

Use the strengths of smooth paperboard to achieve excellent results.

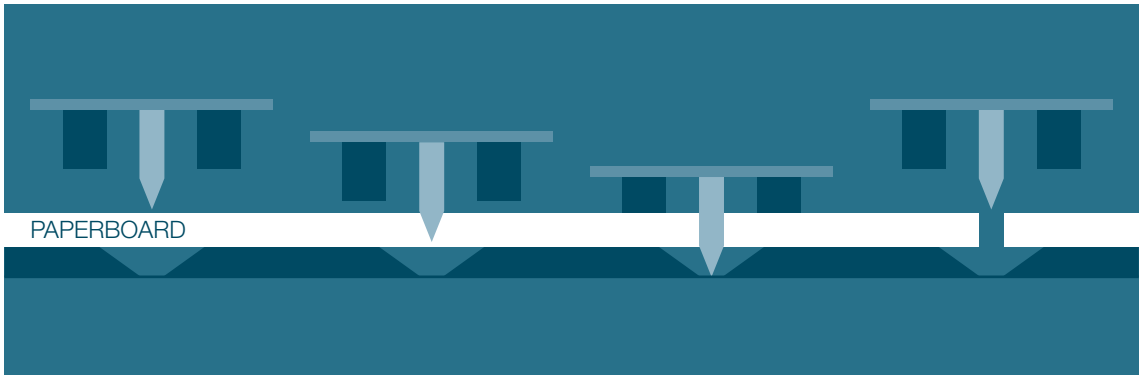
Complex shapes and latticed design in practice

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

The die cutting operation

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



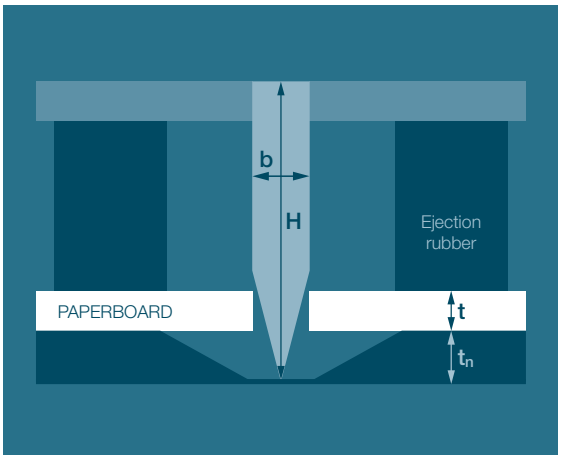


The die cutting principle.

Die cutting and creasing

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

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

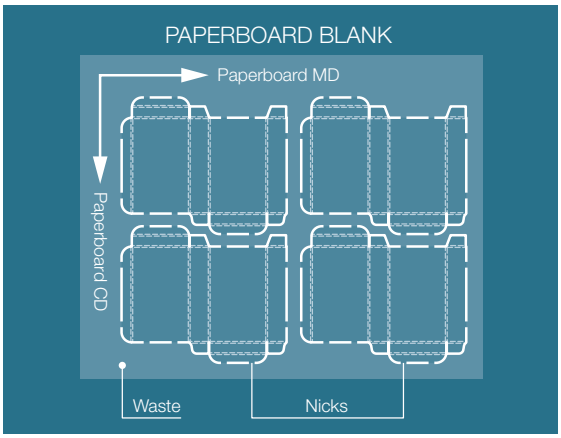


Tool dimensions should be adjusted to the materials to be used. Request recommendations from your materials supplier.

