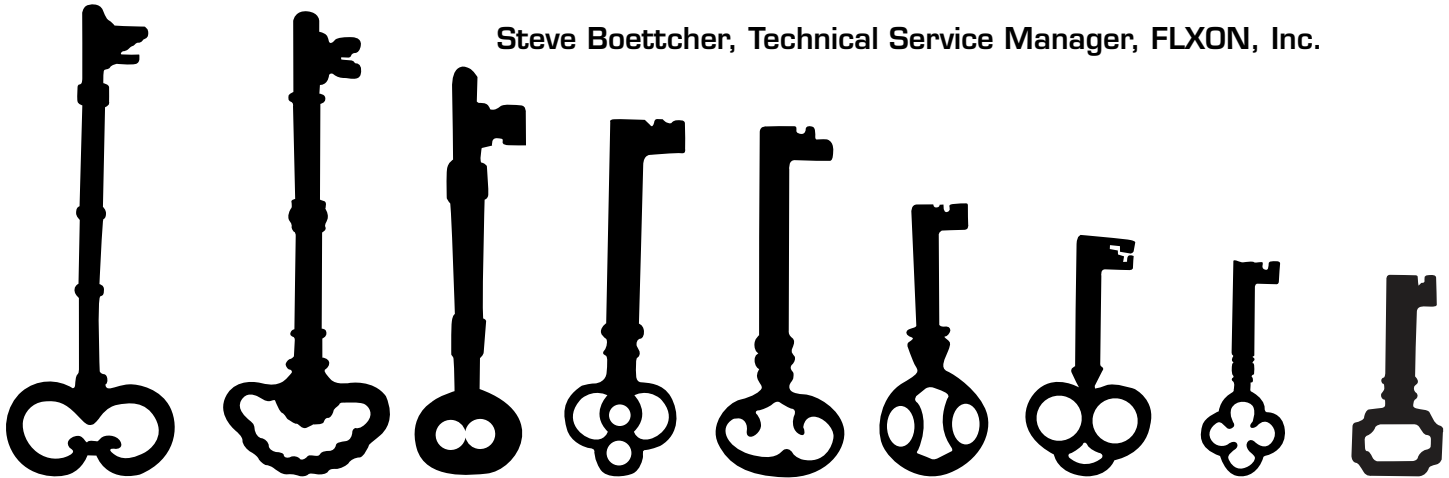


Roto 101 – Doctor Blades

Steve Boettcher, Technical Service Manager, FLXON, Inc.



This is the fifth in a series of articles concerning the fundamental “Key Elements” of the Rotogravure printing process.

In GravurEzine’s July issue, we discussed the second “Key Element” of the Rotogravure process – Ink and Ink Filtration. In this article, we will discuss the doctor blade, the third and final of the core “key” elements that must be kept under control in order to optimize your print process and maximize your “bottom line.”

When compared to the other two of the big three process elements (cylinders and ink), doctor blades are by far the least understood. Because of this, many printing companies still allow for the purchase of doctor blades to be based solely on price as if they were a commodity. Often the decision of which blade to purchase is left up to a plant buyer and not a printer.

A recent survey of prices paid in the industry per 100m/328ft of doctor blade indicates printers pay anywhere from under \$350 to more than \$3,000. How could it be there is such a wide range of price if

they are all the same—a commodity? Is it possible that this wide price range relates to substantial and substantive differences in both quality and the performance of different materials? Of course, the short answer is yes—there are big differences between low- and high-priced doctor blades. In this article, we will explore the differences in some detail.

First about price... I’d like to make a point

If one compares the cost of the other rotogravure printing process elements such as ink, cylinders, substrates, machine downtime, waste, etc., to the cost of doctor blades, the results can be startling. The following are the results of an analysis I recently preformed for an 8-color job run at 48-inches wide comparing costs to that of a top-of-the-line doctor blade:

Relative job costs compared to the cost of a high-end doctor blade...

