OPTIMIZING INK TRANSFER:

FLEXOGRAPHIC PRINTING

QUALITY & EFFICIENCY

LUMINITE®

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Optimizing Ink Transfer For Flexographic Printing Quality and Efficiency

Among the variety of factors affecting the quality and efficiency of your flexographic printing, perhaps none is more critical than effective ink transfer.

Flexographic printers are ever exploring ways to achieve the best ink transfer possible. But better ink transfer doesn't necessarily just mean more ink applied to the substrate. **In reality, quality and efficient printing can be achieved only through optimum ink transfer.** Too much or too little ink transfer can adversely affect your print quality.

Let's explore this further to achieve the highest quality prints with both high definition and color brilliance.

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Understanding Ink Transfer

This process is governed by:

- Ink composition
- Anilox
- Image carrier (sleeve, cylinder, or plate)
- Substrate
- Surface tension of all of the above

Ink moves through the components of your press and ultimately onto the substrate.

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What is Ink Composition?

Image courtesy of PackagePrinting.com

Ink transfer is governed by surface tension, viscosity, and ink components that interact with the substrate.

Surface Tension & Surface Energy

Surface tension and surface energy affect wettability. Proper transfer depends on the surface tension of the ink and surface energies of the image carrier and substrate.

Surface Tension:

Measured in dynes/ cm (or force per unit length), is the tendency of liquids to act in open air as if they're surrounded by an elastic barrier. This is the phenomenon that causes beads of water to form on a waxed vehicle, for example. Incorrect ink surface tensions can prevent the ink from transferring and adhering to the substrate.

Surface Energy:

Measured in joules/sq. meter, is a similar concept that's applied to solids. It's the excess energy at the surface of a material compared to its bulk.

The **ink must have a low enough surface tension** compared to the image carrier so the ink can adhere to it. The **substrate must have a higher surface energy** to fully pull the ink off the image carrier.

Ink Viscosity & pH

Temperature and viscosity (a liquid's resistance to flow) are interlinked. Water-based inks rely on controlling pH levels (acidity or alkalinity) to maintain the solubility and stability of the resins and solvents within.

Automated systems can now control these important variables.

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Ink Types

Flexographic inks have two classifications: **Volatile and energy curable**. Volatile inks contain a liquid (such as water or alcohol) that evaporates and leaves the pigment adhered to the substrate. Energy curable inks dry through intermolecular bonding, which solidifies the ink onto the substrate.

Flexographic printers generally use 4 common types of inks:

- Water based
- Solvent based
- Ultraviolet (UV) & electron beam (EB) cured
- Oil based

Here's a breakdown of each.

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#1: Water Based

- Composed mainly of water and pigment with assorted additives like defoamers and agents to aid in drying and adhesion
- Generally have the highest surface tension of all ink types
- May limit press speeds due to drying time
- Popular in many facets of the flexographic printing industry

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#2: Solvent Based

- Composed mainly of alcohols, acetates, and pigments
- Usually have much lower surface tensions than water based
- EPDM elastomer is recommended
- Popular for flexible packaging and industrial films
- Capable of drying at higher press speeds

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#3:
UV & EB

- Composed of prepolymers, monomers, photo initiators, and pigments.
- Dries and adheres only when exposed to UV light or electron beam
- Higher viscosity
- Popular in the flexible packaging and label industries

#4:
Oil Based

- Composed of hydrocarbons, pigments, and sometimes soy or mineral oil
- Commonly blended with aggressive solvents such as naphtha and hexane
- Popular in the healthcare printing industry

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Ink Transferring Press Components

1. Anilox

An anilox is a cylinder used to transfer ink onto the image carrier. The amount of ink delivered is controlled by a doctor blade, which squeegees excess ink and evenly pushes the ink into a pattern of small precisely sized dimples, known as cells, in the anilox surface.

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This cell pattern is defined by three variables.

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Cell Volume

The cell volume of an anilox is the total space available to hold ink in 1 square inch of cells on its surface. This controls the amount of ink supplied to the image carrier and the resulting ink film thickness on the substrate.

Generally, greater volumes are used for brighter, bolder work, and smaller volumes for finer, high-detail work. Cell volumes are measured in billion cubic microns per square inch (BCM/in2).

