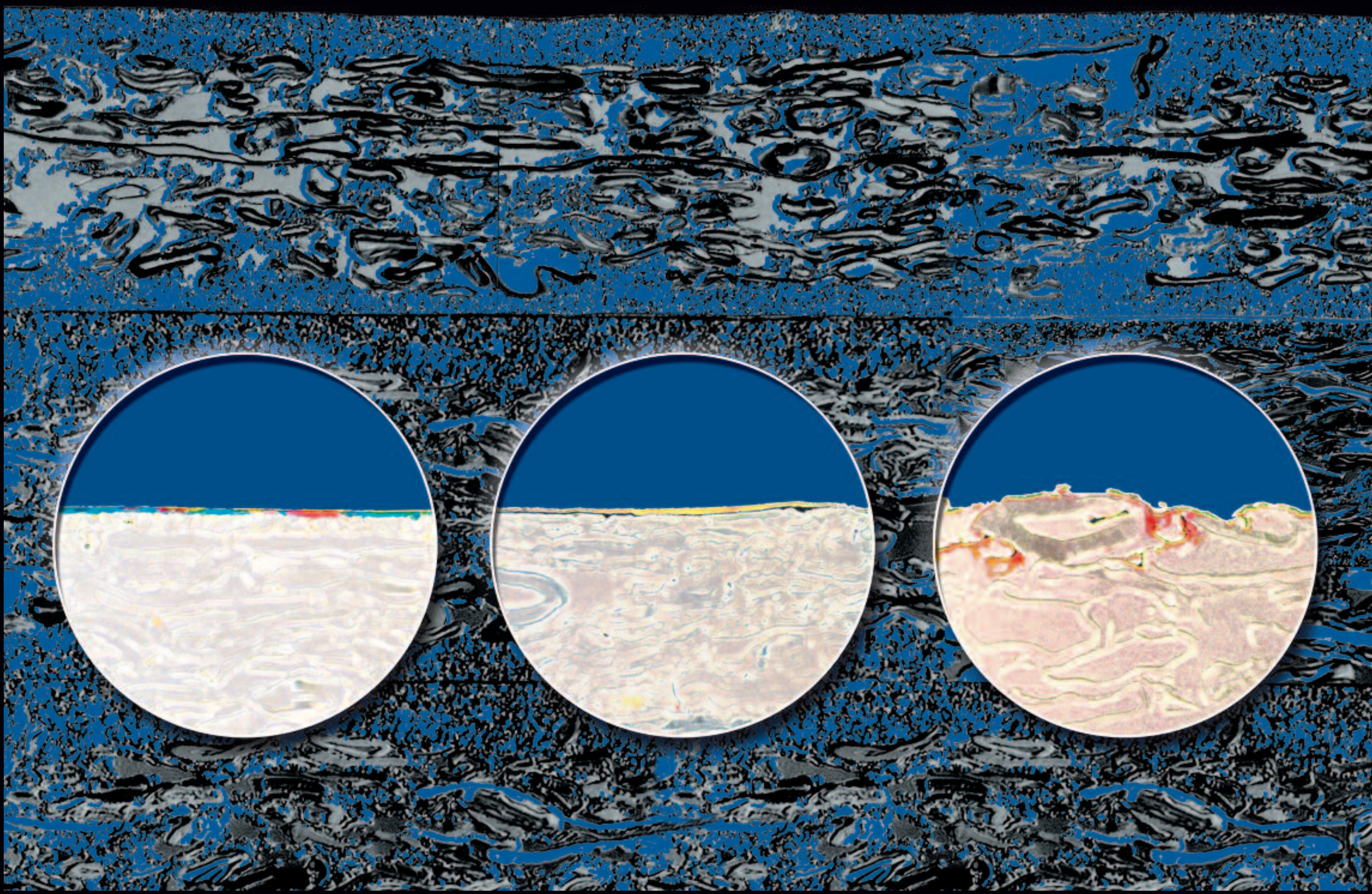
BEST PRACTICE GUIDE FOR WEB OFFSET PRINTERS

# How to avoid surprises
## when changing paper grades



Guide N°3. Edition N°1. €30.
GB

Aylesford Newsprint, Kodak GCG, manroland, MEGTEC, Müller Martini, Nitto, QuadTech, SCA, Sun Chemical, Trelleborg Printing Solutions

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**Best practice guide for web offset printers**

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The content and value of this publication have been vastly helped by the assistance of individuals, printers and associations from all over the world who gave willingly of their time and expertise to review and improve this guide.

**Special appreciation to the leading printers and others who helped us perfect this guide**
GATF (Graphic Arts Technical Foundation), USA, *William Farmer*
Graphoprint UK, *Mike Povah*
Hjemmet Mortensen Trykkeri AS, Norway, *Audun Aas*
KBA, Würzburg, Germany, *W. Scherpf*
Polestar Petty Leeds, UK, *Rick Jones*
Portsmouth Printing & Publishing, UK, *Ian Baird*
Print & Pack, Australia, *John Ostler*
Quad/Graphics, USA, *Tyler Saure*
R.R Donnelley & Sons, USA, *Tariq Hussain*
Roto Smeets Weert, Holland, *Jan Daems*
Rural Press, Australia, *Robert Lockley*
St. Ives, Plymouth, UK, *Jerry Westall*

**Printers participating in St. Norbetts University review workshop**
*Austria*, Sochor, Quebecor- World-Oberndorfer ; *Belgium*, T'hooft, Mercator-Concentra; *Brazil*, Posigraf; Marprint, Esdeva, Editora Tres; *Croatia*, Radin, Vnesnik; *Czech Republic*, Svoboda, Severotisk-Passauer, Unigrafia; *Finland*, Hansaprint, Artukainen-Hansaprint; *Germany*, Bertelsmann, Koerner, Industrie Druck-Krupp, Colorduck-Pforzheim, Eller, Fink, Appl, Vogel Medien, Neue Stalling, Drucklinie Dortmund, Echter Verlag, Vod; *Italy*, Rotolongo; *Netherlands*, Habo Da Costa, Roto Smeets-De Boers-Utrecht, Roto Smeets-De Boers-Weert; *Portugal*, Lisgrafica; *Russia*, Krasnyj Proletarij, Pressa; *Slovenia*, Delo Tcr; *Spain*, Quebecor World-Rotocayfo, Rivadynera, Graficas Ruan, Sociedad General Publicaciones; *Switzerland*, Weber, Benteli, Ringier.

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**Other contributors**
B + O, *Jan Vroegop*; GATF, *William Farmer*, Trelleborg Printing Solutions, *Philippe Barre*, *Gérard Rich*; Muller Martini, *Rolf Steiner*, Norske-Skog, *Simon Papworth*; UPM-Kymmene, *Erik Ohls*, Sinapse Graphic International, *Peter Herman*; System Brunner, *Andy Hollis*

**Special acknowledgement to**
PIA, GRACoL (IDEAlliance) and WAN-IFRA for their assistance and permission to reproduce some of their material.

Managing Editor *Nigel Wells*.
Illustrations by *Alain Fiol*
Design and prepress by *Cécile Haure-Placé and Jean-Louis Nolet*
Photographs: Kodak GCG, SCA, Sun Chemical

 ISBN N° 2-9515192-5-7
Guides are available in English, French, German, Italian and Spanish editions

To obtain printed copies in North America contact PIA printing@printing.org
In other areas contact your nearest Web Offset Champion Group member
or weboffsetchampions.com

**Bibliography and recommended reading**

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**www.printing.org**

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(GRACoL) Graphic Communications Assoc., USA.
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BEST PRACTICE **guide 3**

## CONTENTS



There is a continuing trend to more frequently change paper grade, weight and process. Different papers have variable process requirements that impact pre-press, printing, finishing and total cost. Many publishers, advertising agencies and printers have suffered under-performance from change. Whilst others have optimised their total production process by working closely with their suppliers. By focusing on three grades of paper (LWC, SC, INP) we show what changes to expect and best practices to improve performance. The economic models and research results indicate the importance of different variables. They should not be taken as absolute values because of the diversity of the web offset process and its materials. We therefore recommend that printers monitor their own performance to calculate their own specific position.

**Optimised printing on variable paper grades**

Technology and material changes have led to pre-press becoming progressively even more important to optimum printing performance. The single most important factor affecting total cost and quality is the matching of pre-press profiles to paper grade and press. Effective use of industry reference targets for "printing by numbers" are critical to the integration of digital workflows, creating ICC profiles and the effective use of CTP.

Current printing press control systems can programme paper grade in advance so that the relevant press parameters are changed automatically art makeready — however this function is often overlooked. Other key influences are maintenance, press settings, environmental conditions and the selection of the right combination of consumables for each press.

The purpose of this guide is to provide heatset and coldset web offset printers with a base reference to best practice. The contributing companies play a role in an inter-related production chain and the combination of their expertise is a positive way to help improve overall production process performance :

- Avoidance of predictable problems
- Correct use of materials and equipment
- Systematic problem diagnoses with appropriate remedial actions

*IMPORTANT NOTE :*

*A general guide cannot take into account the specificity of all products and therefore we recommend that it is used in addition to information from your suppliers, particularly the manufacturers of equipment whose safety, operating and maintenance*

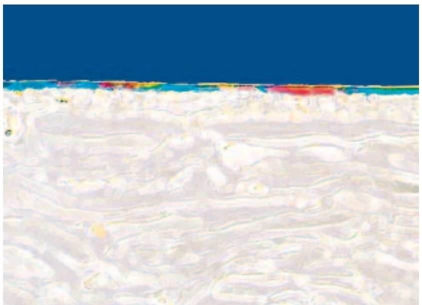
*procedures take preference over this guide.*

*This guide is produced for printers world-wide. However, there may be some regional variations of terminology, materials and operating procedures that are not included.*

**To assist readers we have used a number of symbols to bring attention to key points:**

**Best practice** | **Poor practice** | **Potential cost reduction** | **Safety risk** | **Quality issue**

# Why change paper grades?



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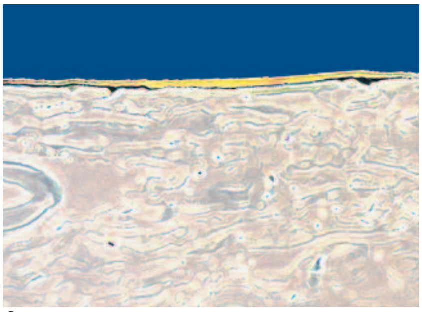

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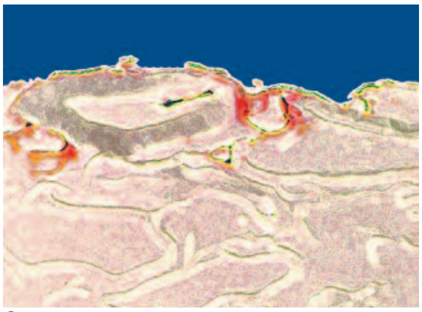


3

*Microscopic cross sections of three paper grades showing how the printed ink interacts with the different surfaces.*
***1****- Light Weight Coated (LWC) paper*
***2****- Super Calendered (SC)*
***3****- Newsprint (NP)*

Paper is usually the single biggest factor that discriminates quality between printed products. Publishers, advertisers, printers and print buyers generally select paper on the combination of two principal criteria: Suitability for use and cost.

## Suitability for use

- Desired paper and print quality
- Bindery or special finishing (higher bulk = higher paper stiffness for efficient processing)
- End product suitability to target reader
- End product life cycle (newspaper, advertising catalogue, magazine, book)
- Environmental aspects (recycling, bleaching, harvesting, etc.)
- Distribution method: Postal (weight = cost), insertion into a publication

Paper selection is a semi-objective assessment of different paper service qualities related to a specific application and end use. Brightness, coating, gloss, weight, light fastness are variable qualities. Each combination is selected to match different requirements ranging from high quality fashion magazines to mass circulation newspapers. The printing process to be used is another key factor. Distribution methods can also play an important factor in paper selection e.g. insertion efficiency into a newspaper or magazine; postal costs are directly related to weight, but lighter paper needs to be offset by a higher opacity.

## Total economic costs

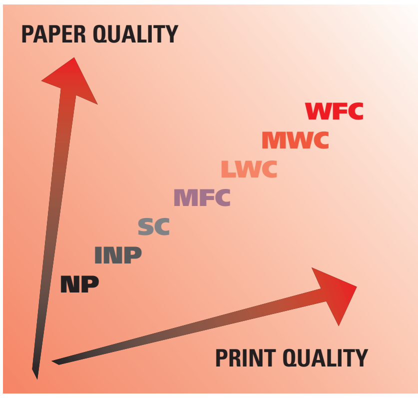
**1** Paper and ink
**2** Printing and binding
**3** Distribution

Paper purchase is significantly focussed on its total price (grade, weight, cost). The overall mix of properties determines the suitability of a paper grade for a specific purpose. A change of paper grade (or print process from gravure to offset, coldset to heatset) changes the properties in the mix and may create a variety of unexpected problems:

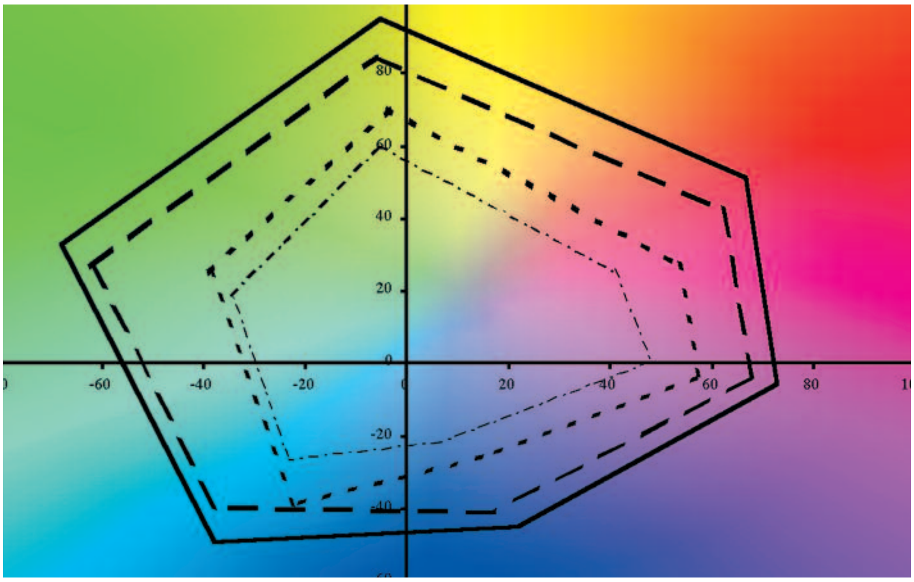
- Paper properties
- Printability and or runability
- Total economic impact

Care particularly needs to be taken when downgrading paper (e.g. from LWC to SC or newsprint) because savings in paper purchase price may be reduced because a lower grade of paper frequently has higher print processing costs. As paper becomes lighter it becomes more difficult to control during printing and finishing and may reduce speed and increase waste.

