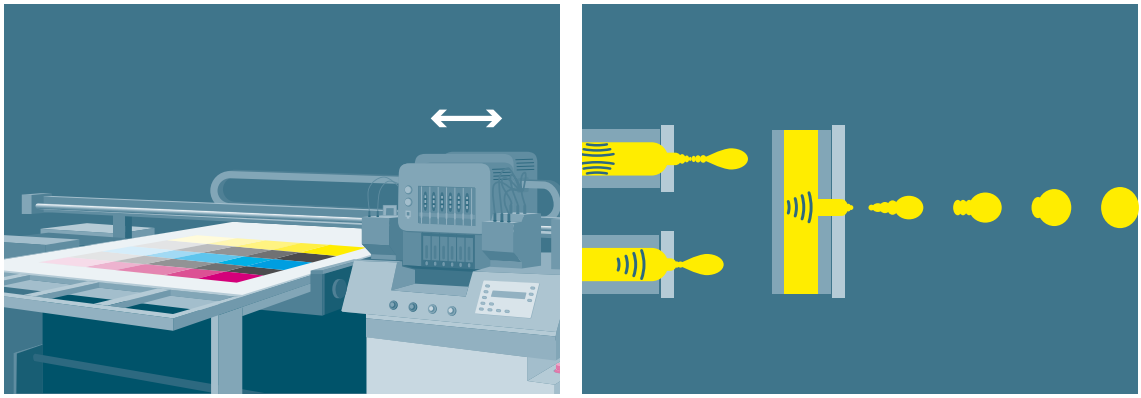
Cons:

- not suitable for high screen ruling (above 100 lines/inch)
- less extensive tone scale than other printing methods (reproduces bright daylight and shadowed areas poorly)
- most printers do not use multi-colour machines, which makes register in multi-colour jobs complicated
- matching colours to previous production is complicated.

Key paperboard features

Whiteness is crucial for achieving excellent graphical presentation. Smoothness and flatness are even more important than in other printing processes. Since screen printing is a direct printing method and thereby sensitive to loose particles and debris, a clean surface is essential.

Digital printing



Principle of a digital printer.

Digital printing is not just one method but many different ones. The common factor is that there is no physical transfer of the image before printing. You therefore gain very rapid make-ready at low start-up costs. However, it is not yet possible to achieve a print quality equal to that of offset – although the technology is developing extremely quickly in this respect.

As digital pre-press production, the digital distribution of information, and cross-media publishing are becoming increasingly common, so, too, is digital printing. The two basic methods are dry and wet, corresponding to copying/toner printing and inkjet printing respectively. The dry toner places high demands on electric charge stability, while the wet toner places high demands on surface tension and other surface properties.

Pros and cons of digital printing

Since digital printing is developing extremely quickly, the pros are rapidly increasing and the cons are correspondingly decreasing. For example, the costs to print medium to high run lengths are continuously being reduced and the print quality is being improved at a high pace as new and improved inks and toners are being developed.

Pros:

- very rapid intake, since there are half as many steps in the pre-press production
- leaves no paperboard waste
- manages variable data
- small editions can be printed at very low cost
- dry-toner presses are often reel fed, which enables continuous designs (for example long banners).

Cons:

- printing quality still not as good as offset
- somewhat inferior lightfastness compared to offset inks
- more expensive than offset at medium to high run lengths
- gives uneven gloss (dry toner) or sensitivity to wear (wet toner)
- wet toner gives more difficult colour control
- there is still limited access to inline finishing equipment that fits these machines.

Key paperboard features

Whiteness, smoothness and surface finish are crucial paperboard features for achieving excellent graphical presentation in digital printing, as well as when using other printing techniques. When designing long banners you need a very strong substrate, so paperboard is an excellent choice.

Finishing options

When you get to the finishing stages you will really discover the strengths beneath the white, smooth surface of paperboard. The fact that beauty is in the eye of the beholder does not exclude our other senses and feelings from also playing a key role. There is a special sense of joy when a designer arrives at a distinctive creative solution that stands out from the crowd. There is also a tactile feel that is instantly recognisable in a carefully finished graphic product. Add common sense plus attention to cost-efficient finishing processes – and you will end up using paperboard.

Thanks to its fibre strength and coating elasticity Invercote is ideal for embossing, even where the depth of the embossing is more than the thickness of Invercote.

Varnishing

Communicate beauty and luxury, sparklingly expressed on a glossy surface or discreetly understated on a matt or silky surface. A matt surface makes text easy to read while a glossy surface brightens the graphic presentation. But varnishing can add value to your design in many other ways than just the choice between matt and gloss.

By varnishing you can achieve a glossy, satin (semi-gloss), pearlised or matt appearance.

Attract the eye

Because the human eye is very sensitive to contrast, varnish helps you to attract the eye's attention. A glossy varnish makes colour images look more saturated in their hues. Sometimes you might use it for the whole area of a cover or a card to intensify the message or expressiveness. At other times you might use a glossy varnish to highlight a special illustration by making its brightness stand out against a matt background. Likewise, a matt-varnished surface against a glossy one also attracts attention.

You can use varnishing to increase or decrease the gloss of your printed material. With spot varnishing (at right) you attract the viewer's eye by using different gloss values on the same surface.

Feel the surface

Varnishing is not only a question of attracting people's gaze; it can also be a method of giving a special tactile feel to a brochure or a book cover. Whether you choose a gloss or matt surface depends on the feelings you want to evoke by the interaction between the eyes and hands of the user.

Varnishing is also a way to protect printed and unprinted surfaces from minor damage. Since the varnish both protects the surface and makes it smoother, it facilitates easy handling. If you don't want to change the character of the paperboard surface, a normal, thin, water-based or solvent-based overprint is the most suitable choice.

The varnishing operation

The varnishing operation can be carried out during printing (inline) or after printing (offline). There are many possible combinations of printing methods, printing inks, types of varnish and varnishing methods. To find the most suitable combination – that is, to avoid trouble and achieve the best result – it is always advisable to consult with a skilled printer. In general, the best effect and highest gloss are achieved with UV-cured varnish. When offset printing is used the varnish is often applied inline as additional ink without any pigments.

Key paperboard features

The crucial paperboard features for varnishing are largely the same as when printing. Since gloss varnish is intended to reflect light in a uniform way, the result is really dependent on a smooth surface with uniform absorption properties. To be able to reflect – and retain – as many colours as possible, the whiteness of the paperboard is most important. Paperboard fulfils these criteria extremely well.

Film lamination

Film lamination is a matter of attractive creative design as well as practical function. Because there are many types of films, it is possible to create a lot of special effects and use various ways to enhance the design of such graphic materials as book covers, exclusive brochures, maps, displays, cards, menus and posters. You may want to make them highly glossy, silky smooth, or just plain durable, withstanding scratches, stains and other damage.

Paperboard laminated with a metallised foil often creates more of a metallic look than that produced by a metallic ink.

Beauty and usefulness

There are many standard and speciality niche products among the films available. Whether you want to achieve aesthetic effects or practical functions, you can always combine beauty and usefulness. The film not only enhances the graphic presentation; it also protects the surface from thumb prints and stains. If you want to achieve a very special tactile feel to the surface of your product, you can try using a transparent matt/waxy laminate.

The film lamination operation

Film lamination is a technique whereby a plastic film is glue laminated to the paperboard surface to achieve various aesthetic effects and protection. Polypropylene (PP) is the most common way to create a glossy surface and protect the print. Polypropylene is a durable material with special appearance and tactile properties. For more information on the film lamination operation, please refer to “The production aspects” chapters.

Key paperboard features

When laminating, key paperboard characteristics include smoothness, surface finish and surface strength. Paperboard provides a perfect base for lamination. A very smooth and dust-free surface is essential, especially when you use laminate to create a high gloss appearance, since any irregularities on the surface will be highlighted.

Hot foil stamping

Hot foil stamping is used to provide an eyecatching or luxury appearance. The size of the area that can be covered varies from very fine details to large, solid areas. There are many types of foil to choose between. They come with gloss or matt finishes and can be brightly coloured, shimmering metallic, pearlised or with holographic patterns. Effects such as marble and snakeskin are also possible.

Paperboard's dimensional stability offers advantages to production jobs that have many finishing stages. This detail is from one of Iggesund's production jobs which combined various printing techniques and a total of 18 printing stages.

Golden opportunities

Hot foil stamping can be used for letters, patterns and all other types of illustrations. These can be wholly covered or just given a thin edging. If you are considering a metallic appearance, this is a golden opportunity to add a touch of exclusive elegance. Or why not use a holographic film to draw attention, or a foil with offset print on top of it? That way you will get an astonishingly bright result.

The hot foil stamping operation

In this operation the foil, which is supplied on a heat-resistant film, is kept parallel to the paperboard during the process. A heated matrix, which is fitted to the stamping cylinder, releases the foil from the film and makes it adhere to the paperboard.

Hot foil stamping highlights one or more details in the printed sheet.

Key paperboard features

For the best visual appearance of the foil, a clean and very smooth surface with a minimum of interfering surface irregularities is important, since any flaws are strongly accentuated when foiled.

Embossing and debossing

Embossing and debossing are strikingly impressive design techniques. Embossing creates a raised image and debossing creates an indented image. Either way you add far more than just a touch of class to your products – you give them an almost matchless look of quality.

The best is good enough

When only the best is good enough for a brochure, book cover, folder, card or menu, it may be just the time to use embossing or debossing. You can use the relief as a most eyecatching decoration or in a very understated way to emphasise the name of a company on an exclusive annual report. Although the operation is a challenging one, the possible patterns are almost limitless when you use paperboard.

Fine details or complicated patterns

To emboss or deboss is to shape the paperboard into well defined permanent relief patterns. The method might be applied to create a pattern covering the entire surface or as a pronounced relief. By using both embossing and debossing in the same pattern, an effect of great depth can be obtained.

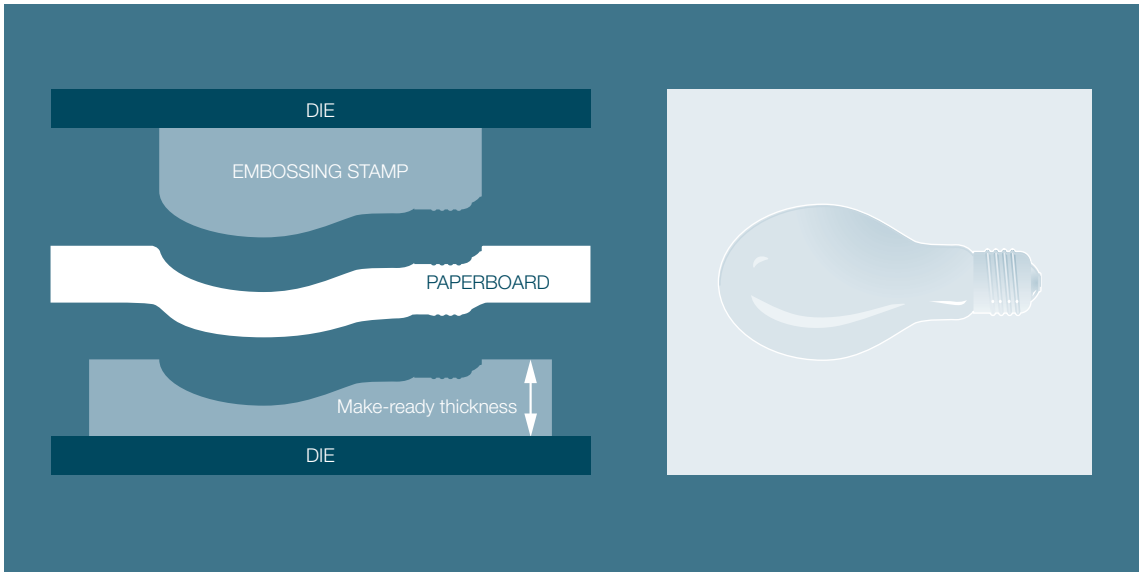
When using multi-ply paperboard you are able to create very fine details or small details close together without being afraid of having a indistinct result or breaks in the board surface.

Not all paperboards can handle deep relief patterns.

Embossing may sometimes also be of very practical value.

The embossing and debossing operation

This operation is carried out with heat and high pressure to make the relief pattern precise and permanent. The tool consists of a stamp and a make-ready (or counter-die). The make-ready is a thin metal sheet with a groove shaped as the relief pattern, while the stamp carries the inverted pattern.



To create the relief, the stamp pushes the paperboard into the groove of the make-ready.

A severe test of the paperboard

Even though all types of paperboard can be embossed and debossed, there are restrictions due to their construction and composition. The operation is a severe test of the strength, resilience, and surface finish of the paperboard. The inner layers must be flexible enough to be reshaped but not crack. Of course the surface must not crack either, so it must be both strong and smooth. Another important aspect is the necessity not to flatten the relief patterns when the sheets are packed tightly into stacks. To prevent this, the paperboard has to be strong, resilient, rigid and flexible.

Foil embossing and other combinations

Let the relief make its own impression – or combine it with other creative techniques. There are many different ways to achieve an immediate and striking impact. Foil embossing is a way to combine relief and foil in the same operation. A combination die is used: that is, an embossing die with a foil breakage edge to the image area. You may of course also choose print, varnish, or hot foil stamping in separate operations to add whatever effects you can imagine to the relief.

Hotfoil stamped, printed with four colours, varnished and finally embossed.

Complex shapes and lattice designs

What can you actually create with paperboard? When it comes to complex shapes and lattice designs, the question might rather be what can't you create? Here are at least three creative dimensions to play with. Beneath the white and smooth surface, you will find all the strengths you require to achieve complex and durable shapes. Try them out!

You can use print, varnish, lamination, embossing or hot foil stamping for the surface design, or just use the white paperboard itself to achieve a highly distinctive structural design. Add your own unique creative dimension to the three spatial dimensions, the four elements of nature, and the five human senses.

Creased, die cut and ready to fold.

What you can achieve with paperboard.

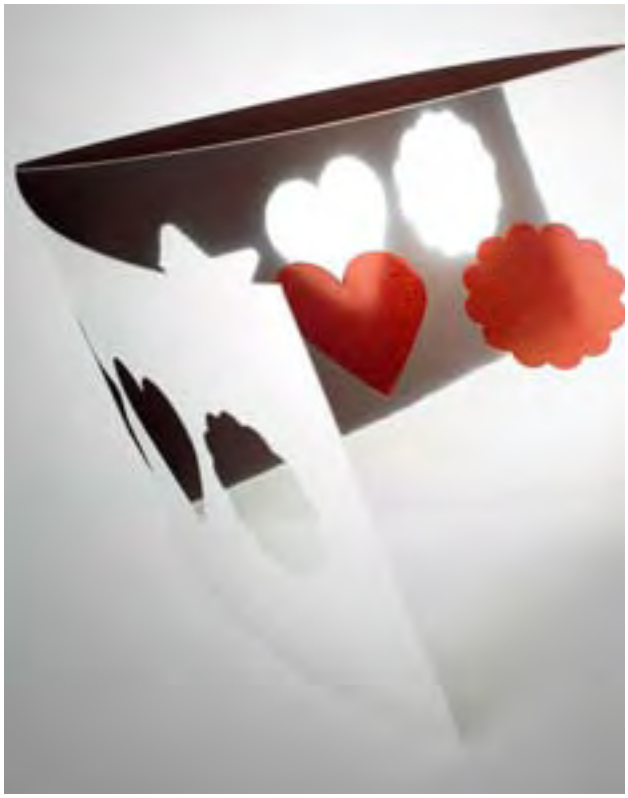
An elegant carton makes its contents taste even better!

Which technique to use?

Creasing, folding, and various cutting methods (die cutting, ram punching or laser cutting) are the basic techniques used to create complex structural designs. Creasing and folding will be discussed in the next section. Here we describe the various cutting methods.

Die cutting

Die cutting is the most general cutting method. The die-cutting tool consists of a cutting edge and counter-die. The tool can be in the shape of a straight line or almost any complex shape you want. Normally the tool is specially designed for a specific shape and paperboard grade. The die-cutting operation can be done at the same time as creasing, and these operations can also be combined with embossing.



Die cutting.

Laser cutting.

Ram punching

Ram punching is a powerful cutting method used to cut large numbers of small shapes such as labels, envelopes and cards. Unlike die cutting, which cuts one sheet at the time, ram punching is used to cut through a whole pile of paperboard. To avoid waste, the paperboard is first cut down to fit the size of the intended shape.

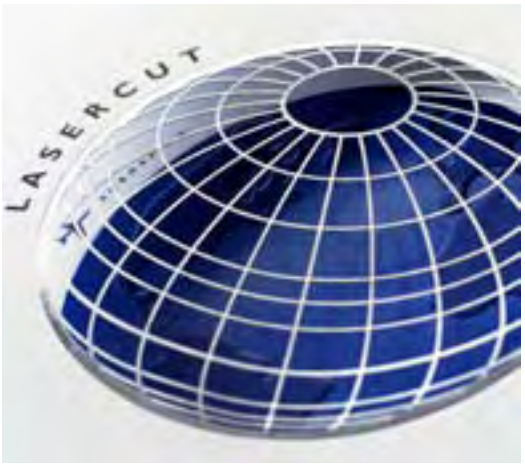
Laser cutting

Laser cutting is the most elaborate cutting method. It permits the finest details and the most complex forms. With the right paperboard almost any pattern can be achieved – only the paperboard sets the limits. The intended design is etched through a copper template, which is positioned over the paperboard sheet. A laser beam then runs back and forth over the template, vaporising the paperboard along the contours of the pattern. A drawback with this method may be that the reverse side is slightly discoloured along the contours of the pattern due to the heat of the laser beam. If you don't want this discolouring to show, you need to cover it with print – but you can also deliberately incorporate it into the design.

Key paperboard features

Which features do complex forms and latticed designs require in the paperboard? You need strength for the sake of formability. Tearing resistance and surface strength are definite musts to accomplish cut edges without cracks, debris or frays. To achieve cut surfaces as white as the paperboard surface itself, you need to use paperboard made solely from bleached pulp. Otherwise, the somewhat darker middle layers will show. Flatness and dimensional stability are crucial for enabling runnable production.

Take extra care when choosing the paperboard.