Here are some general cell volume printing guidelines:

- Solids and Heavy Line: 4.0-9.0 BCM/in2
- Text and Regular Line: 1.0-8.0 BCM/in2
- Spot Vignette: 2.0-3.6 BCM/in2
- Process Color: 0.9-2.8 BCM/in2

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Cell engraving angle

The engraving angle is the arrangement of cells in relation to the axis of the roll. The most common engraving angles are 30˚, 45˚, and 60˚. Take note: 60˚ is the most common for its efficient packing of cells allowing a uniform ink distribution.

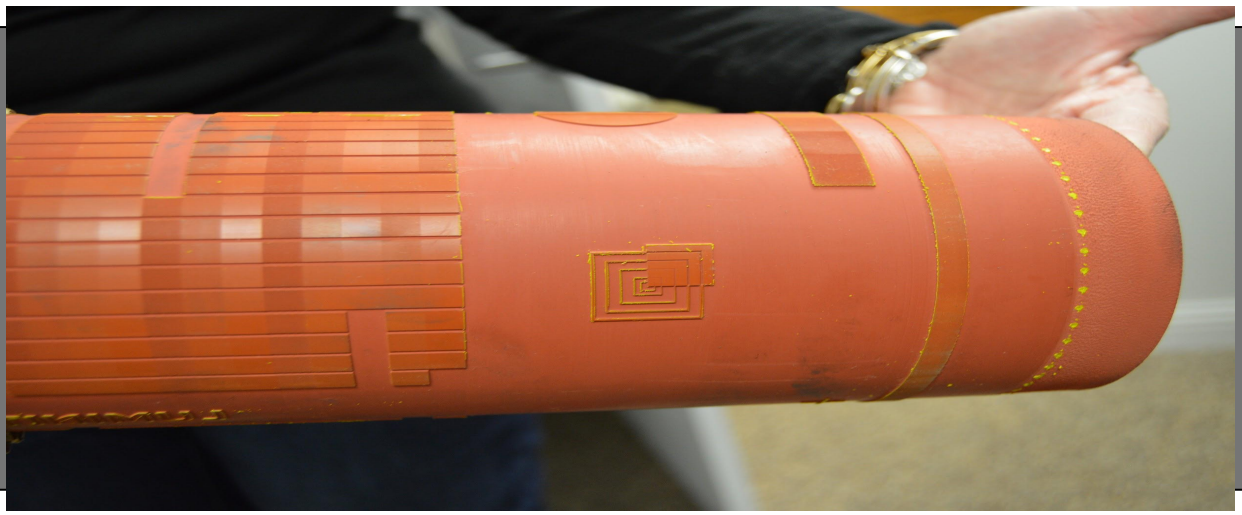
The ideal cell count, cell volume, and cell engraving angle combination differs by substrate and ink composition.

A banded anilox test is often used to compare the performance of multiple cell patterns on a single roll.

Cell Count

Cell count is the number of cells per inch measured along the anilox engraving angle. Higher cell counts (which correspond to lower volumes) are typically more appropriate for finer detail work while lower cell counts (with higher volumes) are better for bold and higher density work.

The industry standard for halftone printing uses an anilox cell count at least 4X the line count of the halftone. This is the minimum requirement for supporting a 2% dot. In practice, even higher cell counts may be more appropriate for rendering highlight detail.



2. Image Carrier

The image carrier delivers the ink to the substrate. It heavily influences the efficiency and the quality of the print.

Image carriers can be made from a variety of materials chosen to accommodate the specific printing variables for a given job, such as:

- Ink formulation
- Substrate characteristics
- Press speed
- Operating temperature

Great print quality happens only when the image carrier pulls all the ink out of the anilox and then releases it completely to the substrate. Image carrier materials must be specially designed to do that while also withstanding stresses of the printing process.

3. Substrate

The substrate receives the ink and becomes the final product when printed. Flexographic printing is capable of marking a variety of substrates, which makes it the method of choice for many of finished product requirements, including:

- High strength
- Flexibility
- Specific appearance or feel

If the **substrate is absorbent**:

- Drying both water- and solvent-based inks is generally similar
- Water based is most commonly used

If the **substrate is non-absorbent**:

- Ability to dry the ink is critical
- Printers typically choose solvent-based or UV-curable inks
- Some water-based formulas do work

With an understanding of the physical components that either enhance or detract from adequate ink transfer, you can now adjust to strive for printing perfection. Here's how.

