Today’s consumers are keen to save the planet and therefore favour renewable and recyclable materials. Stora Enso is constantly developing boards to meet the high market and consumer expectations. Our target is to utilize the full potential of fibre based material intelligently and innovatively.

The results of this development work can take many forms, including efficient logistics solutions, improved materials and novel packaging solutions.

Our products derive their strength from a unique material that combines specially-developed baseboards and proprietary polymer coatings to create the best quality in terms of purity, functionality, printability and convertibility.

Stora Enso is the global rethinker of the paper, biomaterials, wood products and packaging industry. Renewable Packaging division offers fibre-based packaging materials and innovative packaging solutions for consumer goods and industrial applications. We always rethink the old and expand to the new to offer our customers innovative solutions based on renewable materials. Our consumer board range creates an ample playground for imaginative packaging concepts, individual solutions and optimizing packaging in different end uses. We also offer an attractive selection of graphical boards.

Cover image: Die-cutting. Die-cutting is used to produce a different form or shape for postcard, brochure or such. Die-cutter is technically a sharp blade bended into a desired shape, operated with pressure.

Finishings: Hot-foil stamping, multilayer embossing, spot colour printing, matt and glossy water-based varnish.

Page dimensions: 1218.9x790.9

Products and end uses
Get acquainted with our extensive board range for imaginative packaging concepts, individual solutions and optimizing packaging.

Packaging sustainability
Learn how to make packaging sustainable, smart and safe.

Paperboard production
Take a look at the secret recipe for the best quality board materials in terms of purity, functionality, printability and convertibility.
The speed of everyday life has created a growing market for foods and drinks consumed on the go. Stora Enso offers a full range of advanced materials and solutions for the market that serve to the many different needs of today’s active consumers.
The ultimate challenge, however, lies in using the full potential of the material intelligently and innovatively to create solutions and concepts that will have a competitive edge – in product protection, material savings, production and logistics costs, trade preference, consumer acceptance, shelf presence or recycling efficiency. That is where the offering of Stora Enso Renewable Packaging really comes into its own.

We produce a wide selection of premium boards in every category, and we provide the largest variety of barrier coatings. Our offering is based on end use-oriented business competence, backed up by worldwide sales network that provides local customer service and immediate response to your questions and needs. Our Consumer Board range covers liquid packaging board, general packaging board, cigarette board and graphical board products.

High-performance liquid packaging
The liquid packaging end uses include a huge variety of food products – milk, juice, soups, spices, water, yoghurt – as well as non-food products. Packaging for food and non-food liquids has three important functions. Firstly, it must keep the contents fresh and hygienic, unchanged and untainted for its entire lifetime. Secondly, the package must be attractive, build brand image and boost sales. Finally, each solution must comply with the best environmental practices of reduction, recovery, and recycling, thus promoting the use of renewable energy and raw material.

Stora Enso’s liquid packaging boards are used for various types of liquid packages, including gable tops and brick-shaped containers for fresh and ambient end uses. Our high-quality liquid packaging base boards are made of pure primary fibre produced in a strictly controlled production environment. We have certified product and hygiene management systems at our production sites. In addition, we have an extensive range of barrier-coating options.

As a result of continuous development we are able to decrease the use of raw material to gain the same board properties, meaning with lower board grammage you gain the same stiffness. The desired stiff and bulky board structure comes from applying multilayer techniques, whereby the purity of chemical pulps is enhanced with the strength of mechanically refined pulps.

The wide board selection of Stora Enso creates an ample playground for imaginative packaging concepts, individual solutions and optimizing packaging in the different end uses.

Cosmetics, luxury and chocolate
Stora Enso is a leading supplier of premium boards for packaging cosmetics, fragrances and personal care products. Cartons for champagne, wine and liquors are other typical luxury packaging applications. For secondary packaging of cosmetics and luxury products, there is no substitute for high-quality paperboard, endlessly versatile in its capacity to adapt to the needs of a wide spectrum of individual products, whether they are every-day cosmetics or the most exclusive brands.

Several trends in consumer packaging are currently favouring use of board as packaging material for chocolates. Excellent odour and taste neutrality is a common requirement for all the boards for chocolate and confectionery end use.