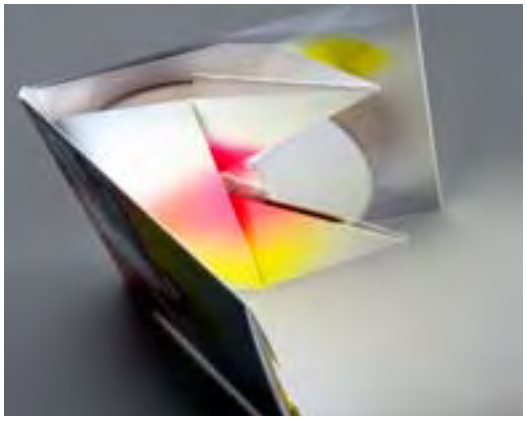


Straight and finely cut lines. This is a simple pattern but a complex design.

Creasing and folding

Unlike paper, paperboard can – and should – be creased before folding. What you gain by this operation, when using a multi-ply paperboard, is the quality expressed by distinct, durable and narrow fold lines, with no disfiguring cracks on the surface of the printed, varnished or laminated folds.

The design deserves distinct and narrow fold lines without cracks.



The multi-layer construction of the paperboard guarantees deep and narrow folds that can withstand frequent opening and closing without cracking.

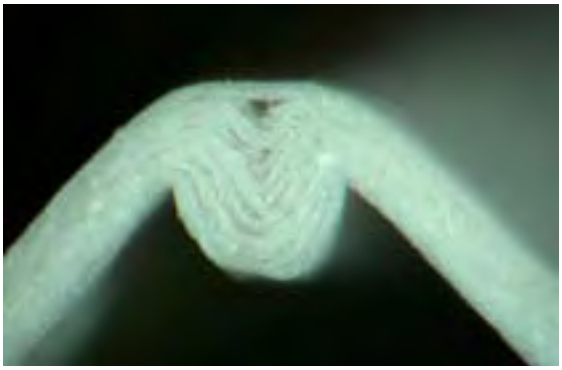
Deep and narrow folds

It is easy to fold creased paperboard. Without creasing, the surface layers will crack and/or the fold line will be undefined. During the creasing operation the paperboard is weakened along well defined folding lines, which then act as hinges for the folding. To achieve accurate folding with low folding resistance the crease should be deep and narrow – the deeper and narrower, the better. Very thick paperboard requires more than one crease or must be scored before folding.

Optimal creasing

Multi-ply paperboard makes it possible to achieve optimal creasing. Ideally, the paperboard should delaminate into a finite number of thin, unbroken layers throughout the thickness of the paperboard. In this way you obtain distinct and durable folds, which contribute to good function and an attractive appearance.

This is the proper way to fold – don't turn the crease inside-out, as sometimes happens.The folding should always be done towards the bead.



Optimal creasing is achieved when the multi-ply paperboard is delaminated into as many thin undamaged layers as possible along a well defined fold line.

The creasing operation

To form the crease, a thin strip of steel with a round, smooth edge (the creasing rule) pushes the paperboard into an accurately cut groove in a thin and hard material (known as the make-ready, matrix or counter-die). The width and depth of the crease are defined by the creasing tool geometry and the paperboard's ability to adapt to the tool. In bookbinding, creasing of the covers is often integrated in the binding machine. In this case the flatbed method described above cannot be used. The creasing is instead carried out using a steel wheel and a counterpart.

Creasability

What is creasability?

Creasability can be explained as follows:

- The paperboard's ability to permit deep and narrow creases. If the crease is too shallow or wide, the folding operation is difficult to perform. In contrast, it is very easy to fold paperboard with deep and narrow creases.
- The paperboard's ability to adapt to the shape of the creasing rule and retain the desired geometry of the crease. Accuracy and precision in crease shape and location are important.
- The paperboard's ability to "forgive". A forgiving paperboard is less sensitive to variations in the creasing conditions (for example due to the tools becoming blunt) and is therefore more reliable in converting machines.

Perfectly creased.

Ply construction

The creasing operation and settings should be carefully matched to the paperboard. The multi-ply construction of different paperboard products results in different characteristics. Your demands for optimising other paperboard features such as stiffness or strength will affect the creasing and folding performance in different ways. A strong paperboard such as an SBB will cater for deep and narrow creases despite being slightly resilient during the creasing operation. A stiff paperboard such as an FBB is easier to crease but will not allow the same fine crease dimensions as an SBB and this in turn affects the folding properties.

Binding — the last strong link

Binding is the last link in the chain of operations for converting paperboard into attractive and functional covers for brochures, annual reports, manuals, books and magazines. This link must be as strong as all the others, so it is important to select your paperboard to suit the binding method you are using.

Binding methods

When using paperboard for covers, the most common binding methods are saddle stitching, wire-O binding, glue binding, thread binding and fadensiegel binding.

Saddle stitching

Saddle stitching is normally used for brochures, annual reports, magazines and booklets. The binding operation consists of creasing, folding and stitching. The folds must not crack as a result of the creasing and folding operations nor during subsequent use. This is particularly important if there is printing over the folds. Saddle-stitched productions put a lot of strain on that small piece of paperboard that holds the cover to the insert by the staple. If you choose a paperboard made from virgin fibres, you minimise the risk of the cover becoming detached from the insert with use over time.

Saddle stitching puts a lot of strain on that small piece of paperboard that holds the cover to the insert by the staple.

There are a number of exciting alternatives to classic saddle stitching. As well as protecting printed materials, binding can also help them stand out from the crowd.

Wire-O binding

For the same reason, it is equally important to use virgin fibre paperboard with wire-O binding, which is often used for booklets and manuals. One practical advantage of this type of binding is that the printed insert can lay flat when required. However, if the paperboard is too weak the cover can rip and fall off after intensive usage.

Wire-O binding can be combined with this type of cover, for instance when you want to be able to easily identify a manual on a bookshelf.

Glue binding

Glue binding is often used for booklets and paperbacks. Book covers need to be especially stable and durable. Depending on the thickness of the insert, creasing and folding can be carried out in various ways to improve both the function and the appearance of the cover.

To achieve an attractive cover with distinct fold lines, you require a strong and sturdy paperboard with a smooth surface. However, to achieve a durable bond, the reverse side should be uncoated or the glue will not adhere easily. If the surface of the cover needs to be smooth and glossy on both sides, special precautions are required. UV varnish must not be used.

Glue binding adheres better to the reverse side if the paperboard does not have the same finishing on both sides. Extra creases on the front and back prevent ugly wrinkles.

Thread stitching

Thread stitching is the classic high-quality binding method. The sheets of the insert are stitched together in bundles with a linen thread. After folding, the block of bundles is glued directly to the back of the cover. When this binding method is used for paperbacks, it provides stability, durability and a high-quality appearance.

Thread sealing

Thread sealing could be regarded as a combination of thread binding and glue binding. It resembles thread binding but is less expensive. It gives extra stability, durability and a high-quality appearance to the covers of printed materials such as large textbooks. The sheets are stitched together with a special plastic thread. After folding, the threads are melted and the insert block is glued directly to the back of the cover.

Key paperboard features

The paperboard features required for achieving successful binding are strength and resilience, consistency in flatness and stability, and good cutting, creasing, folding and gluing properties.

There are various ways to crease and fold book covers.

An example of thread stiching.

Multi-step processing

The production of almost any graphic product is carried out in more than one operation. The simplest production involves only printing, sometimes with the addition of creasing and folding. However, there are products that are more complex and demanding than others. In many cases these products can incorporate almost all finishing processes.

To achieve perfect register in multi-step processing you need a paperboard with extremely good dimensional stability and precise sheet squareness.

Get inspired

This is *Inspire*, the customer magazine of Iggesund Paperboard. Needless to say, the covers are produced on paperboard in order to illustrate what can be achieved with different combinations of printing and finishing techniques. Please visit iggesund.com and find out how the covers are printed and finished.

How to choose

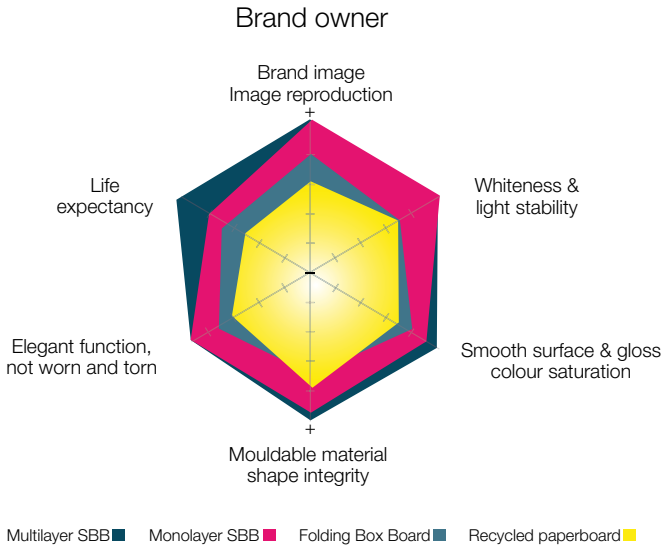
A successful choice of paperboard is achieved by understanding the different paperboard properties, their significance and their interdependence, and relating them to the appearance and performance needs of the intended graphical application. You can simplify your choice by taking a systematic approach. To help you, we offer suggestions related to the specific requirements of different applications. Our recommendations are based on experience in the market and a detailed examination of market needs.

Which paperboard properties are the most crucial for implementing the intended design? Which properties are essential when it comes to cost-effective printing and conversion processes? When everything is taken into account, which paperboard product would be the most suitable for carrying out your intentions? You will find plenty of information in these books and at www.iggesund.com. You are also welcome to contact us.

To make the best choice of paperboard, you must evaluate the most crucial factors of design, production, application and economy.

Selecting paperboard

Since not all paperboard products can be superior in all respects, you need to prioritise the most important factors for your application. Because our assessments are general and your application is specific, we must stress the importance of following up our proposals in practice by proofing and sampling. Our nearest sales representative will always be glad to discuss the best selection for your specific needs.



A cover should reflect its contents, carry a message and provide protection. It should also create a strong visual impression.

Design aspects

Covers often need to have advanced designs to convey an impression and anticipation of their contents. A cover should entice us to investigate its message. The cover is intended to sell something to us, be it an idea, product concept or book. A cover must be attractive and alluring while also providing physical protection for its contents. Usually it must also be durable. The visual impact is crucial because the cover must often convey multiple messages and fulfil many needs, expectations and intentions.

A silky surface, extra details or an ingenious construction – these are all ways to attract the attention that the designer wants.

In addition to acting as a substrate for the graphic presentation, the paperboard must prevent it from aging or yellowing. It also must prevent the corners from becoming dog-eared and the creased fold or spine from being cracked. These factors are especially important for book covers, since books need to endure many years of use and shelf storage without deteriorating in shape or appearance. The printed creases on the spine therefore need to withstand repeated opening and closing without cracking.

The use of virgin fibres and selected coatings provides the whiteness, light stability, smoothness and surface finish necessary for achieving excellent graphic presentation and very high print quality with good contrast between the paperboard surface and the print. Sometimes the same surface properties are also required for the reverse side; at other times the reverse side needs different properties. The smooth surface provides for good rub and abrasion resistance. Embossing, lamination and hot foil stamping require surface strength. Creasing and durable folds demand folding rigidity and tearing resistance. To protect the insert and prevent dog-ears, a strong and resilient paperboard is needed.

Production aspects

To obtain efficiency and runnability in printing and finishing, a flat, stable and dust-free paperboard is essential. Good absorption and drying properties ensure high print quality and also help to minimise process stoppages and material waste. Good cutting, creasing, embossing and gluing properties are important for reliable production and good results.

High-end covers that are produced in a multi-step process require paperboard with exact sheet squareness and extremely good dimensional stability to achieve perfect register. For the converting process, good creasing, folding and gluing properties plus good rub resistance are necessary. For efficient bookbinding, additional important factors are delamination strength and properties that facilitate good clean cutting, folding and gluing of the spine.

To get more inspiration and know-how visit www.iggesund.com.

A paperboard cover gives the designer more surface design possibilities than traditional CD covers.

Iggesund – Graphics Handbook

Production

Discover the production aspects of paperboard – a base material that allows you to achieve more than you can imagine. Paperboard is more forgiving than paper but also a bit more demanding.

Knowing how and knowing why

In the following chapters we describe how to use paperboard with different printing and finishing techniques. You will find information on how to work with and handle paperboard, as well as the features that are crucial for achieving excellent results and cost-effective production.

The production aspects

The white sheet of paperboard and the designer's intentions are the starting points when transforming the creative dimensions of paperboard into reality. The production aspects of paperboard are based on its smooth, uniform, and well finished surface – and on all the built-in features underneath.

More forgiving and more demanding

Paperboard provides excellent printability and runnability in the printing and finishing processes as long as you take a few basic precautions when handling it. With skilled and experienced operators and well run machinery, the path from paperboard to finished product will be as straightforward as when using paper – only somewhat different. The difference can be summarised as follows: you can accomplish more with paperboard – it is a more forgiving base material but also a little more demanding.

Without its stiff construction, paperboard would not be able to perform its primary functions of providing rigidity and strength. Paperboard offers higher stiffness at a lower grammage than paper (you achieve the same stiffness at about 25% lower grammage). This is one of the most appreciated advantages when specifiers choose paperboard.

Paperboard properties are crucial for achieving high-quality results as well as good printability and runnability in the printing and finishing processes. Since paperboard is not used in the graphical industry as often as paper, we will be more specific about aspects to do with printing. When it comes to the different finishing techniques, paperboard's stability and strength offer unique and sometimes superior possibilities of enhanced design and converting efficiency compared to paper.

In the quest to achieve new levels of brand promotion, demands on marketing materials are constantly increasing. The combination of graphic design, finishing techniques and innovative shapes gives a product enhanced appeal and recognition. It is essential that designers and converters understand the interaction between paperboard properties and converting efficiency. The choice of paperboard will affect crucial conversion factors like printability, flatness, dimensional stability and creasing/folding properties, and thereby influence the ultimate design of the product. As a basic rule it is fair to say that the consistency of the paperboard product is the key to high efficiency.

Printing presses, finishing and converting machinery can accept a wide range of paperboard types at acceptable levels of productivity. However, tolerance for irregularities in critical parameters diminishes as speeds and complexity increase.

Handle the paperboard correctly and you will achieve first-class results from all available printing and finishing techniques. For general information on how to handle paperboard before, during, and after the printing and finishing processes, please refer to the chapter “Handling”.

Excellent print quality

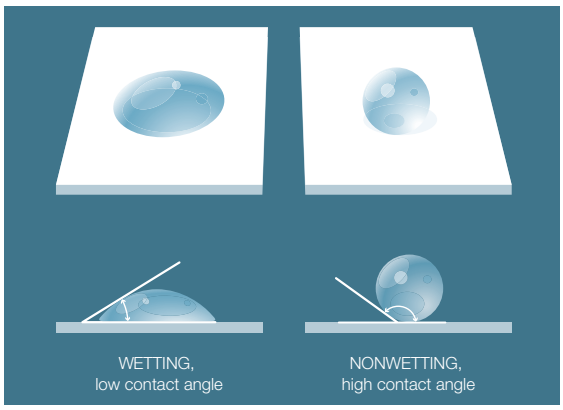
Paperboard for graphical applications must provide excellent print quality. To achieve this, the paperboard must meet stringent requirements in terms of its appearance and its performance during the printing process. The ability of the board to fulfil these requirements is referred to as printability. On the whole, high print quality is characterised by uniform print results, high ink gloss, and true colour reproduction.

Uniform print results

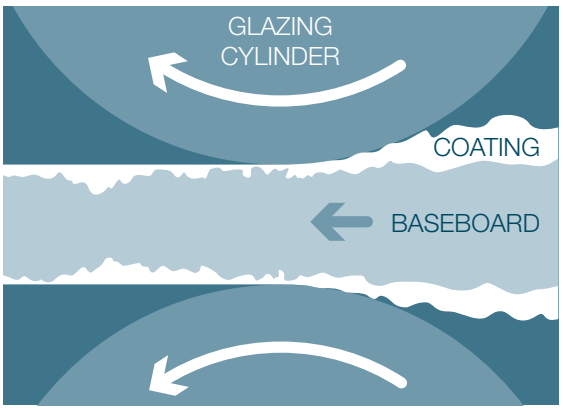
To achieve a good print in both half and full tones it is essential that both the ink transfer and ink setting be uniform.

- Good ink transfer from the ink carrying surface to the paperboard is essential. A uniform surface tension enables sufficient wetting of the surface by the ink. This is particularly important in flexo applications, digital printing (liquid toner), or when printing on extruded plastic surfaces or surfaces coated in some other manner prior to printing.
- Good ink setting is important regardless of the printing process used. This is achieved by ensuring the uniform absorption of oil and/or water (depending on the ink solvent used). For oil-based inks in conventional offset printing, the absorption of both water and oil is required as ink transfer can be obstructed by the presence of fountain water on the substrate surface. In offset printing, irregularities in ink setting can cause mottle or ink dry back (back trap mottle).

To achieve uniform ink transfer and setting it is important that the paperboard has a coating layer with an even thickness. A well monitored coating operation during the paperboard-making process contributes to uniform print results by ensuring an even coating weight and a controlled coating composition.



Good wetting properties enable sufficient ink adhesion and subsequent setting.

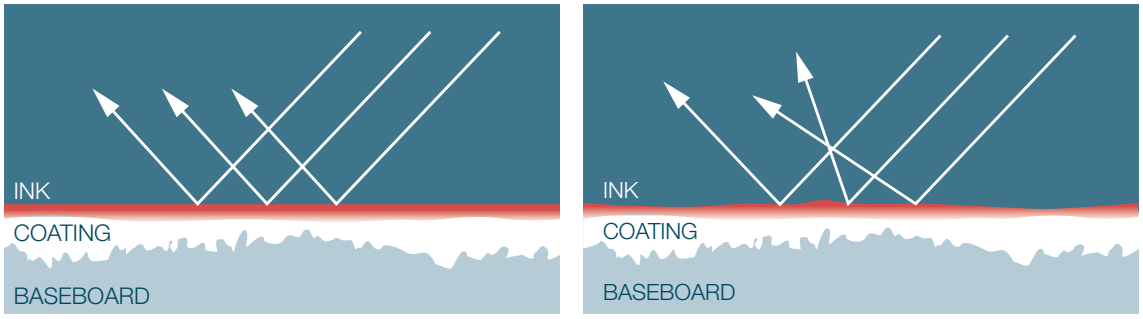


An uneven thickness distribution may lead to variations in coating amount as well as density after glazing. This will affect the absorption properties.

