

Doctor Blade Materials and Profiles

An Overview of Options and their Application

By Bill Warner

The doctor blade appears to be a simple component of the flexographic printing process but, as often is the case, appearances can be deceiving. The casual user might wonder what is there to think about, a blade is only a piece of steel or plastic. To better understand the need for all of the doctor blade options, consider the role of the doctor blade.

Flexographic printing requires the doctor blade to provide a constant wipe throughout the pressrun, so that the ink volume carried by the anilox roll to the plate is determined only by the anilox volume. If the doctor blade is not working correctly, the ink volume carried to the plate will include the anilox roll volume, plus some amount of surface ink. Any surface ink remaining on the anilox roll will be variable and lead to variation in the printed product. To achieve constant wipe, different materials and edge profiles are available so that you can better match a doctor blade to the application.

Years ago, there were only a few choices for doctor blade materials and profiles. Today, the offering of materials, edge profiles, and added coatings has become so extensive that the converter often needs help from a doctor blade supplier to determine the best blade for the application. This article will take some of the mystery out of choosing a doctor blade by providing an overview of the features of the various doctor blade materials and configurations along with generalized application guidance.

Blades & Basic Uses

- Steel is the material of choice for high quality and repeatable doctoring results.
 - Carbon steel blades are economical choices when used with short-run process jobs on non-porous substrates and inks that aren't very abrasive.
 - Long-life steel blades are excellent for use with abrasive inks, such as white inks or other inks with high percentages of titanium dioxide, or solids and/or rough anilox rolls.
 - Ceramic blades are typically used with very abrasive inks or where you are running four-color process work every day with standardized setups.
- Composite doctor blades are used on laser-engraved ceramic anilox rolls and provide longer life at high speeds when compared to carbon or stainless steel blades.
- For doctoring applications, plastic blades have to be thicker than metal or composite blades to provide the same rigidity.

METAL BLADES

Long before doctor blades were used in flexographic printing, blades made from various types of steel had been used in other printing processes. Today, steel is still the material of choice for high quality and repeatable doctoring results in any printing process. There are bright and blue carbon steels, stainless steel, long life steel, coated steel, and ceramics. But which steel is right for you?

