With paperboard all available printing techniques may be used to achieve at least the same high-class graphic presentation as when using high quality graphic paper. The good printability and high print quality, together with the many different finishing options and the superior finishing results, imply many good reasons for using paperboard as first choice.

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

Offset lithography
Offset lithography is perhaps the most commonly used method – or rather a set of methods – to print paperboard. Offset provides very high print quality and is commercially attractive for a wide range of run lengths. With the plate given, the print result follows from a complex interaction between ink, fountain solution (in conventional/litho offset), blanket, paperboard characteristics, and drying mechanisms, together with the pressure, temperature, and press speed. Thin paperboard can be printed in the same type of presses that are used for printing paper. However, the best way to print thicker or stiffer paperboard is in a designated press. In this type of press the cylinders and sheet transport systems are adapted to thicker and stiffer substrates.

With their double-size impression cylinders and specially adapted sheet guidance systems these presses are well suited for thicker or stiffer substrates.

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

Paperboard handling in offset printing
The multi-ply construction of graphic paperboard has several strong advantages over a single-ply paperboard, but it should be handled somewhat differently. To avoid problems when printing graphic paperboard, there are a few things to consider.

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

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

High ink tack

Too high ink tack may cause delamination. If the ink vehicle penetrates very quickly into a very absorbing substrate, the tack build-up of the ink may be high. If it is too high, the substrate may delaminate when leaving the printing nip. Adding suitable gel or varnish to the tacky ink (recommended by the ink supplier) is a way to slow the ink setting and prevent delamination.

Blisters

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

Anti-set-off spray powder

Spray powder is recommended to reduce the risk of set-off. But to avoid problems in later production steps the use of spray powder should always be minimised. Please consult with the people responsible for the subsequent steps before increasing spray powder amount or particle size significantly.

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

The choice of particle origin is not influenced much by paperboard type. However, the use of highly abrasive, large sized particles when using very glossy products is not recommended, since this may cause micro-scratches on the printed surface.

The choice of granular diameter is influenced by the paperboard properties. Ranging from the very fine 15 μm particle to the very coarse 70 μm particle, the choice mainly depends on ink and varnish coverage, substrate surface smoothness, and delivery pile pressure. For fully double-side coated products with a very light ink coverage, and low delivery stack, as small as between 25 and 30 μm particles may be appropriate. To ensure low set-off for only single-coated backside, uncoated reverse, large sheet size, high delivery pile, or fully varnished surface the particle size (or quantity) should be increased.

Alternative offset printing techniques

There are a number of alternative offset lithographic printing techniques, of which UV offset, waterless offset, Direct Imaging presses, and hybrid offset presses are briefly described below.

UV offset printing

UV offset printing means using inks that cure (dry) by exposure to ultra violet light, not by oxidation and absorption like conventional inks. The press has powerful UV lamps mounted in it, and the inks contain a chemical compound (a photo-initiator) that causes a chain reaction when exposed to the UV light. This reaction changes the structure of the ink film from fluid to solid in a split second. In other words, there is very little absorption of ink into the substrate.

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

A common problem, however, is poor adhesion of the printed ink film due to its shrinking during curing, in some cases to a point where it is a problem in post-press handling. The strong UV lamps can also cause the substrate to yellow somewhat, which is why it is important not to use more energy than needed to cure the ink. A high density substrate requires more energy than one with lower density.
Waterless offset printing

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

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

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

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

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

Hybrid offset presses

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

• Offset and flexo: This is an offset press equipped with a flexo unit at the end. The flexo unit is often used for applying water-based varnish but can also be used for special inks. One example is to print a special spot colour with fluorescent ink. Another example is printing metallic inks, which greatly benefit from being applied in a flexo unit, since the flexo technique allows the pigment particles to be larger than in offset ink. The larger particle size increases the metallic shine.

• Offset and digital: Offset presses can also have digital printing equipment mounted. Today there are offset presses with ink jet units to print very simple designs, e.g. bar codes or dates. In the future it is likely that these hybrids will become increasingly popular. As the speed and quality of digital printing techniques increase, combinations of offset and digital presses will be further developed. This will make it possible to combine true individualisation of each print with the high and consistent quality of offset printing.