High ink gloss

High ink gloss is a property of a very flat, levelled ink film. This is true for any ink film and should not be confused with the term “high gloss inks”. Three key factors are involved in achieving high ink gloss: the thickness of the ink film, the ink levelling process, and the ink setting speed. Because a thicker ink film can fill cavities in the paperboard surface, the thicker the ink film, the more likely the ink is to form a smooth surface. It is for this reason that the thick ink films in screen printing often result in high ink gloss.

The ink film will level better if the paperboard surface is very smooth because the levelling process will be faster and easier. It is also very important to have a paperboard coating with uniform absorption properties so that the same amount of ink is absorbed over the entire surface. In addition, a paperboard coating with large pores will absorb ink more slowly, giving the ink more time to level better.



A well levelled ink film gives uniform specular gloss thereby enhancing the degree of gloss.

A factor that contributes indirectly to achieving a high ink gloss is the ink setting speed. The uneven surface of the ink film just after leaving the printing nip levels better if it is allowed to stay wet for a little longer. If the ink sets too quickly the irregularities in the ink surface do not have enough time to level out, so instead they become “frozen” in place. For this reason, slow ink setting helps to ensure high ink gloss. To slow down the ink setting process, look for a paperboard coating with a somewhat slower absorption rate (which is determined by the absorption properties, pore size and pore volume).

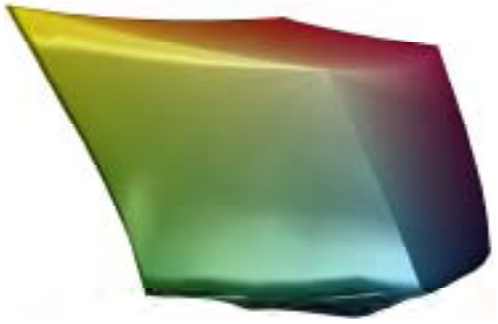
Usually printers want quick ink setting because it leads to fast ink drying, which speeds up the production process and reduces risk of set-off, etc. A desire for high ink gloss must therefore be balanced against a desire for quick ink setting/drying and some compromise may be necessary.

True colour reproduction

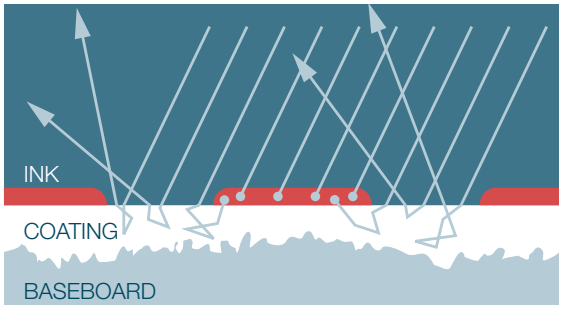
The factors that have the greatest impact on true colour reproduction are high ink density, control of dot gain (mechanical and optical), and the magnitude of the colour gamut that is possible to obtain with a given set of inks.

The ink density is a direct result of the amount of ink pigments transferred to the paperboard surface, depending on the water and oil absorption of the coating layer. Too much moisture on the paperboard surface may result in poor ink transfer for an oil-based ink (this is known as ink refusal). This moisture may be due to condensed water from a cold paperboard pallet, or excess fountain water from a previous print unit in multi-colour printing or excess fountain water that has not emulsified correctly with the ink.

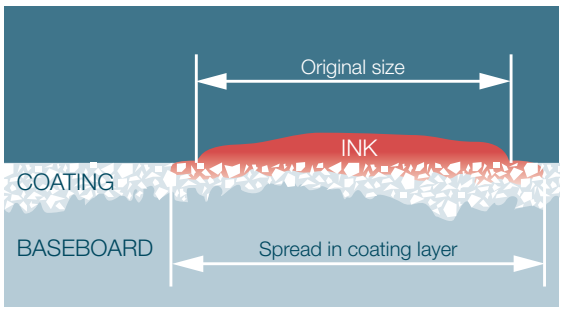
There are two kinds of dot gain: mechanical dot gain and optical dot gain. In offset printing most of the mechanical dot gain occurs before the ink hits the paperboard surface, so it is seldom necessary to consider the paperboard surface as a factor. However, in flexo applications or digital printing (liquid toner) the surface tension and permeability of the paperboard surface could cause the ink to spread more or less on the surface or inside the coating/baseboard structure. Optical dot gain is influenced by the light absorption of the coating and baseboard and their light-scattering properties. Good surface smoothness is considered to have a positive effect on optical dot gain.



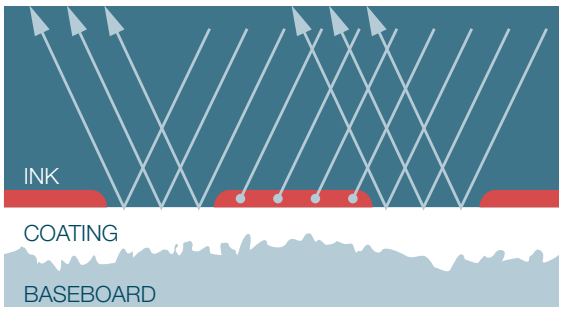
Fountain solution that is either non-emulsified or non-absorbed may obstruct ink transfer to both printed and unprinted surfaces.



The concept of optical dot gain, in which the amount of light is restricted through scattering and absorption compared to the ideal reflection.



Dot gain through spread in the coating layer.



Ideal reflection and absorption of light on a printed surface.

The reproducible colour gamut depends primarily on the ink quality, ink layer thickness, and ink density achieved. Other factors that affect the colour gamut are high ink gloss and the whiteness of the paperboard surface. For the secondary and tertiary colours the ink trapping properties are crucial. Good clean trapping will enable the reproduction of a larger colour gamut. It is essential that as much as possible of the second and third ink layers are transferred in an even pattern on top of the first ink with no irregularities in ink density. The ink setting properties and ink tack of the various ink layers influence each other; for this reason the colour sequence may be important.

Runnability and efficiency

Good runnability comprises the different factors that let you run your job efficiently through the press and finishing equipment with low down time and low material waste. Multi-ply paperboard has many important features that support cost-effective printing and finishing operations, as well as the total quality image of the finished products. The prime building block for efficient converting of the paperboard is a product which behaves consistently in both printing and post-press converting. Consistency makes the product predictable, which means in many cases a shorter make-ready. This reliability will also help maintain expected production rates from batch to batch year in and year out.

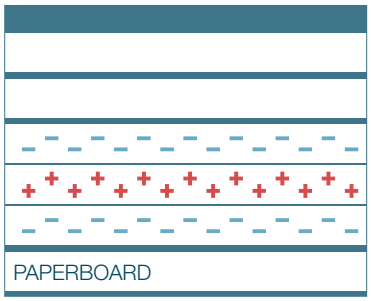
In-feed and operation

How fast you can set up the in-feeder and how well the substrate runs are factors that affect the total economy of a print- or converting job. The factors that mainly determine how quickly the job can be set up and processed are efficient feeding, flat sheets, dimensional stability, and dust-free stock.

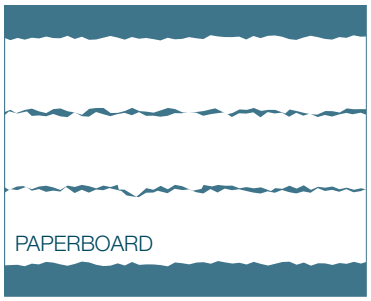
Efficient feeding

The main paperboard properties that affect consistent feeding from pallet to pallet or reel to reel are friction, uniform thickness and paperboard flatness/shape (the last of which is described in the following section). The friction originates from several different sources but the main factors are the surface chemistry and the surface topography.

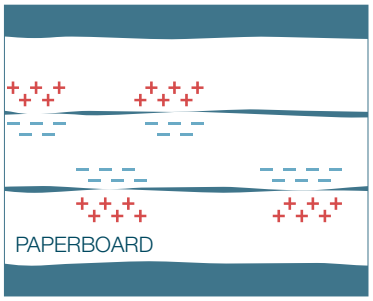
The sheets may adhere to each other due to electrostatic attraction. This is mostly applicable to thinner paper but may occur with lower grammages of paperboard. The best way to prevent electrostatic charges from building up is not to let the paperboard dry out too much.



Electrostatic attraction.



Rough surface enabling mechanical interlocking and friction.



Smooth surface with local charges due to a chemical-like attraction.

If the surface is somewhat rough you risk mechanical interlocking between the sheets, which will obstruct the feeding. On the other hand, a too smooth surface will create a larger contact area between the sheets, which might enhance the interlocking caused by surface chemistry. This effect could be compared to the force that makes it hard to separate two glass plates that are stuck together.

Uniform thickness is of importance in several operations. When feeding paperboard into a printing press or finishing equipment the double-sheet control function can engage if too large variations in thickness occur. This will result in a machine stop and lost efficiency. In a saddle stitching operation a large thickness variation of a thick paperboard cover can, when a very thin insert paper is being used, also trigger the control function which secures the correct number of pages collected. The thickness can also influence the print result in that a sudden drop in thickness can minimise the contact pressure between printing cylinder and substrate. This will lead to variations in print quality and losses in efficiency and quality.

Flat sheets

The flatness of the sheet affects the press speed and sometimes even the print results as well. Flatness irregularities are described as twist or curl. Both will cause difficulties in feeding and running the press or finishing machine. The best way to avoid twist or curl is to maintain the original moisture content of the paperboard (please refer to the chapter “Handling”).

Flatness is a crucial property of paperboard and will affect the efficiency of operations throughout the entire conversion chain. During the paperboard manufacturing process, control of curl and twist is a very complex operation. It starts in the forming of the multi-ply structure at the forming end of the board machine, where the following factors contribute to minimising built-in stress in the sheet:

- Fibre composition in the respective layers of the multi-ply construction
- Fibre orientation
- The content of small particles (“fines”)
- Controlled removal of water and rewetting
- Web tension in the drying section of the paperboard machine.

Optimising these factors will produce a flat sheet and will minimise the risk that uneven tensions caused by hygrodimensional (moisture-related) changes could occur later in the printing or finishing processes, causing distortion of the sheet.

Dimensional stability

In multi-step processing (or even in multi-colour printing) it is important to use a substrate with excellent dimensional stability. The substrate is exposed to many different forces that might stress the structure in such a way that the sheet changes its dimensions. The forces might come from hygro-expansion due to moisture exposure or from mechanical stress imposed on the sheet during either the printing or finishing operations. Different paperboard types are more or less prone to distort due to humidity changes or mechanical stress.

Dust-free stock

To achieve efficient operation of the printing or finishing machine you need a substrate free from dust or fibrous debris. Minimising dust or debris (mainly coming from the sheet edges) is achieved by controlling the pulping process and by optimising the retention of smaller fibres.

- Clean edges depend to a large extent on the fibres' ability to bond with each other. Fibres from chemical pulp are flexible and interlace easily with other fibres to form a strong network. In the case of mechanical pulp, the refining process plays a key role in increasing the binding abilities of the fibre network by providing larger contact areas between the individual fibres. Fine-tuning this process ensures a well bonded network.
- With the help of retention chemicals the small parts of fibres ("fines") are kept inside the network. This provides more contact points in the fibre network and helps to bind the fibres together. Fibre retention is essential for both mechanical and chemical pulp.

To achieve undisturbed run in the printing or converting machine you need a substrate free from dust or fibrous debris.

Ink application

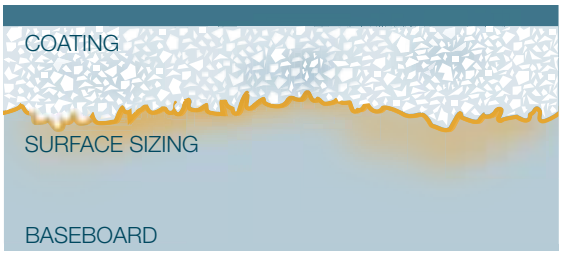
Paperboard features that are especially important for good ink application are good surface strength and good ply bond.

Good surface strength

In offset litho printing the inks have a very high tack. To resist the forces in the printing nip and to prevent coating picking, the coating must be well attached to the baseboard surface. A good bond between coating and baseboard is promoted by the following paperboard properties:

- To provide a strong bond to the coating, the fibres in the baseboard surface should adhere well to each other. If the fibres are not sufficiently bound together the coating can come off, taking some of the top fibres with it as well (this is known as coating picking). The good bond between the fibres is promoted by good fines retention.
- Uniform surface sizing of the baseboard also helps to create a strong base for the coating. Weaker spots may otherwise be torn off in the printing nip.
- Good internal bonding within the coating layer is a vital factor. This is not only an internal coating issue, but can also be influenced by the baseboard. Variations in the baseboard surface porosity may cause binder migration in the coating layer and thereby variations in the internal strength.

Uneven surface sizing penetration will result in locally weaker areas.



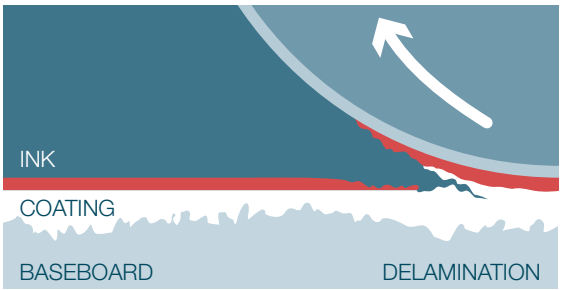
Local variation in the distribution of coating components can be due to variations in surface porosity either indirectly due to baseboard density or directly due to uneven surface sizing distribution.

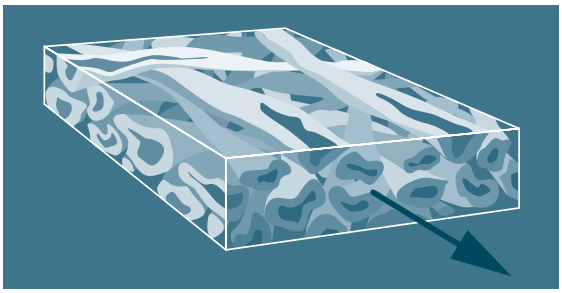
Good ply bond

Good ply bond is primarily applicable to offset litho printing, since the tacky inks impose a high force on the substrate. This force is a combination of pulling and shearing in the exit of the printing nip and may cause delamination. Unlike coating picking, which may occur in the interface between the coating layer and the baseboard surface, delamination occurs within the baseboard structure, either within a ply or between different plies, often close to the surface.

Delamination is very undesirable during the printing process, so the ply bond must be sufficiently strong to ensure this does not happen. However, delamination is necessary during the creasing, folding and embossing operations, so the ply bond cannot be too strong either. Therefore the properties of the baseboard must be very well balanced.

Good ply bond depends on the forming of a strong and elastic network inside the baseboard. This is influenced by the fibre characteristics and the formation of the sheet. The use of virgin fibres with different tensile strength, stiffness, shape and bonding abilities affects the strength of the final fibre network. The key to producing a fibre network with the right strength is to use virgin fibres together with controlled sheet forming on the paperboard machine.



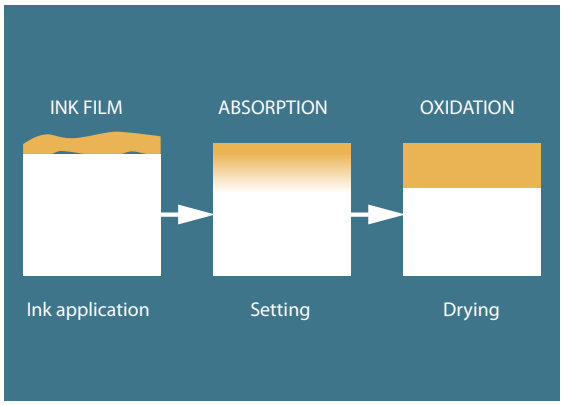


A denser fibre structure promotes strength.

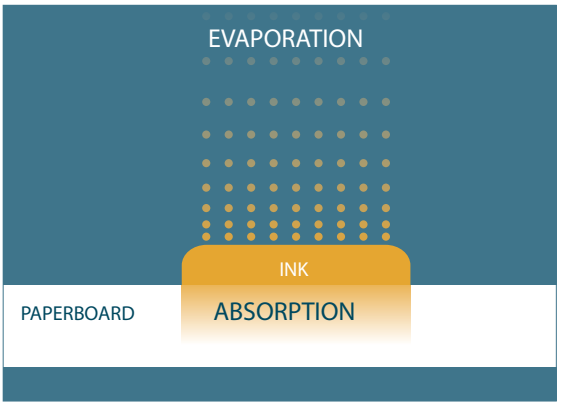
Quick turn around

To achieve high print speed and good economy it is important to be able to turn the sheet around and print the reverse side as soon as possible after the first print run. The most important factor for quick reverse side printing is ink drying. Too much ink or the wrong pH in the fountain water may decrease the drying speed.

Since different ink types are designed to dry in different ways, the drying process is influenced by various surface properties of the substrate. It is therefore vital to match the ink type carefully to the absorption properties of the paperboard. With offset ink for coated surfaces, the ink must set fast enough to enable the drying process. Smaller pores in the coating absorb the low viscosity part of the ink oils more quickly and the total pore volume will affect the speed of ink setting.



The phases of ink drying. Absorption of the vehicle enables oxidation.

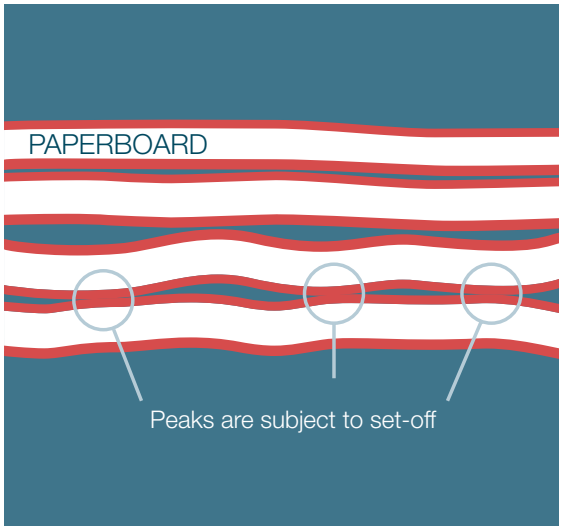


Modern inks often set and dry due to a combination of absorption and evaporation.

