Paperboard Guide

storaenso

Dear reader,

Congratulations, here is your comprehensive guide to the world of paperboard and printing! Today, working with paperboard is very rewarding – it is the renewable and recyclable material option for outstanding packaging and graphical products. Quality is better than ever, providing endless opportunities for ambitious designers and printing houses, who want to excel in graphics and special effects to support demanding brands.

At Stora Enso, we believe the future is wood-based and renewable. Whether for designs that dazzle or products that need pure protection, printers, manufacturers and brand owners alike turn to Stora Enso's paperboard materials for innovative solutions.

Join us in creating a renewable future and a sustainable climate, by making the most out of renewable and very printable materials. We hope this guide will be helpful for you!

Stora Enso
Division Consumer Board

Part of the bioeconomy, Stora Enso is a leading provider of renewable solutions in packaging, biomaterials, wooden constructions and paper globally. We believe that everything that is made from fossil-based materials today can be made from a tree tomorrow. Our materials are renewable, reusable and recyclable, and form the building blocks for a range of innovative solutions that can help replace products based on fossil fuels and other non-renewable materials.

The ambition of the Consumer Board division is to be the global benchmark in high-quality virgin fibre cartonboard and the preferred partner to customers and brand owners in the premium end-use packaging and graphical segments. Our wide board and barrier coating selection is suitable for the design and optimisation of packaging for liquid, food, pharmaceutical and luxury goods.

Premium paperboard for demanding end uses

Building on our heritage and know-how in forestry and trees, Stora Enso is committed to the development of products and technologies based on renewable materials and creating value in a sustainable bioeconomy. Our products, in many cases, provide a low-carbon alternative to many products made from fossil-based or other non-renewable materials.

All our high-quality paperboard products are made from virgin fibre that possesses the highest purity, brightness and smoothness. They meet the often conflicting demands for brand differentiation, consumer convenience and high environmental performance.

Our range includes carton board, food service board, liquid packaging board and board for graphical printing. You'll find Stora Enso carton board in packaging for food and beverage, chocolate and confectionery, pharmaceuticals, cigarette, or wherever high purity, safety and protection are in focus. Or in luxury packaging for perfume, cosmetics and champagne, and other products that demand a special brand experience.

Liquid packaging

We supply premium liquid packaging board that delivers the best in product protection as well as printing, converting and filling performance. In addition, we help packaging manufacturers and consumer brands across the world to use fewer raw materials, create less waste and lower package weights – in short, to conserve nature as well as save money compared with other materials.

Our durable, food-safe, high-quality boards feature an advanced multilayer construction that enables a lower package weight, meaning less material use and improved transport savings. Milk, juice or whatever liquid product you pack, you'll get an exceptionally high standard of moisture protection, food safety and odour and taste neutrality. This makes them ideal for packaging sensitive liquids and keeping them fresh and untainted over their entire lifetime.

Like all our paperboard products, our liquid packaging board is recyclable and comes from a renewable resource – trees. So besides extending product shelf-life, our boards help brands to speak sustainability to today's conscientious consumers.

Fibre-based beverage carton has 45% lower CO_2 emissions than a plastic PET bottle.

Source: SIG Combibloc

Food service and packaging

These days, convenience is king. Although take-away containers may have a short lifespan, those made from our paperboard bring long-lasting benefits like durability, dependability and positive brand association. Based on the highly efficient use of renewable raw material, they also make your food service and food packaging more sustainable.

Our food service boards and food packaging boards are specially designed to stand up to the toughest demands at quick-service restaurants and in-store. They feature high wicking, odour and taste neutrality, and leak and breakage protection. And they have the formability and sealing properties needed to perform consistently in even the highest-speed forming machines.

Our paperboards are food-safe, sustainably produced with renewable and recyclable materials, and deliver outstanding print results. Our barrier coatings promote stability, protection, and efficient, accurate converting to many different forms including cups, trays, clamshells and boxes.

Cigarette packaging

Whether your cigarette brand is value, super premium or somewhere in between, we've got the right board for your brand.

Thanks to the unique fibre structure and smooth surface of our cigarette board, you gain both superior design flexibility and reliable runnability on high-speed packaging lines. This makes the material ideal for demanding finishing techniques and printing – and helps ensure less downtime, less waste and more productivity.

The combination of strength, stiffness and light weight along with dimensional stability and improved curl resistance help converting and durability in use. Our board is also highly clean, with excellent taste and odour control.

Folding cartons

Stora Enso is a leading producer of renewable, virgin-fibre-based carton board that delivers standout performance in packaging for chocolate and confectionery, perfumes and cosmetics, pharmaceuticals and healthcare, wine and spirits, and food packaging.

When you choose carton board from Stora Enso for folding cartons, you open up a world of design and application possibilities that combine high performance and aesthetics. The diversity of our carton board range, including solid bleached sulphate board (SBS), folding boxboard (FBB) and coated unbleached kraft (CUK) products of the finest quality, lets you create innovative shapes

and special effects that help you differentiate your product.

The fresh fibre and strong, multi-layer structure of our boards offer benefits such as higher strength and stiffness at lower weight, resulting in converting excellence, reliable packaging performance and high material efficiency. And, the lightweight material means lower costs in the supply chain.

Graphical products

Printers, publishers and designers around the world trust Stora Enso's range of graphical board products, with all the qualities needed for demanding printing and special finishing effects.

The diversity of our graphical board range provides you options to create truly standout print products. Pick your choice of solid bleached sulphate board (SBS), board with chemi-thermomechanical pulp (CTMP), one-side coated, two-side coated or uncoated board.

A strong yet light fibre combination with multiple layers ensures outstanding cutting, folding and creasability. Optimized surface smoothness, whiteness and brightness give you top printing and finishing results. And our uncoated options offer an appealing rustic surface that consumers will love getting their hands on.

With a striking combination of visual and tactile beauty, form and function, our graphical board helps you deliver a consumer experience beyond the ordinary.

Our boards help brands to speak sustainability to today's conscientious consumers.

Paperboard production

The basic principles of paper and paperboard making have not changed for more than 2000 years. Fibres gained from timber are evenly distributed in water. Multiple layers of furnish are applied, one after the other, on a wire. The water is drained from the pulp and the layers are formed into a strong fibre mat. A smooth surface is achieved by coating and calendering.

Paperboard production and fibres.

Raw materials used for paperboard production

The choice of package materials plays a significant role in packaging optimization. Raw materials and fibres used for making paperboard impact the end product's properties. Chemical pulp and mechanical pulp differ from each other for example in strength and protectiveness.

Almost 96% of the water we withdraw is recycled back to the local environment after being carefully purified.

Chemical pulp
Wood chips are cooked with appropriate chemicals in an aqueous solution at high temperature and pressure. The objective is to dissolve the lignin and separate the fibres intact. The pulp can be used unbleached or bleached to the brightness needed.

Mechanical pulp
Wood is grinded mechanically to make stone pulp. Also steaming may be used in the process, to reduse the total energy needed, and to decrease the damage to fibres. Mechanical pulps are used for products that require less strength, such as newsprint and paperboards.

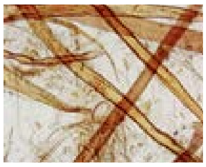
Virgin fibres

Hardwood
Pulp made of deciduous broad-leaved trees such as birch, oak, beech, aspen or eucalyptus. Characteristic are the short fibres.

Softwood
Pulp produced of pine, spruce, or other conifers. The fibres are long.

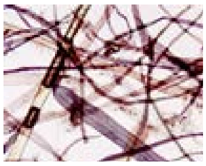
Virgin fibres

Groundwood
Logs of debarked soft woodare pressed against a rotating grinding stone while water is added in order to separate the fibres



CTMP (Chemi Thermo Mechanical Pulp)
Wood chips are impregnated with appropriate chemicals and heated before separating the fibres by a mechanical refining process. The pulp is bleached and washed in several steps.

Secondary fibres



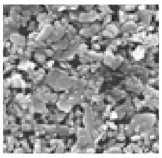
Secondary fibres
are gained from sorted recovered paper or board by purifying and sometimes deinking and bleaching.

Additives

Wet-end additives and retention aid
e.g. starch and aluminium sulphate.

Sizing agents
such as natural resin or synthetic sizes are added to increase strength and decrease absorbance.

Components coating colour rheology modifiers



Pigments
Natural coating pigments and fillers. Ground Calsium Carbonate (GCC) and Kaolin Clay.

Latex
Water dispersion of organic binder for the coating pigment.

Solvent

Water
Water is used as means of transport and solvent.

According to DIN 19303, any paperboard can be described by a combined code of two letters or two letters and one figure.

The first letter describes the type of surface treatment:

A = cast-coated
G = pigment-coated
U = uncoated

The second letter stands for the main furnish:

Z = bleached chemical pulp
N = unbleached chemical pulp
C = mechanical pulp
T = secondary-fibre pulp with white, cream or brown reverse
D = secondary-fibre pulp with grey reverse

Except for the D grades the figure defines the colour of the reverse side:

1 = white
2 = cream
3 = brown

For the D grades, the figure describes the bulk of the paperboard:

1 = $\geq 1.45\ cm^3/g$
2 = $< 1.45\ cm^3/g$, $> 1.3\ cm^3/g$
3 = $\leq 1.3\ cm3^3/g$

Overview of paperboard nomenclature

Definition (DIN 19303)		Type	Description	Pulp stock
uncoated	coated			
	AZ	SBS	Cast-coated solid bleached board with white reverse	Fully bleached chemical pulp
	AC1	FBB	Cast-coated solid boxboard with white reverse	Chemical and mechanical pulp
	AC2	FBB	Cast-coated solid boxboard with cream reverse	Chemical and mechanical pulp
UZ	GZ	SBS	Solid bleached board	Fully bleached chemical pulp
	GN1	CUK	Coated Unbleached Kraft	Unbleached chemical pulp
UC1	GC1	FBB	Folding boxboard with white reverse	Chemical and mechanical pulp
UC2	GC2	FBB	Folding boxboard with cream reverse	Chemical and mechanical pulp

Board machine

Wire section: The web is formed in the wire section by pumping a mixture of water and pulp from the headboxes onto the wire. The water content is over 99%, which is why this part of a paperboard machine is also known as the wet end. The water is drained off and the fibres bond together. The individual layers of fibre are couched. An even fibre formation is vital to ensure optimum strength, surface smoothness and uniformity. After the wire section water content is 80%.