High-End Doctor Blade	\$XX at 48”
Cylinder Cost	13.8x the cost of a high-end blade
Machine Rate	51.3x the cost of a high-end blade
Film (poly prop)	51.3x the cost of a high-end blade
Ink	61.5x the cost of a high-end blade

So, if the doctor blade is so inexpensive when compared to the other printing process components, why target the doctor blade? Unfortunately, the doctor blade is a component that purchasers can easily see when mandated to reduce costs. Unwittingly, their decision to buy the wrong blade can significantly drive up operating costs!

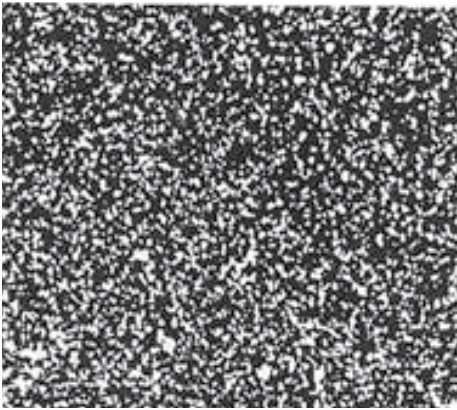


Figure 1

Wow—talk about penny wise and pound foolish! It's a matter of knowing the difference between price and cost. Usually a printer, and not a buyer, knows the difference that the "right" blade can make to your bottom line!

Now that we agree that only performance matters and not price when selecting the right blade, let's consider blade selection criteria.

Looks can be deceiving and even confusing...

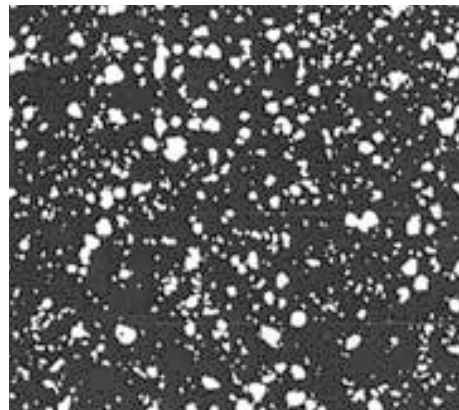
To the unaided eye, doctor blade steel pretty much looks alike. Typically these steels are silver, yellow or blue in color. The color of a steel's skin in and of itself indicates nothing about its performance qualities. The exact same steel in terms of composition, structure, and dimension may be finished to have any one of or all of these colors from batch to batch. Anyway—get my point. You can't judge a blade's quality or predict its performance by the color of its skin!

Not All Steel Is Equal...

It's a matter of content and structure. High-performance doctor blades are manufactured from steel with a chemical composition designed to achieve specific performance qualities—like resistance to

wear and corrosion while at the same time not transferring wear to the cylinder's surface. If carbide and other hard elements in the steel are extremely small, numerous, and evenly distributed throughout; then the blade's edge will wear evenly. The debris produced in the wearing process will be less threatening to the cylinder and not become lodged beneath the blade to cause streaks.

In figure 1, the micro-photo on the left is an example of a very high-quality doctor blade's microstructure. The white indicates the elements are small, numerous and evenly distributed. The photo on the right is of a worn blade's edge that indicates smooth and even wear.



By contrast, the photos in figure 2 show the much coarser microstructure of a low-quality blade and an undesirable edge wear.

Another difference between these two doctor blades, other than microstructure and edge wear, is price. We all know "quality equals performance." So why would anyone buy on price when we know our process will be jeopardized?

Choosing the right Doctor blade (Tip selection/Setup/Thickness)

There are basically only two types of tip configurations that are commonly used for rotogravure—Bevel and Lamella.

Bevel:

This tip has been around as long as gravure itself. The tip is ground at an angle until a point is created. The common cut angles are 2° and 15°. This tip is typically used to provide an initial clean and sturdy wipe. The problem with this blade is that even though the initial wipe is clean, as the blade wears, the contact angle will exponentially get wider as shown in figure 3. The widening of the contact area will no longer wipe clean, increasing the potential for hazing and increased color strength.