The package ensures that the contents will reach the consumer unspoiled, untainted and totally palatable. The packages made of paperboard also have the power to build brands, create powerful shelf-presence and clinch the sale.
Food, drinks and pharmaceuticals

Stora Enso also offers a full range of advanced materials and integrated solutions for the food service market that cater to the many different needs of today’s active consumers who increasingly eat and drink on-the-go. Fast food, catering and vending markets are served with polymer coated boards for cups and trays.

Our products derive their strength from a unique material that combines specially-developed baseboards and proprietary polymer coatings to create the best quality in terms of purity, functionality, printability and convertibility. The barrier coated boards also have a great potential to replace plastic and other non-renewable materials in a number of special food packaging applications. Paperboard trays provide another superb packaging option – in particularly great forms.

Beer multipacks have firmly established themselves as just the tool to attract supermarket buyers. Adaptable to individual needs, distribution methods and marketing strategies, multipacks work for a multitude of products and markets. The eye-catching multipacks made from paperboard are light and strong and easy to buy, carry, open and recycle.

The range of pharmaceutical products is enormous, from the most potent prescription drugs to ordinary over-the-counter medicines. Accordingly, the role of packaging ranges from ensuring product safety and patient compliance to providing a versatile tool for communication and brand building. Stora Enso pharmaceutical packaging boards are widely used in cartons that protect the primary packaging such as blisters, bottles, tubes and pouches.

Cigarette packaging

Stora Enso offers a genuinely wide range of packaging boards and speciality papers for tobacco-packaging. The product offering ranges from FBB (Folding Boxboard), CTMP (Chemi-Thermo Mechanical Pulp) and SBS (Solid Bleached Sulphate) packaging boards to label and wrapping papers. Just-in-time deliveries are secured by our highly efficient mills, and the services are backed up by our strong R&D resources.

Graphical boards

Stora Enso graphical boards are designed to give the best in smoothness and lasting brightness, in printability, runnability and finishing convenience. Our versatile range provides the right choice for books, magazines, catalogue covers, folders, greeting cards or postcards.

There is hardly any application area in which packaging has contributed more to our lives than food products. Food should be packaged in a manner that provides full protection for the valuable contents, enables efficient transport and distribution, serves as a vital source of information, creates powerful shelf presence and enhances the brand image.

Food should be packaged in a manner that provides full protection for the valuable contents, enables efficient transport and distribution, serves as a vital source of information, creates powerful shelf presence and enhances the brand image.
The main raw material of Renewable Packaging is wood, which is a continuously growing biomaterial. Stora Enso is committed to sustainable forestry and plantation management. In the northern hemisphere, one rotation of forest takes about 80–100 years, while in the Southern hemisphere the growth of a eucalyptus tree plantation needs 7–10 years. We work continuously to ensure that our operation also creates benefits for local people and nature. It is part of our continuous effort in all markets.
Today, more than ever, people are concerned about the impact packaging has on the environment. For a package to be truly sustainable, it must provide optimal performance in all its different functions, such as protection, branding, product safety, recyclability etc. without compromising its environmental effects. In addition to environmental impacts, the origin of packaging materials is more important than before.

Paperboard is the sustainable material option in more ways than one. Fibre-based packages help curbing climate change. They are produced from renewable raw material. The raw material for Stora Enso products comes from legal, traceable and responsibly managed sources where continuous growth of trees is guaranteed. Growing forests store carbon effectively.

Preventing waste and product loss
What is a sustainable package? To answer the question we must consider the package performance, environmental impact during its lifecycle and end-of-life options. Protecting the product throughout the supply chain is the main purpose of the packaging, not forgetting effective presentation once the product is on the store shelf. In addition to the packaging manufacturing process, the filling process and logistics are steps in a package’s lifecycle that affect its sustainability. The packages produced must also take into consideration the material and consumer safety legislation or other consumer demands such as senior-friendliness and child safety. Food contact approved materials and good manufacturing practice have a fundamental role in ensuring food safety.

If you are looking for raw material or a packaging solution that fulfills all these criteria, the Stora Enso product portfolio provides you with everything you need to make your package sustainable, smart and safe.