Press section: In the press section, water is removed from the wetweb by mechanical compression in the nips formed by two rolls. There moved water is received by a felt. After press section water content is approximately 60%.

Pre-drying section: The paperboard web is further dried by a series of steam-heated drying cylinders.

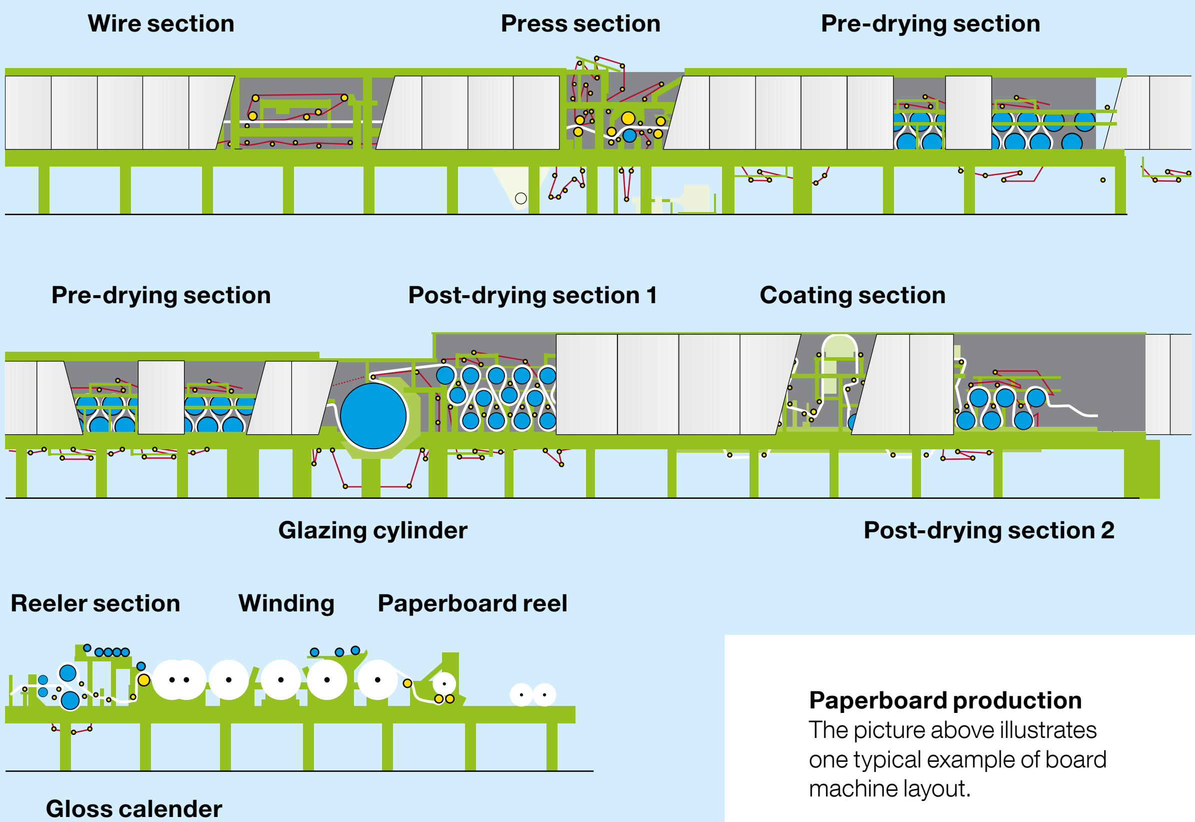
Glazing cylinder: The top side of the web can be smoothed by contact with a Yankee cylinder having a highly polished surface.

Post-drying section 1 and 2: Additional reduction of moisture content.

Coating section: Depending on the quality required, the web can be coated with one, two or three coating stations per side.

Calendering: The smoothing calender further regulates the surface quality. Depending on the grade, the surface is additionally calendered with the hot surface of the gloss calender.

Winding: The finished paperboard is wound up to a jumbo reel which is then rewound into narrower reels and according to customer requirements, either sent to customers in reels or cut into sheets.



Paperboard production
The picture above illustrates one typical example of board machine layout.

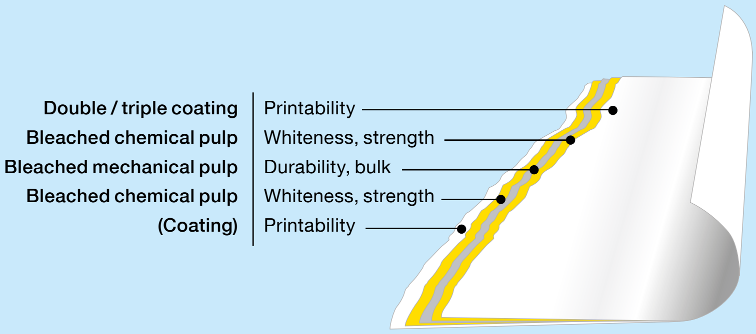
Paperboard grades

A great variety of grades are commercially available and the terms used to describe them vary from market to market. Below the grade categories are based on fibre grades and production technology. Each grade may be tailored for many end uses and for individual customer needs.

Paper and paperboard are made using the same base technology. Paper mainly provides the printing surface, paperboard both printing surface, stiffness, strength and other properties necessary in packaging and graphic end uses. Usually the basis weight, caliper and stiffness are higher than those of paper and also most of the paperboard grades are multi-ply products.

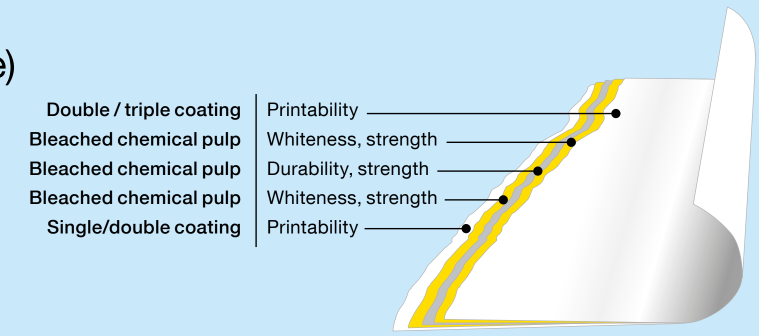
FBB (Folding Boxboard)

A layer, or layers, made of mechanical pulp is placed between layers of chemical pulp. Mechanical pulp may be stone-ground wood (GW), pressurized ground wood (PGW), thermo mechanical pulp (TMP) or chemi-thermomechanical pulp (CTMP). The top layer is bleached chemical pulp and the reverse layer may be bleached or unbleached chemical pulp. The top and reverse side may be coated with mineral pigments.



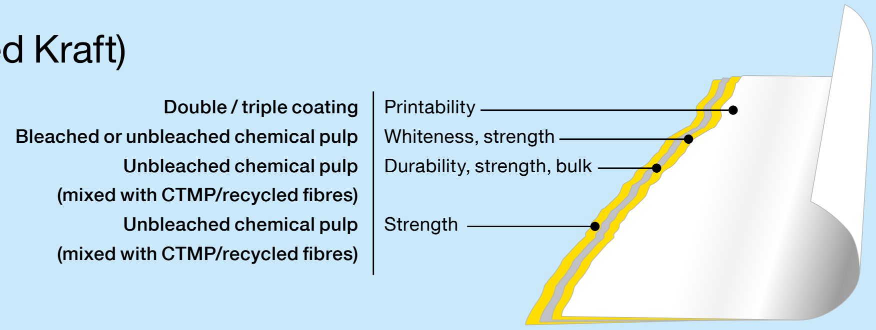
SBS (Solid Bleached Sulphate)

Paperboard made entirely of bleached chemical pulp. The top side and reverse may be coated with mineral pigments.



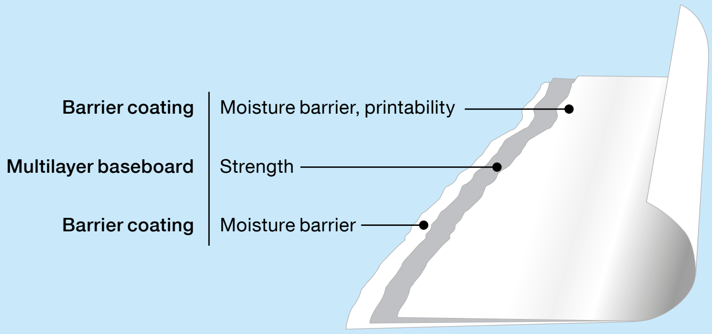
CUK (Coated Unbleached Kraft)

Paperboard made mainly of unbleached chemical pulp. To achieve a white surface, it may be coated with mineral pigments, sometimes in combination with a layer of bleached fibres under this layer. Some CTMP or recycled fibres may partly replace the unbleached sulphate pulp.