No set-off

To minimise the risk of set-off, fast ink setting and drying are crucial. The required absorption properties correspond to those mentioned above. Other paperboard properties that influence set-off are surface smoothness and low density.

- Surface smoothness involves correctly matching the surface properties on both the print side and the reverse side. With a rough surface, set-off from the “peaks” in the surface topography may occur. In contrast, with a very smooth surface, the large contact area between the sheets may increase the risk of set-off. It is therefore extremely important to match the ink type carefully to the surface smoothness of the paperboard.
- A high density substrate, such as a thick, wood-free paper, will result in higher pressure on the underlying sheets in the delivery stack compared to a high bulk paperboard. Given the same height of delivery stacks in a sheet-fed printing press, a high bulk substrate such as paperboard decreases the risk of set-off.



Runnability in general

In addition to the factors discussed above (flatness, dimensional stability and lack of dust) good runnability in the various post-press operations basically depends on good rub resistance and no powdering.

Good rub resistance

It is essential for an ink or varnish film to be durable and preserved through the finishing operations and when handling the finished product. Factors that influence rub resistance are ink type and surface abrasiveness.

- The best way to achieve good rub resistance is to choose an ink with a somewhat higher wax content. Here, too, it is very important to match the ink type properly to the absorption properties of the substrate surface.
- A smooth surface contributes to a good rub resistance by having fewer peaks in the surface topography, thereby helping to avoid loss of ink or varnish in the finishing operations. Surface abrasiveness is also influenced by the coating formulation and choice of coating pigment.

No rub-off

The ink pigments should be well bound to the surface and not come off during the finishing operations. Once again, this requires carefully matching the ink type to the substrate absorption properties. The surface should not absorb the ink binder, which would leave the pigments somewhat less bound to the surface. This can occur when using a substrate with too high or fast ink absorption, a problem that is primarily controlled by coating pore size and total pore volume.

Handling

When you work with multi-ply paperboard and handle it properly, you will find it is a very compliant material. The multi-ply construction is the basis of many of the excellent characteristics that help you to achieve the best quality and runnability in your printing and finishing operations. However, the multi-ply construction also requires a few special – but very important – precautions when it comes to handling.

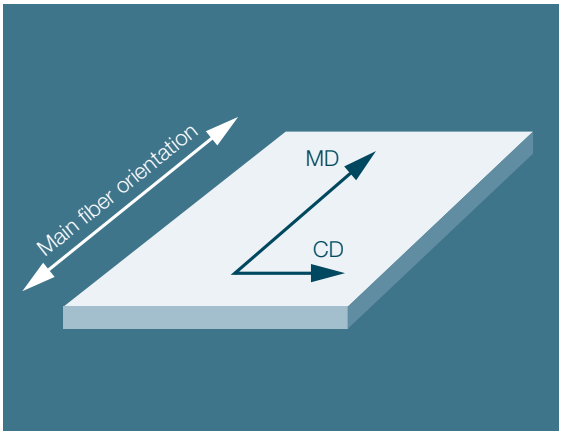
Board, moisture, and flatness

Paperboard is sensitive to changes in humidity. The main way to retain the original characteristics of the paperboard throughout all production steps is to retain its original moisture content. Exposure to variations in humidity will result in a change of paperboard shape or dimensions. Drying out will make the paperboard more brittle.

Our paperboard is produced with an original moisture content to match a relative humidity of about 50%. This is the ideal humidity content with respect to printability and runnability. Before delivery the paperboard is packed in a moisture-proof wrapper, which offers satisfactory protection against moisture changes. This protection lasts as long as the wrapper is left undamaged.

Dimensional changes of the fibres

Cellulose fibres are hygroscopic and will react to changes in humidity by swelling during moisture uptake and shrinking when losing moisture. For the cellulose fibres themselves, the relative dimensional change (swelling and shrinking) is larger by up to three times in the cross-fibre direction than in the length direction. On the paperboard machine the manufacturing process always gives some preference to fibre orientation in the machine direction (MD) of the sheet. This means that the majority of the fibres lie lengthwise, in the machine direction. When converting paperboard, the fibre direction is therefore a key parameter to consider relative to the machine direction used in the printing and finishing operations.

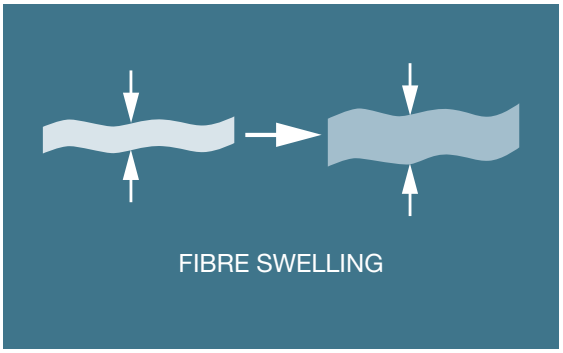


The production process on the paperboard machine always tends to lay the fibres more along the machine direction (MD). As a result, dimensional change of the sheet due to moisture is more pronounced in the cross direction (CD).

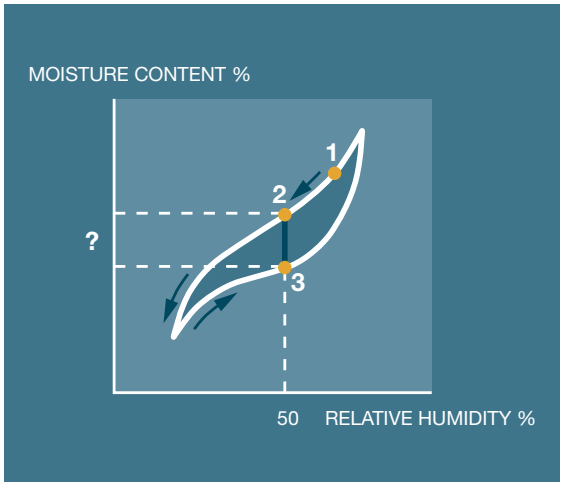
Paperboard is manufactured to be flat in a defined environment of 50% relative humidity. Exposure to another environment will create a situation where the paperboard shape becomes unstable. As paperboard is a natural material, there is practically no way to prevent it from adopting a moisture content which is in equilibrium with the surrounding air. Any change in moisture content will affect the diameter of the cellulose fibres and therefore the shape of the paperboard sheet. If the front and back of the paperboard sheet experience an equal amount of dimensional change due to moisture, any change in moisture will only affect the sheet's dimensions, i.e. expansion or shrinkage. However, when the dimensional changes are unequal (asymmetric), any given change in moisture will cause the sheet to curl.

Different types of curl and twist

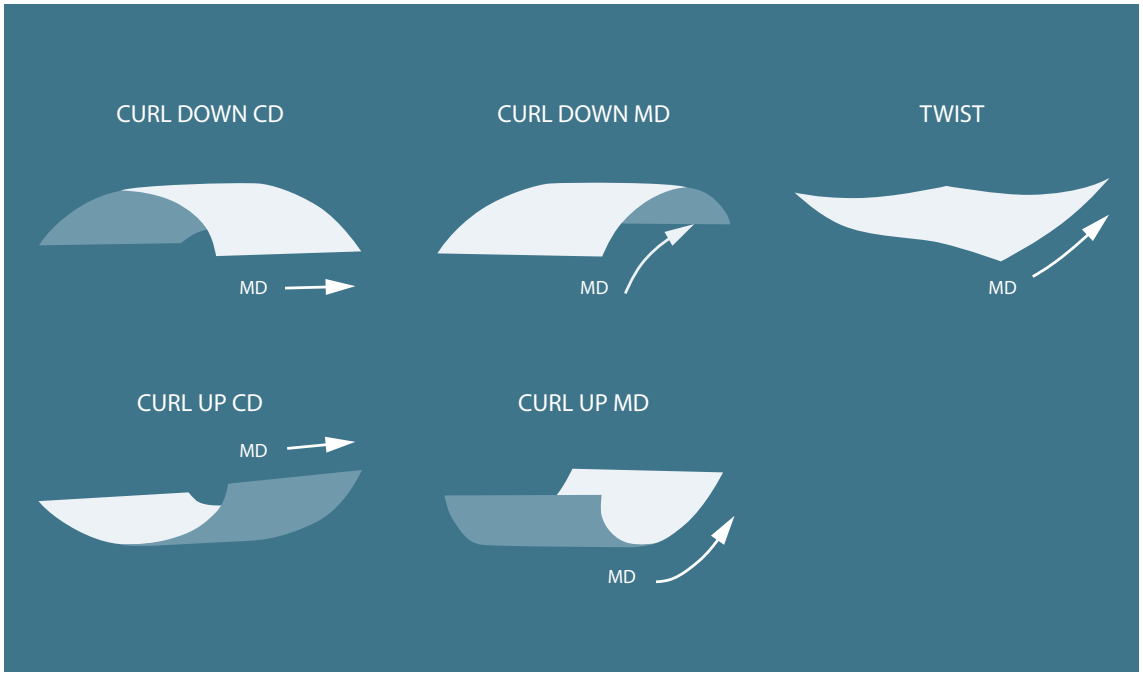
Deviations from flatness are defined in terms of curl and twist. Flatness should be evaluated on a single sheet and not on a pallet, since the shape of a pallet can be influenced by thickness variations. If the curl is oriented in the machine direction of the paperboard, it has nothing to do with moisture effects. This curl, called reel curl, occurs when the paperboard has been stored for a long period of time in reels tightly wound around a narrow diameter core and may have been insufficiently decurled during the sheeting operation.



Wood fibre swells more across its width than along its length.



Due to the hysteresis effect, changes in relative humidity in the converting environment will affect the moisture of the paperboard in different ways depending on whether the moisture increases or decreases.



Best practice after delivery

Arrange for proper storage

It is very important to arrange for the proper storage of the paperboard as soon as it arrives. Since paperboard is hygroscopic, it should neither be exposed to too humid conditions nor too dry conditions in order to maintain its original moisture content. Also, the paperboard should not be exposed to too low or too high temperatures. Direct sunlight should be avoided.

We advise you to take the following precautions

- Leave the wrapping in place until just before you print. This is important because the plastic preserves the original moisture content of the paperboard and also protects it from being damaged.
- Do not leave the paperboard pallets outdoors, not even under a roof. Fluctuations in temperature and humidity may alter the properties of the paperboard due to swelling or shrinking of the fibres.
- Make sure that the paperboard is kept in a room that has even temperature and humidity so that it becomes acclimatised to the environment where it will be printed.

Best practice in production and use

Traceability

The delivered paperboard is identified by its order number and its pallet or reel number. We recommend that you record these numbers to provide identity and traceability throughout printing, finishing and use, or that you keep the labels until the job is finished. Knowing the order and pallet numbers speeds up problem solving in the event of quality variations.

Before printing and finishing

Correct handling of paperboard is very important for achieving the best results in printing, finishing and use. To ensure this we recommend the following procedures:

- Avoid printing on paperboard that has not been at “rest” in its plastic wrapping for two to three days after delivery.
- Do not remove the moisture-proof wrappers until the board has attained the same temperature as the environment in the printing or finishing room. Please note the table below.
- The recommended relative humidity in the printing and finishing rooms to prevent curl, misregister, or other problems is 45 – 60%. Please refer to the above section “Board, moisture and flatness”.
- Avoid manual cutting of the sheets. If the cuts are not 100% correct they might induce stresses in the sheets that might cause the different layers to separate from each other.

The table below shows warming-up times before removal of the wrappers, i.e. the time required for the paperboard to attain the same temperature as the environment, depending on the initial temperature differences.

Pallet or reel weight	Initial temperature difference between board and printing room (room temp assumed to be about 20 °C)		
	10 °C	20 °C	30 °C
400 kg	2 days	2 days	3 days
800 kg	2 days	3 days	4 days
1,200 kg	2 days	4 days	5 days

It is very important to pay attention to the warming-up time. The time required to establish the temperature equilibrium varies depending on the temperature difference and the weight of the board pallet or reel. The wrappers should not be removed before the board has reached the temperature in the printing room. If unwrapped cold paperboard is exposed to a warm environment, the air adjacent to the board might be cooled below its dew point (i.e. point of condensation). This moisture will then be absorbed by the paperboard.

During printing and finishing

Multi-ply paperboard needs to be handled with care or it can easily be damaged. One particular form of damage is cigar rolls (or roll backs) caused by the rolling up of the top layer of a sheet. You can prevent this problem completely by ordering unreamed paperboard and the right sheet size from the manufacturer. If the board is stacked directly on the pallet at the board mill (without any subsequent handling) and the printer direct feeds, then these “cigars” are normally never seen. Should you need to restack the paperboard, avoid moving reams that are too heavy or use two operators.

After printing and finishing

The moisture content can decline after printing, especially when the sheet has been IR or UV dried. If the temperature of the pile attains more than 60 °C – and if the paperboard is not properly protected – it could lose its moisture when cooling.

This is why paperboard in sheet form should be rewrapped with moisture-resistant material after printing. Rewrapping is particularly important in order to ensure perfect register when the paperboard is printed in two or more passes through the printing press. It is also important to wrap in this way in order to achieve good register between the print and the next process, e.g. cutting and creasing, guillotining or bookbinding.

The finished paperboard product should be wrapped in moisture-resistant material after finishing and prior to shipment to the customer or to further finishing operations.

Printing

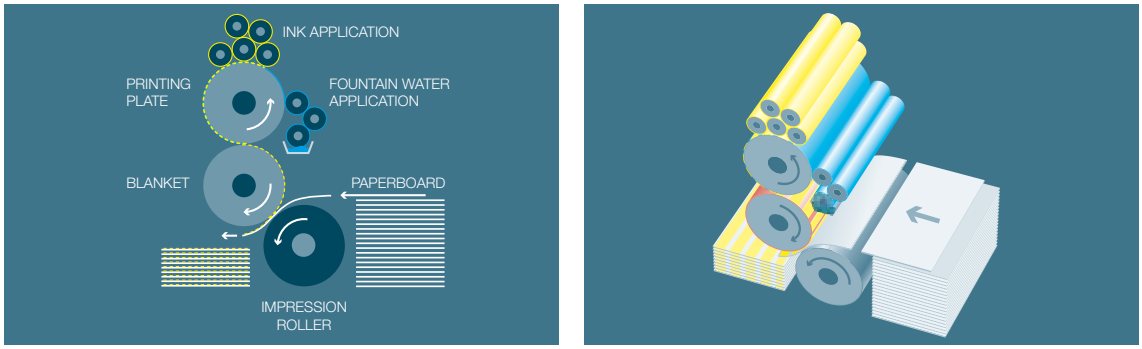
With paperboard you can use all available printing techniques. You achieve at least the same high-class graphical presentation as when using high-quality paper. Paperboard's good printability and high print quality, together with its many different finishing options and superior finishing results, are many good reasons to make paperboard your material of choice.

When you print paperboard there are a few things to keep in mind – things that are not always obvious if you are used to paper. This chapter will highlight some of them. Stiffness and bulk – the favourable thickness/grammage-relationship – are the most significant characteristics which make paperboard superior in many respects. However, the effects can come as a surprise if you are not used to working with paperboard. Another main difference to consider is the multi-ply construction of paperboard.

There are many good reasons to make paperboard your favourite choice.

Offset lithography

Offset lithography is a method – or rather a set of methods – often used to print paperboard. It provides very high print quality and is commercially attractive for a wide range of run lengths. The printing process involves a complex interaction between the ink, fountain solution, blanket, paperboard characteristics, and drying mechanisms, together with the pressure, temperature, and press speed. Thin paperboard can be printed on the same type of presses that are used for printing paper. However, the best way to print thicker or stiffer paperboard is in a press suitable for thicker boards. In this type of press the rollers and sheet transport systems are designed for thicker and stiffer substrates. With their double-size impression cylinders and specially adapted sheet guidance systems these presses are well suited for thicker or stiffer substrates.



The principle of offset lithography.

If a considerably thicker substrate is printed on an ordinary press without changes to the blanket and plate packing, the thicker substrate adds to the diameter of the impression cylinder, making it appear larger than the diameter of the blanket cylinder. As a result, the blanket cylinder and the impression cylinder will have different circumference speeds, creating stress on the paperboard. If the ink is too tacky the paperboard will stick to the blanket longer in the printing nip and be released from the blanket at a greater release angle. A greater release angle causes greater forces on the sheet. This might lead to linting or picking and, in extreme cases, possibly also delamination.

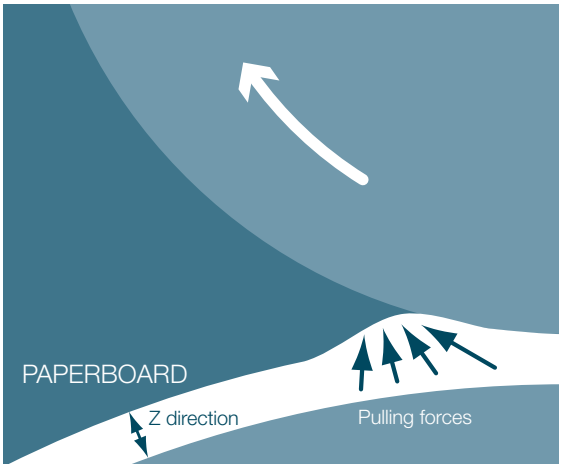
Paperboard handling in offset printing

The multi-ply construction of paperboard has several major advantages over a single-ply paperboard but needs to be handled somewhat differently. To avoid problems when printing paperboard, there are a few factors to consider.

Delamination

The main risk with multi-ply paperboard is delamination. If the paperboard is handled too roughly, the different layers in the multi-ply construction could separate from each other. To avoid this problem please keep in mind the following few points:

- Do not apply higher pressure than necessary between the blanket cylinder and the impression cylinder.
- Do not use significantly tackier inks than normal. Spot colours are known to be tackier than the Euroscale inks.
- Be careful when the press is cold. Start it up slowly to get the ink viscosity right before running it at full speed (the Monday morning effect).
- Reduce the press speed if necessary. Slowing down the press will reduce the force acting on the paperboard.
- Use quick release blankets. This will reduce the force on the board.
- Avoid manual cutting of the sheets. If the cuts are not 100% correct they could induce stresses in the sheets that in turn could cause the different layers to separate from each other.



The forces inflicted on the paperboard after the printing nip are a combination of pull in the Z direction and shear.

Delamination may be avoided if you know how to handle the paperboard.