All grades are manufactured to conform to customer requirements of cost, print quality and runability. Optical properties are generally defined by brightness, shade and opacity. Each paper grade has variable printing characteristics. The specifications of a grade (or individual paper) cannot completely predict its printing performance qualities. Different physical and optical paper properties can be found within the same grade. Paper performance on presses of the same model may vary because of different running conditions (cylinder setting, blanket type, packing, humidity, temperature, web tension, etc.).




*There is a high correlation between each paper grade and its qualities. All paper grades can be printed heatset. Coldset is limited to uncoated and certain pigmentised and matt coated papers (MFP, MFC) with adapted inks which provide brighter results, sharper dot but with low gloss.*




*The relative colour gamut (space) has a direct correlation with paper grade. Lower grades have lower colour gamut which means that matching certain PMS colours becomes increasing difficult.*

*FOGRA - coated*
*SWOP - TR001 - LWC*
*FOGRA - uncoated*
*SNAP - Newsprint*

## Frequent problems when changing paper grade (or process)

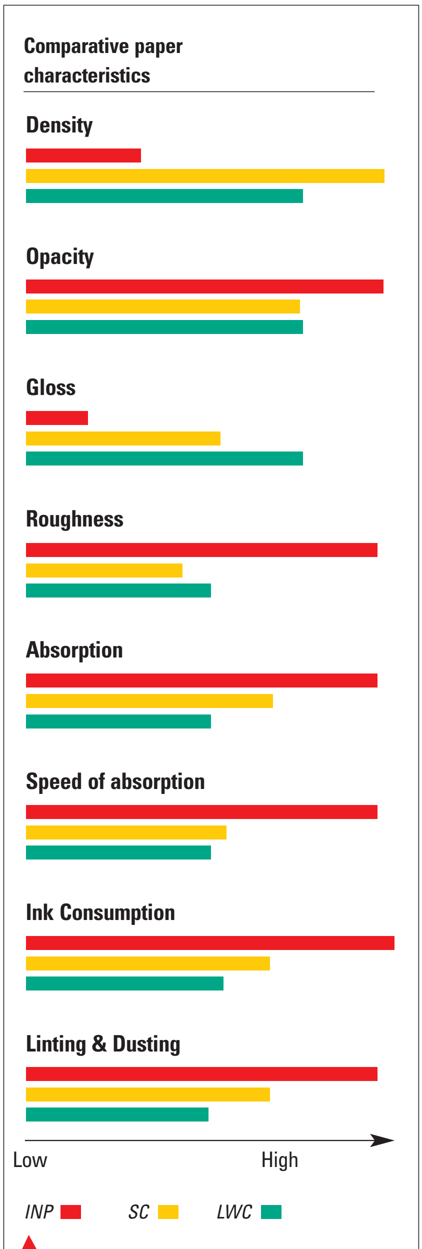
### Publishers and advertisers

• Perceived colour alters as the relative colour gamut has a direct correlation with paper grade (lower grades have lower colour gamut).
• Perceived reproduction quality may change as lower paper grades can affect printing properties and lead to higher fibre roughening and lower printed gloss.
• Graphic design and prepress not adapted to paper-print process qualities (e.g. heatset or coldset, coated or uncoated paper); and if prepress profiles do not match paper grade (e.g. using gravure specifications for offset; using LWC specifications on SC or newsprint).
• Cost over-runs: Printing and drying speeds tend to be slower on SC, on uncoated surfaces and papers over 100 gsm (70 lbs) depending upon dryer and folder limits, increasing production time and cost. Higher ink consumption is common when changing grades downward.
• Missed deadlines: Total printing and bindery time may increase unexpectedly.

### Printers

• Pre-press: Different paper grades require adapted prepress profiles and density specifications to the presses that they will be printed on.
• Runability: The variable paper grade-ink-drying relationships may affect printing speed, ink consumption, blanket washing, moisture content, dryer energy consumption, static, fold cracking, smearing, splicing, web tension, dust generation and cleaning.
• Printability/Quality: Gloss, colour, strength, opacity, streaking, drying difficulties, changes in optical characteristics.
• Finishing: Rub resistance, static, blocking in bindery or transport, overcoating effectiveness.
• Cost over-run and late deliveries.

The best mix of paper-production characteristics should be optimised by a round table discussion between the publisher/advertising agency, designer, prepress manager, paper supplier, printer and distributor. This will ensure the consequences of change are transparent and that every link in the production chain is optimised with each other to obtain the best results possible. A written specification including prepress profiles should be made.




*This overview assessment provides a simple summary of the principal differences between the three principal web offset paper grades.* *See page 254 for explanation of terms.*

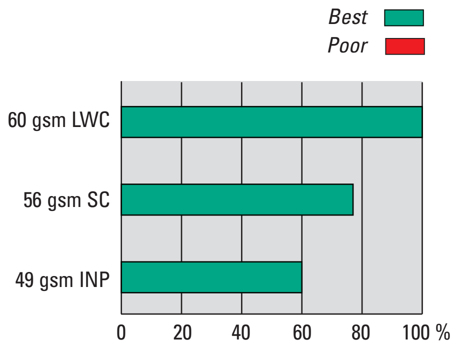
# Operating and economic impact of changing paper grade

Some of these effects are illustrated by the following economic example of printing 100 000 good copies (excluding makeready and bindery waste) using three paper grades. LWC is used as the 100% base reference cost. The “best” case uses adapted pre press profiles, the “poor” case shows the impact of using LWC profiles on SC and INP. (Assumptions of model: 16 page heatset press, 11,2 m/s (2200 fpm) maximum speed, 3-zone heatset dryer, automatic blanket wash at every splice with 500 waste copies, cut-off 620 mm (24,4”) paper 860 mm web width (33,9”), 1270 mm (50”) diameter roll.

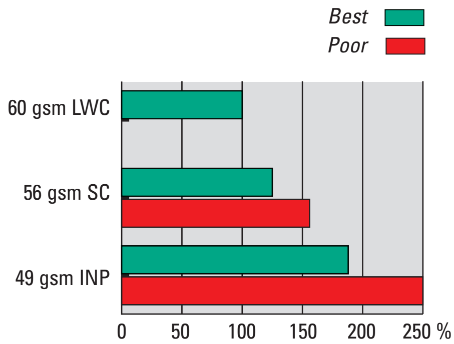

In addition to the cost of paper, total production costs vary between different paper grades and weights from:

1 Number of roll changes (linear length per roll).
2 Running waste allowance.
3 Change of ink and consumption related to paper surface.
4 Blanket washing frequency.
5 Printing-drying speed (can be reduced 10-30%).
6 Bindery/finishing speed (can be reduced 10-30%).
7 Press consumables cost (blankets, knife blades, slitters).
8 Make-ready times may be increased from non adapted pre press profiles.
9 Unrealistic customer expectations may increase waste and running time.

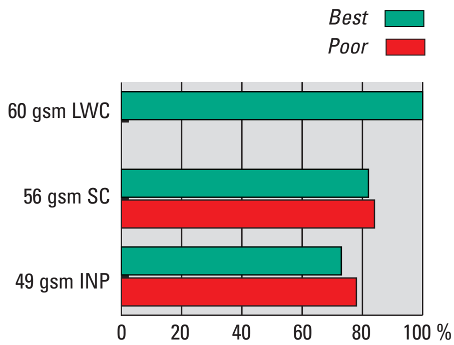
**Relative paper costs**
This example shows the relative paper costs to print the same job on different papers, combined with a simultaneous change of weight.). LWC is used as the 100% cost reference. Interpret with caution as paper prices change cyclically.




**Comparative ink consumption costs**
Ink consumption is related to (a) variable paper properties of each grade, (b) increases from non optimised prepress (poor case), (c) additional over inking if target densities are not adapted to each grade, (d) non optimised ink selection. Ink consumption in this chart is based on data from printers, in extreme cases consumption can be significantly higher.

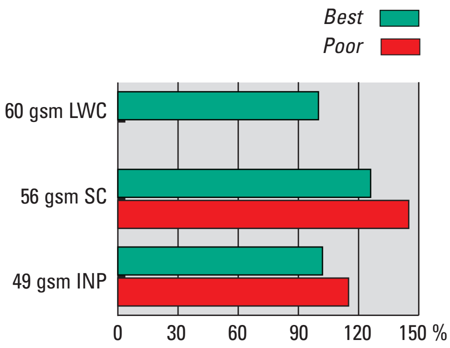



**Combined paper and ink costs**
The combination of paper and ink costs substantially change the relative cost performance between grades.



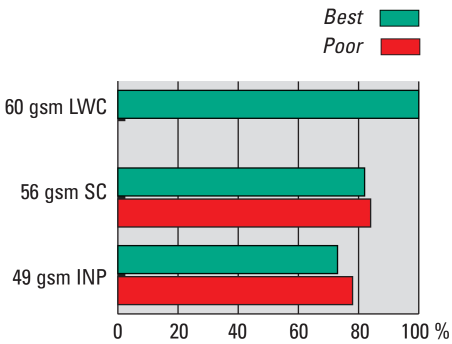
**Relative printing costs**

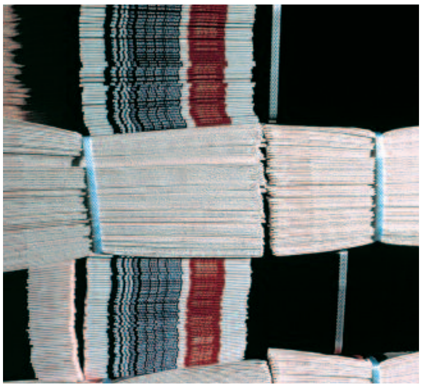
The significantly higher drying requirements of SC and newsprint frequently slow maximum production speed and increase costs (some printers may obtain higher speeds through total process optimisation) Performance declines if prepress is not optimised, leading to overinking and dampening. Folder performance may also be a limiting factor on some presses.




**Total production cost**

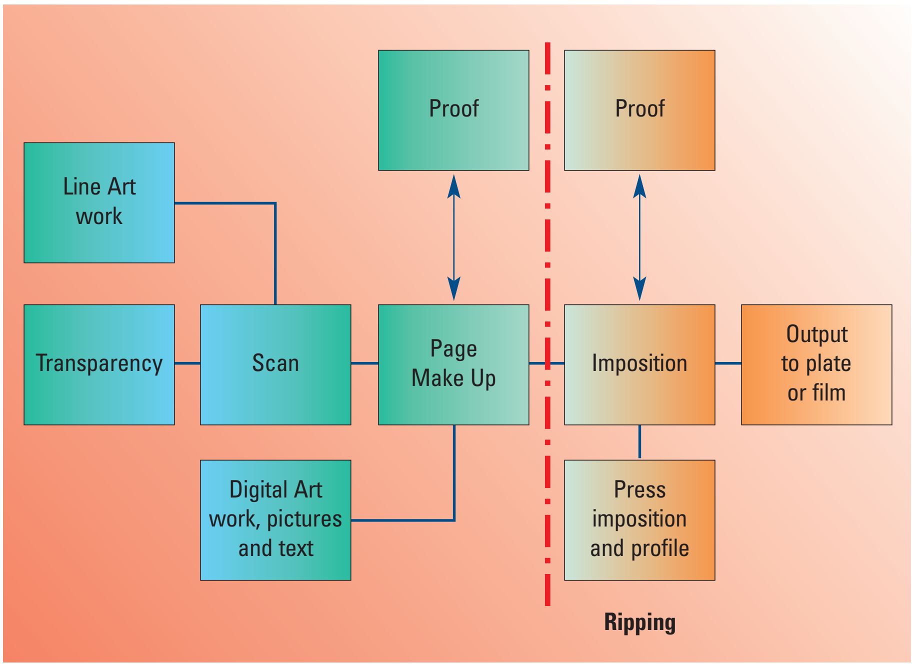
The model shows that best process practice positively impacts economic performance. Optimised pre press profiles for each paper grade (best case) reduce total production cost by 5-7%. In worst cases the differential can exceed 10%. Actual results at each printer will be different due to the wide range of variables in materials and the process.



Optimum prepress profiles significantly reduce operating cost and improve quality.

