Anilox scoring is an expensive and frustrating problem. Anilox ceramic is a metal oxide and although it is extremely wear-resistant, it does not possess impact-resistance or ductility. When any hard particle becomes trapped between the blade and the anilox, there is a potential for the particle to destroy the cell wall structure on the surface of the anilox roller. If the particle is not consumed, once trapped it will ride in that location and destroy rows of cells. These rows of damaged cells appear as thin bands traveling around the circumference of an anilox and are commonly referred to as score lines.

**SCORING TYPES**

There are three types of score lines. First, light polishing score lines appear as light streaks in the printed image. (See Figure 1.)

Second, deep gouging score lines will initially appear as dark streaks in the printed image. (See Figure 2.) Gouging score lines are caused by large particles lodged between the tip of the doctor blade and the surface of the roll. The larger the particle, the less likely it will be deposited on the substrate or consumed before damaging the engraving. The damaged area will typically be several cells wide and run around the entire circumference of the roll. A deep gouge can cause ink to spit or sling. As the doctor blade wears into the score line, a lighter streak will rapidly appear. If this occurs, look for uneven wear on the doctor blade.

In Figure 3, the “polished looking” surface of the land area is a heavy score line. The isolated pressure from contamination that was trapped under the doctor blade polishes the land area, creating a wear pattern. These score lines reduce the ink delivery volume of the anilox roll just enough to show as a continuous, lighter line in the graphic image.

Third, the non-scored printed line is a lightly colored line, resulting from a line of cells around the anilox that cannot be fully filled with ink. (See Figures 4 and 5.)

Before trying to treat the problem, be certain what you have is a true score line. A continuous, lighter line within a graphic image is not necessarily caused by scoring, so a printed sample will not provide enough evidence to make a final verdict. Notice how the cell walls in Figures 4 and 5 are not enlarged. The damage shown in these figures is because of over-impression from debris trapped between the doctor blade and the anilox surface.

Plugged cells can also create lines on graphics. Particles of metal or dried ink actually get pressed into the anilox roll cells, filling them in. This is usually caused by back-doctoring build-up on plastic containment blades. Plugged cells result in a loss of ink transfer and will appear as a score line until the roll has been

**Kicking Contamination**

- Anilox score lines can appear as either light or dark streaks, depending on the cause.
- Most scoring comes from hard particles trapped between the blade and the anilox, or the improper use of doctor blades.
- Shop towels, rags, roll covers, cleaning brushes, work gloves—anything that comes into contact with the anilox surface—can transfer contaminants that create scoring.
- Using rare-earth magnets in tandem with ink filters with 40-60 mesh screens will trap and contain metal fragments.
properly cleaned. If you are having trouble cleaning these cells out, contact your anilox supplier for help.

**PRIMARY CAUSES**

Most anilox scoring occurs when contamination is introduced to the anilox surface through the inking system, doctor blade chambers and ink hoses. There are several ways this can happen.

**Doctor blade tip slivers.** Large pieces of steel blades or slivers created by improper doctor blade use are the primary cause of anilox scoring. (See Figure 6.) These large steel particles break off of overloaded doctor blades as they wear.

**Improper doctor blade use.** In general, normal blade shavings of quality steel do not damage a roll because they are too small to get lodged between the blade edge and anilox cell walls. But when there is too much pressure, the stress causes the doctor blade to bend back, which increases the footprint of the contact area. The resulting increase in friction creates much larger particles. As the tip of the blade wears through, the tip breaks away in the form of a long metal sliver. (See Figure 7.)

**Too much pressure.** Ideally, only the very tip of the doctor blade would touch the anilox, as shown in Figure 8. Correct positioning of the doctor blade provides the best ink metering and print quality while minimizing blade wear. However, improperly aligned chambers, incorrect end seal sizing (and the pressure compensation it requires) and rippled doctor blades from warped or over-tight clamps can create too much pressure. This will result in large slivers and pieces of metal that contaminate the ink system and threaten the integrity of the engraving.

There are several ways to ensure the correct pressure on doctor blades. First, when installing new doctor blades, always back off all mechanical settings and reset the blade pressure. The scenario illustrated in Figure 7 is typical of what occurs when blade settings are not reset after a new doctor blade is installed. An over-impressed blade will yield a thicker ink film and give more color. Although it is tempting to over-impress blades instead of replacing the anilox roller when you need more color, this can send a lot of slivers from the blade into the ink system.

Second, make sure the blade chamber is aligned properly and receives adequate maintenance. Both horizontal and vertical alignment of the chamber are critical determinants of anilox wear. Older chambers warp and pose serious problems.

Third, maintain clean, properly sized end seals. End seals that do not function properly promote doctor-blade over-impression. If the settings are right but it takes additional pressure to prevent end seal leaks, consider modifying the end seals. (See sidebar, “Ink Chamber Maintenance Checklist,” on this page for quick tips on maintaining ink chambers.)

