Fast Presses; Abrasive Inks

THE BEST BLADE FOR EVERY APPLICATION

Bill Warner

It could be a pressman's worst nightmare! A new anilox roller was installed for the first time. Shortly after starting the run, a continuous streak on the print appears. Then, in the same location, a groove develops around the anilox roller.

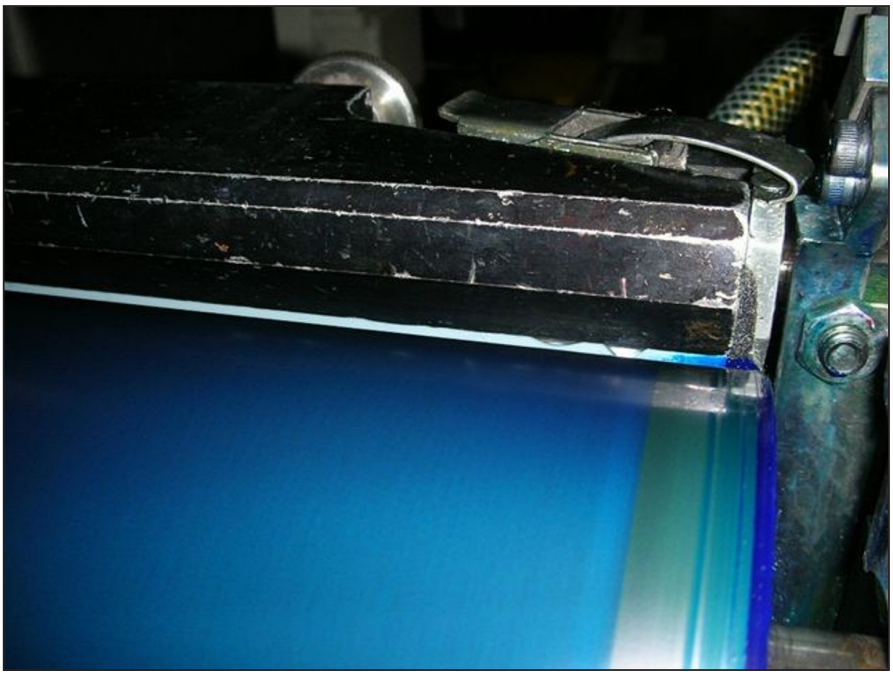
Anilox scoring is a problem. It occurs even when the utmost care is taken to prevent it. Common thought is that scoring is caused by the doctor blade, but that is not completely true. It could just as easily be argued that the rotation of the anilox roller causes scoring. Think about it: If the roller didn't rotate, a score line could not be created.

The scenario applies to other challenges as well. Assigning blame to the blade seems logical at the outset; but later it turns out to be far from the fatal fault. To drive home the point, let's look at the challenges of UV ink spitting, blade life, wipe quality and back doctoring; before returning to our initial issue—anilox scoring.

It's imperative to voice a single caveat, before we begin. Now, more than ever, reducing overall costs and increasing efficiency are necessary. Choosing the wrong doctor blade for the application can lead to inefficiency and increased operating costs due to press downtime and excessive blade usage.

UV INK SPITTING

UV ink spitting is a condition where the UV ink will get past the doctor blade in an uncontrolled manner and ultimately be transferred to the printed web. The result is commonly seen as lines, or other odd shapes, on the printed web. The number can vary from just a few, to too many to count.