**Specify prepress profile when paper is ordered**



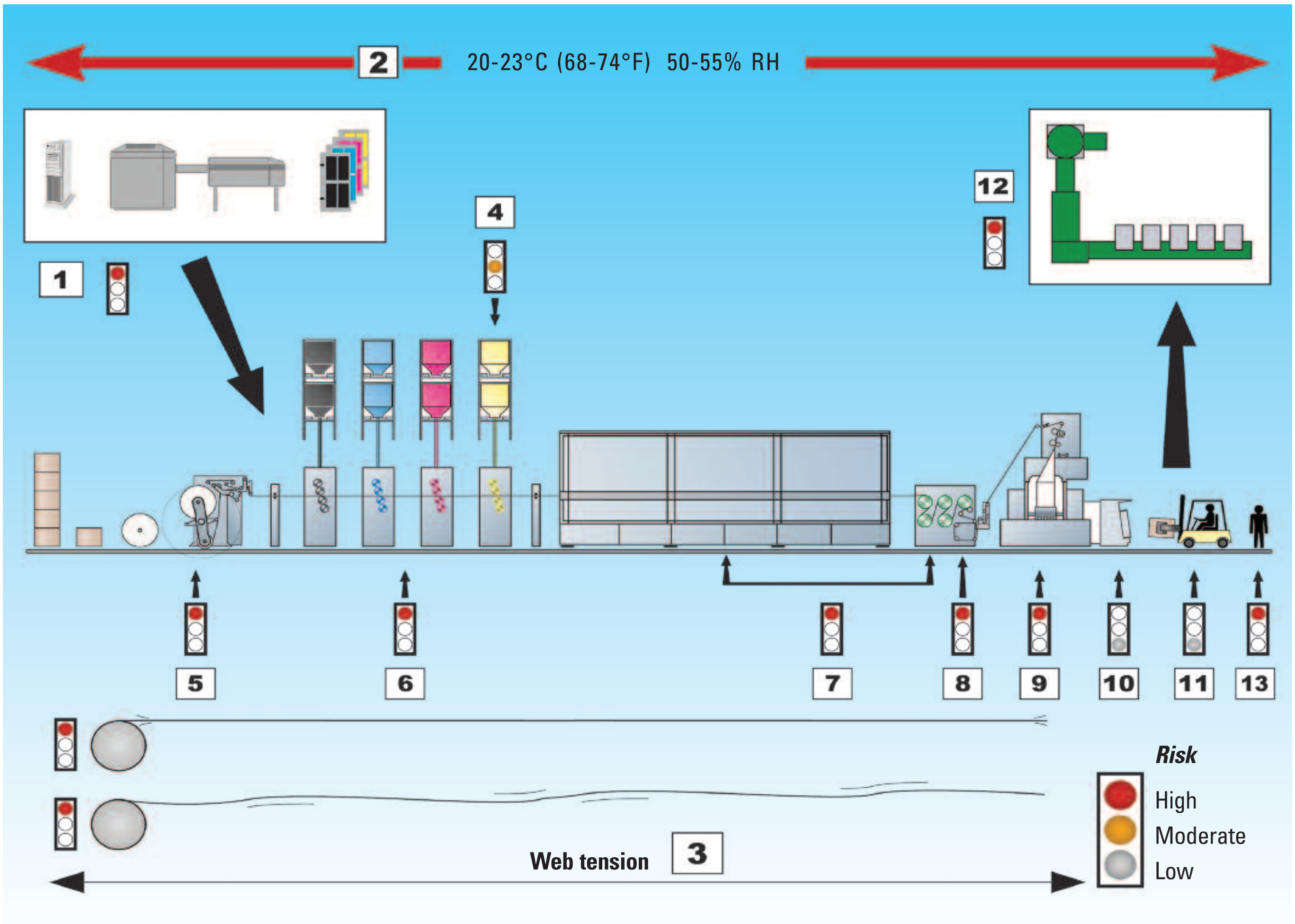

If the paper grade is not defined early, it is not possible to define a paper to press profile. Little effective adjustment can be made once data has been ripped. Consequences are risks to quality, cost and delivery.

Confirm prepress profile to match paper and process prior to ripping where it should not incur any extra costs or delay. Benefits: Optimum production conditions.

Only limited modifications can be made on CTP to the image data for all 4 colours. It is not normally recommended to alter exposure or processing conditions.

Full modifications can only be made if all participants in the workflow use common process-wide ICC profiles.

# Process system




Optimum results require production to be viewed as a total system in which the performance of key elements are inter-related: Pre-press, paper, ink, press, folder and finishing lines within their ambient environment. Best practice is the optimisation of the entire system to reduce avoidable performance problems when changing paper grades.

| | KEY SYSTEM ELEMENTS | PAPER GRADE VARIABLE |
|---|---|---|
| **1** | Pre-press profile on plate | High |
| **2** | Temperature and humidity | High |
| **3** | Web tension | High |
| **4** | Ink type | High |
| **5** | Paper roll conditioning & splice preparation | Low |
| **6** | Printing units | Low |
| **7** | Heatset system setting profile | High |
| **8** | Remoistening | High |
| **9** | Folder | Low |
| **10** | Stacking and bundling system | Moderate |
| **11** | Transport | Moderate |
| **12** | Bindery line | Moderate |
| **13** | Operating & maintenance staff competencies & training | High |

# 20 common problems when changing paper grades

| SYMPTOM | CONSEQUENCES | | | PRINCIPAL CAUSES |
|---|---|---|---|---|
| **1** Moisture wrinkles | ▽ | Q | | Unwrapping roll too early/Poor environment |
| **2** Baggy web | ▽ | Q | ● | Poor paper mill manufacturing profiles |
| **3** Paper ink absorption | ▽ | Q | ● | Variable with paper grade |
| **4** Paper gloss | | Q | | Variable with paper grade |
| **5** Printed gloss | | Q | | Variable with paper, excessive dampening / drying |
| **6** Tone Value Increase (TVI) | | Q | | Variable with paper grade, prepress profile |
| **7** Printed ink density | ▽ | Q | ● | Variable with paper grade, prepress profile |
| **8** Ink consumption | ▽ | Q | ● | Variable with paper grade, prepress profile |
| **9** Ink/water balance | ▽ | Q | ● | Variable with paper grade, prepress profile |
| **10** Ink feedback | | Q | | Uncoated paper surface with loose fibres also incompatibile ink, dampening & temperature |
| **11** Fibre feedback | | Q | | Uncoated paper surface with loose fibres |
| **12** Drying difficulties | ▽ | Q | ● | Variable with paper grade, prepress profile |
| **13** Linting, picking, piling | ▽ | Q | ● | Uncoated paper surface with loose fibres also incompatible ink or poor inking adjustment |
| **14** Web tension | | Q | ● | Variable settings with paper grade and weight |
| **15** Folder | | | ● | Variable settings with paper grade and weight |
| **16** Signature delivery | ▽ | Q | ● | Variable settings, problems from ink and static |
| **17** Static on SC & LWC | ▽ | | ● | Dry environment or cold paper |
| **18** Transit marking | ▽ | Q | | Mismatched inks or incorrect silicone solution or poor chill roll heat transfer |
| **19** Dry back on covers | ▽ | Q | | Residual solvent from inadequate dryer dwell time |
| **20** Blocking SC & LWC | ▽ | Q | ● | Dryer temperature profile incorrect or poor chill roll heat transfer |

*Consequence (● runnability, Q printability, ▽ economic)*

## Rapid diagnosis & actions

**1 Moisture wrinkles:** Caused by a difference in relative humidity between paper rolls and the pressroom. Wrinkles create creases often leading to a web break. Uncoated papers have the highest risk.

- Rolls should be unwrapped just before paster loading and the belly wrapper removed as late as possible.
- Improve ambient environment conditions.

**2 Baggy web:** Mostly caused by poor mill manufacturing profiles.

Runability may be improved by changing press web tension. Increase tension for rolls with baggy ends; decrease if the centre of the roll is baggy. Run rolls from the same tambour (mother roll) position to minimise tension adjustment at roll change.

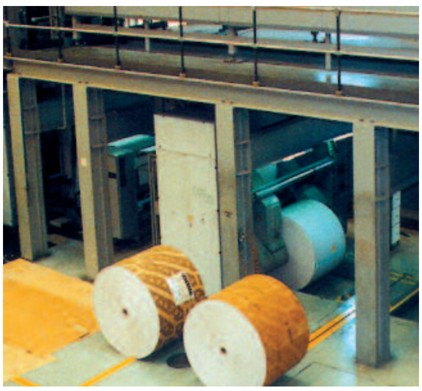
**3 Absorption of paper:** Too much ink absorption can result in poor print quality such as loss of detail or high colour saturation and filling in of shadow areas.

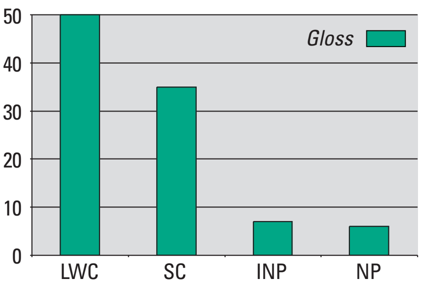
Match the paper to the type of work being printed. Printed images with a lot of fine detail should be printed on a higher grade of paper to avoid excessive absorption and loss of detail.

**4 Paper gloss:** Different papers have variable gloss from very high to little or none. Gloss effects the printed image. Very high gloss papers are smooth and slippery making signature handling more difficult

- Match the paper to the type of work being printed.
- Take extra care to set-up signature handling of high gloss papers.

*Rolls should only be unwrapped just before loading and the belly wrapper removed as late as possible to avoid moisture wrinkles.*






*1*


*2*


*3*

***1-** There is a correlation between paper quality and the printed gloss.*

***2-** Ensure prepress profile and density are matched to paper grade and press.*

***3-** Blistering on coated paper.*

**5 Printed gloss:** There is a correlation between paper quality and the printed gloss of the final product. Gloss level can be influenced by printing process conditions.

- Avoid excessive dampening and high dryer temperatures that cause avoidable fibre roughening and reduce printed gloss.
- Match the paper and ink to the type of work being printed. Adjust process conditions according to the paper.
- Discus in advance with the customer what is realistically possible to achieve in the printed product

**6 Tone Value Increase (TVI):** Different paper grades have variable Tone Value Increase (TVI) ranges due to their different absorption qualities (e.g. higher dot gains on lower grade papers).

tone value increase should be matched to paper and prepress specified accordingly.

**7 Printed ink density:** Each paper grade has an optimum ink density range, beyond this any increase of ink film weight has a diminishing influence on increasing the density. Too high densities result in poor print quality from filling in of shadow areas, excessive dot gains and poor trap, plus higher ink consumption.

- Ensure prepress profile and density is matched to paper grade and press.
- Include colour bars and patches for densitometer control.
- Use a densitometer to monitor and control ink film weight to avoid over inking.

**8 High ink consumption:** In some cases SC and newsprint can consume 100-200 % more ink than LWC. This is mostly due to over inking and the use of unsuitable prepress profiles.

- Ensure prepress profile and density are matched to paper grade.
- Use UCA and UCR to avoid local over inking.
- Use densitometer control to avoid over inking.

**9 Ink/water balance:** Ink/water balance is related to the variable level of paper absorption and coating. Poor balance encourages fibre build-up on the blankets or feedback to the ink dampening solution. Ink/water balance needs special attention during makeready and start-up.

It is much easier to balance ink and water early in the production run than try to recover balance after it is out of control.

**10 Ink feedback:** Mostly found after first print unit. More paper debris feeds back with uncoated paper. If paper pH is high, the dampening solution can become too alkaline effecting printing and drying. Ink feedback on uncoated papers requires adjustment to the dampening solution. Other causes include incompatible ink or too high operating temperatures.

- Ensure dampening solution buffer capacity is adequate. Regularly maintain dampening circulation system and change filters. Maintain dampening solution at sufficiently low temperature. Flow must maintain an even temperature across the width.
- Keep press ink and water settings to a minimum by optimum combination of ink and dampening solution to the various papers being run.
- Many coldset printers print black last (C/M/Y/K) which helps them print good solids and text.

**11 Fibre feedback:** Mostly found on first print unit where loose paper fibres are more easily picked up from uncoated paper surfaces and then feed back through the roller train to the ink duct. A high ink duct roller speed with ink keys closed down tends to trap these fibres in the ink duct and eventually block ink flow to the roller train.

- When running newsprint reduce ink duct roller speed and open ink keys to reduce fibre flowback.
- To reduce linting on newsprint (heatset and coldset) change the black ink type (if this is the first colour printed).

**12 Drying difficulties:** Uncoated papers can have 100-200 % more ink and dampening solution than coated papers. In the worst case of high ink coverage, the dryer capacity may be exceeded requiring the press to be run more slowly. Blistering may occur on coated papers over 80 gsm (55 lbs) if dryer temperature is too high.

Adjust dryer zone temperature profiles to each paper grade. Check web temperature by IR measurement. Reduce dampening quantity and temperature.

**13 Linting, picking, piling:** Different papers behave differently on press and have variable blanket build-up rates which are often unpredictable prior to running. There is significant variability within SC and newsprint grades that may affect printing performance from piling, blanket washing and ink feedback. Piling is more frequent on coated grades when the black ink (from the first unit) piles on to magenta or yellow; other factors include incompatible ink to paper, or incorrectly set inking and dampening systems. Piling can be influenced by different blanket release characteristics.

- Ensure correct ink tacks for different paper grades to minimise the problem.
- Ensure blanket selection and setting are correct.
- Linting on newsprint printed heatset can be severe on the black unit as this first unit carries all text and most solids. Linting can often be reduced by changing the black ink (tack). Coldset ink sequences are more variable.
- Make sure that the last units do not run dry.
- Excessive linting may require a complete press clean prior to running the next job.

**14 Web Tension:** Different paper grades have variable tension profiles. Incorrect tension settings result in poor press performance, erratic ribbon control, web breaks and possible dot slurring or doubling. The lighter the paper, the lower the tension requirements.

Optimise web tension setting throughout the press line; use appropriate blankets which are correctly set.

**15 Folder:** Different folder settings are often required for different paper weights. Lightweight paper may wrinkle if turner bar air pressure is too high and if nip settings are too tight.

- Turner bar air pressure and nip roll settings should be adjusted for different papers.
- Fold cracking of coated papers can be reduced by correct setting of the chopper folder nip.
- Optimum slitter condition avoids excessive dust and ragged edges which may cause web breaks.

**16 Signature delivery:** A common problem is an over-crushed pile causing set-off. Many signature delivery problems are caused upstream and operators should look at the overall press operation to avoid poor incoming shingle of signatures, or blocking caused by improperly set ink.

- Reset signature delivery equipment when changing paper grade or weight.
- Evaluate the whole press system for origin of signature handling problems.

**17 Static:** Common problem on SC that mostly occurs at the infeed, first print unit and on high speed folders and signature delivery systems. Static may occur on LWC if the factory environment is dry or paper is very cold.

- Adjust silicone solution to help eliminate static. Add anti static for SC-A; add fabric softener for LWC during very cold and/or dry weather conditions.
- For serious problems assess devices to remove static in the folder and delivery.