High ink tack

Ink tack that is too high may cause delamination. If the ink vehicle penetrates very quickly into a highly absorbent substrate, the tack build-up of the ink may be high. If it is too high, the substrate may delaminate when leaving the printing nip. Adding suitable gel or varnish to the tacky ink is a way to slow the ink setting and prevent delamination (request recommendations from your ink supplier).

Blistering

One very special defect – though a very rare one – is the blistering that might occur when IR drying with the IR lamps set at maximum. Too much heat may cause the moisture in the paperboard to turn into steam inside the paperboard layers. Since the steam has a larger volume than the original moisture, it will cause blisters on the paperboard. This is why paperboard in general is not suited for heat-set offset applications.

Anti set-off spray powder

Spray powder is recommended to reduce the risk of set-off. However, to avoid problems in later production steps we advise you to always minimise the use of spray powder. Please consult with the people responsible for the subsequent steps before increasing spray powder amount or particle size significantly.

There are many suppliers of spray powder and a number of powder types with several modifications to the particles. The main particle categories are calcium based, sugar based, and starch based. Starch based particles may also come in a modified form microencapsulated in silicone.

Paperboard type does not have much influence on the choice of particle origin. However, we do not recommend the use of highly abrasive, large particles when using our most glossy products, since this may cause micro-scratches on the printed surface.

Paperboard properties do influence the choice of granular diameter. Ranging from the very fine 15 µm particle to the very coarse 70 µm particle, the choice mainly depends on ink and varnish coverage, substrate surface smoothness, and delivery pile pressure. For our products that are fully coated on both sides with a very light ink coverage or if there is a low delivery stack, you may go down as far as between 25 and 30 µm particles. To ensure low set-off when working with products that have a lightly coated or uncoated reverse side, or a fully varnished surface, or when there is a large sheet size or high delivery pile, the particle size (or quantity) should be increased.

Please consult with the people responsible for the subsequent steps before increasing spray powder amount or particle size significantly.

Alternative offset printing techniques

There are a number of alternative offset lithographic printing techniques. We will briefly describe the UV offset, waterless offset and hybrid offset processes.

UV offset printing

UV offset printing means using inks that cure (dry) by exposure to ultraviolet light rather than by oxidation and absorption like conventional inks. The press has powerful UV lamps mounted in it, and the inks contain a chemical compound (a photo-initiator) that triggers a chain reaction when exposed to the UV light. This reaction changes the structure of the ink film from fluid to solid in just a split second. In other words, there is very little absorption of ink into the substrate.

The biggest advantage of UV offset is that the inks dry immediately after being exposed to the UV light. The printed sheets can be handled directly after being printed. The inks also have excellent stability on press and excellent gloss.

A common problem, however, is poor adhesion of the printed ink film due to its shrinking during curing, in some cases to a point where it is a problem in post-press handling. It is important not to use more energy than needed to cure the ink. The strong UV lamps can also cause the substrate to yellow somewhat; Solid Bleached Board is less sensitive to this than other boards.

Waterless offset printing

In waterless offset printing the plates are different from the conventional offset plate. The non-imaging areas are held ink free by the specific surface tension of the plate and not with the aid of water. Aside from this, there is no fundamental difference between conventional offset and waterless offset.

However, since the fountain water plays a big role in the conventional offset process, a waterless system must be composed of different or modified components (inks, additives, and press). It is possible to print dry by mounting waterless printing plates in a conventional offset press and not using the dampening units. However, to be 100% successful it is desirable to have better control of the process. The press should be equipped with water-cooled rollers in order to keep the temperature of the press at the right level. This is important because the inks are very temperature sensitive and will drop in viscosity with increasing temperature.

Waterless offset means faster make-ready. An often reported advantage is also lower dot gain and sharper dots. This enables the use of finer screen rulings than on a conventional offset press. Some printers also report shorter drying times, since there is no water emulsified with the ink.

All paperboards are well suited to waterless offset printing and will give excellent print quality. However, there are some things to note and understand about this printing method and how it should be set up when working with multi-ply paperboard.

All Invercote grades are well suited for waterless offset printing and will give excellent print quality. However, there are a few things to note about the inks used.

The main area to focus on is the inks. For waterless offset they are normally formulated to have higher viscosity and higher working tack than conventional inks. Since there is no water emulsified with the ink it will not decrease as much in tack as a conventional ink on press. This could mean a higher working tack than desired. The ink will also tack up much more quickly than an emulsified ink during a press stop. Even at shorter standstills it may be necessary to spray the rollers with a stay-open compound to keep the ink from tacking up. If the operator is not aware of these factors and does not take appropriate steps to control them, high ink tack may cause delamination.

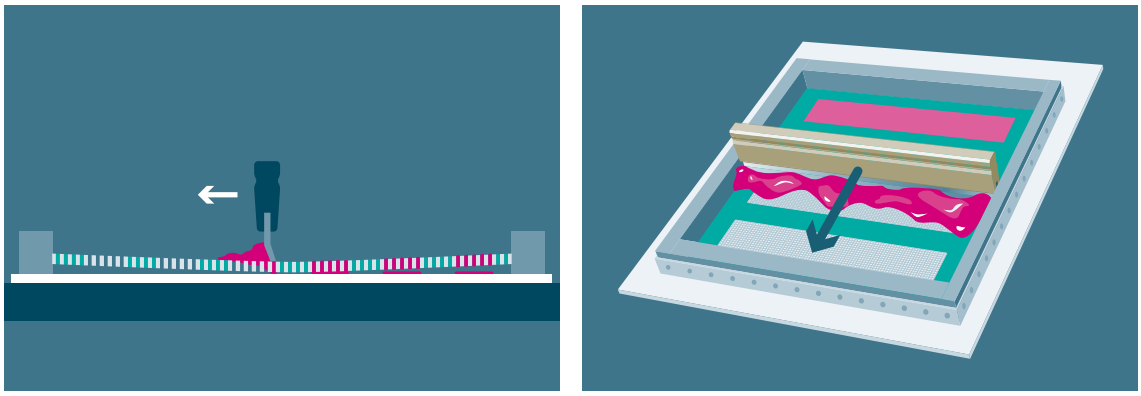
Hybrid offset presses

Hybrid offset presses are offset presses with additional equipment using other techniques, like flexo or digital printing.

- Offset and flexo: This is an offset press equipped with a flexo unit at the end. The flexo unit is often used for applying water-based varnish but can also be used for special inks. One example of this usage is to print a special spot colour with fluorescent ink. Another example is printing metallic inks. These benefit greatly from being applied in a flexo unit because the flexo technique allows the pigment particles to be larger than in offset ink. The larger particle size increases the metallic shine.
- Offset and digital: Offset presses can also have digital printing equipment mounted. Nowadays there are offset presses with inkjet units for printing very simple designs, e.g. bar codes or dates. In the future it is likely that these hybrids will become increasingly popular. When the speed and quality of digital printing techniques have increased, combinations of offset and digital presses will be further developed. This will make it possible to combine true individualisation of each print with the high and consistent quality of offset printing.

Screen printing

There are two different screen printing methods: the flat bed method and the rotation method, of which the former is more common for printing graphic paperboard. Screen printing is very suitable for substrates that are too stiff to be printed on other presses. Some screen presses are also capable of printing much larger sheets than normal presses. These factors make screen printing ideal for producing large paperboard displays.



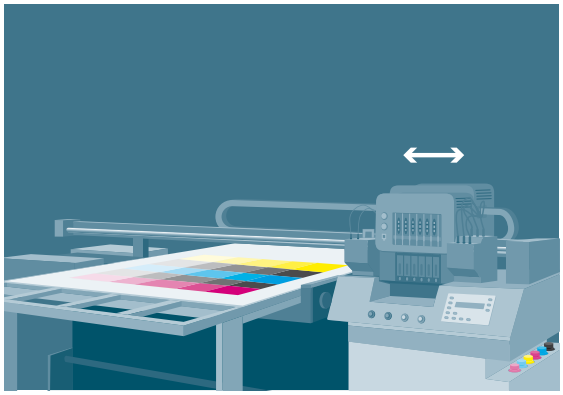
The principle of screen printing.

Paperboard has some clear advantages in screen printing. A substrate with low amounts of dust and debris is important in all printing methods, but in screen printing it will have more direct effects on the production economy and perhaps also indirect effects on the print quality. Spots in the printed image from loose fibres would eventually force you to stop the press to clean it. As a result you lose production time and the mesh may also become clogged with partly dried ink, distorting the hues and image details.

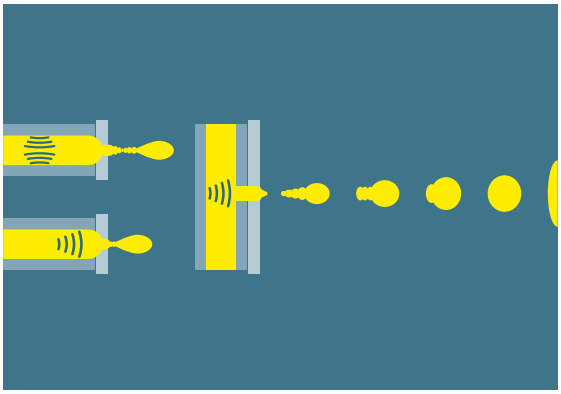
Paperboard's smooth coating is another very important advantage, since it will not absorb much excessive ink. Screen inks are expensive and screen printing produces a much thicker ink layer. This, of course, makes the ink layer more resistant to scratches after a good drying period. The ink layer also retains its hue and/or saturation better when exposed to sunlight compared to other printing methods. Inkjet in large format is gradually moving in to replace screen printing for certain applications.

Digital printing

Digital printing is an expression that encompasses all non-impact printing methods (NIP). The main shared feature of these systems is that you are able to reproduce all colours on a single printing unit. In this printing unit the master image is prepared and positioned directly from a computer file, either directly on demand on each sheet or using an intermediate carrier such as a blanket cylinder or an electrically charged cylinder. The required make-ready time is reduced compared to most other printing methods, but conditioning of the paper or paperboard and adjustment of data files is often needed. However, digital printing is most suitable for very short runs and individualised printings, jobs that were previously extremely expensive to do. A few of the NIP printing methods have been around for years. The most frequently used are electrophotography with powder toner, thermography and inkjet in its simplest form. The development of computer capacity as well as more finely tuned imaging devices and inkjet head design has led to improvements in quality and speed. These have permitted the transition from office printing to industrial production. The introduction of liquid toner in electrophotography and UV resistant inks in inkjet has led to further quality advantages and extended end uses.



The large format inkjet printing principle widely used for displays.



Three general types of drop ejection in inkjet, either directly through piezo-electric crystals or indirectly though acoustic pressure.

Paperboard in digital printing

Due to the multitude of available NIP technologies it is difficult to give specific recommendations. For all methods using electrical charges the moisture level of the substrate needs to be controlled, as a lower level has proved to give better results. For liquid toners and liquid inks the surface chemistry and porosity play an important role in enabling sharp image reproduction and good ink adhesion.

For end uses like displays, cards and covers in smaller volumes, paperboard is widely and successfully used in various print engines. Consistency in thickness is an important feature in the feeding of the sheets as well as in the consistent transformation of toner and ink. It may not be possible to use stiff paperboard if there are tight turns in the sheet paths in the machine. The finishing or converting equipment may also be too weak to process stiff and resilient paperboard.

Make the most of your finishing options

As we said before, paperboard is a forgiving base material. This becomes particularly obvious when it comes to the finishing operations. Below the strong, smooth and white surface you find all the strengths you need to carry out the most demanding applications. Whether you just add a varnish to highlight the graphic presentation or you produce the most advanced designs in multi-step processes, you can rely on getting excellent results.

In post-press finishing you will discover how well the substrate performs in practice when it comes to runnability and cost effectiveness in the different processes. The multi-ply construction and surface characteristics of our paperboard products facilitate a wide range of finishing options. We describe the runnability aspects in conjunction with the different sections in this chapter.

Finishing techniques place different demands on the substrate. The following paperboard features allow you to make the most of your finishing options.

Strength and toughness are measurable as tensile strength, tearing resistance, delamination strength and compression strength. These properties are vital for achieving intricate designs such as embossing and complex structural shapes.

Creasing and folding abilities depend on a complex combination of factors such as tensile strength, compression strength, delamination strength, bending resistance, flatness, and dimensional stability. These factors are vital for the paperboard's ability to "forgive" the permanent deformation of deep and narrow creases and to retain the intended shape of folds.

Flatness and dimensional stability are vital for achieving excellent results in the finishing operations. The choice and composition of raw materials combined with carefully controlled manufacturing processes result in a paperboard that retains its flatness and dimensional stability throughout all operations. However, since paperboard is a hygroscopic material, it should not be exposed to conditions that affect its moisture content. Please refer to the chapter "Handling" for information on how to prevent moisture problems.

The above-mentioned paperboard characteristics plus many more are described in the **Iggesund Reference Manual** and most are specified in the **Product Catalogue**.

Varnishing in practice

Varnishing, be it matt or gloss, is a way to enhance the surface design and also to protect the printed surface. There are many possible combinations of printing methods, printing inks, types of varnish and varnishing methods. You can also increase adhesion for film wrap, apply heat seal varnish or reduce permeability. We will describe the most common combinations below.

Varnishing methods

There are many types of varnishes. They are similar to printing inks but contain no coloured pigments. The vehicle might be a solvent, drying oil, pre-polymer, or monomer. In addition to the vehicle, the varnish may contain resins, dryers, waxes, or photo-initiators.

The varnishing operation can be carried out before printing (matt varnishing is formulated to have a finish which can be overprinted), during printing (inline) or as a separate process after printing (offline). The varnish is applied on a printing unit or by using a special varnishing unit attached to the press, after all the colours have been printed.

The application methods are:

- conventional plate and blanket via a normal ink unit
- modified dampening system
- end-of-press roll coater, dedicated for varnishing
- multiple-coating units for combination work.

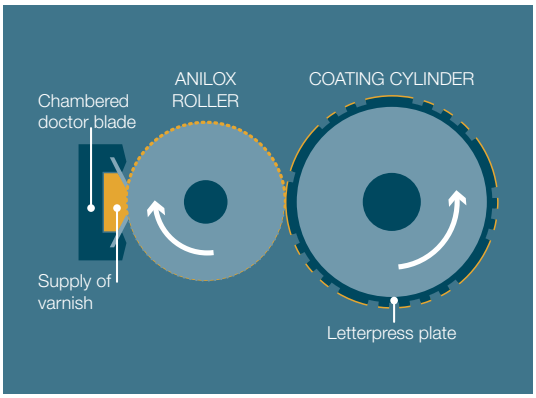
Different types of varnishes

We recommend that you check with your ink supplier which varnish is most suitable for the type of ink you are using, especially if you are considering a UV cured varnish or if you plan to hot foil.

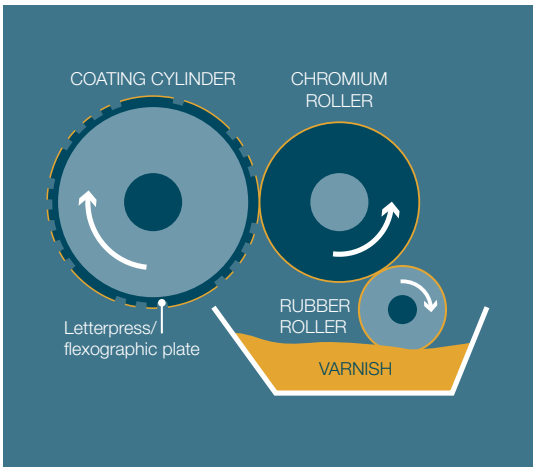
In offset printing the following types of varnish can be used:

- Overprint varnish, which can be described as conventional offset ink or UV ink. The drying takes place with the same mechanism as for quick-setting offset inks, i.e. absorption of the low viscosity part of the varnish and then oxidative polymerisation drying of the vegetable oils.
- Dispersion varnish, which resembles water-based flexo ink. The varnish is applied inline in the printing press in a coating unit and is usually dried with an IR drying unit or heated air.
- UV cured varnish, which can be described as a UV printing ink. The drying is a polymerisation process in which the varnish film is cross-linked with the aid of UV light. The gloss depends on the varnish thickness and viscosity.
- A combination of UV and dispersion varnish for special effects.

Since there are many types of varnish, we recommend that you check with your ink supplier which varnish is most suitable to use with the type of ink you are using.



Chambered doctor blade system.



Varnish application with metering roller.

The advantages and disadvantages of the different types of varnishes are summarised in the following table. All three varnish types are also available in matt versions.

Varnish type	Advantages	Disadvantages
Over-print varnish (conventional offset ink)	High gloss	Slow varnish drying
	Very good rub resistance	Spray powder necessary
	Does not affect the paperboard's dimensional stability	Risk of yellowing
	Resistant to alcohol	Not odour neutral
	Processable as a printing ink	
Dispersion varnish	Very high gloss	Can affect the dimensional stability of the paperboard
	Very good rub resistance	Resistance properties have a limited lifetime
	Quick drying	Alkali-resistant inks necessary
	None to very little spray powder necessary	
	Odour neutral	
	Deinkable	
	No risk of yellowing	
UV varnish	Highest gloss	Odour neutral under some conditions
	Best mechanical and chemical resistance properties	Content declaration necessary (skin irritating)
	No spray powder necessary	Limited deinkability
	No set-off in the stack	High varnish cost
		Difficult to apply inline with conventional inks

Recommendations

The key paperboard properties to consider for varnishing are the same as for printing. Since gloss varnish is used for the purpose of reflecting light in a uniform way, the result depends on a very smooth and uniform paperboard surface. To be able to reflect – and retain – as many colours as possible, the whiteness of the board is also crucial. These criteria are well fulfilled by graphic paperboard. To avoid blemishes, the surface of the paperboard must be clean and especially free from dust or anti-set-off spray powder.

Film and foil lamination in practice

Film lamination is used for the purposes of creative design and practical function. There are many types of films, and this variety makes it possible to achieve a multitude of special creative effects and use different ways to enhance the design of book covers, exclusive brochures, maps, cards, menus, posters, etc. The film also protects the surface from scratches, stains and other damage.

Film suppliers produce standard interchangeable products as well as their own speciality niche products. When combined with paperboard, film lamination offers a very wide range of possibilities. The long-proven glue lamination technique widens the field of paperboard applications into areas where more complicated and expensive constructions would otherwise be required.