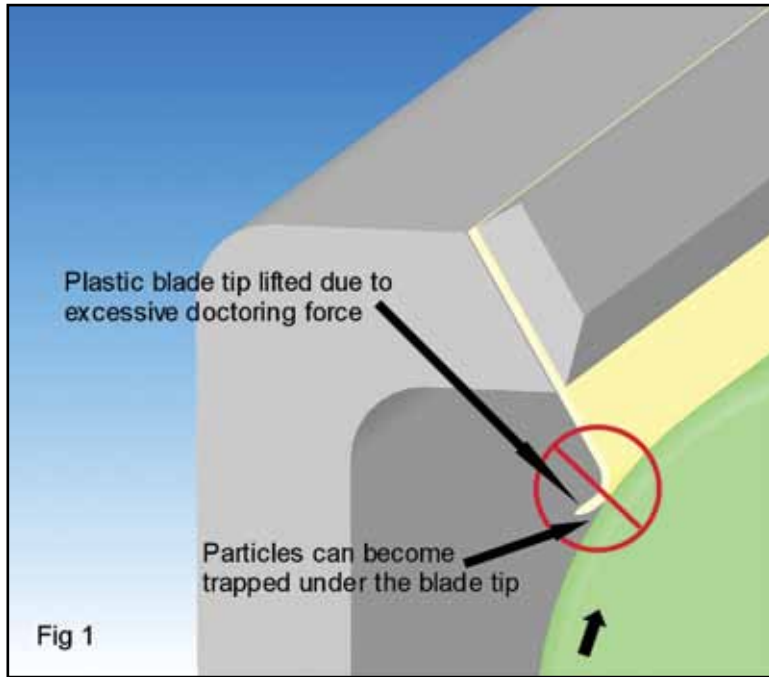
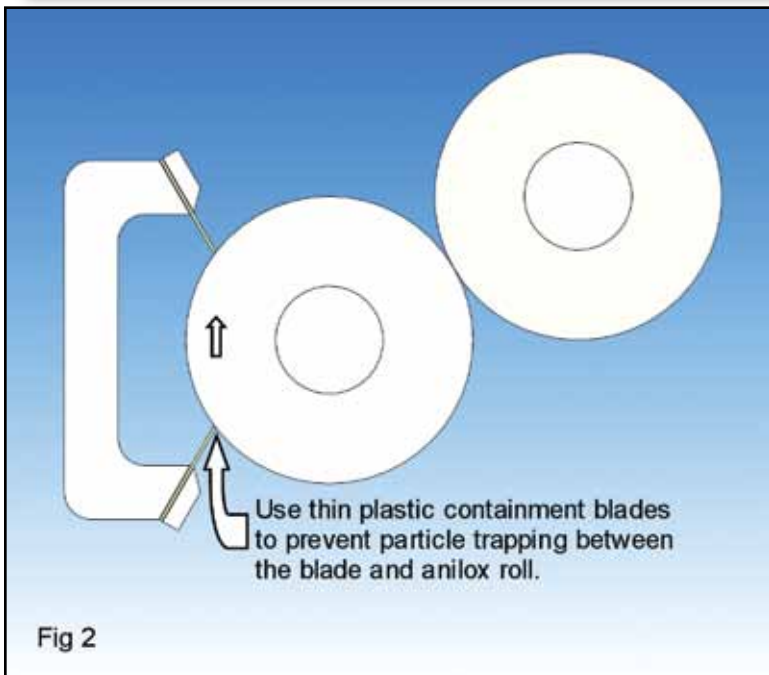
First of all, bright and blue carbon steels are identical materials that share the same metallurgical properties and features. The only difference between the two is the cosmetic blue oxide process that is applied to the steel. It has been rumored that blue steel was originally chosen for doctor blades, so that when a converter was making a blade by hand shaping a bevel, he could easily see the bevel he was making as the blue color was removed. Today, most converters are not making their own blades, so the advantage of blue steel doesn't apply anymore.

Carbon steel blades are economical choices when used with short-run process jobs on non-porous substrates and inks that aren't very abrasive. They can be used on all anilox screens along with solvent, water, and some UV inks. If corrosion is an issue, a stainless steel blade may be a better choice, but use caution when using stainless steel blades with ceramic anilox rolls as some stainless steel materials have been associated with plugged anilox cells through adhesive wear.

Long-life steel blades are excellent for use with abrasive inks, such as white inks or other inks with high percentages of titanium dioxide, or solids and/or rough anilox rolls. Long-life steels are typically made from tool steel alloys that offer good resistance to adhesive wear. Adhesive wear is a welding like effect that quickly causes blades to fail and is also a contributor to anilox roll scoring. Long-life blades are more expensive than carbon or stainless steel blades, but the benefits they provide easily justify their added costs when compared to press down time for blade changes during a run and scored anilox roll repair costs.

Coatings can be applied to steel blades to further extend their life and the life of the anilox roll. A coating will lower the coefficient of friction between the blade and anilox roll, resulting in a clean wipe at lower pressures. However, the metal used in a coated blade has to be the same high quality steel as an uncoated blade, or the blade will not function properly. Another advantage with coated blades is that they typically offer enhanced corrosion resistance. Try a coated blade in your application if you are looking for a little more life, less corrosion, or a cleaner wipe than you are currently getting from your uncoated blade.

Ceramic blade technology will yield the longest life and comes at the highest cost of all blade materials. Ceramic


Fig 1

Fig 2

COMPOSITE BLADES

Composite doctor blades are used on laser-engraved ceramic anilox rolls and provide longer life at high speeds when compared to carbon or stainless steel blades. Since they approach metallic blade performance with respect to fine screen metering, composite blades can be a good choice for most abrasive, high solids, and UV inks. However, a composite blade will typically allow some surface ink to remain on the anilox roll, so use a metal blade if surface ink cannot be tolerated. Composite blades are reinforced with glass fibers which help them to avoid the plastic deformation issues that plague un-reinforced plastic blades during a pressrun.