Always run with the least amount of application pressure possible, while still obtaining a clean wipe, indicated by a matte appearance on the anilox roller.
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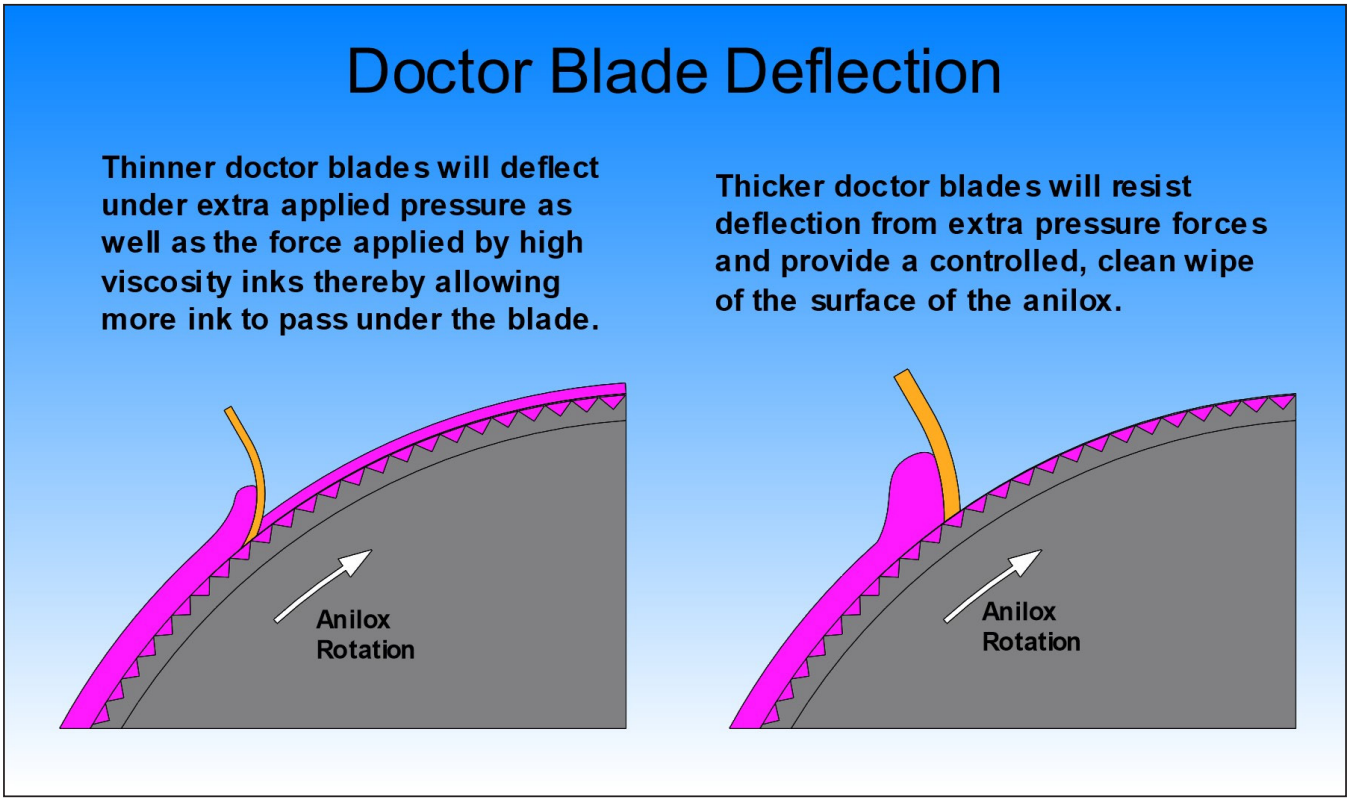


So, what are the causes of UV ink spitting? There are a couple of leading contributors:

» UV inks are much more viscous than water-based inks, typically five times or more
  - Higher viscosity puts more pressure on the doctor blade and can cause the blade to flutter or otherwise deflect, and allow ink to get past the blade if the blade is not set or chosen correctly

» The thixotropic nature of UV inks
  - The *World English Dictionary* defines thixotropic as a fluid or gel "having a viscosity that decreases when stress is applied, as when stirred." The stress applied to the UV ink is a result of the shearing forces that occur when the ink meets the doctor blade
  - A drop in viscosity at the doctor blade/anilox roller interface can allow some ink to flow under the blade. Shear forces on the ink are reduced when the ink moves past the doctor blade and the viscosity again increases, giving the ink the tendency to either spit or spray away from the blade, or accumulate on the back side of the blade
  - Any ink that collects on the back of the doctor blade will build up and eventually flow off the blade and ultimately transfer to the web

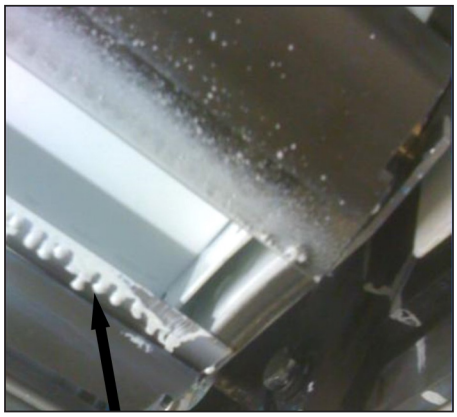
Just about every aspect of the doctor blade can influence spitting, including blade material, edge profile, thickness, contact angle, pressure and alignment. Let's discuss these.

Experience has indicated that most plastic materials and typical carbon steel doctor blade materials are more likely to spit because they will wear faster than a higher-quality, long-life steel material that may have an added wear-resistant coating. As the blade wears, the footprint (area of steel in contact with the anilox roll) will expand, thereby increasing the potential for ink to get past the doctor blade.