Nicks

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

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



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

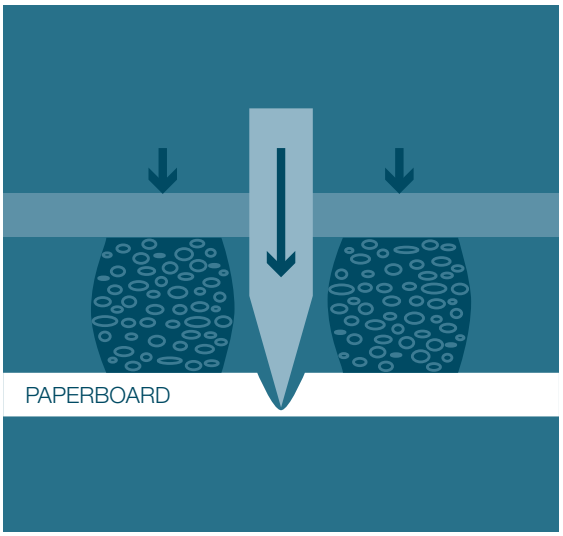


Rubbering of the cutting die

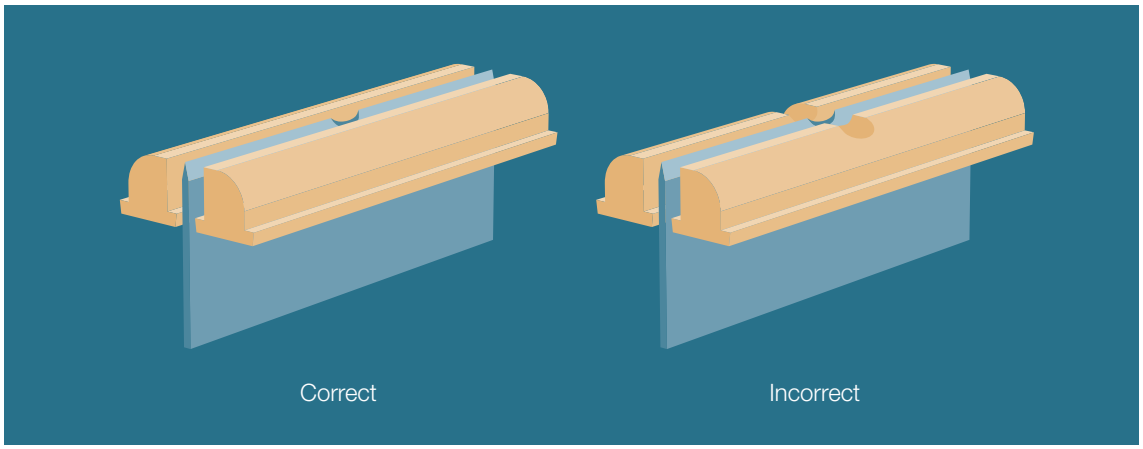
The rubbering of the cutting die plays a very important role for the quality of the final result. Correctly done the rubbering also supports productivity by allowing higher speeds and minimising the risk of stops due to waste coming loose in the machine or sheets not ejecting properly from the die.

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

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



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



Recommendations

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

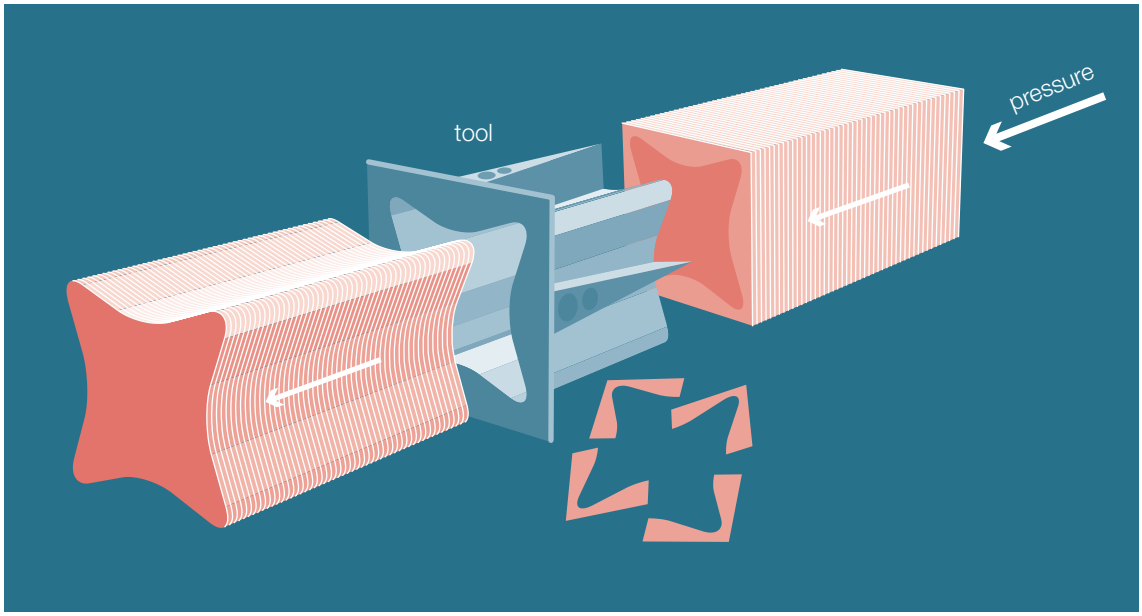
We recommend a very hard profile rubber (7 mm wide). Please note: If undesired pressure marks should occur, reduce the hardness and if possible increase the width.

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

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

The ram punching operation

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



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

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

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

The laser cutting operation

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

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

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



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

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

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

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

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

General recommendations

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

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

Creasing and folding in practice

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