The fibre cycle
For many consumers, recycling is the essence of sustainability. Consumers should have easy access to recycling. Recycling intensity depends on national recycling and collection infrastructure. Using appropriate and right-size packages helps reduce food waste. In average the environmental load of producing a packaging is about 3-10% of environmental load of food processing.

Sustainable packaging starts from seeds.
Developing sustainable packaging is not just about focusing on our own material production. It is about focusing on the entire value chain, from the reforestation through to recycling. It is about changing our way of operating responsibly every day, in every way.
Versatile and light-weight paperboard packages prevent product loss by effectively protecting packed materials against physical damage, contamination and light. Space-saving designs are particularly economical in transportation. Efficient transportation means less usage of fuel and reduces environmental impact.

Curbing climate change
Wood-fibre, a renewable and recyclable resource, is the main raw material in our packaging materials and solutions. Paperboard products offer an attractive alternative to many competing materials in the sustainability respect, thanks to their recyclability and lower impact on climate change, due to renewable raw material and high amount of bioenergy in their production. In many cases, wood and paper products can be used as substitutes for products based on non-renewable, fossil fuels or products with greater climate impacts through their lifecycle.

The carbon cycle of fibre-based packaging is a perfect closed loop. Growing forests store carbon effectively. When wood is harvested and converted into products, carbon remains bound in the products throughout their lifecycle. Paperboard packages can be recycled four to six times into different products. Recovered fibres can be used for producing products such as white lined chipboard (WLC), office papers and magazine papers. In the end the products can be combusted for bio energy, replacing fossil fuels.

Stora Enso applies the principles of environmental and social responsibility in sustainable forest management, wood procurement operations and in board production. Our paperboard mills are integrated pulp and paperboard production sites with third-party-verified management systems in place for quality as well as environmental operations. The primary source of energy for the production process is bio-fuels which are derived from residuals from pulping, forest operations or water purification processes. This enables our products to have a low carbon footprint.

Sustainable forest and plantation management plays a vital role in mitigating global warming. As long as forests and plantations are managed sustainably, new generations of trees will grow back after mature trees are logged, absorbing CO₂ from the atmosphere once again.

We promote third-party forest certification and chain-of-custody certification schemes to guarantee that all our wood originates from sustainably managed forests and tree plantations.
Packaging sustainability

100% biobased packaging
In case moisture, oxygen or other barrier properties are required, wood-fibre as such doesn’t provide the necessary protection for the packaged goods. That’s why we have barrier coatings, which have traditionally been fossil based polymers. Today, they can be replaced in many applications by biobased, biodegradable and compostable coating options.

Stora Enso can offer biobased and biodegradable coating options with several board grades for use in cups, plates, trays and folding cartons. Board materials with biobased polymer coating can be recycled together with traditional polymer coated board materials.

In recycling schemes, biodegradable products are primarily intended for the collection of materials for industrial composting. Collection schemes depend on local collection conditions. Biodegradable coatings are made from either renewable raw material such as polylactide polymers (PLA) or non-renewable raw material or a combination. Biodegradable paperboard breaks down to humus and CO2 in industrial composting.

Stora Enso aims to provide packaging materials and solutions that are 100% based on renewable raw material sources.

Making fast food more ecological.
One growing global consumer trend is changing our eating behaviour. Take-away is becoming an increasingly popular way to quickly satisfy our daily need for nutrition. Recyclable and renewable food packaging materials can make a difference.

Traceable and efficient raw material use
Stora Enso applies the principles for sustainable wood and fibre procurement and land management. We have third-party verified traceability and chain-of-custody systems to control that all wood and fibre raw material comes from legal and sustainable sources.

Traceability involves verifying the origin of wood, tracking it all the way from the forest to the place where it first enters Stora Enso’s possession. We document the origin of all wood and use independent auditors to check that our wood comes from legal and acceptable sources.

The wood flow from certified forests and controlled sources can be verified. Chain-of-custody system documents the journey of wood from a certified forest to the final product and can cover the whole supply chain.