Your doctor blade supplier can help you evaluate doctor blade wear, verify the blade contact angle, analyze the chamber

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**INK CHAMBER MAINTENANCE CHECKLIST**

- Never overpressure doctor blades to get more color.
- Keep chambers and blades aligned.
- Check vertical and horizontal alignment at least once a month.
- Use a .005-inch plastic feeler gauge to test contact between the upper and lower blades and the anilox.
- Bring the chamber (without end seals installed) in toward the anilox, while checking the upper and lower blade until you feel drag from the feeler gauge. The blades should contact the anilox at the same time, top and bottom, side to side. If not, the chamber is not installed correctly, or the bracket is not properly set.
- If stops are available, make sure to use them and have the chamber calibrated, so it cannot touch the anilox.
- Look for signs of wear on blade clamps and check blade clamps for scratches or grooves, which indicate contact with the anilox.
alignment and measure the contact width in microns to ensure that press crews are using the correct doctor blade settings.

SECONDARY CAUSES

Score lines may appear even when blade pressure settings and chamber maintenance are under control. If scoring suddenly becomes a problem in your operation, or on a certain press, chances are that at least one of the following is damaging your anilox inventory:

• The wrong doctor blade “tip” for the application.
• The wrong doctor blade “material” for the application.
• Inappropriate steel without distributed carbides as doctor blades.
• Ceramic chips from damaged roll ends in the ink or ink-ing system.
• Blade overhang (doctor blades that are too long for the anilox and blade holder).
• Pigment milling materials (steel shot or ceramic) in the ink.
• Open inking systems that expose ink to airborne particles and substrate debris. This includes catch trays, open or uncovered ink buckets and free-flowing chamber systems.
• Small dried ink chunks that drop off ink bucket walls and pass through the ink system.
• Ink embedded in plastic or composite blades that are used as containment blades.

• Ink-pan wiper holders rubbing against the anilox roll, blade chambers, splash guards or drip pans.
• Metal shavings generated from worn press parts or machinery.
• Metal shavings from maintenance and modification to the press.
• Shop towels, rags, roll covers, cleaning brushes, work gloves and other items that come into contact with the anilox surface.
• Rusty or non-filtered piping that carries ink, water, solvent or reclaimed solvent to the press.
• Rusty or dirty safety solvent cans used for adjusting viscosity.
• Unfiltered work-off ink.
• Ink mixers rubbing on drum lids or the sides.
• Metal fragmentation from offline cleaning systems.

Sudden or long-term problems with scoring usually stem from a combination of issues and indicate that it is time to audit your entire operation.

MANAGING SCORING

Anilox scoring is best addressed on a preventive level. Flexo inking systems are similar to car engines: Just as changing a car’s oil and filters regularly will keep the car running smoothly, cleaning an inking system’s magnets and changing its blades and filters regularly will prevent anilox scoring.
If you are having difficulty getting scoring under control, isolate an ink station to see where it is capturing contamination. Examine every part of the press that makes contact with the ink, including ink pumps, hoses, hose connectors, stirrers and anything else that comes into contact with the ink as the ink pumps through the chamber. Clean out all crevices in the ink chamber.

Try using a large handheld rare-earth magnet to spot check areas suspected of contamination.

Using rare-earth magnets in tandem with ink filters with 40-60 mesh screens will trap and contain metal fragments. However, these magnets need regularly scheduled cleaning to ensure they will hold onto the fragments and not let them back into the system. (See figures 9, 10 and 11.)

To determine whether using a rare-earth magnet will reduce scoring on your particular press, see sidebar, "Will Magnets Help?".

Remember that there will be residual debris after you correct what caused the scoring, so it is necessary to sanitize and purge the ink system. If the problem was massive, you may still see a score line here and there. This is the time to clean—and even back-flush—your inking system to get rid of all contamination.

**WILL MAGNETS HELP?**

The following steps will help you determine whether using a rare-earth magnet will reduce scoring:

1. Select a roll for evaluation. A new roll with no scoring is best.
2. Purge the entire ink train, including the ink chamber, ink pumps, hoses, hose connectors, stirrers and anything else that comes into contact with the ink as the ink pumps through the chamber. Clean out all crevices in the ink chamber.
3. Install a canister filter and fit it with a strong, large, rare-earth magnet on the in-feed line of a pump. The magnet, filter and selected anilox then become inseparable: The key is to isolate the offending particles, so when you use the chosen anilox, you will also use the magnet on the ink supply line. If it is not possible to combine a canister filter and magnet, a rare-earth, large-tank magnet positioned under the return line discharge will work. If you do not pump your ink, try using a magnet in the fountain. Secure the magnet in a thin-walled plastic bag and set it in the tray. (The plastic bag will make clean-up easier.) If you use a tray liner, another option is to place the magnet underneath to keep it clean.
4. Review the issues concerning blade pressure and overhanging blade ends. Explain the reason for the test to supervisors and press crews.
5. Run the press.
6. Observe the roll for scoring and inspect the kinds of metal pieces collected on the magnet for a designated period of time.
7. Service the filter and magnet every day. This will allow you to see the amount of contamination captured by the magnet and whether the magnet and filter are effective.

**About the Author:** Bill Poulson is the northeast technical advisor for Harper Corporation of America. He has been with Harper for the past 12 years as a technical advisor. Poulson has more than 30 years of experience, including press operation and pressroom management.