**18 Transit marking:** Mismatched inks, or poor thermal stability may cause bindery problems and transit marking.

- A wax additive to the silicone solution can significantly reduce marking on gloss and matt coated papers.
- Ensure chill roll heat transfer is correct (temperature and tension)

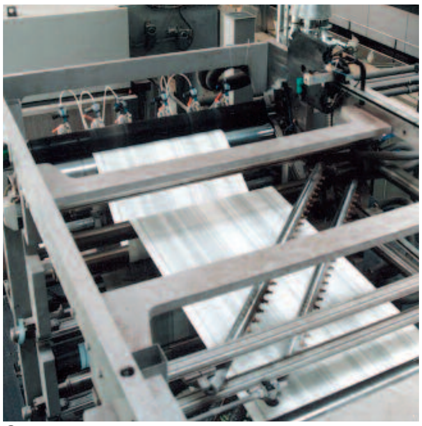
**19 Dry back:** Caused by residual solvent subsequently softening the ink resins. A high risk on coated papers over 80 gsm (55 lbs) with extensive ink coverage needing increased drying temperature. Covers that are sheeted for offline UV coating may have problems from solvent retention.

- Match dryer air temperature profiles to paper grade and weight. Avoid excessive peak web temperatures and limit press speed if necessary rather than run too hot.

**20 Blocking:** Mostly found on SC and occasionally LWC. Usually related to high dryer temperature caused by excessive inking, incorrect dampening, mismatched inks, or inks of poor thermal stability. This problem is worse during the summer in plants without temperature control.

- Ensure printing conditions and consumables allow normal dryer temperature setting.
- Ensure chill roll heat transfer is correct (temperature and tension). Limit press speed if necessary.


*1*


*2*

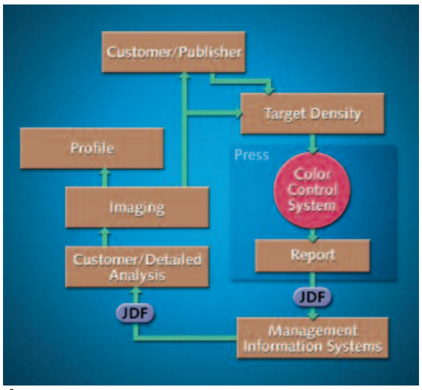

*3*

***1-*** *Piling is more frequent on coated papers.*

***2-*** *Lightweight paper may wrinkle if folder settings are incorrect.*

***3-*** *Handle signatures gently to avoid transit marking.*

# Printing by numbers

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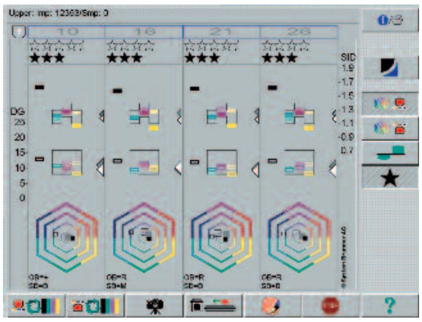


2

Colour perception is both subjective and variable with age, fatigue, heredity and even mood. For these reasons "printing by numbers" is a sound approach to achieve the best possible results from the materials being printed.

The use of on-line and offline Statistical Process Controls (SPC), standards and quality procedures are established operating practices in most industries. They offer lower total cost production, accountable quality control and a process diagnostic aid. This approach should be considered best practice for web offset printing, including:
• Correct prepress profiles for each paper grade (ink density, weight, grey balance, print contrast, etc.).
• All formes should include colour bars, solid and grey patches.
• Systematic use of quality control tools (densitometers, colorimeters, gloss meters etc.).
• Correct setting, use and maintenance of production equipment systems and their consumables.

The trend to print by numbers is being driven by customer requirements for verifiable quality control; the growth of CTP; ICC profiles, globalisation and remote site printing using prepress data transmitted with numeric control values.

The effective use of quality control devices are essential to meet these demands. However, many printing companies either do not use densitometers or use them ineffectively. (Densitometer use substantially increases in companies using printing simulator skills enhancement which make operators more familiar with their use and their value.)

The measurement of different attributes (solid ink density, print contrast, tone value increase, highlight and trap) allows an operator to more effectively control the print process to achieve the best results with the materials available and even predict potential press and print quality problems in advance. There is no single attribute to measure, all must be considered together. Whilst measurement and control are of major assistance to makeready and output monitoring, some final manual settings adjustment are often still required.

• Printers should be supplied with prepress adjusted to paper grade with specifications for print density, tone value increase and contrast ; colour bars and patches on all formes; and ideally proofs which are compatible to the process and paper surface to be printed.
• Quality control tools should be systematically used and maintained.

**Value variations:** The values given for solid ink density, total tone value increase and print contrast are averages. While actual numbers may vary, the values in the chart represent achievable results that can be used as production targets. Allowable variations in run averages are:
• Solid ink density ± 0,10
• Total tone value increase ± 3%
• Print contrast ± 5%

The balance between the values of process colours is more important than their absolute values. For example, to maintain grey balance, SWOP recommends that the total tone value increase values for the three colours should not differ from each other by more than 4% from the target value.

**Screens:** There is a common misunderstanding that fine screens provide higher quality, the reverse can be the case because each paper has an optimum screen size. Coarser screens generally provide better results on poor paper surfaces. Fine screen rulings generally result in higher tone value increase.

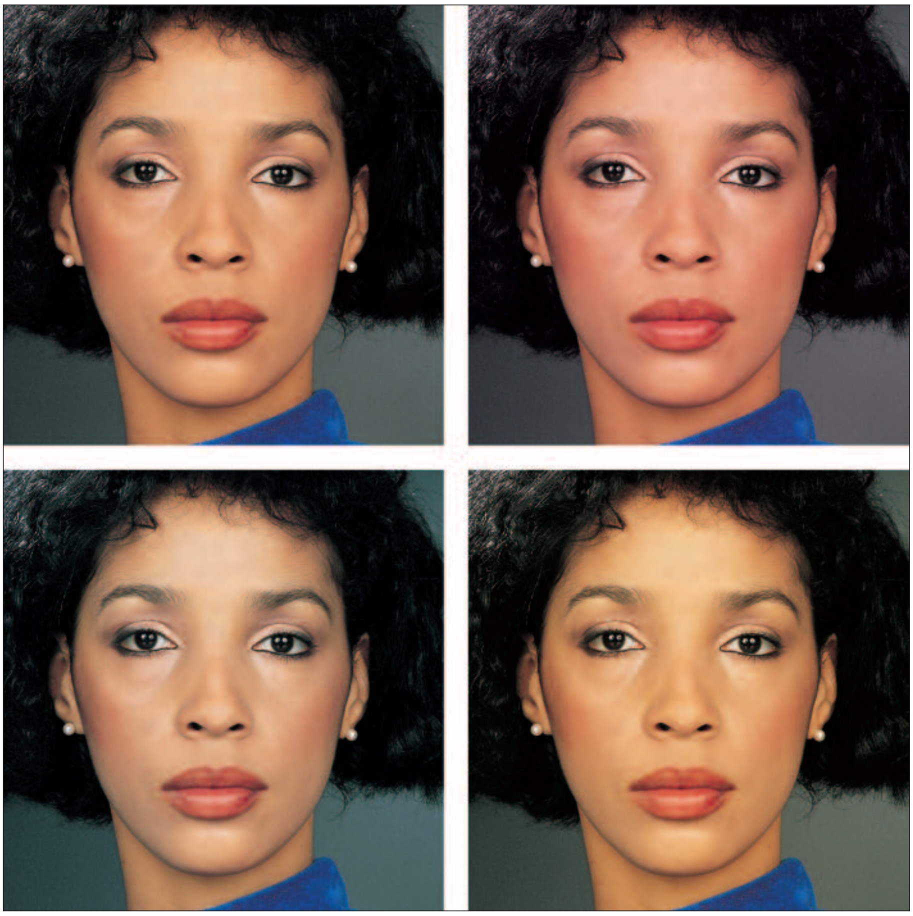
Use the screen size appropriate to the paper.

**TAC (Total Area Coverage):** Controlled during image preparation using under colour removal (UCR).

Some printers have found improved results on SC by reducing TAC by 15% (from 270-280 to 230-240).

*1- An example of data flow for printing by numbers: Print specifications originate with the publisher. The target densities are used by press colour control systems. Data from printing is generated by on press systems is used to report back to publishers and to modify prepress settings.*

*2- Operator screen of an on-line colour control system showing four ink key zones. SID and tone value increase are shown at top and overall colour balance is displayed in the hexagons at the bottom.*



*The effect of different dot gain values when printing with identical SID (solid ink density). The impact of different tone value increase is seen in the mid tones, particularly in the flesh tones of this example.*

**SID (Solid Ink Density):** Measured by reflection densitometer reading of a solid patch in a colour bar. GRACoL uses Status T densitometers (without polarisation filters) to measures dry ink which then requires allowance for dry back. Paper density is not measured.

A major operating task is to prevent ink film weight from continuously creeping up during running.

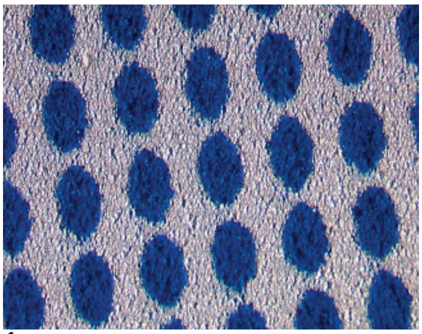
**tone value increase:** A key control variable. tone value increase can be between 15-35% depending on the press, process, paper, the amount of ink applied and its viscosity. Usually, lower quality papers produce higher tone value increase.

- Control of consistency and balance is much more important than absolute value.
- tone value increase is influenced by the type of press and the type of blanket. Making the right choice of blanket can compensate tone value increase variations with different paper grades.

**Print contrast:** Indicates a printing system's ability to hold open the shadow areas while still maintaining high solid saturation (density).

Tone value increase is typically measured in the 50% dot area and print contrast is measured in the 75% dot area. These two attributes tend to work hand in hand. When print contrast falls, tone value increase tends to rise. This can occur with little affect to the solid ink densities, yet still be perceived as a colour shift on press.

# Pre-press

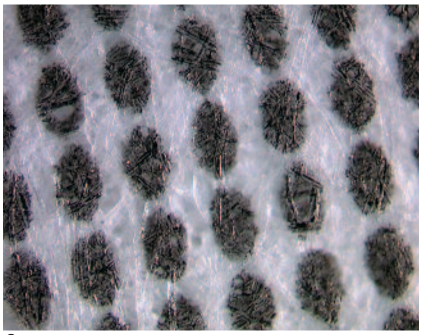


1

Delivering plates with correct profiles for printing on different grades of paper is determined by digital image files being correctly prepared early in the process.

## tone value increase

DGV is the physical and optical gain directly related to the type of paper surface to be printed. It is a key profile factor to control. An important variable in tone value increase is the screen resolution, e.g. moving from 52 to 69 lpc (133 to 175 lpi) will increase DGV. This is amplified when moving from coated to uncoated papers.



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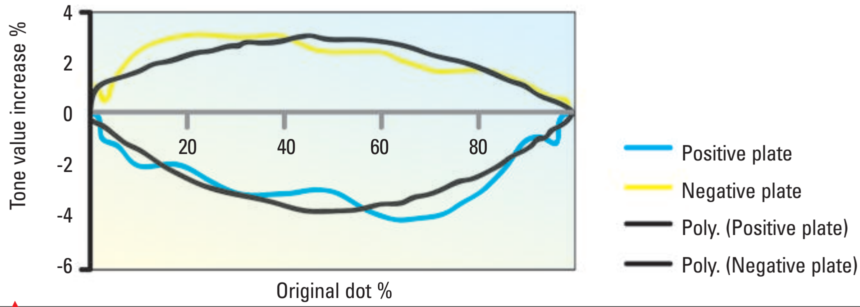
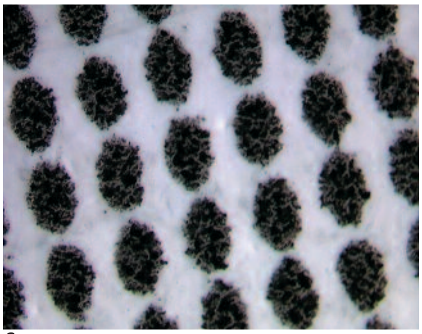



*Plate tone value increase is generally measured in 50% area, with +3% for negative plates, - 3% for positive and 0% for CTP.*



3

## Impact on tone value increase of positive or negative working

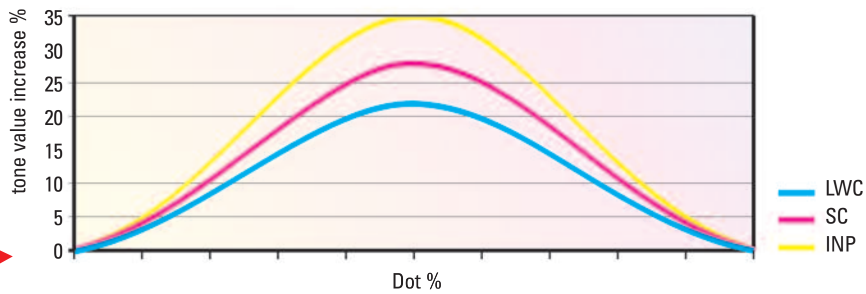
Positive platemaking is common in Europe whilst in the US negative plates are dominant. Only line screen specifications change between them. Plates made from positive film print sharper because of the natural undercutting through exposure; negative production creates tone value increase from overexposure.

• Negative film platemaking is very accurate (or a little full) in the highlight region and can hold a 0,5% dot from the film. It suffers from around 3% growth at 50% and can move a mid-tone break (from press tone value increase and the type of screen) down into critical flesh tones.

• Positive film processing produces a minimum dot around 2%, sharpening can reduce it to 1% or less. Sharpening the dot in platemaking by over exposure is made by web offset printers to counteract excessive tone value increase, e.g. when moving from LWC paper to SC. This is not possible for negative platemaking, where the plate life will be shorter if the exposure is reduced.