The composite material is also harder than plastic materials, so the working tip is less likely to be damaged by hard particles in the ink and they are not prone to embedment problems that can lead to anilox scoring. These blades do not get as sharp as metal blades when they wear, but they do still pose a cut hazard, so adequate safety training is required.

Look for quality composite doctor blades made from cryogenic grade stock that is free of voids and inclusions which lower grade materials can contain. Common applications involve paper and board substrates and line work. Composite blades impregnated with graphite are typically used on larger ceramic anilox rolls. It is common to use them for higher end graphics in corrugated applications. Composites can be used for doctor and containment blade applications and typical thicknesses range from 0.014 in. to 0.035 in.

PLASTIC BLADES

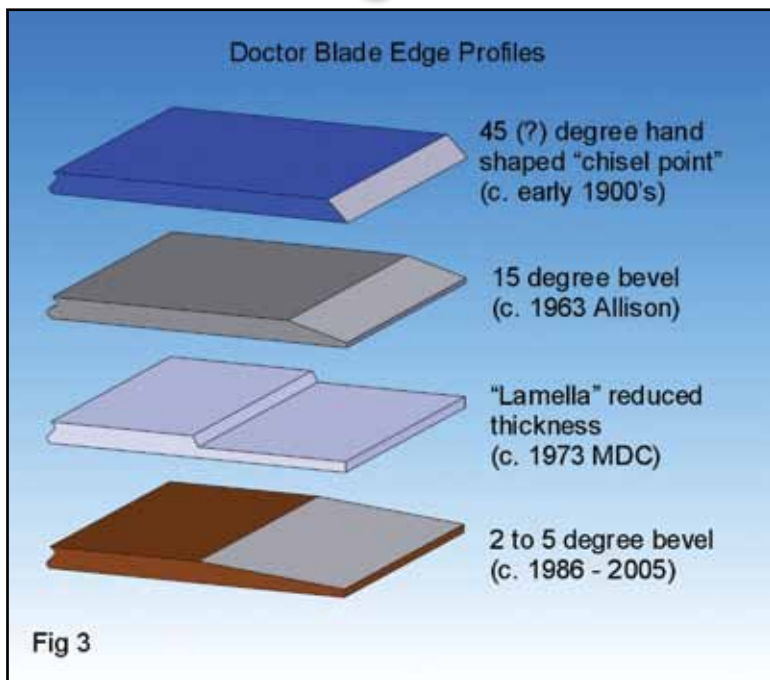
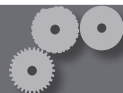
Plastic doctor blades provide a lower coefficient of friction on ceramic anilox surfaces and long life. For doctoring applications, plastic blades have to be thicker than metal or composite blades to provide the same rigidity. However, the thicker material will typically leave the most surface ink on the anilox roll of all blade material types and thereby provide less consistent print quality.

Other issues with plastic blades that may hinder their use as a doctor blade include plastic deformation, which can lead to dot gain; hard particle damage, and particle embedment or entrapment under a lifted tip (Figure 1). When used as doctor blades, plastics work best for line work with less than 400 count anilox screens that are printing abrasive or high solids, as well as water based inks on paper and board substrates.

An area where plastic blades have been proven to be very useful for flexographic printing is on the containment side of a chambered inker. Thin, "floppy" polyester, Mylar, and polyethylene blades have been successfully used as containment blades. Plastic containment blades will prevent back doctoring and particle trapping between the blade and anilox

blades are typically used with very abrasive inks or where you are running four-color process work every day with standardized setups. Other applications may include varnish or coating applications and corrugated applications, where it could take hours to change a blade.