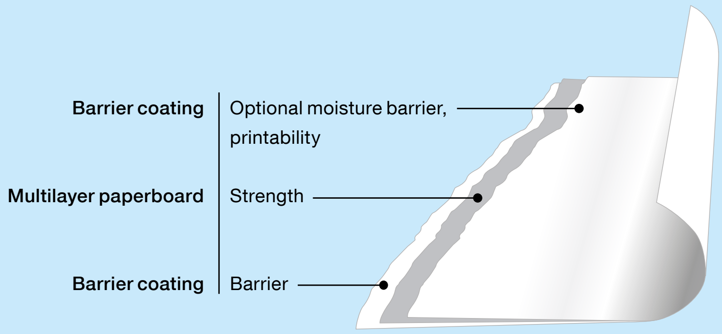
LPB (Liquid Packaging Board)

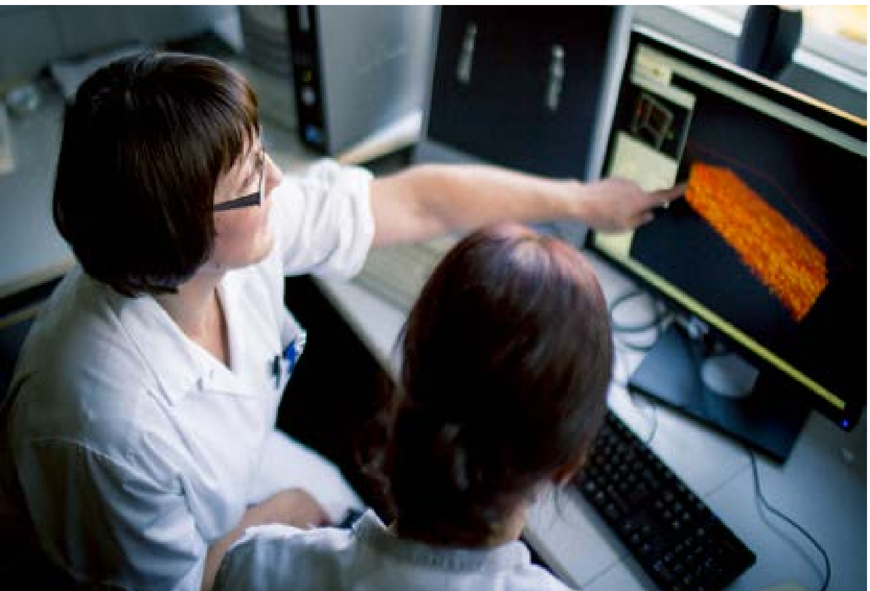
Liquid Packaging Boards (LPB) are used for the packaging of food and non-food liquids, most typically milk, juice and other drinks. The paperboard is polymer-coated for barrier properties - or foil-laminated for long-life beverages.



FSB (Food Service Board)

Typical applications for food service boards include cups, trays, clamshells and boxes. The products are specially designed to stand up to the toughest demands at quick-service restaurants and in-store, and there is a polymer coating either on one or both sides of the paperboard.





Developed for specific use.
R&D professionals develop paperboard with the end user in mind. They support brand owners' and printers' ambitions to create superior product designs and applications.

Barrier coatings for protection and performance

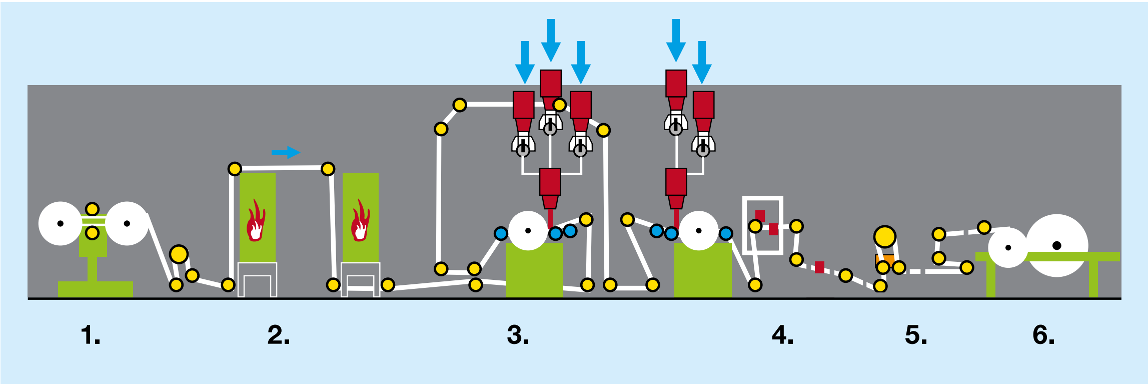
Thanks to barrier coatings, paperboard can be used in far more end use applications compared with paperboard as such. Various barrier coatings provide critical properties such as humidity control, sealing properties, airtightness, light protection, oxygen permeability, aroma barrier, heat resistance, peelability and grease-proofing.

Stora Enso uses extrusion-coating and extrusion-lamination technologies with proprietary coating recipes that optimise the coating, so that you only need a thin layer of polymer to achieve the required barrier. The product is still made of renewable raw material up to a large extent, typically 80-95%. With our plant-based barrier coating options it can be even 100% renewable raw material.
Which barrier coating to choose depends on what kind of product you pack and what kind of protection and performance you want for it. Stora Enso has years of expertise in coatings and provides optimised solutions for all conceivable end uses.

PE, or polyethylene, is the most commonly used barrier coating. Polyolefin barriers, such as LDPE and HDPE polymers, provide excellent humidity protection. In addition to traditional PE coatings, we offer PE Green, which is made of renewable, plant-based raw material, so you get a barrier packaging that is 100% renewable as well as recyclable. Typical end uses include drinking cups and packages for frozen food, ice cream and yoghurt. HDPE-coated paperboard for moisture-sensitive dry foods.

Biodegradable coatings (Bio) are tailor-made polymers offering humidity, oxygen and grease barriers and sealability. Our biodegradable coatings are compostable. However, the biopolymer-coated paperboard can be easily recycled, too, which is usually the preferred end-of-life option. Biopolymers can be produced from natural crops or from fossil raw materials. But the key is that in the end you get a product that is recyclable or it can be collected among other compostable waste that goes into industrial composting. Hardly any application exists where a traditional PE coating could not be replaced by our biopolymer coating! Typical end uses are drinking cups, plates, trays and cartons for fresh foods, salads, sandwiches and dairy products.

PET coating provides a barrier and performs other functions. Black or white PET coatings that provide heat resistance act as an excellent



Extrusion coating
For some end uses paperboard can be extrusion coated. Extrusion coating is a separate process after the paperboard production. Corona treatment is an important part of the process as it affects the surface energy of the material (dyne level). Higher dyne level ensures good adhesion of ink and glue and thereby improves the printability and convertibility of the polymer coated board.

1. Unwinding
2. Flame treatment
3. Coating
4. Coating thickness control
5. Corona treatment
6. Winding

grease barrier and possess solid WVTR (water vapour transmission rate) properties. Typical end uses include ovenable trays, reheatable product packages and bakery products.

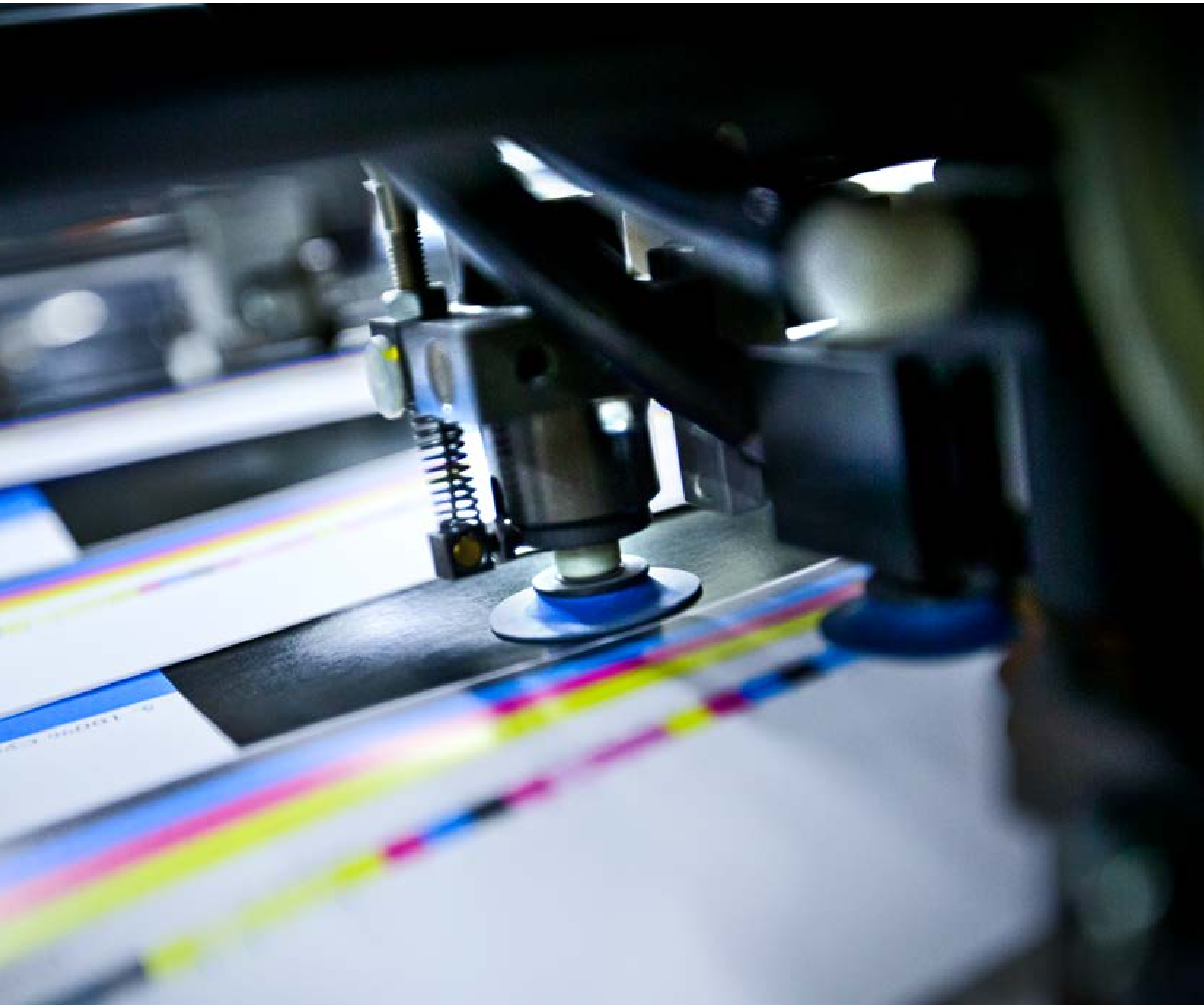
PP or polypropylene coating offers heat resistance for microwave oven and is also suitable for deep freezing. Good sealing properties secure performance in use. Typical end uses are cups and trays for microwave oven and frozen food.