***1****- Dot on plate.*
***2****- Dot printed on uncoated paper.*
***3****- Dot printed on coated paper.*

*Web offset tone value increase varies between 15-35% depending on the paper type and amount of ink applied. This chart demonstrates this effect for 52 lpc (133 lpi). Chart adjusted to make it independent of screen type.*



## Key prepress techniques

Applying these techniques will improve printing quality, runability and reduce ink consumption. They are key factors for success on lightweight and lower grade papers.

**GCR (Grey Component Removal):** Black replaces process colour ink that has a greying effect. May be made to any portion of the reproduction. (GCR is distinct from UCA, which reduces process colours in only dark, neutral areas and adds black.) It is important to add colour back under black ink to maintain gloss and density (using UCA).

**UCA (Under Colour Addition):** Addition of chromatic colours to ensure acceptable density and gloss in shadow areas. When combined with GCR and UCR it ensures acceptable densities and gloss of black solids to minimise over inking, drying and blocking problems.

**UCR (Under Colour Removal):** Reduces process ink content in dark, neutral areas of the reproduction and replaces them with extra black content. Used correctly, there should be no difference in tone values in the neutral areas of the reproduction (even though there is less cyan, magenta, and yellow). May only be done in dark, neutral portions of the image.

- Apply these techniques early in the production process where they add little or no cost.
- Many text printing difficulties can be prevented in prepress. Avoid putting a single colour text into a background colour and using reverse text under 6 point. Note that reverse text trapping for positive platemaking may be to tight for negative platemaking because of the extra spread on negative plates.

**Separation curves:** Tone reproduction represents the cumulative effect of each step of the process on the overall contrast of the final reproduction. It is these inter-relationships and their effect that reproduce the grey scale with the proper shades of grey. Reproductions on coated paper have the highest contrast, uncoated have the lower contrast.

Most commercial RIPS now have the ability to specify press profiles and store individual press-paper combinations using the following procedure:

**1** Output test file film or plate at default, measure plate with densitometer;
**2** Adjust dot % and output linearised plate, check linearity; if OK;
**3** Output CMYK set plates with test file with plate linearity calibration;
**4** Print on press on different paper grades, measure and set up profiles.

## Impact of CTP

Moving from conventional platemaking to CTP makes change necessary to the reproduction curve. Normal printing on LWC papers gives approximately 20% tone value increase at 52 lpc (133 lpi) in Europe (typically 25% in the USA). This difference is caused by the different platemaking methods.

**Photopolymer:** Negative working to write the image. The strength of the dot is built by exposure and like normal negative plates leads to a larger dot. These plates can resolve very fine highlight dots (1%) but have tone value increase in the mid tones and shadow point.

**Silver:** Mostly positive working to write the background. Dot sharpening is less pronounced but there is some dot loss at the highlight end.

**Thermal:** Reproduction is linear when the process is under control. But this means that the dot cannot be sharpened during platemaking so the reproduction must be right in the file set up.

**UV light sensitive:** The diazzo principle is suitable for both negative and positive plates and mostly used for low-mid resolution work. Conventional plates can be processed in exposure frames in combination with CTFilm. A CTcP (Computer To conventional Plate) can expose these plates directly from a digital light projection source.

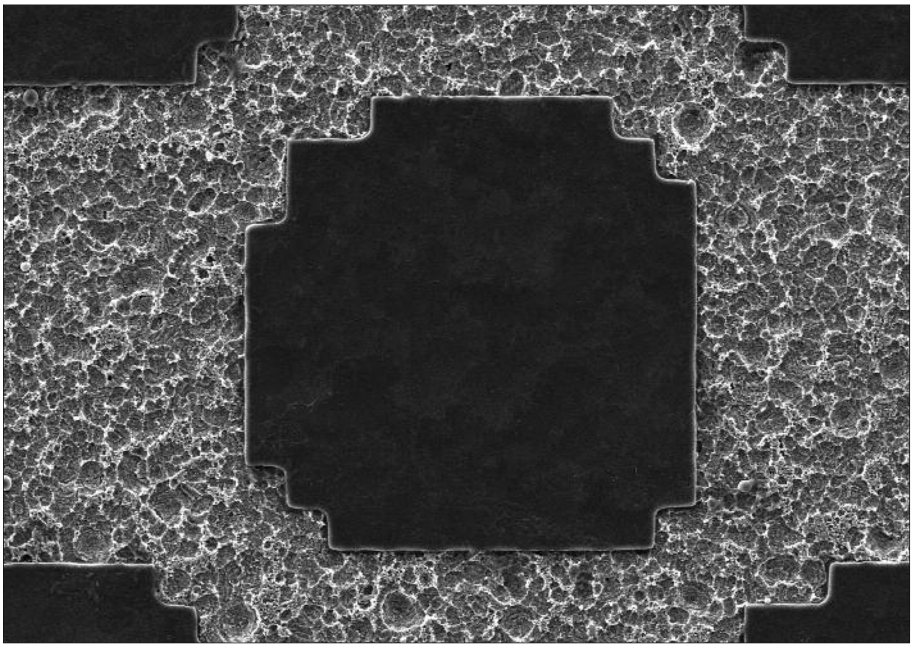
**CTP plate life:** Unbaked plate life is 100-200 000 impressions under normal alcohol conditions. Baked plates will run several million copies and makes plates more resistant to damage and opens all consumables options. It is recommended that both positive and thermal plates are baked for long run heatset printing.

## Proofs

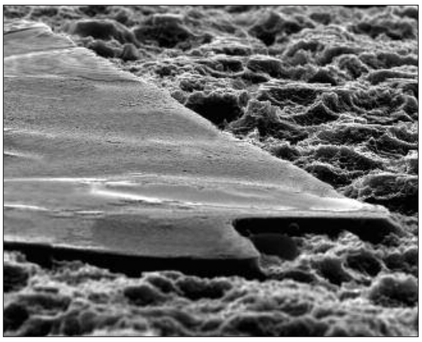
For on press colour matching the proof should simulate as closely as possible the printed results and provide a common quality control tool for customer, prepress and printers. Whilst it is impossible to match a proof exactly this becomes particularly difficult if the substrate does not match that being printed (differences of colour gamut) and does not produce halftones to view tone value increase.

- Make proofs on the grade of paper to be printed.
- Include colour control bars.
- Use proofing systems with calibrated half tone reproduction that simulate on press tone value increase.

Proofs that do not conform to these criteria do not allow assessment of print quality issues in advance. They often contribute to significantly longer makeready, higher waste and unfulfilled customer expectations.



*CTP has improved on press predictability of lithography by providing a very sharp edge first generation dot that reduces error when inking the image.*



• Each of the CTP technologies have different reproduction characteristics. It is important to adjust the platesetter calibration curves to achieve linearity, especially if different platemaking methods are being used at different plants for the same work.
• Test different paper grades and set up separate calibration curves for each.

**CTP calibration curves**

Both the sharpening of silver, and the dot growth of photopolymer plates can be compensated in their calibration curves. Output on most platesetters can be adjusted in two ways.
• To provide linear output (or matching previous positive plate reproduction if desired), this is often called the "plate calibration" or "X curve".
• To alter output for a given press adjusting for the press characteristics. This is known as the "press profile". It is this file that should be altered for different papers.
Some special points

**1** Care must be taken with line items (reverse text and text weight in solids) which are unaffected by calibration.
**2** The spread and choke set by the designer for positive plates can be wrong for photopolymer leading to text that is choked. This effect can only be solved in the file, not on the platesetter.
**3** Thermal plates are linear and can be maintained at linear output. Care is needed when matching expectations of tone value increase from customers used to positive platemaking. The mid tone dot will be higher unless compensated in the plate calibration curve.

• Avoid making compensation in supplied files as this alters the reproduction curve at platemaking, leading to data compression, loss of detail and reduced number of tones.
• As a general rule printers should not alter CTP exposure to influence dot strength as this often has a negative impact on another reproduction characteristic.

Set exposure and processing conditions to linear reproduction of the plate test file whilst altering the curve for individual paper types and compensating for the dot sharpening expected by the customer.

Note: If there is no other choice, the printer can reduce dot curves to avoid a printed product that may be muddy and/or of poor contrast to help achieve the best possible product from the material supplied.

# Paper grade-Ink-drying relationships

## Principal offset paper grades

| CODE | NAME | SURFACE | GSM | BASIS # | MOISTURE |
|---|---|---|---|---|---|
| **NP** | Newsprint | Uncoated | 40-48,8 | 26-33 | 8-10% |
| **INP (MF)** | Improved Newsprint | Uncoated | 45-60 | 30-40 | " |
| **TD** | Telephone Directory | Uncoated | 28-42,5 | 23-28 | " |
| **SC-A** | Super Calendered | Uncoated | 49-65 | 33-43 | 5-6% |
| **SC-B** | Soft Calendered | Uncoated | 49-65 | 33-43 | " |
| **MFP** | Machine Finished Pigmentised | Pigmentised | 54-70 | 36-47 | |
| **MFC** | Machine Finished Coated | Matt coated | 54-70 | 36-47 | |
| **LWC** | Light weight coated | Coated | 36-80 | 24-54 | 4-6% |
| **ULWC** | Ultra light weight coated | Coated | 36-48 | 26-28 | " |
| **MWC** | Medium weight coated | Coated | 80-115 | 54-77 | " |
| **WF** | Woodfree | Uncoated | 80-150 | 54-101 | " |
| **WFC** | Woodfree coated | Coated | 80-150 | 54-101 | " |

The printability of paper is affected by the bulk and surface structure of the sheet combined with the attributes associated with their surface chemistries.

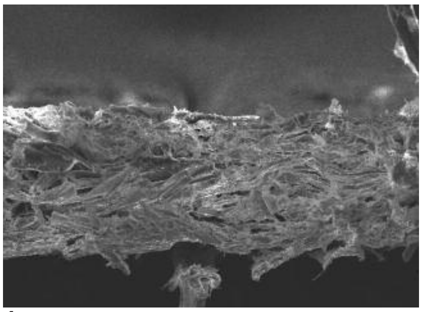
Newsprint has a rough surface and a porous structure compared to LWC or SC paper. A high value of surface roughness means that the ink demand of such a paper will be high, but the porous nature of a newsprint sheet allows the ink to be accommodated within its structure.

On the other hand LWC grades consist of a dense, low porosity - high capillarity layer of coating on to a base paper. This type of sheet is calendered to reduce its roughness and generate gloss. During printing the coating layer filters the ink pigments and resin from the ink oils and the ink film is set on the paper surface. Any ink oils that do penetrate the coating will be accommodated within the coating or base paper structure.

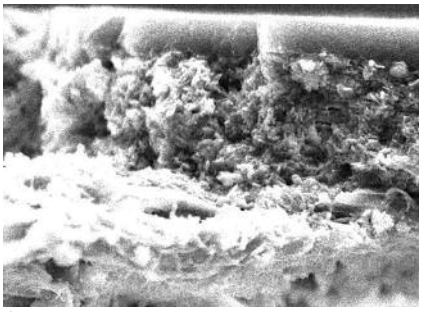
SC paper is as smooth as LWC but has a high content of mineral pigment filler that makes it denser and relatively homogeneous throughout its thickness. This means that there is no selective filtering of the ink and the ink demand of an SC paper is higher than a LWC paper of a similar weight. For a given ink density there will be more ink solvent to dry from an SC sheet than an LWC sheet, which makes SC harder to dry.

Many web papers are produced to specifically suit either gravure or offset production. Each type has significant differences of surface strength and absorbency and their use is not normally interchangeable e.g. a gravure grade printed offset will have less strength than offset, often exhibits surface piling and difficulties with dampening/ink interaction and heatset drying.

Different paper grades have different moisture content. Changes in paper moisture profile, weight and thickness cause variations in web tension characteristics. The volume of ink and dampening vary from low (LWC) to high (Newsprint). Web shrinkage and moisture content after drying are also variable. The use of remoistening devices after a heatset dryer has a positive impact on many issues: on wide webs it maintains finished trim margins, it assists the binding of short grain formats, stops text sections growing outside sheetfed printed covers and reduces fluting and marking.



***1***



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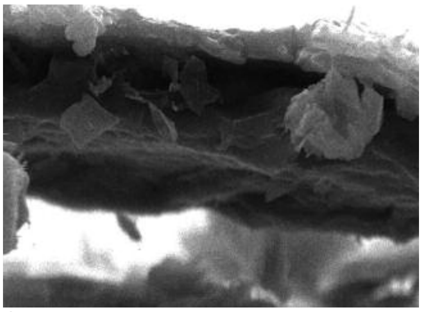
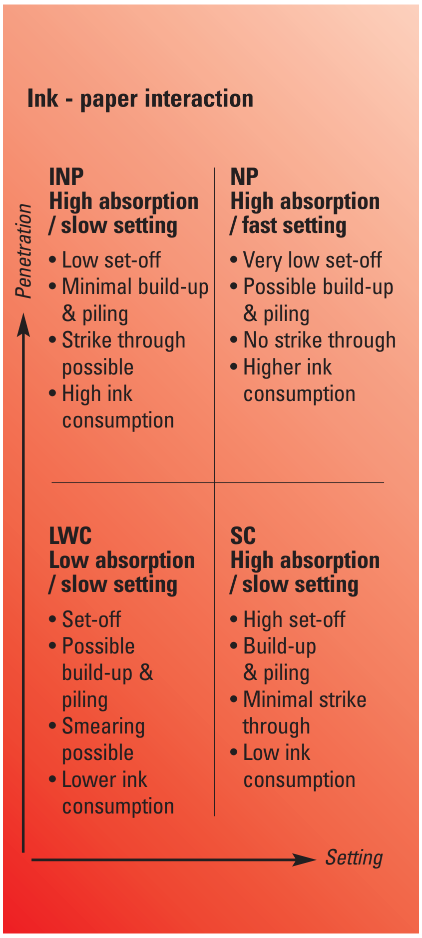