Figure 2

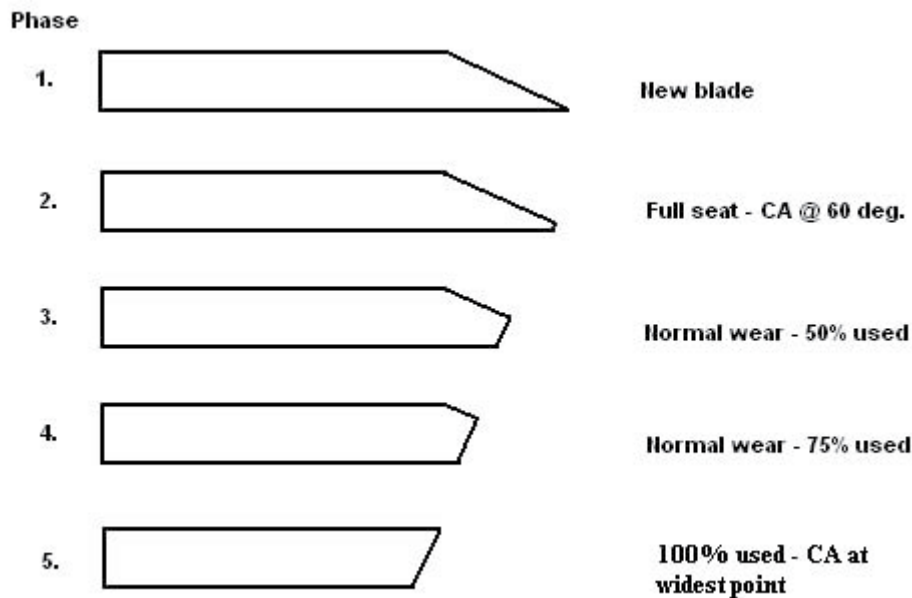


Figure 3

Lamella:

The lamella tip is designed to maintain its contact area width throughout its life (as pictured below in figure 4) until the lamella is completely worn.

It is my opinion that in order to maintain consistent contact area width and color strength, the lamella tip blade is the best option.

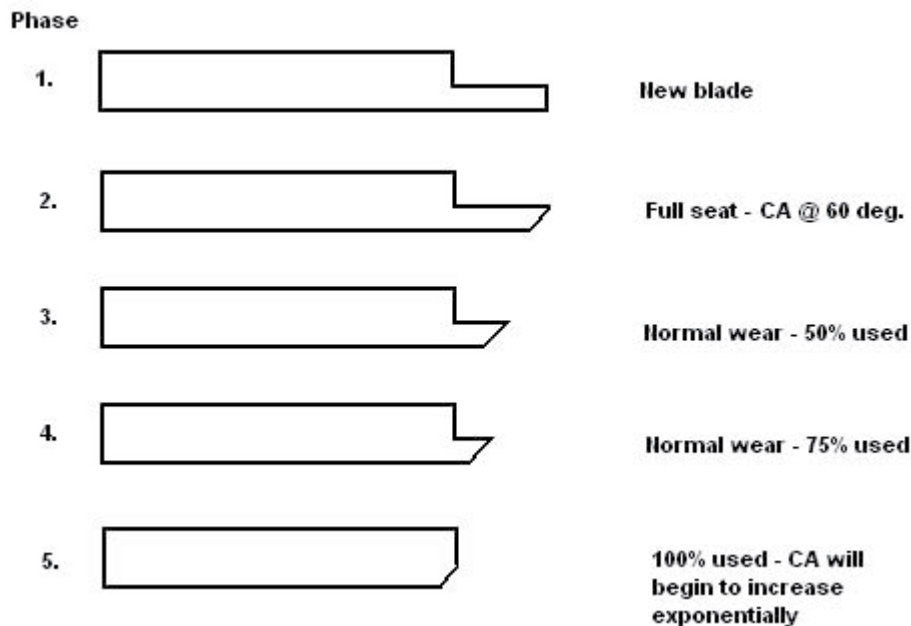


Figure 4

Contact Angles

You now understand microstructure and tip configuration and hopefully will choose a high-quality lamella tip blade. It is equally important to set this doctor blade against the cylinder at an optimum angle to maximize its performance.