A beveled blade is less likely to contribute to spitting than a traditional Lamella blade. Of the beveled blades, the sharper 15-degree bevel is preferred, followed by the longer 4-degree bevel angle. The Lamella edge, by nature, has more difficulty dealing with high viscosities and higher blade loading pressures. The 15-degree bevel angle will provide a more firmly supported working tip for the doctor blade than either the 4-degree bevel or the Lamella edge. The extra support provided by the 15-degree bevel will help to resist blade tip deflection and fluttering due to the higher viscosity.

General recommendations regarding the blade thickness are that you want to run the thinnest blade possible, while still being able to achieve the desired wipe quality. For typical UV applications, a thicker blade is generally used to withstand the increased hydraulic forces applied to the doctor blade by the more

viscous fluids. Steel blades that are 0.010-in. or 0.012-in. thick are commonly used with UV inks with great success. Even though the base of the blade material is thicker, you still need a thin working edge to successfully doctor the UV ink. An initial working edge between 0.002-in. and 0.003-in. thick is needed to minimize spitting issues and is readily available with the 15-degree or long beveled blade.



Ink drips on the containment blade and can be the beginning of back doctoring.

Generally accepted doctor blade contact angles for flexographic printing will fall into the range of 25 degrees to 42 degrees, with a desirable angle being near 30 degrees. Testing has shown that for UV inks, the contact angles should be at least 30 degrees or more to minimize UV spitting issues. The sharper contact angles will allow the doctor blade to cut through the film of ink and clean up the surface of the anilox roller, leaving the desired matte anilox surface appearance. Contact angles less than 30 degrees will tend to leave some surface ink on the anilox and contribute to spitting.

Too much applied pressure will create flat contact angles. Extreme cases will result in an angle that is so flat that it can cause the tip of the doctor blade to lift off the anilox roller. The lifted tip will provide an easy path for the UV ink to get past the doctor blade.

In chamber and most single-blade reverse angle applications, the blade angle is fixed by the geometry of the equipment. If a blade analysis indicates that your contact angles are less than desirable, they can generally be improved by applying less blade loading pressure.

Always run with the least amount of application pressure possible, while still obtaining a clean wipe indicated by a matte appearance on the anilox roller. If you can't lower your pressure, investigate to determine if something is preventing you from operating at a lower pressure. Areas to look at would be improper end seals for the application, excessive ink flow rate, and chamber or blade holder actuating mechanisms that need maintenance.

Proper blade-to-anilox alignment is very important when using a chambered inker setup to minimize the amount of force needed to meter cleanly and maintain desired contact angles. Both blades should contact the anilox roller at the same time and evenly across the face. If there is misalignment in any axis, extra pressure will need to be applied to get the blades to seat properly and provide a good wipe. Extra pressure leads to flat contact angles that contribute to increased potential for spitting to occur.

To help minimize UV spitting issues, Allison Systems recommends its Enhanced Gold long-life steel doctor blade material with standard 15-degree bevel angle. We suggest starting with a 0.010-in. blade thickness and then moving to a 0.012-in. thickness if needed. This combination of parameters is proven to greatly reduce or eliminate UV spitting.

BLADE LIFE

Historically, carbon steel doctor blade materials were the most predominant used for doctor blades. This is still true today. Carbon steel doctor blades are an economical choice for short-run process color work and other non-abrasive applications. However, trying to use a carbon steel doctor blade for long runs and/or abrasive inks can result in press downtime during the run to change the blade.

Ideally, you want the doctor blade to last the entire run without creating any print variability attributed to the blade. Long-life steel and plastic materials are available that will accomplish the task. Coatings can also be applied to steel blades to extend their life.

Some inks are more abrasive than others. For example, white, metallic and pearlescent inks are known to be abrasive to doctor blades. If you are running an abrasive ink in one station and process colors in the remaining stations, you can use a long-life blade for the abrasive ink and a lower-cost blade with the process colors. Ideally, this will result in all the blades lasting through the entire run while minimizing blade costs.

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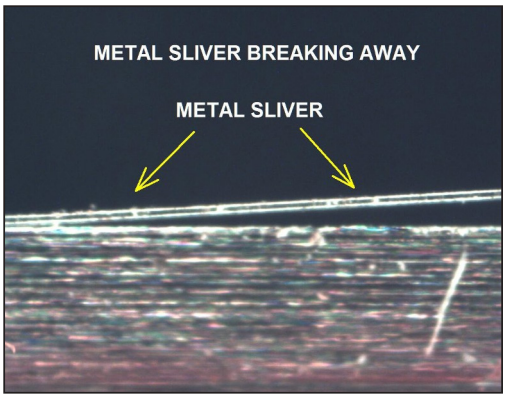
We often hear of "blade wear" being a concern and the cause for frequent blade changes or a reduction in blade life. Occasionally when we analyze the used blade, we discover that there is minimal wear on the blade and sometimes no wear is found. In these cases, it was assumed blade wear was what created the need to change the blade when something else was the culprit.