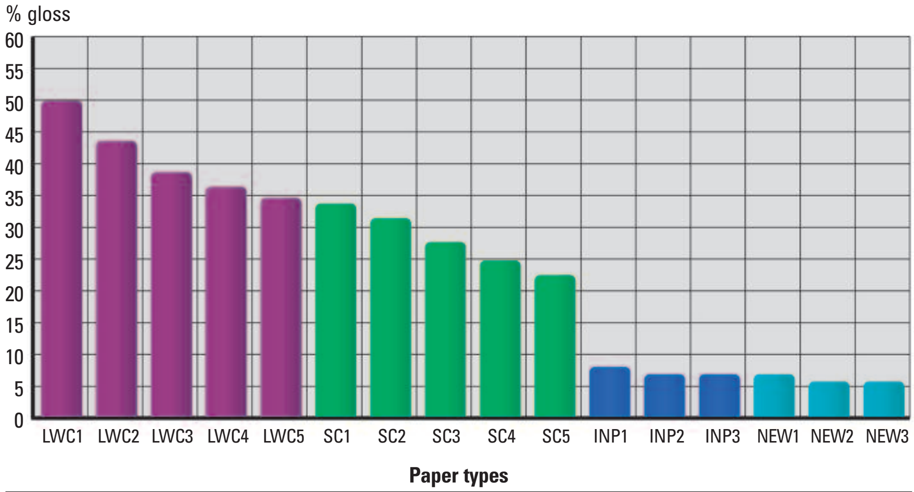
***3***

*Microscopic cross sections of three paper grades:*
***1-** Newsprint (NP)*
***2-** Light Weight Coated (LWC) paper*
***3-** Super Calendered (SC)*



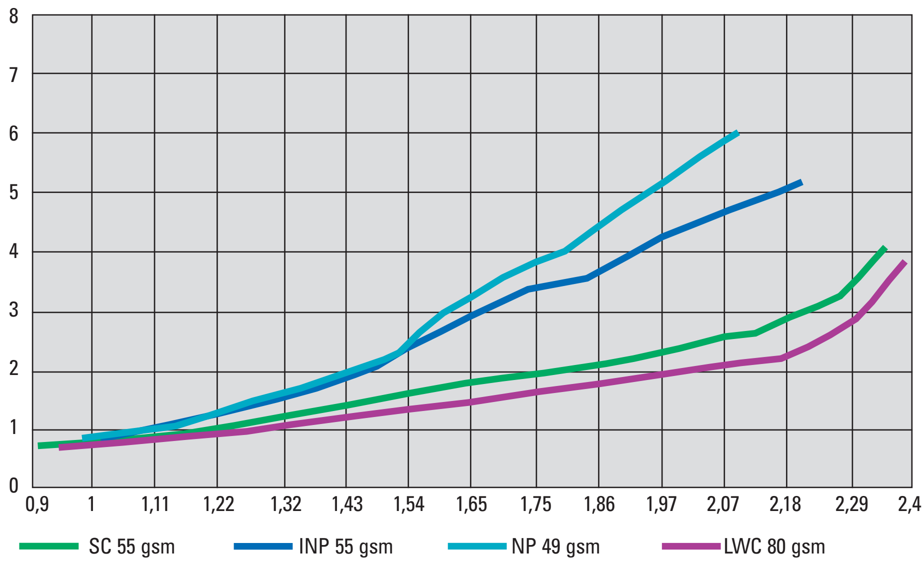

*The speed of absorption and setting of different grades of paper determines their drying performance. Newsprint is easier to dry than SC for this reason.*

**Paper gloss**




*Gloss varies significantly between paper grades. There are also differences of gloss and absorbency within the same grade of paper (gloss meter reading at 60º).*

**Optimum ink density**




*Each paper grade has an optimum ink density, beyond this point any increase of ink film weight has a smaller and smaller influence on increasing the density (as shown in this laboratory test on magenta ink) all process colours show a similar pattern.*

## Coated paper

Ink sits on the surface of the paper.

Minimise ink film weight to achieve high gloss with minimum fibre roughening and reduced ink consumption.

The low moisture content of some heavy-coated papers can make them difficult to fold and prone to cracking.

- Reduce risk of cracking by adjusting the dryer, chopper folder nip settings and use spine softening.
- Scuff resistant ink is recommended on covers over 100 gsm (150 lbs).

## SC paper

**SC-A:** Hard calendering with very smooth surface and high brightness.
**SC-B:** Soft calendering with more open surface.
SC consumes more ink than LWC, has lower gloss and brightness with higher tone value increase. SC (and uncoated grades) typically need higher drying temperatures of (+ 10°C / 50°F) requiring ink to have good thermal stability at high temperature. The difference between the SC grades can also have a significant effect on the performance on press, such as piling, blanket washing, ink feedback and drying.

- SC surface is very smooth but partially water-soluble. Therefore minimal water application is critical to acceptable drying performance and reduced paper surface roughening due to fibre lift and capillary action.
- Use lower tack ink systems to reduce blanket washing frequency and web break risks.

## Coated coldset papers

Coldset can print certain matt coated and pigmentised papers (MFP, MFC) with adapted inks to provide higher density, brighter colour and sharper dot, but gloss remains low. In Europe, a new niche grade called Valued Added Coldset (VAC) is becoming available. A recent Ifra preliminary study of VAC demonstrates better reproduction performance than INP printed coldset. It was found that the properties of ink and dampening solution must be compatible to this paper, otherwise marking can occur from ink build up, particularly on satellite presses.

## Newsprint and directory papers

Uncoated grades usually contain more recycled fibres which affect their brightness, opacity and strength. These papers tend to make colours greyer and weaker than coated and SC papers which should be allowed for as much as possible in prepress. A small increase in ink density can significantly increase show through on newsprint. Uncoated papers consume more ink and dampening solution and therefore require higher dryer performance when printed heatset. Loose paper fibres are more easily picked up from uncoated paper surfaces and feed back through the roller train to the ink duct.

- Ensure correct prepress profiles are used for each paper type.
- Profile dryer temperature to paper grade (see heatset drying).
- When estimating for SC and newsprint, make allowance for extra ink consumption.
- Press speeds may be lower when running SC and newsprint.
- Reduce ink duct roller speed and open ink keys to reduce fibre flowback when running Newsprint.
- To overcome linting on newsprint (heatset or coldset) often requires only the change of black ink type if it is the first colour printed.

### Book printing

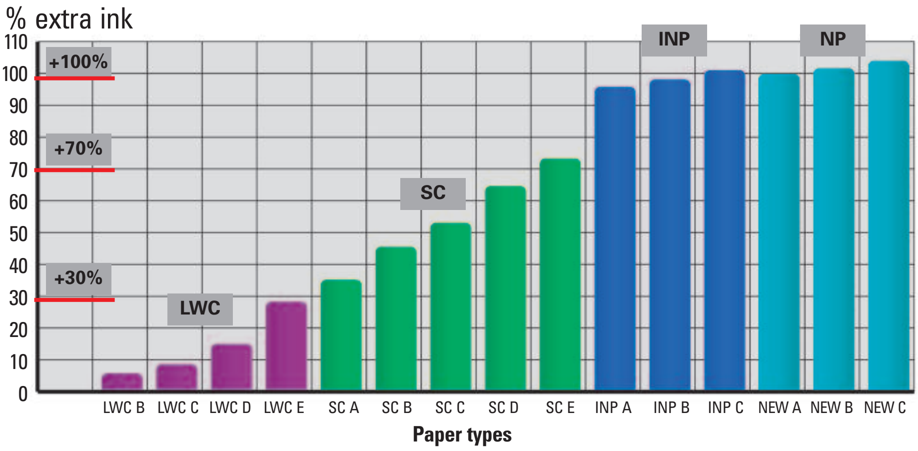
High bulk INP is specified by thickness for 1 and 2 colour printing using an adapted ink (as for directory printing). If a heatset dryer is used, select its lowest setting and use only the fans to provide a 40-60°C temperature to minimise changing paper moisture level.

**Directory paper**:
Production is changing from coldset on yellow paper to heatset printing of a yellow ink tint on white paper. The key for success is an adapted ink combining selected heatset and coldset characteristics.

# Ink & dampening on paper

*Ideally each paper should be printed to its maximum density rating. However, in practice many advertisers require more colour depth leading to higher ink film weights on some papers. Tests show that running a density of 1.3 on different paper grades substantially increases ink film weight and that film weight varies considerably within LWC and SC grades. This chart shows the % extra ink required to achieve a density of 1,3 on different papers.*

**% Extra ink needed on different papers to reach density of 1.3**




## Ink consumption

Different paper grades consume different amounts of ink to produce the same densities. This is caused by the differences in the absorption of the ink into the surface of the papers. Paper absorption is a capillary action related to the size of its pores. High absorption also increases risks of plate drying. Physical surface properties of the paper influence the perception of print contrast or density and can significantly influence ink consumption.

Coated papers have the least absorption, SC higher absorption and newsprint has very high absorption. This leads to ink film weight on different papers varying by over 100 %. To attain a specified density on a coated paper, then match this on SC requires 25-30 % more ink, on Newsprint this increases a further 70-100 %. These figures can double when more ink is needed to achieve a smooth and full solid to the density demanded.

- Use correct prepress profiles (including UCR and UCA) for each paper grade to minimise ink consumption.
- Consult your ink supplier for the correct ink for the paper to be printed.
- Experience and research results indicates a broad variation of consumption even within the same paper grade. It is recommended to monitor ink consumption of the papers used in each plant .

## Density

The highest print density occurs on paper with the heaviest coating (and generally weight). The more absorbent the paper, the lower the achievable print density. This is because the smooth coated paper surface reflects light uniformly, whereas the ink on uncoated papers penetrates further into the body of the paper. Consequently there is an uneven printed surface which has random reflectivity resulting in a reduced print density level. Gloss contributes to density and matt finished papers never reach the same density as a coated paper of the same grade.

The use of coated paper density specifications on uncoated surfaces is impracticable because too much ink would be needed. This would create lithographic water logging, loss of dot sharpness, ink feedback. The high volume of water and ink solvents may also weaken the mechanical characteristics of the paper and increase heatset dryer load.

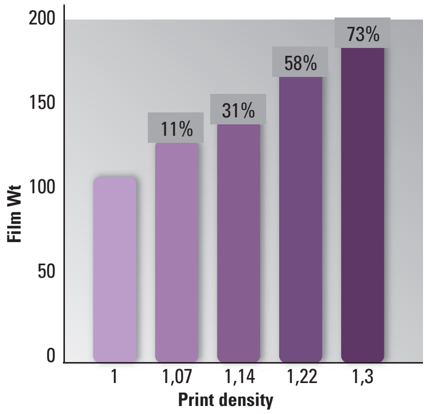
- Use the density specifications appropriate to each paper grade.
- Use a properly calibrated densitometer as a tool to control ink film weight and avoid over inking and drying problems detrimental to quality.

## Over inking

A severe and common problem that frequently causes emulsification, drying difficulties, marking, blocking in the bindery and excessive costs from high ink consumption. It may occur over the entire sheet, but is also frequent in local solid areas on black formes that are over the maximum ink film weight of 1,8 gsm. Ink feedback on a heatset press when running newsprint is strongly related to over inking. A high level of ink on the roller train also increases the amount of dampening required.

The goal of four colour printing is to either match a proof and/or pre determined colour densities. A proof alone allows only a subjective visual colour match assessment. Ideally printers should measure and maintain reference densities with a densitometer.

- Apply UCR and UCA during prepress to ensure good reproduction of solids without over inking.
- A densitometer is an essential production tool to avoid over inking problems.

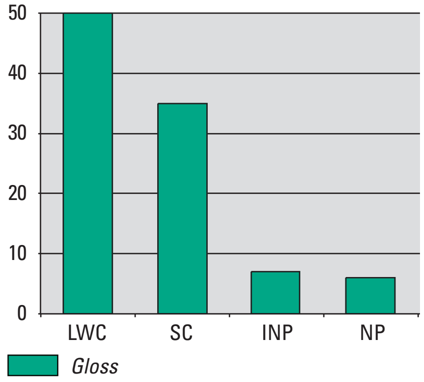



*1*

## Tone Value Increase

Gain varies between papers grades because their different absorption rates determine the amount of ink being applied. The lowest tone value increase is on coated papers, with the highest on uncoated papers where the dot is more spread and collapsed. Coldset dots penetrate more than heatset as increased ink is needed to bottom the paper causing higher levels of tone value increase.

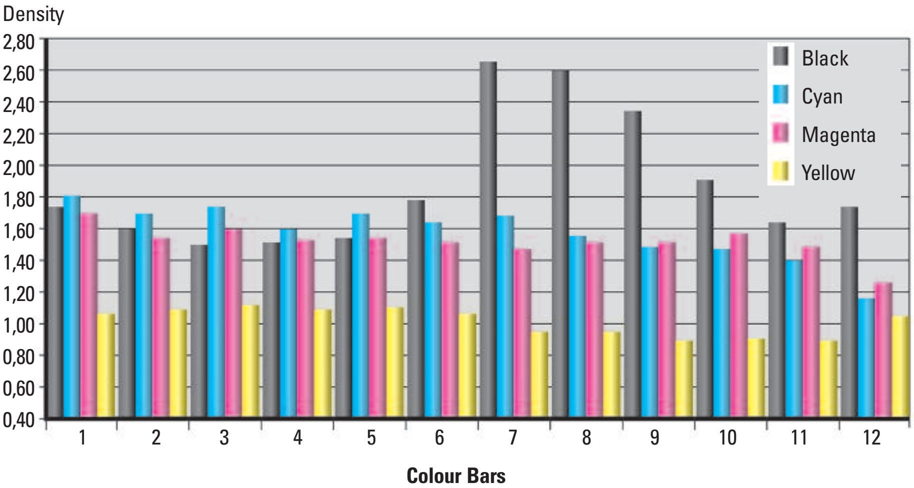
Make allowance for the tone value increase in prepress, particularly when moving paper grade down.




*2*

## Printed gloss

Gloss varies significantly between paper grades. Reflection and absorption of light is relative to the level of smoothness of the paper surface. The highest gloss is achieved on coated papers; SC papers have lower gloss levels and newsprint has poor gloss because of its uneven surface and its higher level of absorption. There are also differences of gloss and absorbency within the same grade of paper. The amount of ink absorbency affects the final gloss, the amount of ink needed to attain a required density, and ink consumption. A high level of dampening solution can reduce gloss if it causes fibre puff making the surface less reflective.




