

Problem

The printed image visually appears undesirably blotchy, streaky or non-uniform.

Description

Print mottle is usually the result of uneven ink lay or non-uniform ink absorption across the paper surface, especially visible in mid-tone imagery or areas of uniform color such as solids and continuous-tone screen builds. This visible non-uniformity may be the result of differential ink gloss, density, or color of the printed ink film, or it may be a variable function of randomly connected and disconnected mid-tone dots. Mottle is most often described in terms of its more specific root cause by mottle type.

Printers Mottle
Ink Trap Mottle
Back-trap Mottle
Water Interference Mottle
Plain Paper Mottle

Printer's Mottle

The result of a misconfigured press that transfers an inconsistent ink film to the paper. This potential mottle cause should be the first focus for trouble-shooting.

Causes and Solutions

- **Prepress** – First determine that the mottle pattern is not inherent in the original art or the color separations. Check for conflicting screen angles, moiré patterns, or mid-tone inconsistencies. Avoid using flat screens in the 50% range.
- **Ink Train** – Roller condition, durometer, and settings are key elements. Insure that the chill system temperature preset is optimum. Most conventional ink formulations transfer best at 75-80° F. (24-27° C.). Consult ink supplier.
- **Fountain Solution** – Insure proper conductivity, pH and uniform, moderate delivery to the plate. Avoid excessive use of alcohol substitutes.
- **Ink** – Ink film thickness on the rolls should be optimum for proper ink transfer. Some ink formulations such as grey and brown can be problematic. Using varnish instead of tint base to formulate tints can often improve ink lay.
- **Plate** – Check plates for consistent caliper and packing requirements. Surface grain can affect water pick-up.
- **Blanket** – Check surface condition for proper smoothness and release characteristics. Harder blankets can often smooth print mottle on solid ink lay.

Print Mottle (continued)

Insure solvent and blanket compatibility to minimize potential for swelling and embossing. Maintain proper and consistent caliper, packing, and torque specs. Avoid mixing blanket types.

- **Blanket Packing** – Inspect packing for uniform basestock formation and caliper accuracy.
- **Impression Squeeze** – Check for weak or excessive impression squeeze. Back-off impression squeeze until image breaks, then increase minimally to optimize print.

Guidelines for Troubleshooting

- Check consecutive press sheets. If the mottle pattern is consistently the same sheet-to-sheet, focus on plate, blanket, impression, and packing integrity and insure proper packing height over bearer with a packing gauge. Compare mottle pattern to the plate image to insure prepress integrity.
- Isolate mottle to an individual unit of print by analyzing solid ink lay in the color-bars. If only one color in the ink rotation demonstrates visible mottle, focus on the components of that particular unit of print. Running dry solids in the suspect unit of print can offer an effective tool for analysis.
- Lift varnish or aqueous coating off impression and compare print quality.
- Determine if mottle manifests itself immediately on start-up or if it slowly develops on the run. If press starts up without mottle, blanket swelling from solvent wash may be masking other issues. Focus on plate, blanket, impression, and packing relationships.
- Flip sheet and compare, or try a competitive sheet of equal grade, surface, and basis weight. If condition persists, continue focusing on press related issues.

Ink Trap Mottle

Poor or inconsistent unit-to-unit ink trap which transfers non-uniformly to the paper and/or previous ink films. Trap requires one wet ink film to capture or “trap” subsequent ink films. Incorrect ink tack grading, wrong ink sequence, screens over solids, and paper absorbency are most often the cause.

Causes and Solutions

- Ink does not build tack fast enough to effectively trap subsequent ink films. In multi-unit printing, the previous ink must be of greater tack than that of the ink being applied to maximize percentage of ink trap. Initial ink tack and ink tack build through the press should be graded accordingly.
- Improper ink sequence. Ink sequence should be determined by tack grading and ink coverage. Avoid trying to trap screens on solids or light coverage on heavy coverage.
- Paper or substrate set rate is incompatible with ink set rate. For example, a tighter, gloss surfaced sheet would require a quicker ink set than a more open, soft-surfaced sheet.

Print Mottle (continued)

Guidelines for Troubleshooting

- Insure that *Printer's Mottle* is not the issue.
- Document and analyze ink sequence in relationship with ink tack ratings.
- Isolate suspect units of print and determine if mottle involves at least two overprinting colors.
- Analyze color-bars for individual unit print integrity and measure the percentage of trap between the suspect colors.
- Pull single prints and progressive combination prints and compare print integrity.
- Determine if the mottle may be the result of poor ink trap and subsequent back-trap due to light ink coverage printing over heavy ink coverage. Blue-sky images, where light coverage magenta prints over a heavier cyan is a common example of this type of mottle. In this case, transposing the cyan/magenta ink sequence and tack may be an opportunity to improve ink trap and dot fidelity.
- Flip sheet and compare, or try a competitive sheet of equal grade, surface, and basis weight. A faster setting sheet may improve progressive ink trap. (Note: A faster setting surface may also adversely diminish ink holdout and retained ink gloss).

Back-trap Mottle (BTM)

As the sheet travels from unit-to-unit, the ink film non-uniformly traps back onto subsequent blankets resulting in uneven ink transfer and absorption on the paper. Paper uniformity and setting characteristics, ink set rates, poor ink trap, and blanket type are the usual suspects.