All of the metal blades discussed can be used for doctoring applications as well as containment in dual blade flexographic chambers. Metal blades can vary in thickness from 0.004 in. to 0.020 in. and even thicker in some cases. Typical blade thicknesses are either 0.006 in. or 0.008 in. with more demanding applications requiring the use of 0.010 in. or 0.012 in. thick blades.



tainment blades only and are not recommended to be used as doctor blades.

Rounded-edge blades are a step above square-edge blades as they offer a precision, polished working edge. Since they don't require the additional machining that beveled and lamella blades require, rounded blades can be offered at an economical price. Rounded-edge blades offer a strong working edge that is not easily damaged, but they will typically allow a little surface ink to get past the blade until it seats in fully. Rounded-edge blades are especially useful when trying to doctor rough anilox rolls.

Whatever type of edge profile you use, remember the footprint of the blade must be small enough to seal against the anilox roll's cell wall grid, without requiring application of high forces to the blade. Blades applied to the anilox roll with high force could result in excessive wear of the blade and anilox roll, as well as print defects. A general rule of thumb is that the footprint should be less than 0.010 in. for process work or fine screen anilox rolls and less than 0.025 in. for line work or coarser anilox rolls.

roll (Figure 2), as well as reduce blade related wear on the anilox roll.

Inker design permitting, these blades work best when they are 1/16 in. to 1/8 in. wider than the doctor blade. Plastic blades are the safest for an operator to handle because they are not likely to impose a cut risk. Typical plastic doctor blades range from 0.030 in. to 0.062 in. and typical containment blades range from 0.014 in. to 0.020 in.

EDGE PROFILES

As mentioned earlier, doctor blades were originally hand shaped in house by the converter, using stones or hand files. By the time doctor blades began to be used in flexographic applications, doctor blade manufacturers were providing pre-finished doctor blades that were more precise and consistent than the hand-made blades.

Typical blades in the 1960s were made with a 15-degree bevel and some had a tip that was "lapped" to help the blade seat on the cylinder faster. The footprint of the 15-degree bevel grows rapidly as it wears, which can lead to print variations throughout the run. In the early 1970s, the lamella blade was introduced that offered a consistent footprint that is small and remains constant as it wears. The lamella shape doesn't have the support of a beveled blade and can be adversely sensitive to applied force levels. Today, blades are available that have bevels in the range of two-to-five degrees. These "long" bevels combine the support and effective tip control of a beveled blade, with a nearly constant footprint comparable to the lamella blade.

Doctor blades are also available without a beveled or lamella profile and are typically referred to as square and rounded edge blades. The square edge blade is essentially raw material stock that may or may not have a precision working edge. Square-edge shapes are typically plastic con-

FINAL THOUGHTS

I once heard a purchasing agent report that he spent more money on supplies for his facility's restrooms than on doctor blades. In my mind, that statement puts the cost of doctor blades in perspective with other costs related to flexographic printing. I'm sure that same agent could not say the same thing about the expenditures on ink, substrate, and press time.

With the doctor blade being a mission critical part of the printing process, purchase the best quality and most appropriate blade you can for your application and doctor blade related problems will be reduced or eliminated. Work with your doctor blade supplier to determine the best choice of material and profile for your doctor blades. Your blade supplier most likely has had experience with the same printing requirements, issues, and problems that you have and will have targeted guidance in the choice of blades for your application.

Regardless of the type of doctor blades you use, material quality is of utmost importance. Protect your anilox rolls and print jobs by making sure basic metal, composite, and plastic blade stock is proven in service and is purchased from a quality source and traceable by the supplier. Beyond the choice of doctor blades, your doctor blade supplier will also likely be able to help with doctor blade usage and safety training, as well as diagnostic worn blade analysis. ■

About the Author: Bill Warner is a design engineer with Allison Systems Corp. He has 23 years of experience with doctor blades and custom retrofit doctor blade systems for flexographic and other printing processes. He can be reached at 856-461-9111 or wjwarner@allisonblades.com.