*3*

*1- Print density increase related to film weight.*

*2- Heatset ink gloss variation across four paper grades (gloss meter reading at 60°).*

*3- Over inking is common on black formes where local solid areas exceed the ink film weight limit of 1,8 gsm. This chart from a printed job, shows that across 20% of the width, ink density was double the average (at 2,6 gsm).*

## Ink selection criteria

| | COATED PAPERS | UNCOATED PAPERS |
|---|---|---|
| **Ink choices available** | High Gloss<br>Standard Coated<br>Universal or Combination | Universal or Combination<br>Standard Uncoated<br>Enhanced Coldset<br>Special rub-resistant |
| **Desirable Properties** | Maximum gloss<br>Transparency<br>Higher tack<br>Increased viscosity | Lower tack, Extra pigmentation<br>Increased rub-resistance<br>Wider water-window<br>More opacity in colours<br>Extra ink flow-out |
| **Dampening solution** | Alcohol-free programme | Alcohol-free programme |
| **Printed results** | Brighter secondary colours<br>(scarlet,green,purple)<br>Minimum Dot-gain<br>Higher optical densities<br>Denser solid blacks | Smoother solid ink-lay<br>Reduced dot-spread<br>Shinier solids<br>Better colour contrast |
| **Press performance** | Maximum press speeds<br>Less paper waste<br>Faster start-up to good copy | Less blanket washes<br>Reduced ink misting<br>Lower levels of ink feed-back<br>Better drying and less marking<br>in the folders or stackers |

## Ink selection

The selection of inks must balance properties of high gloss against maximum colour density, and higher tack and dot sharpness against the possibility of linting and extra blanket washes on newsprint and SC. The perfect solution is three separate types but this has higher costs from washing, waste, separate pumps and supply lines. Many printers use two complete lines (for LWC and SC) and buckets for special inks.

**Universal inks:** Formulated to print on a selection of papers (e.g. LWC and SC, or SC and INP). Their main difference is an adjusted tack with a slight compromise in dot structure and gloss, but their drying characteristics and rheology are almost identical. A single ink formulated for LWC, SC and INP will exhibit some compromise in quality on LWC.
**Combination inks:** Single ink formulated for both coldset and heatset printing. When INP is printed heatset there is reduced piling and blanket washing.
**Enhanced coldset inks:** A single ink formulation for newsprint, INP and VAC with improved dot and tone values.

## Dampening system

Dampening levels need to be kept as low as possible to reduce the opening of the paper surface and release of fibres into the ink train. Uncoated papers absorb a high volume of ink and dampening solution that consequently requires high dryer capacity to evaporate.

A low system temperature also helps maintain a better ink to water balance, reduces over emulsification and improves heatset drying performance

*Universal inks are becoming popular in Europe as more printers run a single ink type from bulk containers to simplify plant logistics and reduce costs.*

- Keep press ink and water settings to a minimum by optimum combination of ink and dampening solution to the various papers being run.
- Regularly maintain circulation system and change filters.
- Keep dampening system temperature low (10 - 12 °C / 50 - 54°F).

Some printers using alcohol free systems run up to 16°C (61°F).
- Ensure blanket washing fluid does not contaminate the dampening system.


### Recommended temperatures for heatset printing

| | | |
|---|---|---|
| Fountain pans | 12-16°C | 54-61°F |
| Inkers | 26-34°C | 79-93°F |
| Plates | 28-35°C | 82-95°F |
| Blankets | 28-35°C | 82-95°F |

### Water cooled ink vibrators

26°C (79°F) ± 12% recommended surface temperature.

> 30°C (86°F) = increased ink tack caused by faster solvent evaporation, risk of ink mist or fly.

< 26°C (79°F) = increased ink viscosity and reduced ink transfer. May also cause emulsification in high humidity conditions.

### Fountain solution pan

10-12°C (50-54°F) set the recirculating tank to low temperatures to achieve these readings.

Some printers using alcohol free systems run up to 16°C (61°F).

> 12°C (54°F) Higher temperatures increase evaporation (also contributes to dot gain).

< 10°C (50°F) Lower temperatures reduce ink transfer from the plate.

**Chemistry is a major variable**

Uncoated paper feeds back more debris and this requires adjustment to the dampening solution. If the paper pH is high the dampening solution can become too alkaline effecting printing and drying. (Paper pH can vary between 6-11 irrespective of paper grade.)

Ensure dampening solution buffer capacity is adequate.

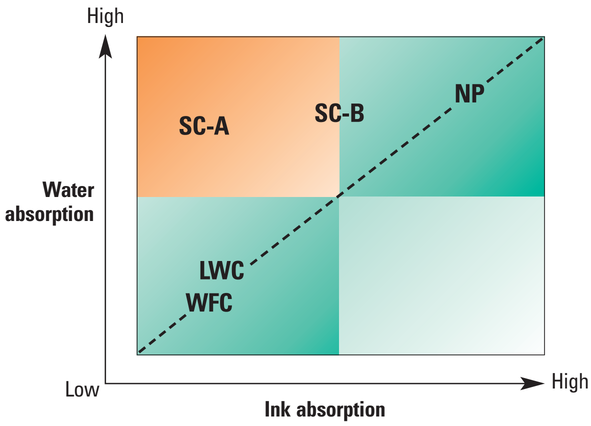
- Alcohol (and alcohol replacements) can attack the surface of unbaked CTP plates.
- Alcohol-free is more sensitive to dampening solution contamination from paper fibres and coating materials.

Dampening system weekly maintenance of solution tanks and pans for optimum water receptivity:

- Drain system pans, lines and tanks. Refill with hot water.
- Add prepared dampening system cleaner, and pump into pans to circulate.
- Maintain flow of cleaning solution through system until only discoloration of the solution is visible, and no large particles are left.
- After system is clean, drain, flush with clean water, drain, wipe out pans and tanks.
- Change all filters before refilling with dampening solution.
- Before dampening solution is pumped into pans, clean all damper rollers and etched chrome rollers.
- Desensitise roller surfaces by cleaning and etching them (rubber, chrome and ceramic rollers).

# Heatset drying system

**Drying different paper grades**




*There is a strong correlation between the speed of absorption and setting of different grades of paper with the drying performance required. For this reason newsprint is easier to dry than SC.*

Dryers are sized to heat the web as rapidly as possible without defects, and to provide maximum dwell time for solvent removal at the required drying temperature. Dryer sizing is normally calculated from maximum coated paper weight, ink coverage and printing speed, these specifications vary between press manufacturers and printing applications.

## What is "dry"?

There is no single simple measurement or property which defines "dry". It can only be assessed as a combination of physical characteristics that comprise the desirable behaviour of the dried product:

1. Solvent oils must be reduced to a level where the ink viscosity (after chilling to 32°C / 90°F or below) is sufficiently high to allow "reasonable" handling (slitting, folding, binding, packing, shipping and use).
2. Excessive friction and /or pressure on the ink surface must be avoided in "reasonable" handling. The addition of silicone (after chilling) reduces surface friction in material transport which may otherwise reheat and soften the ink causing marking. Silicone improves slip between copies to aid folding and stacking.
3. Solvent removal must be sufficient to avoid lay-up of solvent or ink on rollers (marking), as well as tackiness or blocking. For acceptable dryness, total retained solvent in both the ink and paper is typically in the range of 3-5% of solvent to ink solids. (Retained solvent alone is not a complete indicator of what is "dry": In some cases, values well below this may be considered "not dry", others can be adequately dry with more than 10% retained solvent).

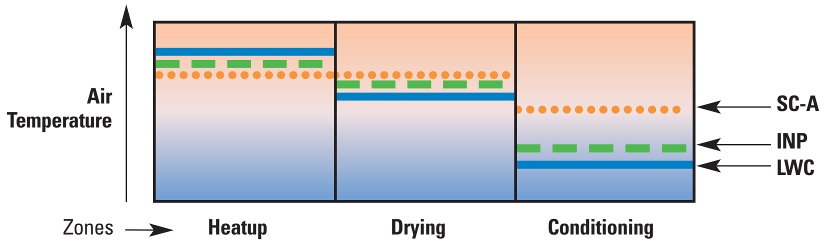
LWC and WFC have good holdout (low absorption) of both ink and water. Newsprint and INP absorbs both ink and water at a high rate. SC (particularly SC-A) has the dualistic behaviour of holding out the ink while absorbing water that need special drying conditions by requiring both high temperatures and flatter zone temperature profiles than LWC.

Dryer air temperature is variable to paper grade. SC and uncoated papers absorb more ink and dampening solution and therefore require higher dryer performance than coated. The consequences may include reduced drying speed, particularly if there is excessive over inking. Using LWC prepress profiles on SC and INP increases ink coverage and can reduce SC drying speed by 15-30 % to deliver signatures without tackiness. INP ink film weight may be 200% higher than LWC, in this case the total solvent load in the exhaust to the oxidiser will be the limiting factor reducing press speed by about 10%.

**Relative air temperature profiles for different papers (3-zone dryer)**

| PAPER GRADE | Zone 1 - HEAT-UP | Zone 2 - DWELL ZONE | Zone 3 - CONDITIONING | PEAK PAPER TEMPERATURE | EXIT PAPER TEMPERATURE |
|---|---|---|---|---|---|
| **WFC** | Mid-high | Mid | Low | 150°C / 302°F | 110°C / 230°F |
| **LWC** | High | Mid | Low | 150°C / 302°F | 110°C / 230°F |
| **NP/INP** | Mid-high | Mid | Mid -low | 160°C / 320°F | 115°C / 239°F |
| **SC*** | Mid-high | Mid -high | Mid | 140-160°C / 284-320°F* | 115-150°C / 239-302°F* |

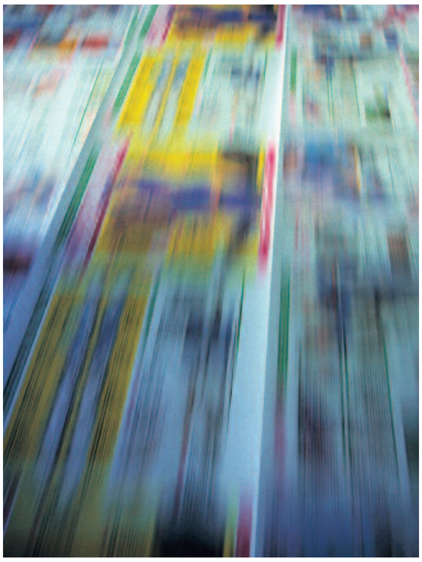
**Dryer Air Temperature Profiles**




**Some printers can achieve close to 100% press speed on SC by completely optimising all process variables over time. The maximum temperatures in this table have been achieved on some of the wide variety of SC papers. Peak temperatures above 140° may result in some quality reduction (e.g. risk of fibre puff and reduced gloss) and should be closely monitored and maximum temperatures adjusted downward if necessary.*

- It is essential to adjust complete dryer temperature profile (not just web set point temperature alone) and regulate chill rolls.
- It is often better to run a "flatter" air temperature profile with uncoated grades, i.e. temperatures of the first and second zones may be nearly equal.
- Regulate the dryer and chills together as part of the same system.
- Check that right prepress settings have been used.

## Possible actions for drying difficulties



**1** Ensure prepress profile is optimised to paper printed including GCR and UCA for local solid areas.

**2** Immediate solution is to print at reduced press speed to increase dwell time in dryer.

**3** Adjust dryer temperature profile (and record data for future jobs) see table below.

**4** Check ink used: Drying problems, such as smoking and chill roll condensation, can be caused by printing inks with unstable or impure polymer resins at high temperature, or unstable solvent oils (including vegetable oils) at high temperatures.

**5** Experience in 2 zone dryers shows that running high web temperatures improves results on SC and INP. The challenge is to find the point where there is no smoking and no condensation. If dryer exit temperature is high (> 110°C / 230°F) smoking may occur. If air temp is too low (< 90°C / 194°F) condensation may occur in 3rd zone.

**6** Covers over 100 gsm (150 lbs) that are to be UV varnished may have solvent retention problems. If necessary minimise retained solvent by a longer dryer dwell time (lower speed).

**7** Papers over 80 gsm (54 lbs) with high ink coverage may risk dry back as ink resins may subsequently soften from residual solvent retention. In these cases increase the drying temperature. The problem may also be related to way signatures are handled (see stacking).

**8** When making dryer temperature adjustments it is also important to regulate the chills as part of an integrated process.

On uncoated paper a common response is to increase heat, this makes the problem worse.

**Blistering:** Moisture in the middle of a coated paper is heated up and expands causing surface delamination. This problem can become severe when there is heavy ink weight on both sides of the web and particularly if some solids also back one another up.

If blistering occurs, lower temperature in first zone. If extreme, slow press speed.

## Chill rolls

When printers have drying problems they usually adjusts only the dryer, but it is also important to regulate the chills as part of an integrated system.

**1** The surface temperature of the first chill roll should be maintained between 24-27°C to minimise condensate, but avoid paper temperatures that are too high which may cause smoking in the chills.

**2** Chill roll (and folder) build-up is linked to paper grade and flotation of the web over the chill rolls. This may be related to the ink's thermal stability.

**3** Chill roll gain should ensure maximum heat transfer to the web, if not blocking may occur.

## Silicone application

The applicator provides several functions:

**1** Applies silicone to the paper surface to reduce friction and avoid marking in the folder, during binding or transit (particularly on covers and in areas of high ink coverage).

**2** Reduces static "moisture kills static".

**3** Slightly remoistens the paper.

Experience shows that a silicone content of around 2-4% provides optimum results.

- Too much silicone results in slippery signatures that are difficult to handle.
- Too little silicone causes ink smearing.

Higher concentrations should be used for sheeter production.

## Static

- SC papers are more sensitive to static, therefore add anti static to silicone solution.
- Add fabric softener to silicone solution to reduces static on LWC.
- A wax additive can be added to solution to give an extra coating to protect signatures from marking during postpress processing. Printers also report success of wax additive to improve newsprint signature feeding from automatic log feeders for binding lines.