All parts of tree are used efficiently
Different parts of a tree are often used for different purposes. The thickest parts of trunks typically go to the sawmill, while thinner sections are used to produce pulp for paper and paperboard production.

Eco-efficiency and developing lighter and more functional packaging materials are important elements of Stora Enso’s product development. Our production technology of pulp and paperboard has been improved considerably in recent decades.

As a result of continuous development we are able to make more from less: to use less raw material but gain the same board properties and to keep the packaging performance the same or even improve it. This serves the brand owners’ needs to reduce their overall consumption of packaging materials and to improve their profitability by using lower-weight packages.

• We promote sustainable forestry and support forest certification.
• We only accept legally harvested wood.
• We have traceability systems in place which track the origin of all wood and fibre coming in.
• We do not convert natural forests or rainforests into plantations.

As a result of continuous development we are able to make more from less: to use less raw material but gain the same board properties and to keep the packaging performance the same or even improve it.
The basic principles of paper and paperboard making have not changed for more than two thousand 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.
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.

### Components coating colour rheology modifiers

- **Pigments**: Natural coating pigments and fillers. Ground Calcium 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.

### 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.

### 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.

### 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 reduce 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.

### Secondary fibres

- **Groundwood**: Logs of debarked soft wood are 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 darkening and bleaching.
According to DIN 19003, 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 = ≥ 1.45 cm³/g
- 2 = < 1.45 cm³/g, > 1.3 cm³/g
- 3 = ≤ 1.3 cm³/g

Overview of paperboard nomenclature

<table>
<thead>
<tr>
<th>Definition (DIN 19003)</th>
<th>Type</th>
<th>Description</th>
<th>Pulp stock</th>
</tr>
</thead>
<tbody>
<tr>
<td>uncoated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Az</td>
<td>SBS</td>
<td>Cast-coated solid bleached board with white reverse</td>
<td>Fully bleached chemical pulp</td>
</tr>
<tr>
<td>A1</td>
<td>FBB</td>
<td>Cast-coated solid board with white reverse</td>
<td>Chemical and mechanical pulp</td>
</tr>
<tr>
<td>A2</td>
<td>FBB</td>
<td>Cast-coated solid board with cream reverse</td>
<td>Chemical and mechanical pulp</td>
</tr>
<tr>
<td>UZ</td>
<td>SB5</td>
<td>Solid bleached board</td>
<td>Fully bleached chemical pulp</td>
</tr>
<tr>
<td>GN1</td>
<td>SUS/CMK</td>
<td>Solid unbleached board with white reverse</td>
<td>Unbleached chemical pulp</td>
</tr>
<tr>
<td>GN4</td>
<td>SUS</td>
<td>Solid unbleached board with brown reverse</td>
<td>Unbleached chemical pulp</td>
</tr>
<tr>
<td>UO1</td>
<td>FBB</td>
<td>Foiling board with white reverse</td>
<td>Chemical and mechanical pulp</td>
</tr>
<tr>
<td>UC2</td>
<td>FBB</td>
<td>Foiling board with cream reverse</td>
<td>Chemical and mechanical pulp</td>
</tr>
<tr>
<td>UT1</td>
<td>WLW</td>
<td>White lined chipboard with white reverse</td>
<td>Secondary fibres</td>
</tr>
<tr>
<td>UT2</td>
<td>WLW</td>
<td>White lined chipboard with cream reverse</td>
<td>Secondary fibres</td>
</tr>
<tr>
<td>UT3</td>
<td>WLW</td>
<td>White lined chipboard with cream reverse</td>
<td>Secondary fibres</td>
</tr>
<tr>
<td>UT4</td>
<td>WLW</td>
<td>White lined chipboard with brown reverse</td>
<td>Secondary fibres</td>
</tr>
<tr>
<td>UD1</td>
<td>WLW</td>
<td>White lined chipboard high bulk ≥ 1.45 cm³/g</td>
<td>Secondary fibres</td>
</tr>
<tr>
<td>UD2</td>
<td>WLW</td>
<td>White lined chipboard high bulk &lt; 1.45 cm³/g, &gt; 1.3 cm³/g</td>
<td>Secondary fibres</td>
</tr>
<tr>
<td>UD3</td>
<td>WLW</td>
<td>White lined chipboard high bulk &lt; 1.3 cm³/g</td>
<td>Secondary fibres</td>
</tr>
</tbody>
</table>

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. The removed 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 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.