Troubleshooting Ink Transfer

Numerous flexographic printing defects stem from poor ink transfer. There could be dozens of causes behind ink either not transferring between press components or not fully adhering to the substrate.

Often times, issues stem from:

- Pressure
- Ink consistency from chemicals, solvents, pH balance, or viscosity
- Surface tension
- Combinations of issues

Ink transfer defects can also result from the image carrier, which must be produced correctly and optimized to suit the ink type and substrate material.

These defects stem from:

- Incorrect image carrier material
- Incorrect image carrier thickness
- Incorrect mounting tape *(occurs with plate only)*
- Air bubbles between the mounting sleeve, tape, or plate *(occurs with plate only)*
- Contamination of the image carrier surface
- Image carrier swelling
- Incorrect screen count to for the printing specs
- Deviations in circumference, concentricity, and parallelism of the image carrier

Yet, there's even more you must monitor.

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Monitoring Your Press

Image courtesy of Adkins Lighting Center

Get to know your flexographic printing press and what makes it work effectively.

Basic Press Mechanics

Closely monitor and adjust all rollers including the anilox, image carrier, tension rollers, and substrate wind and unwind.

Balance and evenly distribute the rollers' mass to avoid the following issues that could affect your imagery with poor ink transfer:

- Wobbling
- Resonant vibrations
- Excessive image carrier wear
- Uneven tension

Drive systems, which should pull the substrate evenly through the press's rollers, must be calibrated to achieve a **constant speed, even tension and pressure to ensure the substrate uniformly contacts the image carrier**. Worn-out bearings and gears can also cause the substrate to experience unwanted lateral or vertical movement.

All of these variables could cause poor contact and ink transfer between the anilox and image carrier and/or the image carrier and substrate.

Pressure

Appropriate pressure is required to move ink from your image carrier to your substrate.

Simply enough: **Not enough pressure, not enough ink.** Too much pressure can cause issues of its own. Ensure pressure is constant and uniform across the web.

Doctor Blade

A worn or otherwise malfunctioning doctor blade will not provide adequate ink control. In this case, you could initially experience too much ink transfer from the anilox to the image carrier.

But eventually, excess ink buildup and broken-off pieces of the doctor blade, however microscopic, could damage the cell walls. **Dirty, worn and/or damaged anilox cell walls will no longer transfer the correct amount of ink.**

Maintaining your doctor blades is crucial. It may seem as if your doctor blade could sit there wiping away ink indefinitely. But unfortunately, it too will get old and out of shape.