The film lamination operation

Lamination is a technique in which a film is glue laminated to the paperboard surface to achieve aesthetic effects or surface protection. The film is reel fed and the adhesive is applied to the film (except when using thermal film). The paperboard web is fed into the press and, when passing through a calender, it is pressed against the plastic film. Since glue lamination involves adding and removing moisture, this operation must be carried out very carefully so that the process results in strong, flat products.

Films and adhesives

A wide selection of films can be used in combination with paperboard. The most common way to create a glossy surface and protection for the print is PP (polypropylene). It provides a durable material with special visual and tactile properties. The type of film may be limited by the chosen adhesive system. In the case of water-based and solvent-based adhesives, the film is dried to increase the tack of the adhesive. The advantages and disadvantages of different types of adhesives are summarised in the following table.

Type of adhesive	Advantages	Disadvantages
Water-based (acrylic)	Light stability	Not suitable for all substrates
	Good creasing, embossing, hot foil stamping ability	
Solvent-free (polyurethane, acrylic, polyester)	Very easy to run	Solvent extraction equipment
Solvent-free (polyurethane)	Reduction in glue weight	Difficult to run
	Full range of plastic film possible	
	High production speeds (70 m/min)	
	No dryers (less energy)	
Thermal films (preapplied thermal adhesive)	Easy to run	Specific equipment needed
	Rapid machine start-up	Cost of film
		Problem when hot foil stamping
UV adhesive	Short start-up time	Cost of glue and machine
	Excellent adhesion	Yellowing
		Risk of cracking and curl

Recommendations

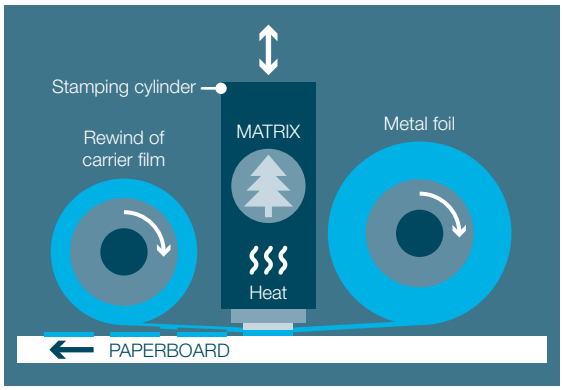
- An extremely smooth and uniform paperboard surface is very important especially when using gloss or metallic films, which highlight any irregularities in the surface.
- To avoid blemishes in the laminated finish, the paperboard surface must be clean and completely free of dust or anti-set-off spray powder. The fast ink setting properties of the surface make it possible to minimise the amount of spray powder used.
- Graphic paperboard gives very good results with water-based glue, but when using this type of glue the printing inks must be very carefully selected.
- If the glue comes in contact with the inks, it is extremely important that the ink and glue should not interact with each other or the ink layer could be insufficiently adhered.

Hot foil stamping in practice

Hot foil stamping is a finishing method used to give texts and patterns an eyecatching appearance. The foil can have a glossy or matt finish with a coloured, metallic or holographic appearance. The size of the area that can be covered varies from very small details, such as letters, to large solid areas.

The hot foil stamping operation

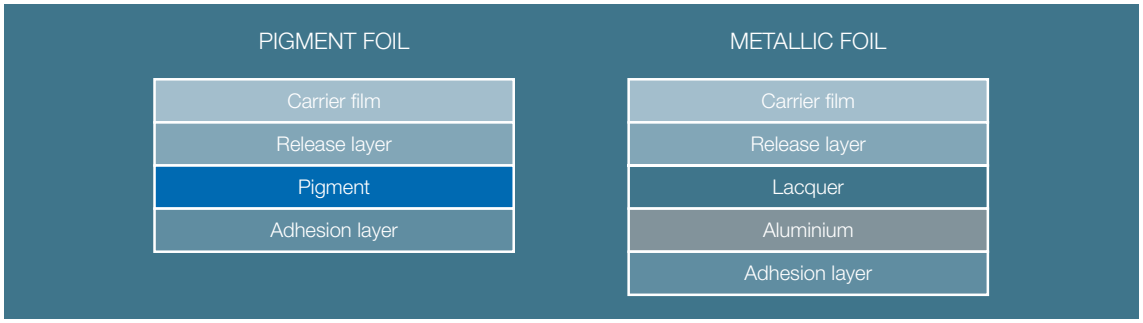
The foil is carried on a heat-resistant film. During the operation the paperboard and the foil are kept parallel. A heated matrix, which is fitted to the stamping plate or cylinder, removes the foil from the carrier and makes it adhere to the paperboard.



Hot foiling operation.

Since the carrier film reacts with the foil due to the pressure and heat of the stamping process, the composition of the paperboard surface is crucial for providing good runnability and satisfactory bonding of the foil. The paperboard surface must be very smooth and free from impurities and spray powder. Factors essential for good hot foil stamping are:

- foil type
- time of pressure (seconds)
- pressure (bar)
- temperature (°C)



Different film compositions.

Recommendations

For the best visual appearance of the foil, it is important to have a clean and very smooth paperboard surface with a minimum of interfering surface irregularities, since these are strongly accentuated when foiled. The tool's ability to conduct heat and the smoothness of the tool surface are equally important factors. To produce the best gloss during longer runs, the surface of the tool should be polished.

Key paperboard features when performing hot foil stamping are:

- smoothness
- surface appearance and surface finish
- adhesion
- surface strength
- flatness and dimensional stability at the specified moisture content.

Embossing and debossing in practice

Embossing and debossing involve shaping the paperboard into well defined permanent relief patterns. Embossing creates a raised pattern and debossing creates an indented pattern. Both these methods create strikingly impressive design results. They can be applied to cover the entire paperboard surface or used to achieve pronounced relief patterns.

The embossing and debossing operation

Embossing and debossing are done at high pressure to make the relief patterns precise and permanent. The tool consists of a stamp and a make-ready (or counter die) onto which the relief pattern and its mirror image are respectively etched.

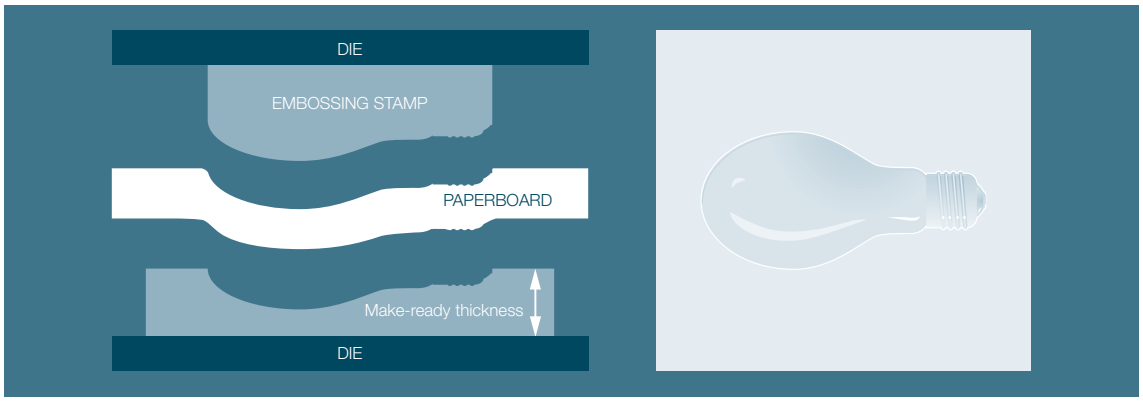
A relief pattern can be 0.15 to 2.5 mm high or deep. If the relief has only small differences in levels, the possible machine speed will be higher and stacking the finished sheets will also be easier.

Embossing and debossing may be carried out either "blind" or combined with other techniques.

Embossing/debossing principle.

Tool preparation

The tool must be specially produced for every embossing operation. The paperboard grade and thickness as well as the relief shape and depth are of major importance for the tool construction. Therefore tool preparation is usually individual for a specific paperboard grade and grammage, which means that it is very difficult to process different grades with the same tool.

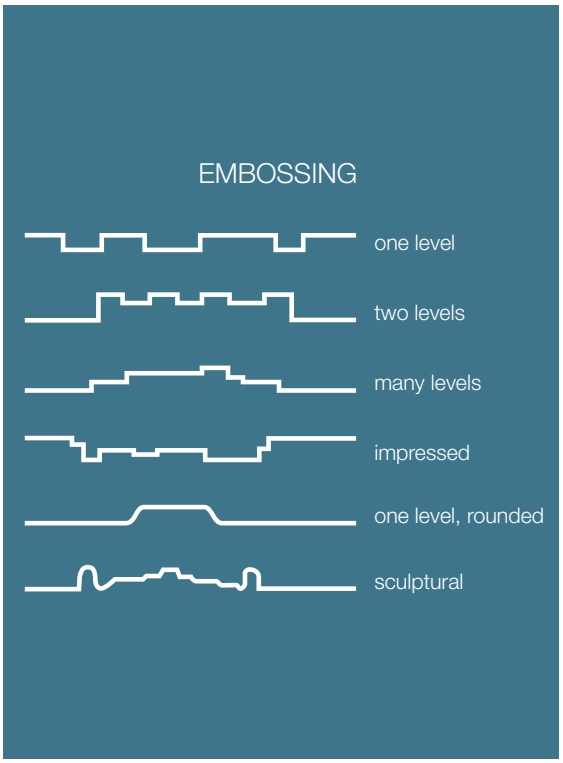


Details of an embossing stamp.

To achieve the best results we recommend that you always give your tool supplier a sample of the substrate you intend to use. When producing the tool there are a number of factors to take into account. The run length will determine the choice of material for the stamp. The grade and grammage of paperboard will determine the design of the make-ready.

FBB-type paperboard (Folding Box Board) is somewhat more compressible than SBB-type (Solid Bleached Board) and will therefore absorb some of the pressure within its structure. The make-ready needs to compensate for this, i.e. it needs to be properly adjusted to both the compressibility and the thickness of the substrate.

Therefore please note that we recommend you purchase the make-ready as well as the stamp from your tool supplier rather than use a do-it-yourself material (e.g. a make-ready board or a moulded make-ready from a one- or two-component paste). A do-it-yourself make-ready will only withstand short run lengths. Even more important, it will not provide the required precision, that is, you will not be able to adjust the make-ready properly to the board.



Examples of different embossing and debossing configurations.

Material	Production technique	Durability	Configuration
Brass	Engraved	++++	Multi-level
Copper	Etched	+++	Mostly single level
Magnesium	Engraved	++	Limited multi-level
Magnesium	Etched	++	Only single level

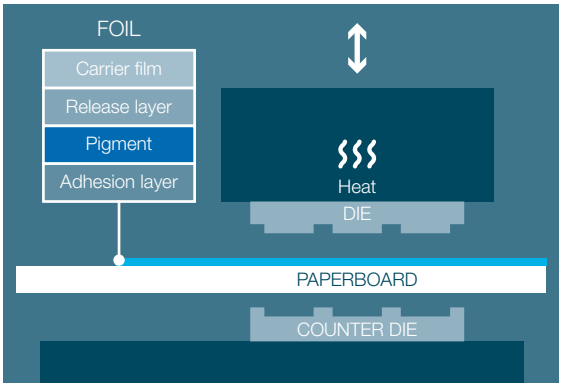
Recommendations

All types of paperboard can be embossed or debossed but their individual construction and composition do pose limitations on achieving optimal results. To achieve an accurate, precise, and permanent impression from the tool, you need to use a paperboard that is strong and rigid enough but also elastic. The paperboard must “forgive” a high degree of elongation without cracking but also retain a permanent deformation after the impression, i.e. have good formability. To avoid surface cracking, high elasticity of the coating is important.

The finer the details and the deeper the relief required, the fewer types of paperboard exist that can successfully fulfil the requirements. Paperboard made from chemically processed long fibres will satisfy all these requirements. A fully bleached paperboard gives the best result for a deep relief, thanks to its multi-ply construction and its long, strong fibres. The board’s density, strength and elongation permit complex patterns and large deformations without any visible damage. Uniform density throughout the different layers contributes to the quality of the embossing. There will be a permanent relief and no cracking.

Foil embossing and other combinations

Embossing and debossing are often combined with other creative methods such as print, varnish, or film lamination. If so, the embossing/debossing operation is the last one to be carried out. However, if the relief pattern is to be covered with metallic stamping foil – hot foil stamping – these two operations are carried out simultaneously (foil embossing) to achieve perfect register between the relief and the foil. In this case the depth of the relief can range from 0.25 to 0.60 mm.



Details of tools and materials in a foil embossing operation.

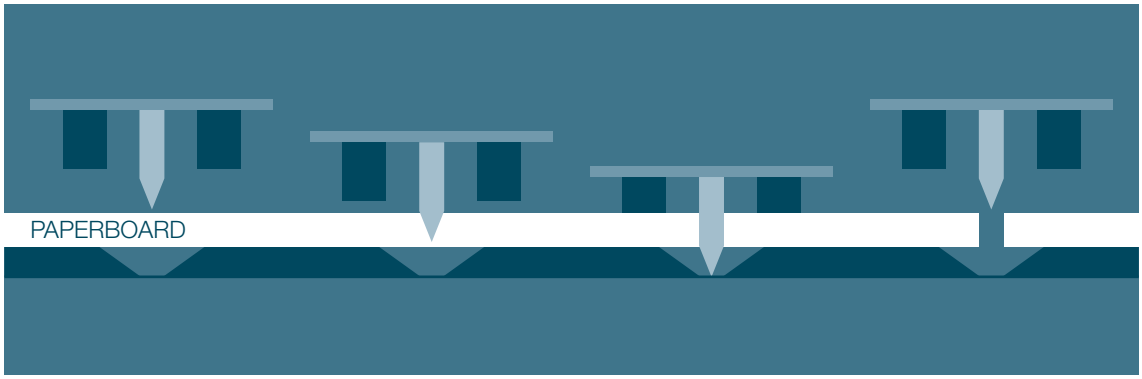
Use the strengths of smooth paperboard to achieve excellent results.

Complex shapes and latticed design in practice

Multi-ply paperboard has all the strengths required to achieve complex designs in cost-effective processes. The techniques for creating complex structural shapes are creasing, folding, and a number of cutting methods (die cutting, ram punching, and laser cutting). Creasing and folding will be discussed in the next section. In this section we describe the different cutting methods.

The die cutting operation

Die cutting is the most common cutting method. The tool consists of a moving die with one or more knives and a counter-die (or make-ready). The tool can have the shape of a ruler or almost any complex form. Normally the tool is uniquely designed to create a specific shape and suit a specific paperboard grade. The tool geometry must be well adapted to the thickness of the paperboard. Due to the strength and density of the paperboard, the high force required to cut through it must also be well controlled to minimise the overshoot of the moving die. If the knives hit the counter-die too hard, this will quickly damage the edges and thereby soon degrade the quality of the cuts.

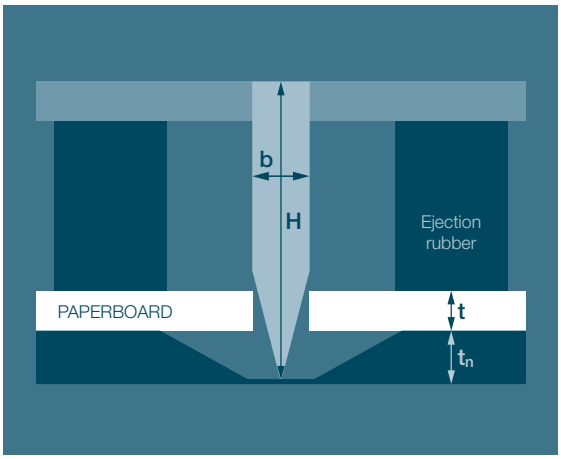


The die cutting principle.

Die cutting and creasing

Die cutting and (when applicable) creasing operations are often performed simultaneously and may also be combined with an embossing operation. To achieve a consistent and accurate result, as well as good runnability throughout the process, it is important to carefully select the most appropriate tools, machine settings, and types of paperboard. These factors need to be considered differently for each shape and application.

A vital precaution, common to all shapes and applications, is that the ambient humidity must be firmly controlled in order to keep the original moisture content of the paperboard unchanged. Too high moisture in the paperboard will make it difficult to cut, while too low moisture will make it brittle (please refer to the chapter “Handling”).

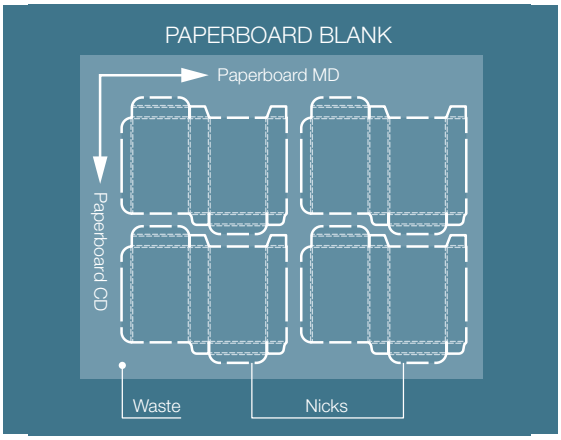


Tool dimensions should be adjusted to the materials to be used. Request recommendations from your materials supplier.

Nicks

The principle of die cutting can be illustrated with a packaging application. When outer profiles are die cut, the cut blanks remain attached to the skeleton by nicks. To prevent unwanted separation of the sheet during its transfer to subsequent stations, the nicks must be strong enough to hold together. At the same time they must be weak enough to be easily separated in the stripping operation, in which the paperboard waste is removed.

With a strong paperboard you can achieve very thin nicks that are easily stripped off, leaving the edges nice and clean. The result is an attractive product. It is important to note that nicks in the machine direction (fibre direction) of the paperboard are twice as strong as those in the cross-fibre direction.



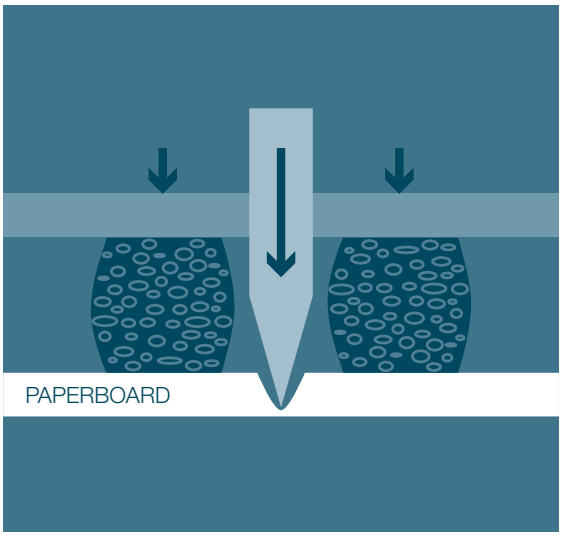
Positions of nicks, which are obtained by a notch in the cutting tool.