What is optimum?

Optimum metering is a function of the “contact” area or the amount of the blade actually touching/riding against the cylinder. Ideally, the contact area should be kept to a minimum (while achieving optimum defect-free ink transfer) to promote both cylinder and blade life. The contact area is determined by the running or “contact angle.” An initial indicator of the contact angle is the machine “set” angle to the tangent. The “set” angle + blade thickness + tip dimension + extensions + blade to cylinder pressure + cylinder dimension and surface and even inks and operating speeds ultimately combine to achieve the actual operating “contact” angle.

Optimum contact for printing on film or paper is normally $60^\circ \pm 5^\circ$. Even though the blade might be initially set at 65° , 2 bars of pressure will create a 50° actual contact angle. To increase the “actual” contact angle, the blade holder should be adjusted higher or steeper to create the 60° actual running contact angle. At this point, the contact area will be reduced, ink—especially in the land area—will be reduced, and fog or haze will be reduced. At a lower, flat and broad contact area, more ink passes beneath the blade and will increase due to hydraulic pressures as speeds increase.

This entire concept can be easily demonstrated using a drawdown blade in the color-matching process. The reason an

This illustration shows - The lower the 'Contact Angle', the more ink passes beneath the Blade.

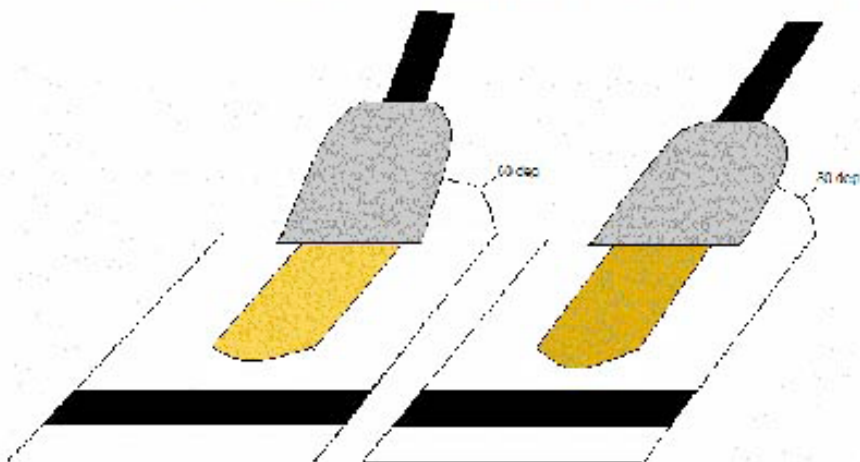


Figure 5

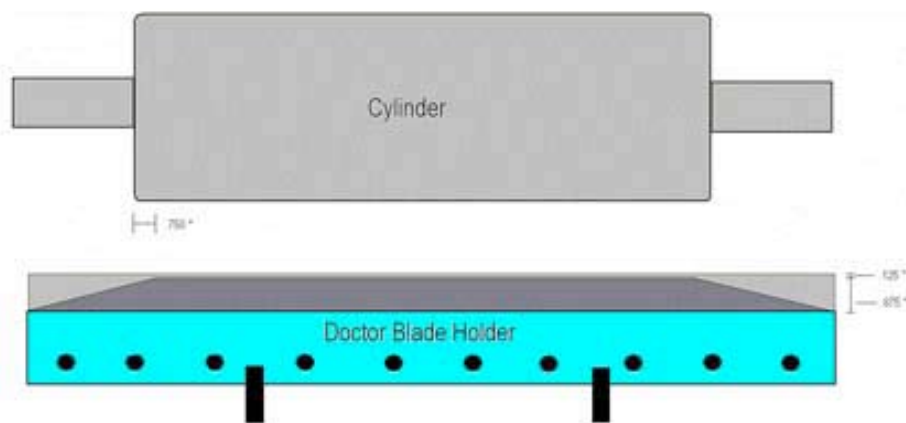


Figure 6



Figure 7

ink company uses a K-proofer with a fixed blade setting to avoid this ink volume/ laydown variable.

The illustration in figure 5 depicts the K-proofer concept.

Figure 6 below is a printed sample with a considerable amount of blue haze throughout. This is a common result of running with low contact angles.

Doctor Blade Setup:

