

Ink Chalk and Scuff



Sappi Printer Technical Service

877 SappiHelp (727 7443)

Problem

Although the printed ink film is dry, residual ink pigments transfer to where they are unwanted, usually onto unprinted areas of the paper; or ink and paper visibly mark through the mechanical action of rub or abrasion.

Description

Ink scuff is often described in other terms such as marking, chalking, ink rub, and setoff. Although the latter term more typically defines the non-mechanical action of wet ink offset, ink scuff refers to the transfer of dry ink pigment through the abrasive mechanical action of contact and rub. Ink chalking and surface abrasivity are the primary mechanisms contributing to ink scuff. If ink holdout is especially low and the ink penetrates too deeply into the paper surface, ink vehicles may drain off the resins, dryers, and waxes that would normally “bloom” to the surface to solidify the pigments. This condition, which also can retard ink dry, is known as ink pigment filtration and usually results in ink chalk and scuff.

THE THREE PRIMARY COMPONENTS OF INK SCUFFING ARE:

- **Ink film resiliency** – After properly transferring to the plate, blanket, and paper, the conventional sheetfed ink film must effectively set, which is defined as the physical loss of ink solvent as it absorbs into the substrate. The second phase is the chemical process of actual ink dry through oxidative polymerization. In contrast, web heatset inks dry by evaporation, utilizing dryer heat to evaporate the unabsorbed ink solvents and a chill-roll system to gel and set the melted ink resins. Sheetfed inks, with higher levels of oxidizable resin, are considered much more durable and scuff resistant than web heatset inks. In either case, effective ink set must allow the ink vehicle to “bloom” the resins, dryers, and waxes to the surface to properly bond with the pigments during the drying process.
- **Paper smoothness and hardness** – Matte, silk, satin, and dull coated papers typically have a rougher surface which creates an abrasive rub making these papers more susceptible to marking and scuff. In addition, rougher or soft-surfaced papers, in conjunction with certain quick-set ink formulations, can absorb ink solvents much quicker and deeper than smoother tight-surfaced substrates creating the potential for ink pigment filtration. These compounding characteristics can make ink scuff and marking a definite concern.
- **Mechanical action** – Areas of the printed piece that experience the most pressure and contact may rub too roughly through post-print production processes. Ink scuff is usually worse near folds, bulky spines, or shingled pages. Ink scuff and marking can occur through equipment contact with wheels, nips, and belts through the feeding, delivery and finishing processes.

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Causes

- Ink formulation and/or ink set rate not compatible with absorbency rate of paper. Ink sets too deep resulting in ink pigment filtration.
- Unprotected coarse-ground ink pigments such as reflex blue and metallic inks.
- Lack of wax or slip agents in the ink formulation.
- Ink dries too slowly. Conditions that may compromise ink set and dry include:
 - Incompatible set rate of ink and paper.
 - High relative humidity in the pressroom (over 60%).
 - Improperly conditioned paper (i.e., cold paper in a heated pressroom).
 - Paper absorbing excessive moisture transferred from the plates.
 - Over-emulsified ink from excess water or high-acid fountain solution.
 - High acidity of fountain solution compromising ink drier.
 - High conductivity of fountain solution compromising effective ink set.
 - Too much or too little drier in the ink.
- Substrate surface is rough and abrasive.
- Excessive use of anti-offset spray powder causing abrasive contact points for scuffing in transit.
- Lack of protective overcoat.
- Dull varnish over unprinted paper. Most dull varnishes are formulated with coarse-ground dulling agents, which are both abrasive and susceptible to surface filtration during the setting process. In addition, these dulling agents are hydrophilic and tend to take on water which can retard the ink drying process. These characteristics, in conjunction with the abrasive nature of soft-surfaced papers, can be very problematic, especially when dull varnish is used without the benefit of cross-linking with a wet ink film.
- High contact paper-to-ink or paper-to-equipment rub pressure during production operations.
- Loose packaging inducing high-contact rub and movement during shipping.