SUB (Solid Unbleached Board) SUS (Solid Unbleached Sulphate)

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.

WLC (White Lined Chipboard)

Multilayer paperboard comprising at least one middle layer of mainly recovered fibres. The top layer is bleached virgin chemical pulp or white recovered pulps. Between the top layer and the middle layer(s) there may be a layer of chemical, mechanical or deinked recycled fibres. The reverse layer may consist of selected recycled fibres or bleached and / or unbleached virgin fibres. The top and reverse side may be coated with mineral pigments.

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.

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 dairy products. The paperboard is polymer-coated for barrier properties - or foil-laminated for long-life beverages.

SBS (Solid Bleached Sulphate)

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

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.
Stora Enso’s barrier coating range is the widest on the market, offering solutions for practically all packaging needs. The role of coating in the packaging boards is to produce the desired barrier properties for the package, resulting in superior product quality and prolonged shelf-life. Creative use of different coatings, together with individual matching of the most suitable baseboards for the purpose, optimizes package performance, ensures high visual quality, saves materials, simplifies converting and packaging, and reduces waste.

Barrier coatings typically form a tight film on the paperboard in order to provide the desired barrier and other functions. Generally, barrier coating in packaging boards refers to the use of polymers as extremely thin layers on the baseboard. These polymers give excellent product protection properties plus substantial economic and ecological benefits. Polymer coatings produce effective barriers for a wide variety of products, including perishable foodstuffs.

The main purpose of coating is to protect the product from the undesirable effects of such factors as light, oxygen, humidity, and microbes. Depending on the application, coating functions also include improved grease proofness, heat resistance or peelability, or enhanced printing and finishing properties.

Extrusion is the most commonly used barrier coating technology for polymers such as:

- **PE** (polyethylene), **PP** (polypropylene) and other polyolefins
- **EVOH** (ethylene vinyl alcohol) and **PA** (polyamide) as high-barrier multilayer coatings

- **PET** (polyethylene terephthalate), **PBT** (polytetrafluoroethylene) and other special polymers.

Polymers can also be applied as water dispersions by using traditional pigment coating methods. New groups rapidly gaining ground include biopolymers and green PE, which is based on sugar cane as the raw material.

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
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-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.

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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 m³ (1m x 1m x 1m) 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.
**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 should be very light ("kiss"). The pressure at the printing nip should be very light ("kiss").

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 newspapers.

**Digital printing**
A digital printing system is a system that prints images directly from ripped information without a static master, so that every consecutive print can be different. Until recently, electrophotography was the only technology used in production-type colour digital printing machines. However, new solutions for production-speed digital colour printing are now being developed and existing technologies are being refined. Today, digital printing usually means systems based on dry toner and liquid toner or inkjet.

Digital printing is gradually entering the field of consumer goods packaging. The advantages of digital printing and the modern converting processes include the ability to use variable data, on-demand manufacturing and cost-effectiveness for short print runs. The limitations include smaller colour gamut compared to traditional presses and lower printing speed. The variety of substrates available for use is also smaller than in traditional printing.

Here, two of the most common digital printing methods are discussed briefly with remarks on the special requirements for each method.

**Electrophotography**
Paperboard grades work satisfactorily in a variety of sheet- or web-fed electrophotographic production machines. Either dry toner or liquid toner can be used. In general, it can be said that paperboard runs better in machines in which the path for the board inside the printing machine is as straight as possible. It is advisable, however, to evaluate compatibility in each individual case.

**Inkjet**
Inkjet Paperboard is highly suitable for printing with UV inkjet inks and for one-colour inkjet printing (black). The compatibility with other inkjet inks depends on the ink composition and should be evaluated on a case-by-case basis.
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 (drier, 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.

Simple yet stylish.
Minimism is one trend in luxury packaging. Premium quality paperboard material with subtile printing creates a stylish package for premium products, such as selective cosmetics or champagne. Metallic inks give the print a finishing touch.
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 (colour/tint 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 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.
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 applications may be necessary in order to secure good processability of the 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.