Once you have chosen the right doctor blade, it is equally important to set this blade correctly. Figure 7 is an illustration showing the correct doctor blade setup. The backup blade is tapered back .75" beyond the edge of the cylinder radius to prevent the doctor blade from breaking out and causing ink spits. The doctor blade extends out 1" from the doctor blade holder and the backup blade is recessed back .125" from the doctor blade. I recommend .008" doctor blade and .010" backup blade thicknesses.

It is important to maintain the specific dimensions in figure 7 to ensure adequate blade flexibility, which will provide optimum wiping throughout the run. The most common issue I see in the field is that printers will increase the backup blade thickness to overcome "hazing." Unfortunately, this will only cause the tip of the doctor blade to deflect, which will decrease the contact angle, causing more hazing. The lower the contact angle, the more steel there is against chrome, which results in more frictional heat, excessive cylinder wear, smeared print, the potential for a build-up of contamination on the contact area, and, ultimately, the need to prematurely change the blade—down-time!

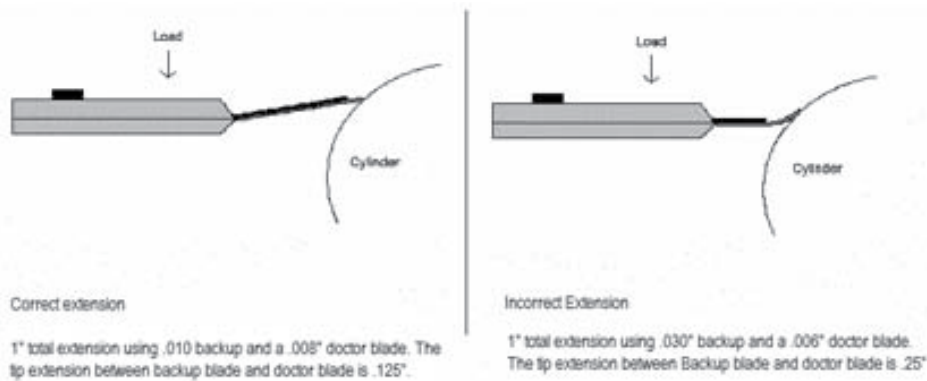


Figure 8

In figure 8, both blades have equal down pressure applied; however, the figure on the right shows the doctor blade severely deflecting. This deflection will decrease the contact angle.

Coated or Uncoated Doctor Blades:

There are several doctor blade manufacturers who have taken their standard carbon steel doctor blade and applied a coating in order to enhance its performance. I believe this innovation was necessary to reduce particle sticking, friction, wear, printing defects, and, ultimately, reduce waste. However, this brings up two separate issues concerning coated blades. One is the type of coating and the material over which it is applied.

If a coating is applied over a poor-quality doctor blade, its performance will eventually be limited. If the coating is harder than the doctor blade and the chrome of your cylinder, the doctor blade will resist wear and actually cause damage and premature wear to the cylinder. In my experience, a doctor blade should be designed to wear in a specifically desirable way. If the contact area of the doctor blade does not wear and maintain a sharp edge, contamination will collect on the contact area, causing print defects.