Our patented high-barrier coating consists of a multilayer EVOH and PE polymer structure. It provides excellent oxygen, humidity and aroma protection. The high-barrier coated boards and papers are also greaseproof. Typical end uses are many: delicate foods, chocolate, cereals and dairy products; dry foods such as sweets, savoury and processed snacks, coffee and tea, milk and cocoa powders; liquid products such as juices, soft drinks, green tea, water, soups, desserts and wines, and even non-food such as liquid detergents and fabric softeners.

Oxy Barr Al provides oxygen barrier. It has aluminium lamination on one side and optional PE coating on the printing side of the board. Typical end use is coffee packaging and other very sensitive foodstuffs.

A metallized PET film with a silver colour on one side of the board can be used for an excellent visual appearance and a feeling of luxe. Typical end uses are luxury packaging, cosmetics, perfumes, wine and spirits.

Barrier coatings enable paperboard to be used in far more end use applications compared with paperboard as such.



Printing paperboard

Due to their structure, all boards are ‘living’ material. An unwrapped sheet of paperboard reacts with the air very quickly and needs to be handled properly. Before printing, you must make sure that the moisture in the air and temperature of the sheets are in balance with the conditions of the press room. Large differences in these parameters can lead to problems such as curling of the sheets and slow ink drying.

Make sure that the paperboard is acclimatized to where it is going to be printed. The necessary time for settling can be found on our pallet labels.

Example: If the size (volume) of the pallet is 1 m^3 (1 m x 1 m x 1 m) and the temperature difference between the pallet and the press room is 20 °C, the settling time needs to be 46 hours in the press room.

For paperboard, the ideal humidity of both the warehouse and the press room is 50–55% relative humidity and the ideal temperature 20–23 °C. Increased relative humidity can cause drying and rub resistance problems in the printed surface. Another possible reason for slow drying may be a shortage of the oxygen that is needed for ink polymerization.

Remove the wrapping just before printing. This will ensure even and smooth settling of the pallet. The wrapping also protects the sheets from dirt and damage.

Printing methods

The final print quality is influenced by many variables, such as paperboard properties, printing press and process parameters, and ink properties. For optimal results, it is important to understand the interaction between vital paperboard properties and the chosen printing process.

This chapter describes the most common printing methods, although the information below focuses mainly on the sheet-fed offset process, which is the dominant printing technique for paperboards. The information will facilitate the processing of our paperboards and enhance the quality of the print work. Moreover, these guidelines may serve as a token of our ongoing endeavours to add our manufacturing experience to the expertise of the printing and converting industries.

Offset printing

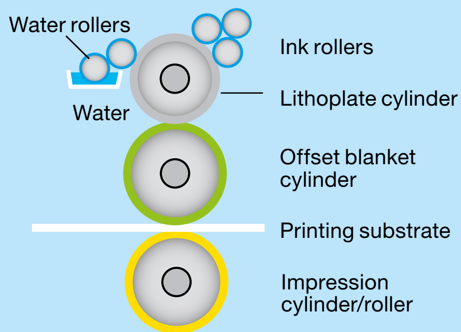
The dominant printing method is offset, which is divided into three different processes:

- sheet-fed (sheets) SFO
  for paper and paperboard
- heatset web offset (reels) HSWO
  for paper and low-grammage paperboard
- coldset web offset (reels) CSWO
  for newsprint

Offset printing is based on physicochemical reactions between the ink, fountain solution, printing plate and blanket. The printing plate is made of aluminium. The plate is chemically treated so that image areas accept greasy ink (oleophilic) and are water-repellent. The non-

Stability for storage is a must.
Paperboard is a living material and needs to be stored carefully. The ideal humidity of the warehouse is 50–55% and the ideal temperature 20–23°C. When moving and handling the paperboard pallets, care should be taken not to tear the wrapping as this may lead to printing problems. Wrapping should not be removed until just before printing.

Offset printing



- **dots are uniformly covered with ink**
- **edges are ragged**

printing areas are hydrophilic, meaning that they repel ink but accept fountain solution. The average thickness of the ink layer carried by the plate is 2–3 µm and that of the water layer 1–2 µm. The ink is transferred from the printing plate to the printing blanket, then onto the surface of the paperboard.

The structure of the printing blanket is a texture of 2-4 layers covered with rubber layers. The blanket has different hardness levels (70-85 ShoreD), the harder blankets being more durable and meant for higher printing speeds. By using a soft blanket, better contact with the paperboard can be achieved. The blanket is not allowed to react with ink solvents during the printing process. The printing blanket transfers the printing image from the printing plate to the surface of the printing material.

The offset inks are very tacky and require high surface strength in the print material. The sheet-fed inks dry by absorption and oxidation, heatset inks by evaporation (aided by dryers). UV (Ultraviolet) offset inks need UV light to dry by polymerization. The inking unit transfers an even ink layer to the printing plate, makes the ink fluid and flexible and keeps it at the correct temperature.

The fountain solution forms a thin water layer on non-printing areas of the printing plate. The pH, hardness and conductivity are important properties for the fountain solution. The pH should be between 4.8 and 5.3, hardness between 7 and 15 °dH and conductivity 50–200 mS/m to achieve the best printing result.

Waterless offset (dry offset)

In waterless offset printing, no water is involved in the printing process. In the dry offset (waterless offset) process, more tacky inks are used and special printing plates treated with silicone are needed. The silicone material of the printing plate has a very low surface energy and makes up the non-printing area of the plate. This material will resist the ink, provided the ink's viscosity is such that it has a greater affinity for itself than it does for the silicone.

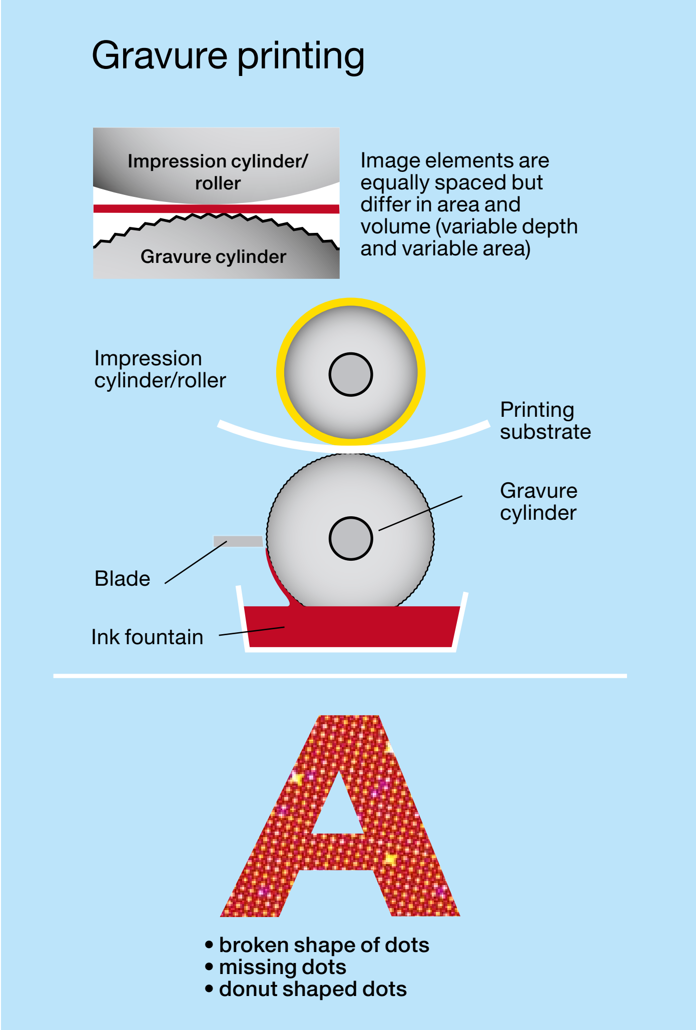
Temperature control of printing inks is very important. The temperature should be stable. The optimum temperature range for dry offset inks is narrower than for conventional offset inks. If the temperature is too low, the viscosity of the ink increases, resulting in poor fluidity/rheology of the ink and inferior ink transfer. In printed areas, this results in picking, ghosting, mottling (unevenness), low printed gloss and problems resulting from poor ink transfer. If the temperature is too high, the ink viscosity decreases, causing some of the ink to be transferred to the unprinted areas of the printing plate, resulting in doubling problems (dye toning: weaker ghost dots next to true dots whose position is out of register).

The operating temperature ranges for dry offset inks are 26–35 °C for black, 24–31 °C for cyan, 22–28 °C for magenta and 20-29 °C for yellow. The exact temperatures depend on the manufacturer of the ink and the ambient conditions. Waterless offset printing is environmentally friendlier due to the absence of wastewater and residues from IPA (isopropyl alcohol) or additives.

Gravure printing

Gravure is used for long print runs on paperboard, magazine paper and plastic films, and for security printing. The printing ink is transferred from the printing cylinder cells to the surface of the printing material. The metallic printing cylinder and soft rubber backing roll form the printing nip. The pressure at the printing nip is high to ensure optimal ink transfer. The most important requirement for the print material is smoothness to ensure good contact between the paperboard, the ink and the printing cylinder. Because of the high pressure at the printing nip, the compressibility of the paperboard is also important.

The printing ink is solvent- or water-based with a very low viscosity level. The inks dry by evaporation in the drying unit.