Rubbering of the cutting die

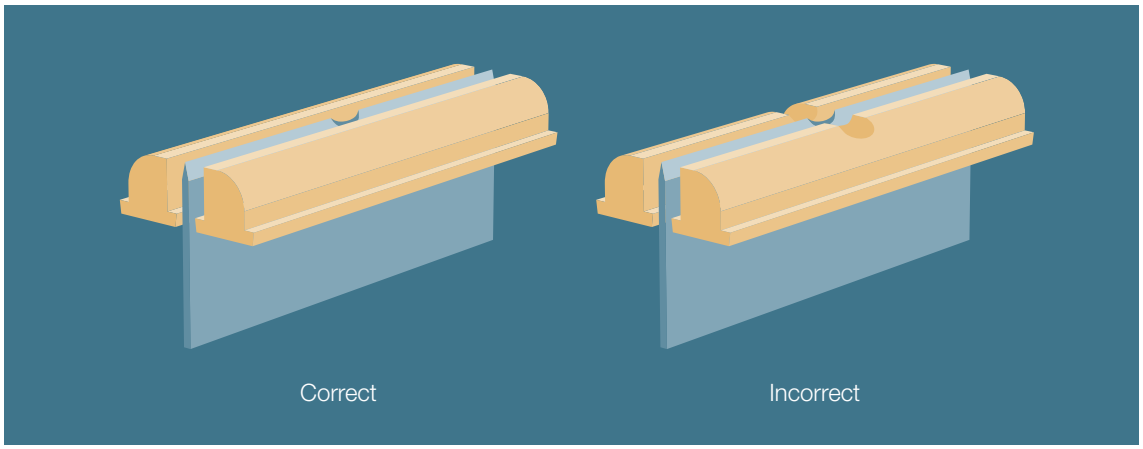
The rubbering of the cutting die plays a very important role for the quality of the final result. Correctly done the rubbering also supports productivity by allowing higher speeds and minimising the risk of stops due to waste coming loose in the machine or sheets not ejecting properly from the die.

In the cutting operation the rubbers fix and secure the sheet before and during the cutting and help to strip the cut material from the sheet. All die rules around the outer edges of the design should be rubbered with “closed” rubber types. These will trap and compress air within the design and help to eject the sheet from the cutting die.

To avoid unwanted stress on the nicks the notches should not be ground through the rubbers. This would put extra stress on the nicks during the cutting operation and may decrease their strength by up to 30%, risking premature breaking.



The hardness and profile of the supporting material vary depending on whether its function involves fixing the paperboard during cutting or ejecting the blank after cutting. Both cork and different types and hardnesses of rubber are used.



Recommendations

Rubbers for blank separating rules with notches: The rubber is generally positioned between 1.0 and 2.0 mm from the cutting rule in order to prevent breakage of nicks. The use of profile rubber (shape-designed to distribute the stress in the compression stage in a more accurate way) has proven to give better results: stronger nicks, fewer pressure marks, and a more accurate fixing of the paperboard during the cutting operation.

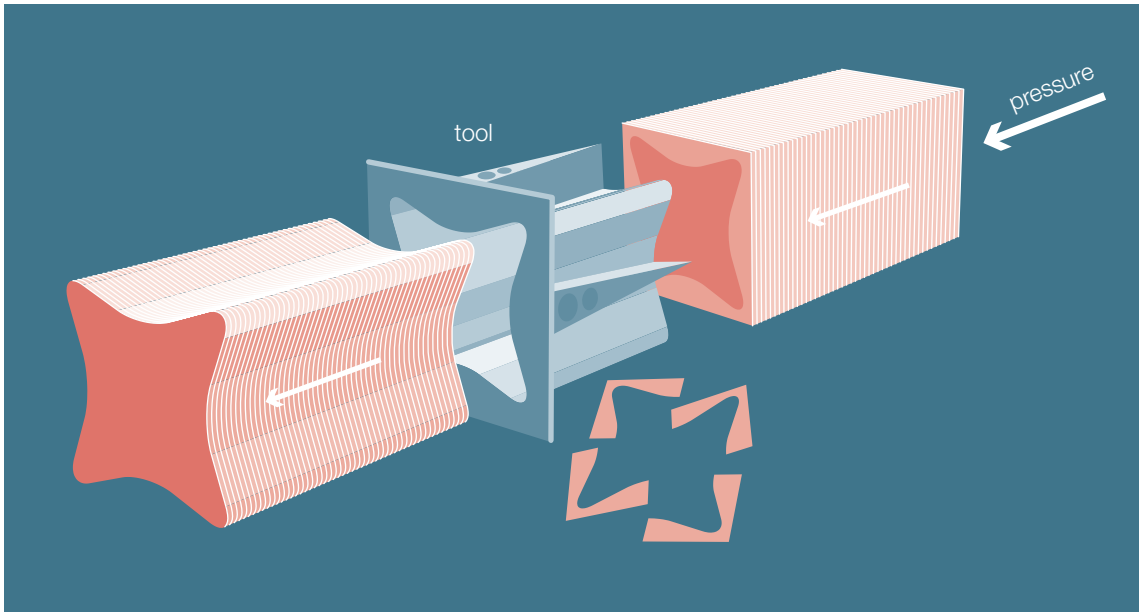
We recommend a very hard profile rubber (7 mm wide). Please note: If undesired pressure marks should occur, reduce the hardness and if possible increase the width.

Rubbers for rules without notches: The rubbers for such an area serve only to eject the sheet after it has been die cut. The most important paperboard property in this context is good elasticity. The rubber should be compressible to at least 50% of its normal height.

Rubbers for paperboard printed on both sides: When die cutting a paperboard which has been printed on both sides it is important to increase the hardness of the rubber. In this way you avoid ink flaking on the reverse side. This is especially important when using a UV curable (hard) ink or varnish. We recommend a cork rubber or a hard elastomer. The rubber profile should be mounted as close as possible to the cutting rule.

The ram punching operation

Ram punching is a powerful cutting technique used to cut numerous amounts of small shapes such as labels, envelopes and cards. Unlike die cutting, which cuts one sheet at a time, ram punching is used to cut through a pile of substrate. This means, of course, that ram punching and creasing cannot be performed simultaneously.



Ram punching is often used to cut paper but can also be successfully used with multi-ply paperboard to cut simple shapes. To avoid waste, the paperboard is first cut down in an ordinary cutting machine to fit the size of the intended shape, leaving a margin of 5 to 10 mm.

The ram punching tool consists of a punch mounted on a jig. To prevent edge delamination and other damage, we recommend counter pressure, i.e. that a hydraulic piston is used to press the paperboard pile against the punch. In our experience, under demanding conditions the choice of a suitable varnish that can lubricate the knife may also prevent edge damage.

A high density paperboard such as SBB is more suitable for ram punching operations than competing paperboard types.

The laser cutting operation

Laser cutting is by far the most elaborate and exclusive cutting method. It permits very small details and very complex designs. With the right paperboard almost any pattern can be achieved. The operating principle is rather simple. The original design is etched through a copper template which is positioned over the paperboard sheet. A sharply focused laser beam runs back and forth over the template. Wherever there are etched areas the laser beam vaporises the paperboard.

The paperboard used in laser cutting should be as lightly coated as possible for two reasons. The first reason is that the lighter the coating is, the faster the laser cutting works. The second reason is that the operation leaves a slightly brownish discolouration on the reverse side of the paperboard, and this is more noticeable on a heavily coated paperboard. This discoloration can be covered by printing but it can also be regarded as a part of the design.

Since the sheets are fed into the laser cutting machine with the print side down we strongly recommend a protective varnish to avoid scratches on the print. We do not recommend the use of paperboard thicker than approximately 500 µm due to limitations in the laser cutting process. If you are uncertain, please contact your supplier for advice and if possible a test.

When using a multi-ply paperboard there are few limits to what can be achieved with laser cutting.

The advantages and disadvantages of multi-ply paperboard products in laser cutting are shown in the following table:

Paperboard type	Advantages	Disadvantages
Folding Box Board (FBB)	Low density compared to thickness means less energy needed for cutting (economical production).	Lower strength than SBB
	Single side coated FBB will have less discolouration from the coating. The amount of coating compared to the thickness is less than for alternative grades that are coated on both sides.	
Solid Bleached Board (SBB)	The strong network in an SBB baseboard permits a design with finer details (better strength in the most fragile designs than alternative grades).	Double side fully coated SBB gives more discolouration, since the coating amount is higher compared to the thickness than for single side coated paperboard.

Multi-ply paperboard has several major advantages when using laser cutting compared to alternatives such as coated wood-free paper or WLC (White Lined Chipboard).

- Coated wood-free paper has a higher coating/baseboard ratio and usually contains fillers (for opacity). Relatively more energy is therefore needed to cut the same thickness (longer production time). Due to the high amount of coating and fillers, the discolouration is also more pronounced than for paperboard.
- WLC contains impurities from recycled material. This may cause a discolouration closer to black than light brown. Depending on the type of WLC its lower tearing resistance and tensile strength may also limit your ability to produce a highly detailed design.

General recommendations

The interaction between the machines, cutting tools and paperboard differs depending on the cutting method, the design, the previous surface treatment (e.g. lamination), and the choice of paperboard product selected for each specific application.

- Generally speaking, flatness and dimensional stability are crucial for achieving high runnability.
- Moisture content is equally crucial. Too high a level of moisture will make the paperboard too strong to cut, while too low a moisture level will make the paperboard too brittle.
- Strength is always necessary in the paperboard for good runnability and good formability. The most important strength properties are tearing resistance and tensile strength.
- If white cut edges are required, paperboard made solely from bleached chemical pulp must be used.

Creasing and folding in practice

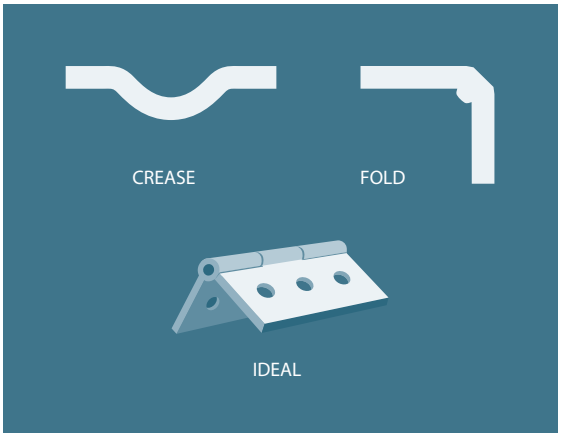
Paperboard should always be creased before being folded. This increases the visual impression of high quality because you achieve distinct, durable and narrow fold lines with no disfiguring cracks on the printed, varnished or laminated folds. The creasing operation facilitates the folding operation and provides the conditions for the graphic product to obtain its shape and function. Thanks to the multi-ply construction of graphic paperboard you achieve optimal creasing. The best result is obtained when the paperboard is delaminated into as many thin, undamaged layers as possible.

The creasing operation.

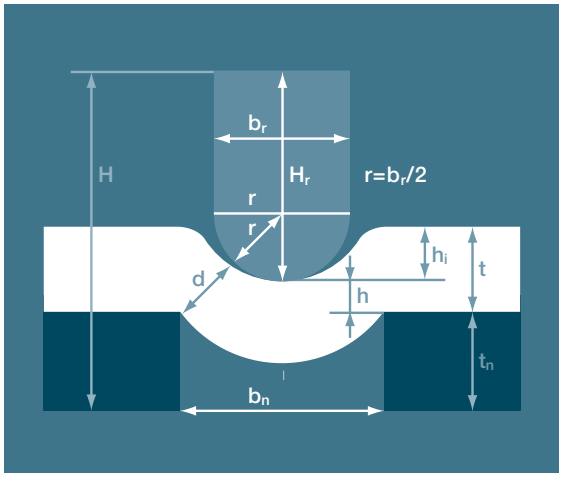
The creasing operation

To achieve a perfect crease, the relationship between its width and depth is very important. The paperboard's quality and the construction and performance of the creasing tools are crucial for the correct placement of the crease and achieving the best results. The crease should be deep and narrow in order to obtain an accurate fold with low folding resistance.

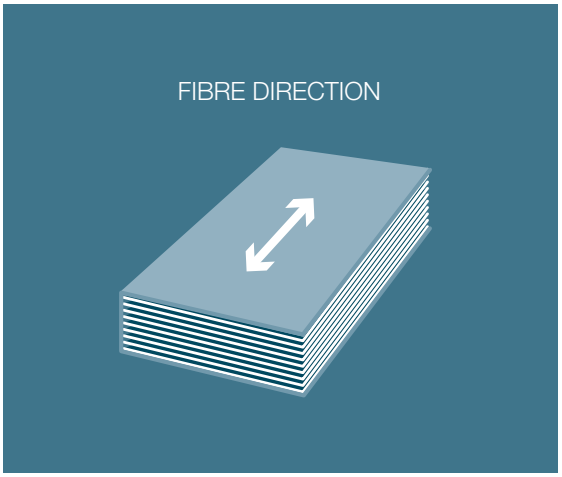
The best creases are obtained by using flat-bed equipment. To form the crease, the paperboard is pushed by the creasing rule into an accurately cut groove in the make-ready (matrix or counter-die), on which the paperboard sheet is located.



Deep and narrow creases act as hinges.



Creasing tool geometry.



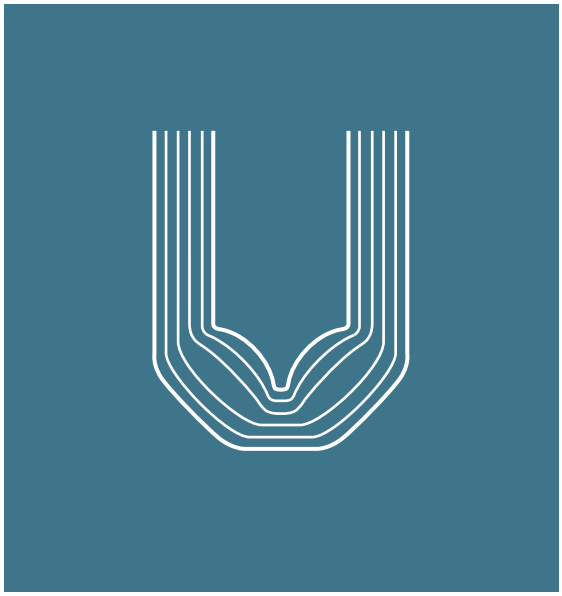
A crease parallel to the fibre direction is always best.

Recommendations

It is always easier to produce a perfect crease parallel to the fibre direction of the paperboard than parallel to the cross fibre direction. If there is a need to have many creases close to each other, it is advisable to have them parallel to the fibre direction. For best results in complex jobs we recommend that you adapt your tooling before doing cross-direction creases.

Paperboard type and thickness

To obtain the best results, the creasing tools should be designed to suit the chosen paperboard type and its thickness. The thickness is the most important variable. However, different types of paperboard require different tool geometries, since they have different thickness/grammage relationships and different physical properties. For each type of paperboard, there are recommendations in our **Product Catalogue** to help you to obtain the best result when creasing.



When converting extremely thick material the use of double creasing is a normal procedure.

Creasing tools

Factors essential for good creasing are:

- height and width of the creasing rule
- thickness of the make-ready
- groove width
- accuracy and hardness of the make-ready
- pressure of the creasing rule.

Folding

To achieve the best function, folding should always be done towards the bead. In a flat-bed operation, creasing should therefore be done with the print side up. Otherwise the fold will be less durable and the print will be more exposed to wear.

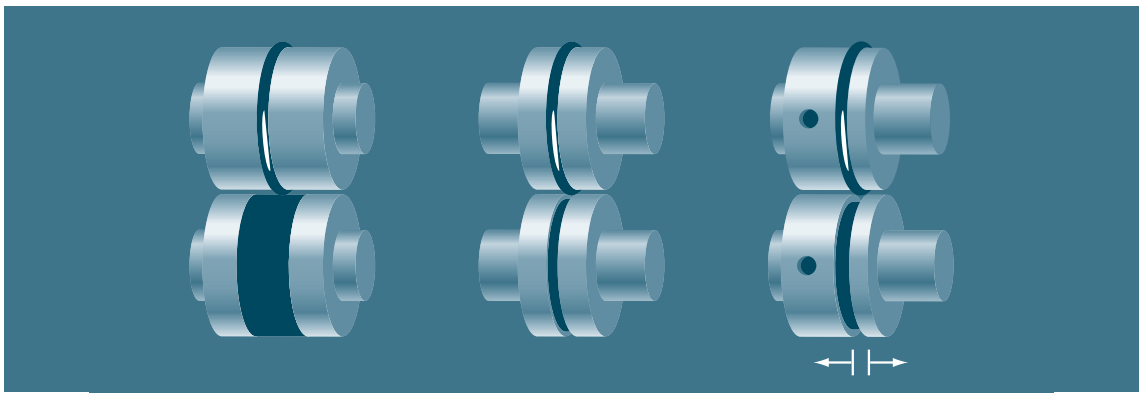
Scoring

The bookbinding industry is developing in many fields. Demands for shorter make-ready time, shorter runs and higher speeds make the traditional creasing technique less profitable. The prevailing technique is to use inline scoring in the binder for both soft cover production and saddle stitching as well as for folders.

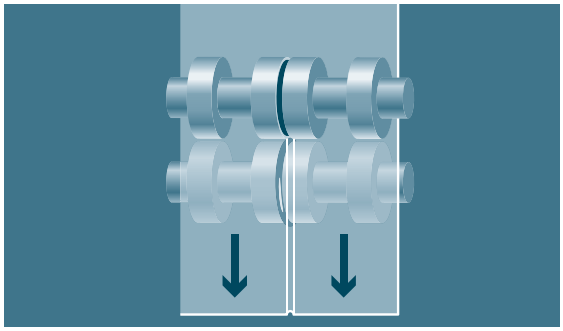
The scoring operation

The paper or paperboard travels through a set of counter-rotating tools with a male and female part which press a permanent groove into the substrate.