There can be many reasons why a blade doesn't perform as expected and you shouldn't always assume the blade wore out. Work with your blade supplier to determine the cause. Sometimes the blade choice is not the best option for the application; other times press conditions can be limiting the adjustment of the blade. Many blade suppliers will offer used blade analysis as an important tool to determine how a blade was set up and why it failed to perform as expected.



Metal sliver formed on edge of blade from flat blade angle, or too much applied blade pressure.

WIPE QUALITY

The function of the doctor blade is to entirely remove all surface ink from the anilox roller, so that the only ink transferred to the plate comes from the cells of the anilox. If the doctor blade does not remove all the ink from the surface, some of that ink will also be transferred to the plate and result in dot gain and high print densities or coat weight.

Ultimately, poor doctor blade wipe quality will lead to increased print defects, excessive ink usage, and lost press time. Many aspects of the doctor blade can affect the quality of the wipe the blade will produce. The width of the doctor blade needs to be what the OEM design intended. Running a blade width other than what is specified will change the contact angle to potentially be out of normally accepted standard:

» Wider blades create flatter contact angles

» Narrower blades create sharper angles

» Either one could create adverse wiping conditions

» A blade that is too thin will easily over-deflect under applied blade loading and prevent a clean wipe

» Faster press speeds, thicker inks and more abrasive conditions have led to a migration to thicker doctor blades

Historically, 0.004-in.-thick steel doctor blades were commonly used with 0.006-in. and 0.008-in. being for more demanding applications. Now, 0.004-in. is rarely used and a common thickness is 0.008-in., with 0.010-in. and 0.012-in. being used for more demanding applications.

Finally, edge shape will have a major impact on wipe quality. Common edge shapes available today are rounded, beveled and Lamella. Rounded edge shapes are generally used with lower-screen anilox rolls and coating applications. Beveled and Lamella edges will provide the wipe quality needed for higher linescreen aniloxes and high-definition printing applications. Again, because of the wide array of blade products available, it is best to work with your blade supplier to select the best blades for your application.

Doctor blade setup issues will also contribute to poor wipe quality. If using a beveled or Lamella edge, be sure the bevel or Lamella is installed facing away from the roller. There seems to be a common misconception that the bevel or Lamella is intended to run on the roller.

Any blade supplier will confirm that is not the case and that the blades should be installed with the machined profile away from the anilox. Other setup issues that can lead to poor wipe quality are excess applied blade pressure, blade misalignment, damaged or dirty blade holders, and incorrect blade length.

BACK DOCTORING

Chambered blade systems are found on many narrow web and most wide web flexographic presses. The chamber is designed to contain the ink within the chamber using the contact between the anilox roller, two end seals and two blades. One of the blades functions as a traditional doctor blade and is responsible for wiping all the surface ink from the anilox roller. The second blade is commonly referred to as a containment blade and is only needed to contain the ink within the chamber. This blade is not intended to wipe the anilox roller clean and in fact works better when it doesn't provide a clean wipe.

If ink is leaking from the chamber, it is usually getting past the end seals or dripping from the containment blade. Ink dripping from the containment blade can be the result of the blade wiping ink from the anilox roller, commonly known as back doctoring. Since the ink has no place to go, it will accumulate on the containment blade and eventually flow off the blade.

Telltale signs of back doctoring are stalactite-like ink formations on the bottom of the chamber when the containment blade is

also on the bottom. If the containment blade is on the top of the chamber, back doctoring will form puddles of ink on top of the blade, which may flow off the sides of the chamber.

Often the ink that is being removed by the containment blade is ink that should have been removed by the doctor blade, but for some reason the doctor blade is not providing a clean wipe. Even if the doctor blade is wiping perfectly clean, the containment blade can wipe ink that was not transferred to the plate and has migrated out of the anilox cells.

There are several ways to help minimize or eliminate back doctoring. First, make sure the doctor blade is wiping the anilox clean. If the doctor blade is wiping the anilox clean, the surface should have a matte appearance. If the surface looks shiny, there is still some surface ink remaining. If slight application pressure adjustments don't result in any changes in surface appearance, then you are possibly not using the correct blade for your application. Work with your blade supplier to determine the best option for you.