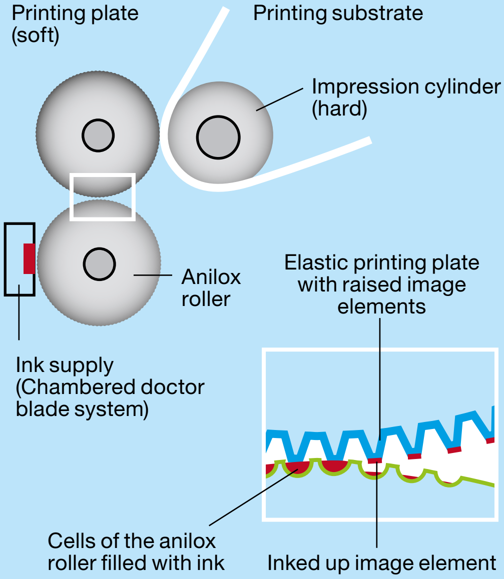
Flexo printing

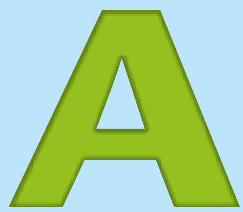
The printing ink is transferred by an anilox roll to the printing plate. The surface of the anilox roll is full of small, engraved cells and extra ink is wiped away by using an oscillating doctor blade or a chamber doctor blade. The printing plate is made of photopolymer or rubber. The uplifting parts of the printing plate transfer the ink from the plate to the printing material. The soft printing plate and hard steel backing roll form the printing nip. The pressure at the printing nip should be very light ("kiss").

The flexo inks are water- or solvent-based with a very low viscosity level. UV inks can also be used. Water- and solvent-based inks dry by evaporation in a drying unit that normally follows each printing unit. UV inks need UV light to dry by polymerization. The surface energy plays an important role in flexo printing. The surface energy should increase in printing order (lower for ink than for printing material) to ensure optimal ink transfer and adhesion.

Flexo printing is mainly used for printing on flexible packaging, labels, paperboard and fluting board, plastic bags and newsprint.

Flexo printing





- **ink is pressed to edges**
- **shadow in the edge of text**

Digital printing

In digital printing, images are printed directly onto a substrate without a static master, so every consecutive print can be different. Digital printing technology is also entering the field of consumer goods packaging.

The benefits of digital printing include variable data printing, print-on-demand and cost-effective short runs. The limitations include smaller colour gamut compared with traditional presses, and a slower print speed.

The latest digital printing and converting technologies have made it cheaper and faster to create limited edition packaging, for example, to capture consumers' attention. Features such as real-time tracking and analytics have a wide range of applications in solutions to improve customer engagement.

Brand owners use digital printing to create new business models, combining features such as versioning and marketing with social media applications. Consumers receive personalised information about the product, its ingredients or components, complementary products or environmental information. It may also be possible to gain access to various loyalty schemes, competitions or social networking communities.

Digital printing technology

Two of the most common digital printing methods are electrophotography and inkjet. Image creation follows the same principles in both dry and liquid toner electrophotography printing processes. The image is first formed on the surface of a photosensitive drum, and then the charged toner particles are transferred to the substrate in a toner transfer nip with an electrostatic field. Toner particles are attached to the substrate by a combination of heat and pressure. The quality of the image is determined by the substrate surface roughness and electrostatic adhesion.

In inkjet printing, varying volumes and sizes of droplets are ejected from the print heads to create very small, precise dots on the page. The substrate must be able to absorb ink fast enough to prevent the dots from spreading before being dried in the printing press.

Both sheet and web-fed production-scale inkjet presses are becoming mainstream, offering both good image quality and high productivity. There are several different types of inkjet inks on the market, covering a wide variety of applications and end uses.

Cartonboard is generally suitable for inkjet printing, but pre-treatment may be required. Compatibility depends on the surface properties of the cartonboard, and the type of ink and composition. Testing on a case-by-case basis is recommended.

Printing inks

There are many different types of printing inks, each suited to different applications. We hope that the following serves as a guide to key features of inks.

The main components in a printing ink are:

- Pigment that creates the colour and colour strength and gives the ink its optical properties
- Binder that binds the pigments into the printing material and affects ink drying and ink gloss
- Solvent that adjusts ink viscosity and has an effect on ink setting and drying. The solvent dissolves the binder
- Additives (dryer, wax, antiskinning agent, antifoaming agent and surfactants/flexo, gravure)

Sheet-fed offset inks dry by oxidation and absorption and heatset offset inks dry by evaporation. Offset UV inks dry by polymerization. The ink contains photo initiators that absorb UV emission. The ink monomer has to react with UV emission. Drying progresses through the ink layer from top to bottom and is dependent on ink layer thickness and ink type (dark or light ink shade).

Offset UV inks are slightly tackier than the conventional inks, which means that the paperboard needs a higher degree of picking resistance.

No odour or taint problems normally occur with UV inks if the drying capacity and time are optimal. The UV-printed surface is now ready for further processing.

Flexo and gravure inks can be solvent- or water-based and both inks dry by evaporation.

Metallic inks for offset

The amount of metal pigment in silver inks is 25–30% and in gold metallic inks up to 50%. The metals used in gold inks are copper and zinc. The gold colour shade (copper red to greenish yellow) is dependent on the proportions of copper and zinc. Aluminium is used in silver inks. The platy metal pigments are produced using the ball mill process (gold and silver) or the foil process (silver). The particle size of the metallic pigment is larger than that of conventional ink pigments. All metallic inks have good coverage. The metallic ink dries through absorption and oxidation. The setting of the ink does not differ from conventional inks. When metallic inks are used, the fountain solution can be the same kind as for conventional inks.

The adhesion of metallic inks to the printed base is weaker due to the lower binder amount and higher pigment amount in the ink. However, these are known facts when using metallic inks, and any problems are caused by the inks, not by the paperboard to be printed. If the base board is very rough or has very high porosity, it should be sealed before printing with metallic inks. The technique known as underprinting can also be used. Under printing with yellow, red or orange ink can be used under gold ink, and cyan ink under silver inks.

The shade of the ink will remain unchanged and the rub-off resistance will be improved.

The best paperboard grade for metallic printing is produced in neutral or alkali processes to avoid ink shade differences. Printing with metallic inks is best done in the last printing unit.

The rub resistance of metallic inks is lower than with conventional inks but can be improved by varnishing the printed surface. Typical procedure when using metallic inks is as follows:

- metallic ink + varnish
- sealing of base board + metallic ink + varnish (when the base board is very rough)
- underprinting of base board + metallic ink + varnish (shade of ink and rub-resistance will be better)

The adhesion of varnish to the surface of the metallic ink layer is poor, partly because the ink layer is slippery. The metallic ink should not contain wax – or at any rate as little as possible. The ink layer should be thoroughly dry before varnishing, to improve adhesion. The amount of varnish used should also be as low as possible. The best varnishing process for a metallic ink layer is: metallic ink + water-based varnish + UV varnish. Remember to use glossy varnish if you wish to have strong metallic outcome.

Food safe inks

Packages and materials that are in direct contact with food, are to be printed with food safe inks. Usually these inks are vegetable based, without any toxic or solvent based particles. Some Pantone colours are available, even some metallic inks. Contact your print operator or colour supplier in good time before you start planning. It may take some time to order these special colours.

Practical printing instructions

Choosing the right type of ink is important. The following criteria must be taken into consideration:

- desired print gloss
- processing/converting of the product
- drying time of the ink
- desired scuff resistance
- number of colour units
- possibility of IR/UV drying
- tack
- special features required from the job (odour/taint etc.)
- subsequent UV varnishing

Certain properties of the ink depend on each other. The most important of these are print gloss, setting speed, scuff resistance and ageing in the press. These properties are closely interrelated. For instance, if a high-gloss ink is chosen, more time has to be reserved for drying. For more detailed information, it is best to contact the ink supplier.

Amount of fountain solution during printing

The entire offset process is based on the balance between ink and water. However, as much as 30% of the fountain solution may emulsify into the ink in normal printing circumstances. There is no benefit to using an excessive amount of fountain solution in the press. It quickly affects the quality of the end product, causing, for example, drying problems, print gloss reduction and weaker colours. When the amount of fountain solution is increased during printing, it also increases the amount of water on the surface of the paperboard, either in the ink or on the unprinted areas. The correct fountain solution level exists on the press when there is the minimum possible amount of water on the plates to achieve an optimum printing result (adequate ink film) and when the fountain solution pH is correct, i.e. 4.8–5.3. Under these conditions, the paperboard does not absorb an excess of fountain solution, from either unprinted or printed surfaces. Furthermore, this ensures quick ink drying, the desired print gloss and the correct colour balance on the printed surface.

Amount of ink

Ink density is one of the most important features measured from the printed surface. Remember that print contrast is reduced if excessive ink is carried. Ink film thickness also has an influence on the ink drying time and on the risk of set-off. During printing, the contrast of each colour should be maximized by attaining the optimal density level. The smaller the amount of ink needed to achieve maximum contrast, the finer the screen that can be used in reproduction, resulting in the sharpest possible image in the final product.

Drying of the ink

Drying of standard sheet fed offset colours is affected by a chemical reaction. If you want to speed up drying, the printed sheets can be acclimatized by turning them, either manually or using a pile turner.

The reason for a drying problem may be:

- too high humidity in the press room
- temperature changes in the press room
- too short a settling time of pallets before printing (the material is cold or moist)
- unsuitable ink or ink series for the paperboard being used
- excessive amount of water or ink
- fountain solution too acid
- IR (infrared) dryer temperature too high

The drying of UV inks starts within a fraction of a second due to polymerization. The sheets are ready for further processing immediately after printing. If UV coating is applied over conventional offset inks, the ink surface must be absolutely dry before coating, and/or the inks must be carefully selected. Otherwise, the result may be a lower coating gloss or flaking of the coated surface.

Grain direction (machine direction)

The direction in which most fibers lay in a finished sheet of paperboard is referred to as grain. Fibers flow parallel to the direction in which the paperboard travels on the board machine during manufacture. The end use of the product must be taken into consideration when choosing the grain direction. It is important to know how the end product will be used and what requirements are related to its function. For example, the direction of a score or fold or the required sturdiness of the end product should determine the grain direction when the sheets are ordered. Another important factor for choosing grain direction is the printing press. Almost without exception, the runnability of the paperboard is better if printed with the grain direction parallel to the cylinders.