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. Gluing should be carried out on unvarnished areas.

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, if all other properties are the same, then:
- 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 difference between 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.

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 if the knife presses too heavily against the back layer of the paperboard. This is observable as a torn area next to the cut. Damage will also occur if the knife 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 or laminated products with an extra tough layer (for metal plate. The knife wears and becomes blunt, which then act as hinges for folding packaging and graphic 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 in difficulties 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.

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.

**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 graphic 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.

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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

**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.

**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.
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/m² – anything lower may cause problems.

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 gluing in packaging machines).

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)
  - wet lamination
  - dry lamination
  - 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

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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 – grammage, caliper, moisture and brightness – are also calibrated or measured 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)

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 every week in three shifts. Every machine reel is tested according to the procedures described in the ISO 8801 system. Some of the properties are tested across the web in many positions and some in one position only. In quality control, most of the tests are performed immediately after production, without air conditioning.

General properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grammage</td>
<td>g/m²</td>
<td>ISO 536:1995</td>
</tr>
<tr>
<td>Moisture</td>
<td>%</td>
<td>ISO 267:1985</td>
</tr>
<tr>
<td>Thickness</td>
<td>μm</td>
<td>ISO 534:1988, SCAN-P 7:96</td>
</tr>
</tbody>
</table>

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

Physical strength properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stiffness (L&amp;W)</td>
<td>mN</td>
<td>ISO 2485:92, SCAN-P 29:95</td>
</tr>
</tbody>
</table>

Stiffness is determined by measuring the bending moment 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 machines and cross directions by a stiffness tester. Taber stiffness is measured according to the TAPPI 489 standard.

Surface properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roughness (Bendtsen)</td>
<td>ml/min</td>
<td>ISO 8791-2:1990</td>
</tr>
<tr>
<td>Smoothness (PPS)</td>
<td>ml/min</td>
<td>ISO 8791-4:1992</td>
</tr>
<tr>
<td>Porosity (Bendtsen)</td>
<td>ml/min</td>
<td>ISO 8793-3:1992</td>
</tr>
</tbody>
</table>

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. Roughness is measured on both sides of the sheet and the tests carried out by Autoline.

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 dyestuff inks, 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.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Unit</th>
<th>Standard/Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brightness D65/10</td>
<td>%</td>
<td>SCAN-P 3:93</td>
</tr>
<tr>
<td>Brightness C/2°</td>
<td>%</td>
<td>ISO 2470:99 (ISO -Brightness)</td>
</tr>
<tr>
<td>CIE Whiteness D65/10</td>
<td>%</td>
<td>ISO 11475, SCAN-P 66:93</td>
</tr>
<tr>
<td>L<em>a</em>b* D65/10</td>
<td>%</td>
<td>SCAN-P 72</td>
</tr>
<tr>
<td>L<em>a</em>b* C/2</td>
<td>%</td>
<td>ISO 5631</td>
</tr>
<tr>
<td>Opacity</td>
<td>%</td>
<td>ISO 2471</td>
</tr>
</tbody>
</table>

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 brightnessD65/10 unfiltered and brightness D65/10 with a 420 nm cut-off filter.

Gloss (Hunter)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Unit</th>
<th>Standard/Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gloss</td>
<td>%</td>
<td>TAPPI T480 om-99</td>
</tr>
<tr>
<td>ISO 8254-1:1999</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.
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:** chemi-thermomechanical pulp; 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).

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**Food packaging has to meet high standards.** The package needs to provide physical and barrier protection, communicate the brand and product and be convenient in use. Paperboard is a versatile and sustainable material choice. For example cereals can be packed in a paperboard box, without an inner plastic bag, when using the right materials and coating / finishing techniques.

**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 (electronic 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 oven-dry 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

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 (HSWC)

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

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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
Redesigning the Future with Renewable Packaging

Chocolate & Confectionery

Cigarette

Cosmetics & Luxury

Cups

Drinks, Wines & Spirits

Food

Graphical

Liquid

Pharmaceuticals

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