# Web tension, printing units, blankets, folder

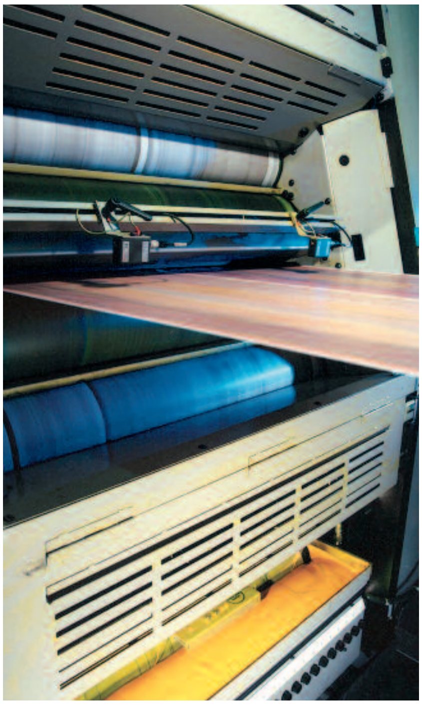
## Web tension

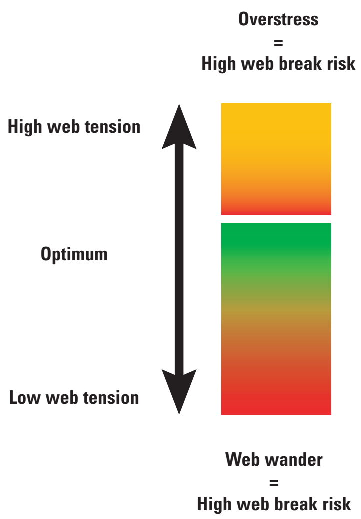
Frequent changing of paper grades requires close attention to web tension to avoid web breaks, runability and printability problems (see also Guide N°2 "Web break prevention & diagnosis").

Tension needs to be coherent throughout the press line: The starting point when setting press line tension is always the press cylinders and blankets, to which the other control points are then referenced:

**1** Paster should have a low tension (in relation to the infeed) to remove excessive tension fluctuations.
**2** Infeed reduces remaining tension variations to a very narrow band for the printing units.
**3** Blankets and packing can make significant differences to web tension. The limit of blanket compressibility means their speed marginally increases when they are at contact in the nip.
**4** Chill roll tower is an outfeed that must exert a slight positive gain to ensure the web is pulled correctly out of the print units and dryer.
**5** Web leads and air turns.
Undriven idle rollers are responsible for tension gain from friction and inertia. It is essential to keep them clean to avoid increasing their drag.
Change air turn pressure settings to match different papers to maintain a minimum contact free clearance.
**6** RTF and nipping rollers require a slight gain to draw a flat web into the folder. When changing grades adjust turner bars, air pressure, nip setting, delivery belt speed.

- Maintain tension at minimum level necessary to hold register whilst avoiding slurring and doubling.
- Always reset tension when changing paper weight.
- Set low start-up tension level (to minimise risk of web break at low speed).
- Fine tune the tension during makeready and running.
- Record settings for each paper and web width for faster future set-up with less waste.
- Web tension levels to be adjusted via infeed and chill speed controls as required by paper grade.






## Printing units

Generally little adjustment needs to be made when changing paper grades. Key points are slurfree impression without doubling. Quick fixes to a problem (adjustment of dampening solution, ink, blanket change) may provide compromise improvements but there is no simple quick fix. Focus on avoiding problems.

Maintenance becomes more critical when changing paper grades frequently. This is not just cleaning, but also setting rollers, ensuring correct system operating temperatures, ink temperature and maintaining the dampening system.

**Inking and dampening:** Ink/water balance: Very high quantities of ink and water make it difficult to obtain a correct balance and creates a high risk of feedback.

- Adjust ink duct speed if too much paper debris feeds back from uncoated papers.
- A complete press clean is recommended when switching from uncoated to coated papers.

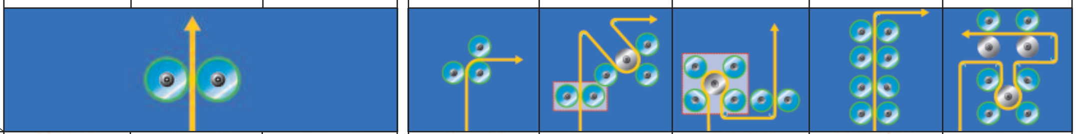
## Blankets

Blankets play a key role in image transfer and influence many printing parameters.

Paper feed behaviour in the press is influenced by the press cylinder configuration (wrap) and blanket construction. This may require blankets of different roughness on each side of the web on some heatset presses.

| BLANKET CHARACTERISTICS | EFFECTS ON PRINTING PARAMETERS | COMMENTS |
|---|---|---|
| **Construction** | Paper feed, Registration, tone value increase, Vibrations, Thermal behaviour in the nip | High or low tone value increase related to paper and print specifications |
| **Surface** | Tone value increase, Dot shape, Release, Registration, Ink emulsification, Ink transfer, Piling, Washing frequency | Variable surface energies and properties related to blanket surface material |
| **Packing** | Tone value increase, Paper feed, Registration, Piling, Vibrations, Durability | Low packing can cause problems |

**Application guide for blankets**



| *Application* / *Blanket type* | Blanket/Blanket | | | Y units | Mono to Halfdeck | Satellite to Mono | 4 High Tower | 6 Couple Tower |
|---|---|---|---|---|---|---|---|---|
| | High-feed | Low-feed | High-speed | | | | | |
| **Negative web feed** | 1 | 4 | 3 | 1 | 4 | 1 | 1 | 3 |
| **Neutral web feed** | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 3 |
| **Positive web feed** | 4 | 2 | 4 | 4 | 2 | 4 | 4 | 4 |

1 *Not recommended* 2 *Can be used in some cases* 3 *Works well* 4 *First choice*

*This chart is property of MacDermid Graphic Arts*

The plate-to-blanket and blanket-to-paper nip behaviour is a complex mechanical problem influenced by different blanket surface properties. A particular blanket is like a paper grade and cannot do all things for all print jobs. A single blanket type can be a good compromise for a variety of papers, but a specific blanket design may be required to increase or decrease tone value increase, reduce piling, fan-out and vibrations.

- Check with suppliers to identify optimum blanket to meet the mix of paper grades run and presses used.
- Strike though on heatset presses may occur when changing paper grades. In some cases, this may be solved by changing blanket roughness.

**Folder**: Reset turner bars, air pressure, nip setting, delivery belt speed as required for different grades.

Paper over 80 gsm (54 lbs) may be difficult to fold and prone to cracking. Chopper nip setting should be adjusted according to the paper weight and thickness. Fold softening can prevent this problem.

**Electro static**: Folded signatures that suffer from static (and in delivery systems) or are too slippery should be addressed at the silicone applicator.

- 3-5 % web moisture level practically eliminates static.
- Optimum production is achieved in operating environments with high relative humidity (over 30 % RH).

# Signature delivery systems

Many signature delivery problems associated with paper change are caused on the press line and these cannot be corrected by delivery system adjustments alone. It can be very easy to overlook these upstream conditions such as:

• Poor quality logs resulting from a poor incoming shingle of signatures. This may need to be addressed at the folder if this is the source of the problem. Improve signature compression during folding by perforating signatures with closed head or foot to help air to escape.

• Blocking may not be able to be corrected with stacker adjustments if the cause is improperly set ink. Dryer adjustments, and sometimes press speed reductions may be needed to overcome blocking.

• Signatures that suffer from static or are too slippery should be addressed at the silicone applicator.

***The information is a highly concentrated extract of key criteria, contact your supplier(s) for more detailed information.***

## Stackers

**1** Paper weight: Different paper stocks will require different settings for a log stacker.
**2** Signature format: Adjust the stacker, joggers, head stops and guides when product dimensions change.
**3** Signature counts: The caliper of the paper and the flatness of the fold effect the quantity of signatures in a stack or bundle.
**4** Paper coating: Different paper coatings require different belt speeds to achieve proper shingling.
**5** Crusher: Settings are effected by the caliper and coating of different paper. Very high gloss papers can crack and wrinkle under heavy settings while LWC and uncoated papers often need higher settings to produce a flatter signature.

## Print roll systems

**Ink damage during wind-up:** This may occur both in the area of the strapping tape and also across the entire signature width if the ink cannot withstand the pressure of the winding process.

• Essential criteria for optimum roll system performance is that the ink should not re-dry (block) inside the roll. Consult suppliers of ink, dryer, press and electro-static systems to optimise performance.

• Ensure drying temperature will minimise risks of marking and blocking.

**Marking and roll misalignment:** May occur when strapping tapes are not imbedded into the shingle. (The tape pressure is then only supported by the small area of the tapes, causing a partial high surface pressure and an unstable roll with a tendency to lateral misalignment.)

Reduce roll pressure to ensure that signatures are under an even load distributed across the entire width:

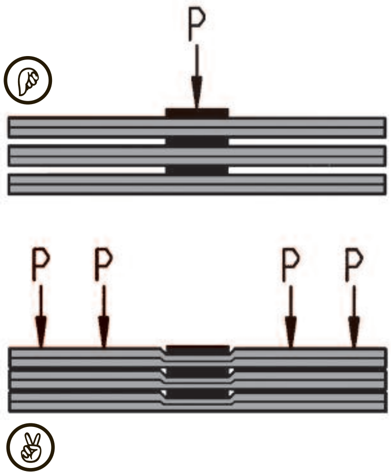
• Improve signature compression during folding by perforating signatures with closed head or foot to improve air escape before they are wound up.

• Improve fold compression of thick signatures prior to wind-up by using an upstream pressure unit (if fitted).

• When signatures are pushed into a thick shingle (8 -12 mm / 0,3-0,5” compressed) marking is reduced because the full roll has a reduced number of layers which reduce its inner pressure and tape tension.

• Ensure the tape imbeds itself completely into the shingle to allow its force to be supported over a broader surface to reduce local tape pressure.

**Electro static:** High static levels reduce unwinding speed. Thin shingles are more subject to static effects during unwinding as their release from the wind-up layer is slower than thicker shingles which are released easier due to their heavier weight.




*1*

*__1-__ If print roll strapping tapes are not imbed into the shingle, their pressure will not be distributed across the entire width causing a partial high surface pressure and an unstable roll with a tendency to lateral misalignment.*

**Aylesford Newsprint** is a dedicated manufacturer of premium quality newsprint. Its "Renaissance" brand is widely used by many major European newspaper publishers. The mill specialises in 100% recycled newsprint of exceptional runability and superior printability — brighter, cleaner and with high opacity. All products are made exclusively by recycled paper using highly skilled staff operating the most advanced technology available. The company's continuous improvement programme helps ensure the attainment of the highest operational and environmental standards. Aylesford Newsprint is jointly owned by SCA Forest Products and Mondi Europe who bring a wealth of experience in quality paper manufacture.
**www. aylesford-newsprint.co.uk**

**Kodak GCG** (Graphics Communications Group) provides one of the broadest product and solutions portfolios available in the graphic arts industry today, including a wide range of conventional lithographic plates and Computer to Plate solutions; Kodak GCG branded graphic arts films, digital, inkjet, analogue and virtual proofing products, as well as digital printing solutions and colour management tools. Kodak GCG is a leader in prepress technology and have received 16 Graphic Arts Technology Foundation (GATF) InterTech Technology Awards. With headquarters in Rochester, NY, USA, the company serves customers around the globe with regional offices in the United States, Europe, Japan, Asia Pacific and Latin America.
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**manroland AG** is the world's second largest printing systems manufacturer and the world's market leader in web offset. manroland employs almost 8 700 people and has annual sales of some Euro 1,7 billion with an export share of 80%. Web fed and sheetfed presses provide solutions for publishing, commercial, and packaging printing.
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**MEGTEC Systems** is the world's largest supplier of webline and environmental technologies for web offset printing. The company is a specialised system supplier for roll and web handling (loading systems, pasters, infeeds) and web drying and conditioning (hot air dryers, oxidisers, chill rolls). MEGTEC combines these technologies with in depth process knowledge and experience in coldset and heatset printing. MEGTEC has manufacturing and R&D facilities in the US, France, Sweden and Germany, China and India along with regional sales, service and parts centres. MEGTEC also provides energy and efficiency consulting and machine upgrades.
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**Muller Martini** a globally active group of companies is the leader in the development, manufacture and marketing of a broad range of print finishing systems. Since its foundation in 1946 the family-owned business has focused exclusively on the graphic arts industry. Today, the company is segmented into seven operating divisions: Printing Presses, Press Delivery Systems, Saddle Stitching Systems, Softcover Production, Hardcover Production, Newspaper Mailroom Systems and OnDemand Solutions. Customers rely on a worldwide manufacturing, sales and service network of approximately 4 000 employees. Subsidiaries and representatives provide Muller Martini products and services in all countries of the world.
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**Nitto Denko Corporation** is one of the world's specialist suppliers of polymer processing and precision coating. The company was formed in Japan in 1918 and employs 12 000 people all over the world. Nitto Europe NV is a subsidiary, which was founded in 1974 and is the group's leading supplier to the paper and printing industries with products like repulpable double-coated adhesive tapes for splicing systems. Nitto has also become the reference supplier to offset and gravure printers worldwide. Nitto Europe NV is ISO 9001 certified.
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**QuadTech** is a worldwide leader in the design and manufacture of control systems that help commercial, newspaper, publication and packaging printers improve their performance, productivity and bottom line results. The company offers an extensive range of auxiliary controls, including its best-selling register guidance systems (RGS), the award-winning Color Control System (CCS) and the widely-known Autotron. QuadTech, founded in 1979, is a subsidiary of Quad/Graphics and is based in Wisconsin, USA. The company was ISO 9001 registered in 2001.
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**SCA** (Svenska Cellulosa Aktiebolaget) is a global consumer goods and paper company that develops, produces and markets personal care products, tissue, packaging solutions, publication papers and solid wood products. Sales are conducted in 90 countries. SCA has annual sales in excess of SEK 101 billion (c. € 11 billion) and production facilities in more than 40 countries. SCA had approximately 51 000 employees at the beginning of 2007. SCA has a range of high grade, customised publication papers for newspapers, supplements, magazines, catalogues and commercial printing.
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