The paperboard is more flexible in the sharp curves of the press and problems can be avoided even at high speeds. This factor becomes even more important when the grammage of the paperboard is higher.

Moisture

Remember also that the moisture applied in the press increases the dimensions of the sheet. Because of the structure of the paperboard, the fibres generally expand more in diameter than in length. It is obvious that if the grain direction of the sheet is the same as the direction of print, a register problem can occur. The likelihood of this problem occurring is greater if large formats are to be printed with a very precise register. To avoid such problems, the orientation of the sheet should be planned by taking into consideration both the end product and the printing press.

Converting and finishing

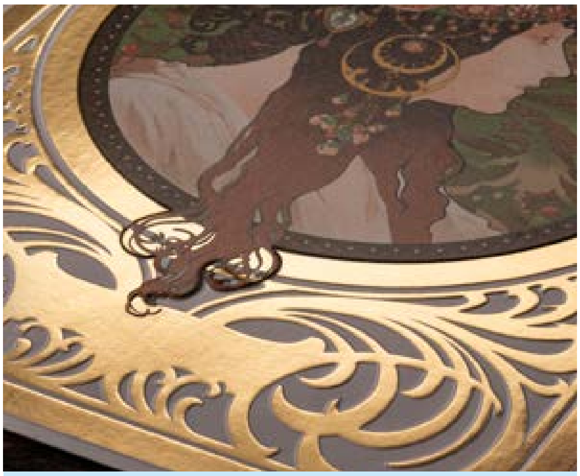
Different converting and finishing techniques are applied to paperboard to make the end products more eye-catching. Varnishing, embossing and other effects highlight desired messages on the packaging. Paperboard is a great material for packaging as it can be processed in various ways without weakening its functional properties.

Varnishing

Varnishing improves the visual appearance of the printed surface. Varnishes may be matt or glossy. Spot-varnishing can also be used to highlight certain areas and make them more prominent. The varnish should be resistant to mechanical rubbing and solvents. A glossy varnish lowers the friction coefficient (COF) of the paperboard which should be high enough in order to secure good runnability of the paperboard in the following converting process. Normally when having matt varnish the COF level is high.

The final gloss level of the varnished surface is dependent on paperboard properties, the thickness of the varnish layer and the chemistry of the varnish used. If the pores in the coating layer are small, the varnish has difficulty penetrating into the coating layer and tends to remain on the surface. If the surface is very rough, two varnish layers are needed; the first one closes the surface and the second one smoothes out the roughness.

Solvents in the varnish should not react with the coating binder or the ink binder, since such a reaction may result in softening of the varnished layer. Yellowing of the varnished layer can be prevented by choosing the right binder system for the varnish. Varnishing will improve the rub-resistance of the printed surface. The three main methods of on-line varnishing are offset varnish, water-based varnish and UV varnish. Varnishing can be carried out by using an ink unit (offset varnish), online varnish unit (flexo unit for water-based varnish) or a separate varnish unit. Glueing should be carried out on unvarnished areas.



Textured hot-foil stamping
Textured hot-foil stamping can be used, for example, to create metallic, stylish authentication labels or figures.

Embossing

Embossing is done to emphasize printed area or print impression or even unprinted surface. Although a bulky paperboard might seem easier to emboss, the aim is usually to achieve a certain height so that the embossing is more pronounced. A bulky paperboard will respond in a more spongy way. High-density boards give more pronounced embossing (at the same tool height). The embossing machine must be correctly adjusted for the paperboard grade to be processed.

Required paperboard properties:

- chemical fibre is better than mechanical fibre
- long fibres are better than short fibres
- higher moisture is a benefit (inhibits cracking)
- thick paperboard is better than thin
- strength properties, especially bursting strength, are important
- the coating should be flexible to avoid cracking
- multilayer boards are better than single-layer boards

Hot-foil stamping

Hot-foil is a technique using very thin aluminium foil in a variety of metallic colours, such as red, blue, silver or gold. The metallic foil is (loosely) fixed to a carrier film. A tool bearing the image to be hot-foiled strikes this web. Through heat and pressure, the image is transferred to the paperboard. Care should be taken when applying hot-foil stamping on varnished paperboard. For best results the foil needs to adhere strongly to the substrate. The presence of any kind of debris or dirt will have a negative influence on the end result. The printing and coating therefore need to be flawless and adhere strongly to the paperboard.

Multilayer embossing
Embossing is typically accomplished by applying heat and pressure with male and female dies that fit together and squeeze the fibres of the substrate. The combination of pressure and heat raises the level of the image higher than the substrate, while "ironing" it to make it smooth.

In addition to being used as a design element, embossing can be used to improve the performance of paper and paperboard products.

Die-cutting and creasing

Characteristics differ between different types of paperboards, such as solid bleached paperboard (SBS), folding boxboard (FBB) or white lined chipboard (WLC). All grades can be cut and creased, but to obtain the best result for each application it is important to fine-tune the treatment. The operating window of die-cutting and creasing varies according to the type of paperboard and its individual properties.

It is true of all paperboard types that results differ depending on the grain direction, moisture content, thickness, and the amount and type of surface treatment (pigment, plastic, foil, etc.). Moisture content and thickness are the most important factors. Tool life will also be affected by the paperboard type chosen. For cutting and creasing, there are basically two methods in use: rotary or flat-bed. These different methods place different demands on the paperboard. The main difference between them is:

- In rotary cutting, the knife does not meet the "anvil." There is a gap of some 5 microns.
- In flat-bed cutting, the knife should just touch the counter plate for best results.

In addition, flat-bed cutting can be performed either inline or off-line. All of these variables will to some extent place different demands on the paperboard. For rotary cutting, the web must stick together, rather than fall apart, until the blanks enter the splitter/collector/stacker. At the same time, clean cuts are desired. This can be achieved by using specially adapted qualities, but speed of the die-cutting equipment is of course also important. In off-line flat-bed cutting, almost the opposite could be said to be true. While clean cuts are still desired, the paperboard should separate easily in the puncher. The following description mainly focuses on flat-bed cutting.

Die-cutting

A good cut should be clean and free from loose fibres and particles. The most important strength properties of the paperboard are tear and tensile strength. These properties differ between different paperboard types and the die-cutting process has to be adjusted according to those properties. The correct moisture content is essential for both runnability and quality during the die-cutting process. Too high a level will make the paperboard stronger, tougher and more difficult to cut. Too low a moisture level will make the paperboard more brittle and difficult to transfer, and may cause dusting.

Difficulties in cutting may be caused by the paperboard thickness, moisture variation or tool wear and adjustments. It is important to control the climate to keep the moisture content unchanged. Controlled climate helps to achieve a precise register between the work stages.

If the cutting knives are sharp and meet the counter die correctly, the cutting occurs as desired. A problem may occur if the sheet moves during the process. This is often due to incorrect rubbering and results in flaking and premature tearing of the back layer of the paperboard. This is observable as a torn area next to the cut. Damage will also occur to the knife if it presses too heavily against the metal plate. The knife wears and becomes blunt, leading to dust and hairy-cut edges. Plastic-coated or laminated products with an extra tough layer (for instance PET) should preferably be die-cut from the plastic-coated side.

Creasing

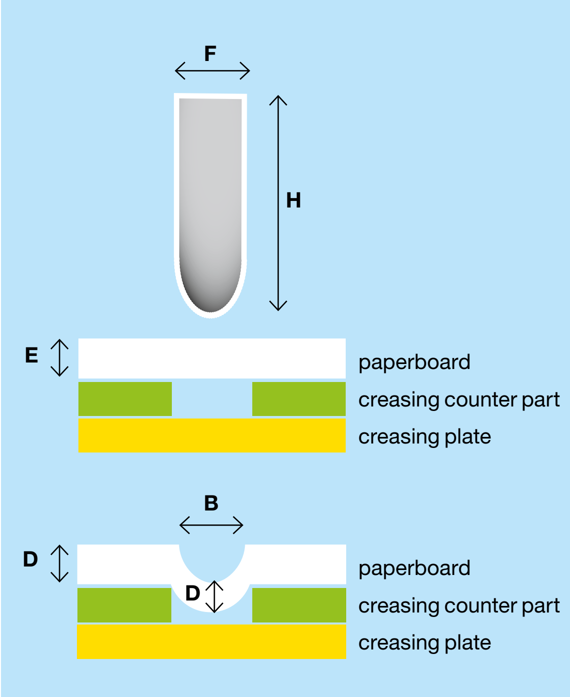
A crease forms when paperboard is pressed into a groove with a rule. This causes a plastic deformation in the paperboard, allowing the paperboard to fold easily without cracking. A good crease is sufficiently deep and narrow to enable precise folding. The main factor for setting the adjustments is the thickness of the paperboard. The type of the paperboard is also important.

Obviously the pressure of the die-cutter also affects the creasing.

During creasing, the paperboard is weakened in well-defined folding lines, which then act as hinges for folding packaging and graphical products. Creasing is carried out by using a thin strip of steel with a round smooth edge and an accurately cut groove in a thin hard material known as the counter plate. The creasing rule pushes the paperboard into the groove of the counter plate, located under the paperboard, creating a permanent crease.

A good, functional fold occurs when the paperboard delaminates in the crease into as many thin, undamaged layers as possible. Ply bond strength must be a compromise, so that delamination occurs easily in a crease while the structure holds together in other areas. Thicker boards require a wider rule and groove. Bulky boards are easy to crease. Creasing requires a flexible coating and strong surface layers. The fibre composition and number of layers are important. A multilayer structure in creasing is desirable. Because thick material cannot fold without breaking the structure, the fibre layers delaminate in a crease. The bonding between the layers weakens in creasing, causing them to loosen from each other more easily in folding.