Options and Solutions

- Ink set rate should be compatible with absorbency of the substrate surface. A tighter-surfaced, high-holdout substrate may require a quick-set ink, whereas, a more absorbent soft-surfaced substrate may demand a less interactive and slower ink set to increase holdout and improve “hard-dry” capability.

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- Coarse-ground ink pigments, such as metallics, should be protected with either a varnish, aqueous, or UV over-coat.
- When over-coat and post-press applications permit, the inclusion of Teflon wax in the ink formulation will improve ink resiliency and surface slip.
- For timely and thorough ink dry consider the following best-practices:
 - Select the ink formulation best suited for the job and substrate. Do not alter inks without consulting with ink supplier.
 - Ideal pressroom environment is 45% (+/-5%) RH @ 72° F. for North America and 52% (+/-5%) RH @ 21° C. for Europe (See Sappi tech tip on Paper Conditioning & Characteristics).
 - Allow paper to fully acclimate to recommended pressroom environment before unwrapping. Paper acclimation is relative to volume of paper and environmental extremes, but the industry-accepted best-practice is 24–48 hours.
 - Optimize ink/water balance and minimize water to the plate whenever possible.
 - Fountain solution should be buffered to a pH no lower than 4.0 (European printing systems tend to run more alkaline recommending a pH value no lower than 4.8).
 - Consult with fountain solution supplier for appropriate conductivity of fresh solution.
 - “Wind” printed loads in small lifts after ink has sufficiently set.
- Cover grades and more absorbent matte, dull, and silk finishes may demand special consideration to improve ink film resiliency and minimize scuff and rub.

Inks typically known as “hard-dry” or “cover set” formulations may contain additional oxidizable resins and/or Teflon waxes.

Although not as hard and resilient as sheetfed inks, web heatset inks, which dry by evaporation, may be formulated with small amounts of drying oils which will allow for additional post-press hardening through oxidative reaction. Consult with ink supplier.

Most importantly is the consideration of a protective UV, aqueous, or varnish overcoat. Gloss varnishes offer more surface resiliency and better scuff resistance than dull varnishes. A satin varnish with at least 60% gloss in the formulation is usually considered the best compromise for a dull effect. The best options for overcoat surface protection are as follows:

- UV coating

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- UV varnish
- Aqueous coating
- Oil-based varnish

Since web heatset ink lacks the resiliency of sheetfed ink, it may be necessary in some heavy coverage web heatset print applications to overall varnish both image and non-image with a gloss or satin varnish to increase ink-to-paper slip.

- The use of spray powder can be beneficial in maintaining sheet separation, but keep micron size and dispersion volume as small and light as possible to prevent it from becoming an abrasive agent.
- Avoid running straight dull varnishes over unprinted paper. An industry-accepted compromise to reduce high-glare gloss is the use of satin varnish with at least a 60% gloss varnish in the formulation. If the project demands a maximum dull image effect, consider a strike-through dull varnish application, which allows for a protective, in-line gloss aqueous overcoat. Consult with ink supplier regarding the need for a special strike-through dull varnish.
- Scrutinize printed material during all post-print production processes to determine areas of high contact and scuff, and backtrack through the process to decrease or move any undue pressure or contact. Keep rubbing to a minimum.
- Consider slip-sheeting finished pieces to minimize potential ink scuff around high contact areas such as spines, folds, and embossed surfaces.
- Shrink-wrap or package finished pieces as tightly as possible to avoid potential movement during transit.

PRODUCTION TIPS FOR PRINTING ON MATTE, DULL, SATIN AND SILK PAPER SURFACES

Soft, warm, and inviting, matte, dull, satin, and silk finished papers have their own set of production needs. The very surface and finish qualities that make them attractive, including their good opacity and bulk, their readable, writeable, non-glare surface, also make marking/scuff a concern. Formulating hard dry inks can help reduce scuffing concerns.

Additionally, applying a protective overcoat will prevent inks from rubbing off onto facing pages. Finally, consider protecting your covers with slip-sheets or envelopes, especially when covers are embossed.