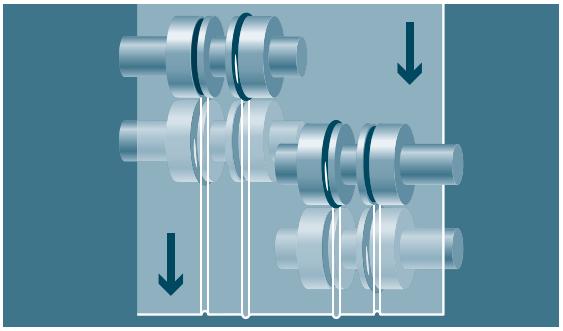
At the cover station of a saddle stitcher the cover is gripped and fed around a rotating drum with a male scoring wheel. At the cover station of the perfect binder the covers are fed through two sets of shafts with tools. Tools for spine grooves as well as decorative grooves for front and back covers are fitted in an opposing manner.



Different tool configurations for scoring. The best folding function is achieved by using an adjustable female tool.



In the folder the substrate travels though the tools mounted on shafts before going through the knife folding unit.



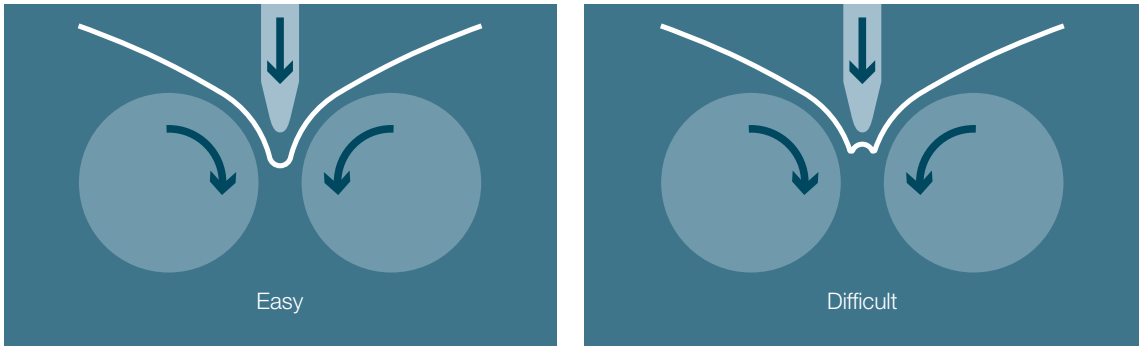
At the cover station for soft cover production the paperboard is scored with four scores, two facing inwards and two outwards.

Scoring in practice

The main difference between traditional scoring and carton blank creasing is the direction of the score. Whereas the bead is always directed inwards into the fold in carton creasing, scoring for books and brochures is mainly done in the opposite way. The are two reasons for this:

First, the technique is mainly used for thinner fine paper when the prospect of creating a well defined delamination within the structure to facilitate a good fold with low resistance is poor due to the paper's monolayer construction and high internal bond.

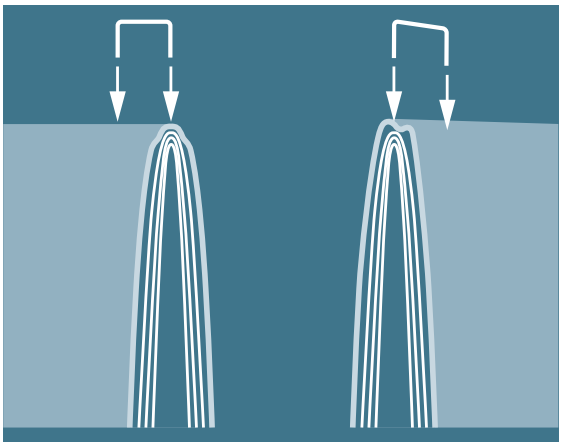
Second, there are clear practical reasons in different cases: When folding the bead would, if facing the "correct" way, obstruct the accuracy of the folding knife in the folder when the knife hits the bead to push the cover between the folding rollers. This could lead to misregister and variations through the run.



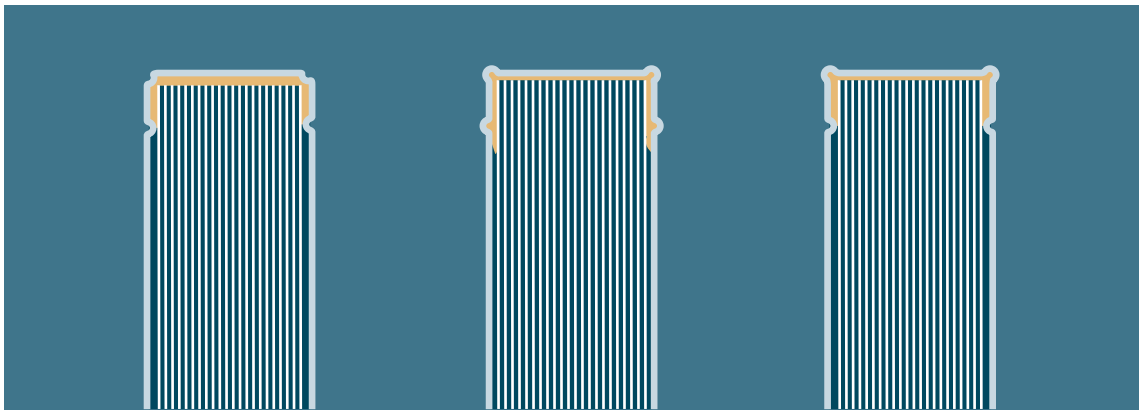
The traditional direction of a crease with the bead facing inwards in a fold may obstruct proper folding in a knife folding operation.

If the bead is folded towards the insert of the magazine, the alignment of the insert in relation to the cover could be obstructed. This could lead to misregister between artwork which spreads over both cover and insert, and reduce the possibility of having a controlled and consistent operation.

When applying the cover onto the insert in a perfect binder, the bead will obstruct either the tight fitting of the spine or the integrity of the side glue seam on the front and back of the cover.



Creasing the cover from the face side will produce a bead that may obstruct the alignment of the cover with the insert.



Different configurations of creases for a perfectly bound cover. In some cases the crease obstructs a tight fitting of the cover on the insert.

The result of the scoring process can be expected to be shallower and wider than the creased material. Traditional creasing results in a deeper and narrower crease, which improves the folding performance. When scoring, the tooling and settings need to be adjusted to negative penetration (according to the DIN standard) and the width of the female tool needs to be set to an absolute minimum without inflicting a cut in the surface.

We recommend scoring tools with a defined female part. The use of plain rubber counter rollers without a groove will not result in a groove that is sufficiently deep and narrow to facilitate high-quality folds.

Ply construction

Optimal creasing can be achieved when using multi-ply paperboard. The best result is obtained when the paperboard is delaminated into as many thin, undamaged layers as possible along a well defined fold line. For successful creasing the surface layers and coating layers must be strong.

Please note that folding should always be done towards the bead. Otherwise the fold becomes less durable and more exposed to wear.

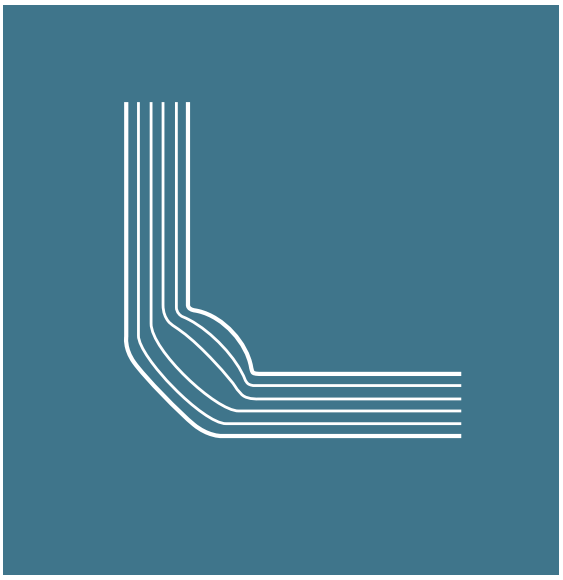
The creasing demands should be carefully matched with a suitable paperboard. The two main types of paperboard, Solid Bleached Board and Folding Box Board, differ as follows:

Solid Bleached Board (SBB) is a dense and resilient paperboard with strong layers throughout for demanding creasing jobs:

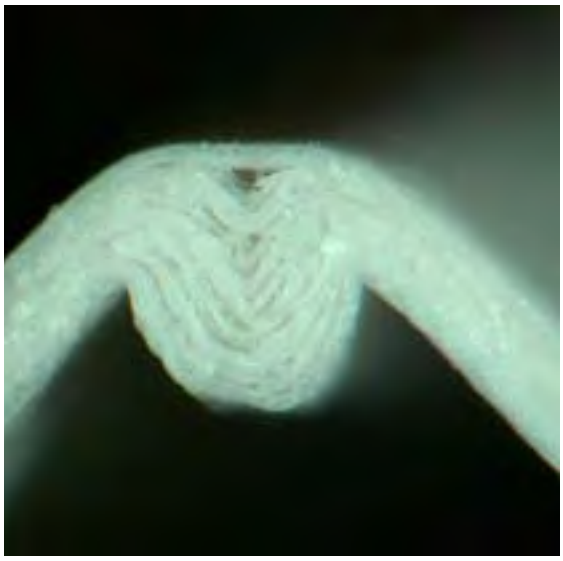
- SBB develops well defined permanent creases easily
- SBB gives creases with low folding resistance and good foldability over a wide range of crease geometries
- SBB accepts very narrow and deep creases without damage.

Folding Box Board (FBB) is a low density, stiff paperboard with strong surface layers to withstand creasing stress and deformation:

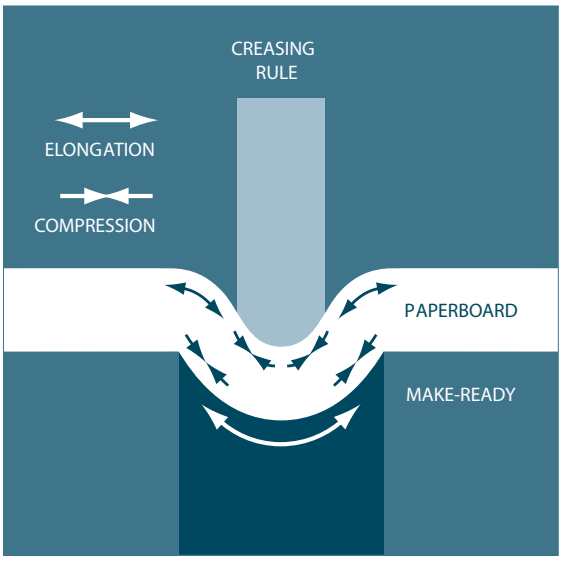
- FBB develops well defined creases
- FBB has high stiffness in relation to its folding resistance, which gives good foldability
- FBB has a compressible interior, which gives less permanence of the crease as defined by the tools.



Multi-ply construction is an important contribution to the creasability and foldability, which are basic features for achieving folds with no cracks.



Optimal creasing is achieved when the paperboard is delaminated into as many thin and undamaged layers as possible along a well defined fold line.



During creasing and subsequent folding the paperboard is subjected to severe stresses and deformation.

Folding factor

Paperboard's folding ability is expressed by the folding factor. Folding factor 0 corresponds to uncreased paperboard, while folding factor 100% corresponds to a perfect hinge. The higher the folding factor attained without the surface cracking, the better the creasability and runnability. The creases are subjectively evaluated for defects, cracks, etc. The effectiveness or inadequacy of a crease should be checked by bending it at an angle of 180°. The folding factor should be above 50%.

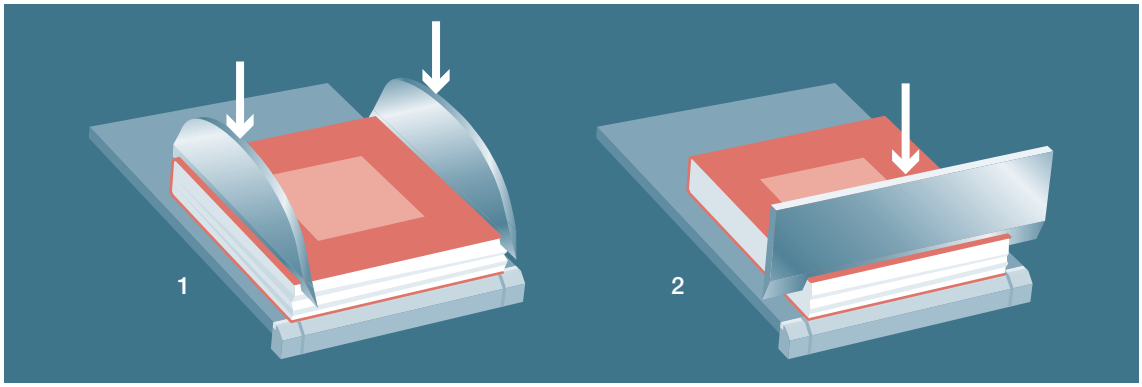
Binding – the last link

Binding is the last link in the chain of operations which transform the paperboard into attractive and functional covers for brochures, annual reports, manuals, books, or magazines. This last link must be as strong as the others, so it is equally important to choose a paperboard product that suits the binding methods used.

General precautions

The most common binding methods for paperboard covers are saddle stitching, wire binding, glue binding, thread binding, and fadensiegel binding. In all of them, the fibre direction in the binding operation is a key factor. Please note that the folds of the cover (as well as the insert) must always be parallel to the fibre direction of the paperboard. This is necessary to achieve a durable bond, narrow and permanent fold lines and low folding resistance, and to avoid waviness of the binding. Thanks to its long and strong fibres, a fully bleached paperboard gives the best results under difficult binding conditions.

In this section we will concentrate on the gluing operation. But first we will just say something about trimming. To ensure a good cutting result without risking delamination of the edges, parameters to be closely controlled are the pressure on the book, the knife angle, sharpness and lubrication, and the wear of the counterpart.



With well controlled trimming you avoid delamination of the edges.

The gluing operation

Gluing is not difficult but negligence in performing it can be costly. Either you use glue binding (in which the sheets are folded, bundled, and then milled to adhere better), or if you use thread or fadensiegel binding (in which the sheets are stitched, folded and bundled). The insert is then glued directly to the back of the cover.

Types of surface

The type of glue and results of the gluing process depend on the type of surface to be glued. We can classify surfaces into three different types:

- easy surface – uncoated or lightly coated surface
- demanding surface – fully coated, printed surface
- difficult surface – UV varnished, film laminated or PE coated surface.

Types of glue

The most common types of glue for bookbinding are cold glues:

- polyvinyl acetate (PVA) for easy surfaces
- ethylvinyl acrylate (EVA) for easy, demanding or difficult surfaces
- co-polymers for difficult surfaces.

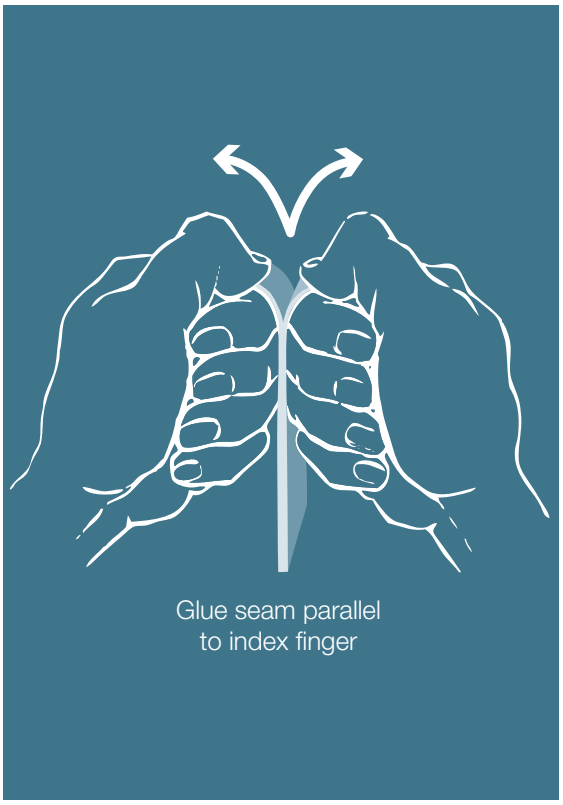
Important factors

Important factors to consider when gluing are:

- the glue must wet the substrate and adhere to it
- the glue must be applied in the right place
- there must be enough glue to form a good bond but not too much so that it squeezes out
- the time between glue application and joining the surfaces must not be too long
- the pressure must be maintained until the bond is strong enough
- the glue must meet the demands of the binding machine regarding correct temperatures and clamping time before the book is removed from the machine
- the folding resistance in the spine creases must be low to avoid failure of the side glue seams after clamping.

Side seam gluing

Side seam gluing is mostly used in packaging applications but also for CD covers. In this method the glue is applied to the first paperboard surface with an applicator. The glue wets the surface and starts setting. The second paperboard surface is applied under pressure and the glue bond starts to develop. If the glue is water based the paperboard first absorbs the water, enabling the glue to set.



Glue seam parallel to index finger

Recommendations

The paperboard properties generally required to achieve successful binding are uniform strength, consistency of flatness and stability, together with good cutting, creasing, folding, and (when applicable) surface properties suitable for gluing. When using saddle stitching or wire binding, strength is especially important. Saddle stitched operations put a lot of strain on that small piece of paperboard that holds the cover to the insert by the staple. When glue binding, a paperboard with a lightly coated reverse side is the most suitable choice. Otherwise special precautions when choosing the glue are required, as mentioned above.

Multi-step processing

The production of almost any graphical product is carried out in more than one operation. The most common situation is the combination of printing, creasing and folding. However, some products are more complex and demanding than others and can sometimes undergo all possible finishing stages after being printed.

Implementing a complex and demanding design is far from being an easy process. It requires skills plus a paperboard that provides perfect register in multi-step processing, that is, a paperboard with extremely good dimensional stability and exact sheet squareness. To arrive at an excellent result, it is of the utmost importance that the paperboard retains its original moisture characteristics throughout the whole sequence of production steps from start to finish. Otherwise the sheets may deviate from their original stability and exactness (please refer to the chapter “Handling”).

As we said before, paperboard is a forgiving base material. This becomes particularly obvious when it comes to the finishing operations. Below the strong, smooth and white surface you find all the strengths you require for carrying out the most demanding applications. Whether you are just adding a varnish to highlight the graphic presentation or producing the most advanced designs in multi-step processes, you can rely on obtaining excellent results.

A complex and demanding design requires skill and a paperboard that provides perfect register in multi-step processing.

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