The creasability properties depend on the fibre orientation. A crease in the machine direction usually has worse folding properties, because the stiffness is lower in the cross-fibre direction. Stable moisture content is important, because dry paperboard can crack more easily, while moist paperboard has a lower stiffness, resulting indifficulties with delamination. The creasing properties can also be analyzed by making a “creasing window.” At laboratory scale, the Marbach equipment is used by changing the groove width and depth, blade/rule width and the penetration of the creasing rule into the groove. The bending forces of creases are measured. The creases should have certain stiffness after bending – in MD (machine direction), 45-60% and in CD (cross direction), 55–65%. A visual judgment of creases is also made. If the paperboard has a large operating window, the creasability is good. In general, plastic surface layers improve the creasability, because they have very good elongation before they break and tend to reduce the risk of surface cracking in the creases, compared with plain paperboard.



Creasing
B = creasing groove width
D = creasing groove depth
E = board thickness
F = creasing rule tip thickness
H = creasing rule height
G = thickness of groove bottom

Glossy UV varnish
This process involves applying an extra high-gloss varnish (a clear liquid) over the top of a printed area, either to specific areas of a design such as logos in order to highlight them, or to the entire surface of a printed item, resulting in an extremely glossy and luxurious appearance.

Glueing

Side seam or point glueing is often the final operation in the carton-making process. The most common glue types used for packaging purposes are waterbased dispersion and hot-melt glues. Setting of the glues proceeds by chemical reaction, cooling down or reduction of solvent. The glue can be applied using a glue wheel/disk or a nozzle system. Water-based glues are applied using both systems, while hot-melt glue is applied by nozzles. When the delamination (breakdown of the seam) occurs in the fibre layer, the seam is acceptable assuming the internal strength of the paperboard is on acceptable level. If it breaks in the coating layer, there may be a problem during use. Delamination in the glue layer is a theoretical possibility.

The smoothness and porosity of the paperboard surface have an effect on the mechanical adhesion of the glue. The glue should be anchored to the paperboard surface. The absorption of the top and reverse layers must not be too different since this would result in penetration of the glue mostly to the highly absorbent side. The glue must wet the surfaces properly. For printed and varnished surfaces, the seam areas are often devoid of ink and varnish to assist adhesion. It is important to correctly adjust the glueing machine settings to the most suitable open time, compression time and force. Normally the glues are water-based dispersions of polyvinyl acetate (PVAc). The most important parameters for glueability are the paperboard and the glue type. Surface energy and smoothness play an important role. The surface energy of the paperboard surface must be higher than that of the glue to ensure good adhesion. With plastic-coated surfaces, the corona treatment is used to increase the surface energy of the surface. The lower limit for surface energy of the paperboard surface seems to be 38 mJ/m^2 – anything lower may cause problems.

There is more to finishing treatments than meets the eye. Also tactile touch and feel properties have a strong impact on the user experience.

The amount of glue applied is dependent on the paperboard and glue types – varying with the glue's viscosity for example – as well as on the application system (disk or nozzle). The glue dries as the water penetrates into the paperboard surface. Penetration is dependent on the moisture and porosity of the paperboard surface. A portion of the glue itself should also penetrate into the paperboard. The recommended penetration depth is 1–3 times the fibre diameter. Hot-melt glues are used to glue materials with a low porosity level (plastic coatings and metallic laminates) or in processes that require short setting time of the glue (e.g. in-line glueing in packaging machines). Hot-melt glue contains resin (affecting adhesion), wax (creating a suitable rheology for the melted glue) and polymer (for cohesion). Hot-melt glue is melted and applied to the surface at a temperature of 120–200 °C. When glueing plastic-coated board, the glue must be so hot that it will melt the plastic to some degree. Care should be taken when using hot-melt glues in cold surroundings or under cold conditions.

Lamination

It is to some degree incorrect to talk about lamination as a component of finishing. Paperboard is often bought by a converter and laminated, then sold to a printer. If this is the case, there are basically two main applications for lamination. Both of them typically involve paperboard in reels:

- Lamination of polypropylene, aluminium foil or metallized polyester film onto a paperboard
- Lamination of one or more boards to a core-web of paperboard, foam or similar

The idea of the first process is often to give a luxurious look after printing on the pack. The other application is more typically intended to produce a display paperboard for advertising purposes. In this second lamination process, two or more webs are glued and pressed together to obtain a paperboard grade with a higher grammage level. As described above, a centre layer of some type is often included to give a thick product.

The lamination may be:
- wax lamination (molten wax is applied to the paperboard surface)
- glue lamination (two or more webs are glued together)
    - o wet lamination
    - o dry lamination
    - o solventless lamination
- extrusion lamination
- hot melt

Wax or resin-modified wax is used as a hot-melt adhesive in wax lamination. The wax is heated, applied to the surface and cooled. In wet lamination, one of the webs must be porous to ensure absorption of the solvent, while the other web may be porous material, aluminium foil or plastic web. In dry lamination, the glue layer is dried after application. Dry lamination can be carried out by hot lamination. The dried glue layer is sticky at high temperatures after emerging from a drying unit. Extrusion and hot melt lamination are hot lamination processes.

No solvents and no drying are used in solventless lamination. The adhesives are 100% solid materials, used in single-component or two-component systems. The glue in wet lamination is normally water-based PVAc glue (solid content about 50%). The glue dries through absorption of the water by the paperboard surface. No drying unit is needed. It is recommended that the paperboard be sheet-cut online just after the lamination to avoid curling problems. It is also important that the webs to be glued together have similar caliper and grammage profiles. Smoothness of the paperboard is often very important in these processes. Other factors, such as the glue, will also affect the end result, but a smooth paperboard has a higher chance of delivering the desired result. The paperboard surface must be sufficiently absorbent to ensure the penetration of the glue solvent. Paperboard can also be glued onto a medium (other paperboard, foam, etc.) as sheets. This is normally done after printing and the process is known as pasting or paper-lining. In other words, the process is different but the end result may look similar.

Testing methods

The tests apply to ISO, SCAN and TAPPI standard methods. If standards are not available, the mill's own methods, or methods developed in cooperation with customers, are used to predict the properties of the product. Testing is performed using modern devices and most of the tests are made in standard conditions. The standard conditions are: 23 °C temperature and 50% relative humidity according to the standard ISO 187 (SCAN-P 2:75).

Online testing
Online testing is used to measure the most important properties of the paperboard. The measuring head of the process computer measures basis weight, caliper and moisture continuously from every machine reel. The online measurement provides data throughout the entire machine reel and enables the machine personnel to control the basic properties of the paperboard simultaneously. The machine personnel check the entire machine reel visually at every reel change. They also check impurities, colour and formation from the cross-profile sample. The online measurement properties such as grammage, caliper, moisture and optical properties are also calibrated or tested in the laboratory.

Automated laboratory testing
There are automated laboratory test stations (later referred as Autoline) in the paperboard laboratories. These testing devices can be equipped with instruments such as:

- Two-sided gloss
- Caliper (thickness)
- Two-sided smoothness (PPS)
- Two-sided roughness (Bendtsen)
- Porosity (Bendtsen)
- Burst strength (Mullen)
- Basis weight
- TSO (Tensile Stiffness Orientation)
- Optical properties

The Autoline measuring devices measure and move 30 cm-wide cross-profile samples automatically. The results are saved in the computer and transferred automatically to a quality-data handling system. Manual laboratory testing sheets across the machine reel are delivered to the laboratory for manual testing by the machine personnel. The size of a single sheet is 30 cm x 30 cm and the number of sheets depends on the width of the paperboard machine. Testing is performed seven days a week in three shifts. Every machine reel is tested according to the procedures described in the ISO 9001 system. Some of the properties are tested across the web in many positions and some in one position only.

General properties

Grammage
Unit: g/m^2
ISO 536

Grammage is determined by weighing a known area of a sample. The grammage is measured both online and by Autoline.

Thickness
Unit: µm
ISO 534

Thickness is defined as the distance between the two outer surfaces of a single sheet measured at 100 kPa pressure and over a 200 mm^2 test area. In addition to the online testing, thickness is measured by Autoline.

Moisture
Unit: %
ISO 287

Moisture is measured by the online testing. The moisture content is also checked daily in the laboratory with a measuring device that uses microwaves to determine the moisture level. In addition to these measurements, weekly calibration is performed by determining the loss of weight of samples dried at a temperature of 105 °C.

Physical strength properties

Stiffness (L&W)
Unit: mN
ISO 2493

Stiffness is determined by measuring the bending force required to deflect a sample from its original position when one end of the sample has been anchored. Stiffness can be measured as bending stiffness DIN 5°, bending moment Taber or bending resistance L&W 15°. For example, in the L&W bending resistance test, the bending distance is 50 mm for paperboard and 10 mm for paper. Testing is conducted in both machine and cross directions by a stiffness tester. Taber stiffness is measured according to the TAPPI 489 standard.

Surface properties

Roughness (Bendtsen)
Unit: ml/min
ISO 8791-2

Roughness is defined as the flow of air which leaks between the surface of a sample and a metal ring pressed against the surface under specified conditions. Roughness is measured on both sides of the sheet and the testis carried out by Autoline.

Smoothness (PPS)
Unit: µm
ISO 8791-4

In the Parker Print Surface (PPS) smoothness test, smoothness is defined as the average distance between the paperboard surface and a metallic ring pressed against the sample under specified conditions. Air flows inside the metal ring. The air leakage between the metal ring and the sample is measured by a flow meter, which converts the value to µm. The PPS smoothness testing method provides more information about micro-scale roughness than the Bendtsen method.

Porosity (Bendtsen)
Unit: ml/min
ISO 5636-3:1992

Porosity (ml/min) is determined by measuring the amount of air that flows through a given area of the sample.

Optical properties

In Europe, the ISO standard is normally used to measure brightness. When the brightness is expressed as ISO brightness, C/2 light must be used for the measurements. Since C/2 light does not take into account the effects of OBA (optical brightener) and dyes, this measurement gives lower brightness values compared to measurements using D65 light. D65 brightness takes into account the effects of both OBA and dyes. The CIE whiteness measurement uses a wider wavelength and corresponds more closely to how human eyes recognize the whiteness. TAPPI brightness, measured with GE equipment, is used in the US.