Fortunately, the pressroom I was working in many years ago was one of the Beta sites for a new coated doctor blade from Sweden. Through stringent testing, we found this blade to wipe extremely well under almost all circumstances. The normal screeching heard in the pressroom (friction) was gone, and the person in charge of the cylinders noticed less wear and scoring. Because the friction was reduced and the need to apply excessive pressure was gone, the doctor blade not only ran longer, its wear did not reflect the etching pattern of the cylinder. We were able to run a job without “sticking off” a blade and without stopping. On top of that, our defects and waste dropped big time.

The blade we trialed was made under an ISO 9000 CERTIFIED quality assurance program.

As I have stated many times in this and previous articles—tight process controls must be in place to maximize your efficiencies. This includes making sure your doctor blade’s quality is also consistent. Unfortunately, the coating process increases the cost of this type of doctor blade. It must be run efficiently in order to justify its cost.

Recap:

We should all be concerned with increasing our “bottom lines”. We need to keep in mind that even if we aren’t continually engaged in process control and process improvement, our competition is.

The information I have shared with you over the last five articles is intended to help all rotogravure printers equally. Our competition is no longer each other. It consists of foreign competitors as well as different printing methods (litho, flexo, and offset). Remember – survival belongs to the fittest!

This information is an accumulation of 23 years of trial and error. There is no reason for printers to keep struggling day in and day out. Business shouldn’t be like the movie “Groundhog Day” where every day is the same, and the outcome remains the same as well.

My opinion—I would run a quality coated doctor blade at .008” thick. Extend 1” out from the holder and use a .010” backup. The distance from the tip of the doctor blade to the tip of the backup blade should be .125” (1/8). Trim the backup blades to reduce doctor blade breakout and make sure you have 3/4” oscillation. Use minimal pressure to reduce friction and maximize cylinder and blade life. Keep the running contact angle at 60°—no less. If this is not working for you, please refer to the other articles because one or more of the other “Key Elements” are out of control.

To recap what we have discussed in the “Key Elements” series:

1. Change is necessary and good.
2. Bottom-line profits must be maximized to remain competitive.
3. It is important to establish policies/procedures and train all employees accordingly.

4. Everyone must be held accountable (managers, employees, and vendors).
5. Cylinder quality is a major key element that must be controlled to reduce process variation.
6. Ink must be clean and stabilized to ensure defect-free printing.
7. Choose quality ("Quality equals performance"), not price, when selecting the right doctor blade for you.

This is the last article in the "Roto 101 Key Element" series. It's been a pleasure to discuss these points with you. I wish you the best success in controlling your process and achieving your goals. Keep efficient and continually improve! Feel free to contact me at sboettcher@flxon.com.

About the Author:

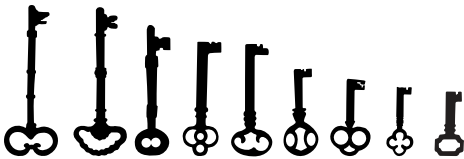


Steve Boettcher is a 23-year veteran of rotogravure and no stranger to all facets of the pressroom. For two years Steve fixed presses as a mechanic. He operated a roto-

gravure press for ten years, and spent eight years at different levels of pressroom management at several major flexible packaging companies including Menasha Corp, Milprint, Alcan, and American Packag-

ing. For the last three years, Steve has been the Technical Service Manager for FLXON, Inc., a printing-solutions company. His main role has been to educate printers on pressroom efficiencies and the direct relationship doctor-blade quality has on achieving these efficiencies. Steve also performs doctor-blade analysis and is the product manger/designer for the new G-2 product line.

Steve's goal is to educate every printing manager on the responsibility they have to ensure that the "Key Elements" (Doctor Blades, Ink, Cylinders and Operator practices) of printing are understood and that every vendor is held accountable for delivering consistent, quality products.



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