Regarding the containment blade, there are two suggestions:

» When running steel blades in both the doctor and containment positions, use a thinner blade on the containment side. For example, if your doctor blade is 0.008-in. thick, run a 0.006-in. containment blade

» For the containment blade, run a plastic blade. Plastic blades work well for most containment applications because they don't have the spring qualities that steel blades have. This will allow the containment blade to deflect easily and permit any ink remaining on the anilox to pass back into the chamber, instead of being doctored off the roller

If using either steel or plastic containment blades, a bevel or Lamella edge shape is not necessary and a rounded or square edge shape is preferred. Allison suggests using a 0.014-in.- or 0.020-in.-thick polyester-based plastic containment blade that is also 1/16-in. to 1/8-in. wider than the doctor blade. The extra width will force the containment blade angle to be flatter and more easily allow ink to pass by the blade.

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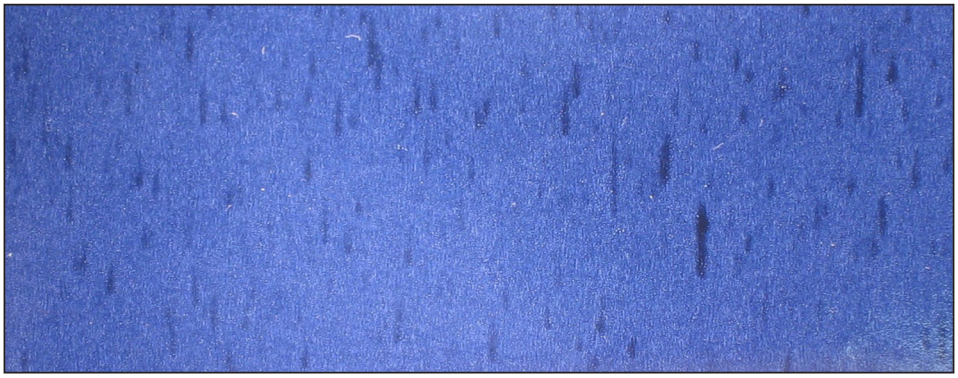
ANILOX SCORING

Obviously, the anilox roller must rotate and the doctor blade must contact the anilox roller for the flexographic printing



UV ink will get past the doctor blade in an uncontrolled manner and transfer to the printed web. The result—spitting—is commonly seen as odd shapes; the number can vary from just a few, to too many to count.

process to work. The real cause of anilox scoring is hard particles getting trapped between the rotating anilox roller and doctor blade. The particle could be anything that is hard enough to cause wear on the surface of the anilox when it gets trapped under the doctor blade.

The most common sources of these particles are ceramic particles broken off the edges of the anilox roller, larger steel particles from doctor blade wear and other hard particles—like sand—that were introduced into the ink system from other sources.

Using plastic doctor blades can help reduce scoring issues, but they will not eliminate the potential since hard particles can also be trapped by plastic doctor blades. In fact, some of the softer plastics can contribute to anilox scoring, since any hard particle can become embedded in the soft plastic and not have a chance of being flushed away by the ink flow.

Lower-grade carbon steel is more likely to produce wear particles or metal slivers that are large enough to cause score lines. High-quality tool steel wears in much smaller particles and, when used appropriately, will not produce metal slivers.

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Used appropriately is key here because any doctor blade that is applied to the anilox with excessive pressure will result in flat blade angles leading to a situation that is more likely to create and trap debris that can score the anilox.

To minimize the potential for anilox scoring and provide long life with excellent wipe quality, Allison Systems recommends its Enhanced Gold doctor blade material. This high-quality tool steel wears in the form of very small particles that approaches powder-like consistency. These particles are easily flushed away by the ink flow around the doctor blade.

In addition, we always recommend using ink filters and magnets in your ink systems. Narrow web presses that don't have re-circulating ink systems will still benefit from using magnets in the ink pan, or the chamber, and filtering un-used inks before they are returned to the inkroom to be reused. ■

ABOUT THE AUTHOR: *Throughout his 35+ year career with Allison Systems, Bill Warner has been involved in the application of doctor blades and doctor blade-related components for various printing processes. Specific areas of experience include doctor blade sales, technical support, training, R&D, and the design of custom retrofit doctor blade holders and systems.*

Bill started with Allison as a design and applications engineer and eventually became the engineering manager. In 2012, he was appointed vice president. He has a mechanical engineering degree from Drexel University. Learn more at allisonblades.com or contact Bill directly at bwarner@allisonblades.com.