Causes and Solutions

- Fast setting inks. An ink that is setting too fast through the press is releasing its vehicle too quickly and may then be pulled back off the printed sheet (back-trapping) non-uniformly onto subsequent blankets as it progresses from unit to unit.
- Dark solids or coarse ground, heavy-pigmented inks printing in first-down units with no fresh ink overprint in last-down units. Change sequence to run these colors further down in rotation. Ideally, these types of colors and solid images print and smooth out best when bumping off only one subsequent unit.
- Excessive plate/blanket or blanket/impression squeeze. Improper blanket surface or release characteristic causing non-uniform ink film split. Change to quicker-release blankets.
- Heat generated during long press runs can increase ink tack through rapid evaporative solvent loss.
- Extended make-ready or press downtime can also result in high ink tack through excessive evaporative solvent loss. Keep rollers well lubricated between press pulls or rinse rollers if necessary.

Print Mottle (continued)

- Cyan/magenta ink traps, such as blue-sky image, are notorious for back-trap mottle potential as is any situation where poor ink trap transfers through subsequent units of print. Adjust ink tacks or transpose ink sequence as necessary. (Refer to *Ink Trap Mottle*).
- The more units of print, the greater the potential for back-trap mottle. Optimize sequence to minimize the number of units on impression. This may be of particular concern running web offset where open units subsequent to the first unit of print must run on “wet” impression.
- Non-uniform drainage of ink into the paper or non-uniform paper absorbency.

Guidelines for Troubleshooting

- Insure that *Printer's Mottle* is not the issue.
- Document and analyze ink sequence in relationship with tack ratings.
- Determine that affected color is in an early-down unit and printing through subsequent units with minimal or no fresh ink overprint.
- Run singles and compare print integrity.
- Progressively lock off impressions of later-down units from the last unit back, one unit at a time, to determine if first-down colors print smoother without bumping off subsequent units. Maintain consistent press speed during this test.
- Vary press speed. Increased press speed may minimize back-trap mottle.
- Paper or substrate set rate is incompatible with ink set rate. Optimize ink set rate to substrate. If condition persists, flip sheet and compare, or try a different production run of paper, and/or a competitive sheet of equal grade, surface and basis weight.

Water Interference Mottle

The non-uniform acceptance or rejection of the fountain solution across the sheet surface. If the sheet does not absorb fountain solution uniformly, ink applied in subsequent units may not transfer and lay uniformly. Ink and water imbalance can affect the uniformity of ink transfer resulting in a non-sharp, hollow, or weak dot structure in respective units of print.

Causes and Solutions

- Any inconsistency in the metering of the fountain solution or irregularity in the solution mix, such as high conductivity or pH, that may necessitate running heavy water to the plate to keep the non-image clean. Excessive water can over-emulsify the ink and adversely affect the paper's ability to uniformly absorb the excess. Adjust to carry less water to the plate in all units.
- Incorrect ink water pick-up compromising proper ink emulsification and transfer.

Print Mottle (continued)

- Excessively heavy ink film on the rolls also demands excessive water to the plate.
- Increase impression cylinder squeeze and compare print integrity.
- Non-porous paper or substrate surface can not absorb water quick enough from unit to unit or carry and transfer water effectively. Low or non-absorbent substrates demand less water to the plate.
- Paper surface does not absorb water uniformly from unit-to-unit. Excess water on the sheet surface negates uniform ink transfer.

Guidelines for Troubleshooting

- Insure that *Printer's Mottle* is not the issue.
- Inked solids and dots appear washed out under magnification.
- Over-emulsified ink will transfer dots that exhibit feathery edges or hollow centers.
- Progressively lock off impressions in first-down units preceding the mottle and compare prints.
- Pull progressive, single-unit prints and compare print integrity.
- This type of mottle has greater potential on light coverage forms with light ink take-off. Consider using take-off bars to increase fresh ink displacement. This will help maintain ink integrity and transfer capability.
- As with *Back-trap Mottle*, the more units of print, the greater the potential for water-interference mottle in later-down units. Avoid running "wet" in open or pre-dusting units.
- Flip sheet and compare, or try a different production run of the same paper. If condition persists, try a competitive sheet of equal grade, surface, and basis weight.

Plain Paper Mottle

Non-uniform ink lay that is the result of paper manufacturing process variables or the result of unique paper surface print characteristics.

Causes

- Paper manufacturing process variables such as uneven coat weight, binder migration, wire/felt patterns, poor basestock formation, or fiber clumps.
- Non-uniform surface absorption of the paper.
- Non-uniform basesheet contributing to gloss variation and surface galvanization.
- Optical incompatibility between basesheet and coating.
- Wrong paper surface choice for the job.

Print Mottle (continued)

Options and Solutions

- Compare both sides of the sheet and run the more critical imagery on the smoother side.
- Replace the paper with a different production run of the same grade.
- Softer, more absorbent paper surfaces may demand double-hits or underlays to smooth and maximize solid ink holdout and depth. Avoid connected dots in the mid-tone range (45% - 60%) to minimize visual mottle when printing continuous flat screens and screen mixes on these types of surfaces.
- Determine the appropriate grade and surface most suitable for the imagery in question and consult with customer.

Guidelines for Troubleshooting

- Insure that *Printer's Mottle* is not the issue.
- Mottle is evident in all colors and usually worse in heavy coverage solids.
- Check sheet-to-sheet print consistency. A problem sequentially repeating mottle every third sheet suggests a paper issue.
- Flip sheet and compare, or try a different production run of the same paper.
- Some textured, soft-surfaces offer an aesthetic appeal that can result in non-uniform ink holdout by design. Depending upon imagery and desired affect, the end print result can be perceived as either mottle or texture. Consult with customer to align reasonable expectations.