Gear Characteristics & Maintenance

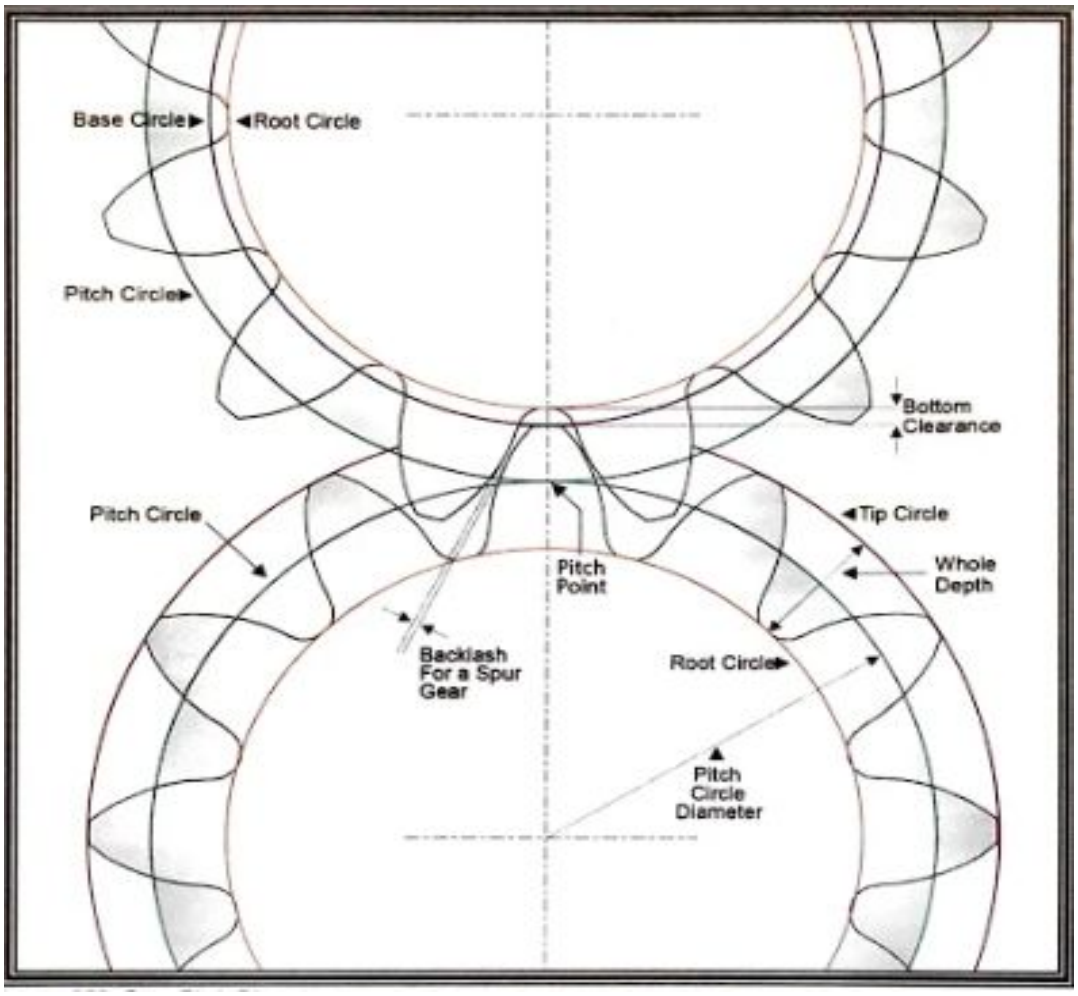
While gear chatter can be a noisy and costly flexo printing defect, it's not often considered alongside ink transfer. Those striated gear marks that at times appear in light-and-dark patterns across your substrate are a certain indication of a **mechanical ink transfer** problem.

Gears also wear over time, leaving extra space for print cylinders to wobble out of balance and for other gears to misalign. **Drive gears must be cleaned and lubricated regularly to allow gear teeth to mesh properly**.

In addition to choosing the proper number of gear teeth, gears are often chosen by a combination of scale measurements including:

- Pitch circle
- Root circle
- Gear pitch
- Tooth angle
- Face width
- Pitch surface

The parts are shown in this diagram below:



[Image courtesy of FTA]

Image Carrier Maintenance & Cleaning

Properly maintaining and cleaning your image carrier will ensure quality prints and extend its life.

Cleaning needs to be done immediately after removal from the press to prevent ink from drying on the image carrier.

Use cleaning chemicals and tools that are non-abrasive and appropriate for the ink type and image carrier material. Use mild soap and water or industrial alcohol for water-based ink on most elastomer types. **A soft-bristled brush is recommended to clean stubborn ink and debris.** Rinse thoroughly and let your flexo prints air dry for AT LEAST 4 hours before storing in temperate conditions. Avoid ozone exposure with protective wrapping, and by storing away from ozone-emitting appliances.

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Optimizing Ink Transfer for the best Flexo Quality & Efficiency

To begin troubleshooting ink transfer, you must understand the components of your ink chain and how they work together to produce a final result, including:

- Press mechanics and adjustments
- Ink characteristics and interactions with different image carrier materials and substrates
- Pressroom environment

Optimizing ink transfer also requires careful maintenance and monitoring and of all press moving parts.

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About Us

Luminite Products Corp. introduced laser engraving elastomer printing plates and cylinders to the United States in the 1970s. Decades ago, it was a great alternative to plate-mounted cylinders, which were inconvenient to change and less durable.

Today we're the global standard for **the most successful printers**. Luminite specializes in flexographic printing products and is the most recognized manufacturer of continuous laser-engraved printing cylinders in North America. We've also patented a revolutionary air sleeve called Load-N-Lok.

You're aiming to boost your printing efficiency and productivity. Air-assist mounting sleeves will allow near continuous operation and unmatched quality.