Brightness D65/10
Unit: %

Brightness C/2°
Unit: %
ISO 2470:99 (ISO –Brightness)

CIE Whiteness D65/10
ISO 11475

L*a*b* D65/10

L*a*b* C/2
ISO 5631

Opacity Unit: %
ISO 2471

Brightness (%) is defined as the intrinsic reflectance factor measured at an effective wavelength of 457 nm. For measuring brightness, D65/10° illumination with a defined amount of UV light is normally used.

Although two sheets may have the same brightness, there can be a large difference in visual perception. Visual differences can be estimated from differences in the L* a* b* colour coordinates in the CIELAB colour space. L* is the scale for the whiteness impression, ranging from 0 (black) to 100 (white). a* measures shades in the red/green area. Positive a* indicates red, while a negative a* value indicates a green shade. b* measures shades in the yellow/blue area. Positive b* indicates yellow, while a negative b* value indicates a bluish shade.

CIELAB colour space
The L&W Elrepho method measures brightness, colour properties, fluorescence and many other optical properties by using different lights and angles. The amount of optical brightening agents is also determined by calculating the difference between brightness D65/10 unfiltered and brightness D65/10 with a 420 nm cut-off filter.

Gloss (Hunter)
Unit: %
TAPPI T480 om-99
ISO 8254-1:1999

The surface gloss of the coated paperboard or paper is determined as the reflectance of light from the sheet surface. The light strikes the surface at an angle of 75°and the reflection is recorded by a photoelectric cell. The result is expressed as the percentage of light reflected. The gloss is measured by the Hunter Gloss Tester in the Autoline and is calibrated with a test piece of known reflectivity.

We hope that this guide has offered you useful information and inspiration in the fascinating world of paperboard. Check out our entire product range and technical product specifications on storaenso.com.

Glossary

What makes paper different than paperboard? Is it just the thickness? How about whiteness and brightness, do they have the same meaning? Technical terminology is precise, but at the same time confusing and complicated. This glossary is collected to help communication between designers, converters, print operators and to all who need the right words when working with paperboard.

absorbency: ability of a paperboard to take up and retain a liquid with which it is in contact

blade coating: most widely used coating method, in which excess coating material is scraped off by a blade

bleaching: removal and/or modification of coloured components in pulp to improve brightness, carried out in one or more consecutive stages

broke: paperboard discarded during manufacture or converting; usually repulped

bulk, specific volume: reciprocal of paperboard density, also known as specific volume

calendering: operation carried out by means of a calender on the, at least partially, dried paper or paperboard, with the aim of improving the finish, the process permitting some control of the thickness of the paperboard

caliper, thickness: thickness of paperboard

chemical pulp: pulp produced by using cooking chemicals which dissolve lignin, the glue in the wood, to release the cellulose fibres

chemi-thermomechanical pulp, CTMP: pulp produced by refining chemically impregnated, preheated woodchips

China clay, kaolin: mineral used in paperboard making, as both filler and coating pigment

CIE whiteness: degree of whiteness measured according to recommendations of the CIE (Commission Internationale de l'Eclairage)

CKB, Coated Kraft Back Boards: paperboard consisting of either bleached chemical pulp or a mineral-coated top layer or both, an unbleached back and a middle layer of unbleached chemical and/or mechanical pulp; used for packaging food and non-food products

coating: process by which paperboard is coated with an agent to improve its brightness and/or printing properties or its barrier properties; layer of extruded plastic on paperboard provides barrier properties or good printability for the substrate; layer of pigments and binding materials, such as latexes, improves printability of paperboard

CTMP, see: chemi-thermomechanical pulp

deinked pulp, DIP: recovered paper pulp which has been de-inked through chemical or mechanical processing

digital printing machine: printing machine that prints directly from a computer data file onto paperboard, using the same image transfer techniques as are used in copiers and printers; often includes binding operation

DIP, see: deinked pulp

FBB, Folding Boxboard: multilayer paperboard, often mineral-coated, with an outer layer of sulphate (kraft) pulp and middle layer of mechanical pulp (groundwood, pressure groundwood or TMP; in top grades CTMP pulp may also be applied); used primarily for consumer cartons for packaging of dry or moist foods, cigarettes and other consumer products; also used in the graphical industry for catalogue covers, postcards and folders, etc.

Folding Boxboard, see: FBB

filler: substance (often white pigment) added to the furnish in order to improve paperboard properties

fully bleached pulp: pulp that has been bleached to the highest brightness attainable

furnish: mixture of pulps and fillers which is processed by the paperboard machine to make paperboard
gloss finish: shiny and highly reflective surface quality of paperboard obtained by gloss calendaring

grade: classification of paperboards differentiated from each other on the basis of their content, appearance, manufacturing history, and/or their end use

grammage, gsm: mass of paperboard divided by area, typically expressed as g/m2; one of the basic units to specify a paperboard grade

gravure printing, rotogravure: printing process where the image is engraved (electronically or chemically) in the form of cells in the surface of a metal cylinder

groundwood pulp, mechanical pulp: mechanical pulp manufactured by grinding wood, against a grindstone for example

gsm, see: grammage

hardwood: wood from a deciduous broad-leaved tree (such as birch, oak, beech, aspen or eucalyptus) as distinguished from that of conifers

ISO brightness, diffuse blue reflectance factor: intrinsic reflectance factor at an effective wavelength of 457 nm; measure for the brightness of paperboard

kaolin, China clay: mineral used in paperboard making, as both filler and coating pigment

laminated: product overlaid with a layer of plastic foil or veneer

lignin: polymer which binds the fibres in the wood together and gives them stiffness

long fibre pulp: pulp produced from softwood (softwood pulp)

matt finish: matt calendered surface resulting in a dull finish to the surface of paperboard and having a diffuse reflection; opposite of gloss finish

mc, see: moisture content

mechanical pulp, groundwood pulp: mechanical pulp manufactured by grinding paperboard, against a grindstone for example

moisture content, mc: weight of water contained in wood, expressed as a percentage of the weight of the ovendry paperboard

offset press: printing press using an offset method, whereby the image is transferred from the plate cylinder onto paperboard via a blanket, plate or impression cylinder

opacity: property of paperboard that prevents show-through of printing, the opposite of transparency

optical characteristics: characteristics of the appearance of paperboard, the most important of which are shade, brightness, opacity and gloss

permeability: ability of a surface or coating of paperboard to allow passage of a gas, liquid or vapour

permeance, porosity: combined volume of the pores, capillaries and other voids between the fibres and fillers in a paperboard

plastic coating and laminating: coating of paperboard by polymers, typically polyethylene, and/or laminating with other materials, typically aluminium foil, plastic film or other paperboard

plate: any material used to make a printed impression by letterpress, gravure or lithography

porosity, see: permeance

press: sets of opposing parallel rolls in a paperboard machine through which the paperboard web passes during manufacture and between which it is subjected to pressure, at the same time increasing the dryness of the paperboard

primary fibre, virgin fibre: wood fibre never before used to make pulp or paperboard

printability: function and interaction of paperboard with other components, e.g. the ink in the printing process; subjective assessment judged from the printing result and covering all the paperboard properties that influence the results of printing an image. Compare: runnability

recovered paper: Used paper and board separately collected for re-use as fibre raw material in paper and paperboard manufacture

reel-fed web offset printing: printing on a continuous roll of paperboard in a printing press which uses a curved printing plate mounted on the plate cylinder (HSWO)

rotogravure, gravure printing: printing process in which the image is engraved (electronically or chemically) in the form of cells in the surface of a metal cylinder

roughness: degree of roughness of the surface of paperboard; opposite of smoothness

runnability: feature covering all the paperboard properties that create a trouble-free run through a paperboard machine or printing press (also how well cartons run on an automatic packaging line); see printability

SBS, Solid Bleached Sulphate Board: paperboard consisting of one or several layers of bleached chemical pulp, often also pigment coated, used in the graphical industry and for various consumer cartons for packaging dry or moist food products and in the non-food sector, typically for cigarette and luxury goods cartons

sheet-fed offset printing: offset printing where individual pieces of paperboard are fed into the press

short fibre pulp: pulp produced from hardwood (hardwood pulp; e.g. birch, oak, beech, aspen, eucalyptus)

sizing: process where a sizing agent (e.g. starch, ASA) is added to the paperboard to increase strength and decrease absorbance

smoothness: degree of evenness and regularity of the surface of a paperboard sheet; opposite of roughness

softwood: wood of pine, spruce, or other conifers; with the advantage of having long fibres which enhance the strength of paperboard

Solid Bleached Sulphate Board, see: SBS

specific volume, bulk: reciprocal of paperboard density, also known as specific volume

SUB (Solid Unbleached Board): paperboard used for food and non-food cartons, consisting of a bleached chemical pulp or a mineral-coated top layer or both, an unbleached back and unbleached chemical and/or mechanical pulp middle layers sulphate pulp, kraft pulp: chemical pulp produced by cooking woodchips in an alkaline solution of sodium hydroxide and sodium sulphide

tearing resistance: mechanical property of paperboard, force needed to tear paperboard thickness, caliper: thickness of paperboard

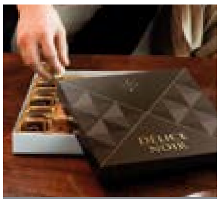
TMP, thermomechanical pulp: mechanical pulp produced by the pressurized pre-steaming of woodchips prior to defibration in a refiner

web fed offset printing, web offset: offset printing on a roll of any substrate that passes continuously through a printing press

White Lined Chipboard, WLC: paperboard made mainly or wholly from recovered fibres, often mineral-coated, and used for consumer cartons for dry food and non-food products as well as graphical end uses virgin fibre, primary fibre: wood fibre never before used to make pulp or paperboard

WLC, see: White Lined Chipboard

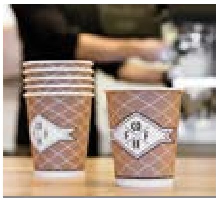
Materials fit for purpose



Chocolate & Confectionery

Cigarette

Cosmetics & Luxury



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Drinks, Wines & Spirits

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