BEST PRACTICE GUIDE FOR WEB OFFSET PRINTERS

Total process colour control

& Alternative Screening Technologies

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GB

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

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Digital workflows have increased the speed and efficiency of offset printing. They have also enabled the development of Alternate Screening Technologies (AST) that can add value to offset printed images by improving their visual quality. However, the digital printing workflow chain also has multiple potential sources of colour and quality deviations. This guide focuses on optimising the conventional AM digital workflow process which is also the prerequisite to the successful use of ASTs such as FM, Hybrid FM/AM and high lpi AM screenings.

This guide is complimentary to the work of ICC, WAN-IFRA, GATF, IDEAlliance and other organisations and its objectives are to help optimise best practices that improve quality, consistency and productivity. As part of this project, 35 current users have shared some of their experiences with ASTs that confirms our conclusions that that key process success factors include:

An integrated industrial manufacturing strategy (that combines standardisation, colour management, process control and effective maintenance) is essential to achieve consistent high quality and productivity benefits.

- Successful AST users indicate that the window of operating variability is tighter for AST and requires better control of all process variables.
- An optimised conventional AM workflow is the absolute prerequisite to assess, select and introduce ASTs.

IMPORTANT SAFETY NOTE !

Always check a machine is in its specified safe position before working on any component (e.g. with compressed air, electrical power and gas disconnected). Only trained maintenance personnel adhering to safety regulations should perform maintenance work. A general guide cannot take into account the specificity of all products and procedures. We therefore strongly recommend that this guide be used in addition to information from your suppliers, whose safety, operating and maintenance procedures take preference.

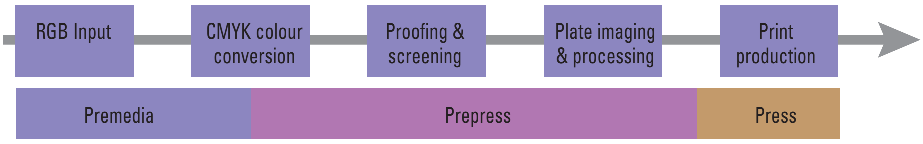
This guide is produced for printers worldwide. However, there are some regional variations of terminology, materials and operating procedures. Care should be taken before applying US printing reference values outside of North America as variations may include different ink strengths, densitometry filters, screen rulings, and platemaking (US mainly uses negative processing and any slight over exposure spreads the dot, whereas in positive processing this sharpens the dot).

CONTENTS

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**

Digital Process Workflow Chain



Digital workflows have simplified and increased the speed of offset workflows. However, the digital printing process workflow chain also has multiple potential sources of colour and other deviations.

"*Over 90% of deviations in 4-colour printing of photographs are process-related and impact on quality, consistency and productivity that are all key customer satisfaction and profitability factors.*"
Daniel Würgler, System Brunner.

"*The primary colour management implementation obstacle reported by printers is process control.*"
The Pain of Color Management, PIA/GATF.

"*Approximately 80% of all process problems can be traced to incorrect activities and/or decisions being made due to not fully understanding or identifying process variables.*"
Jack Suffoletto, Senior Prepress Technical Consultant PIA/GATF.

"*The critical factors to successfully implement ASTs are good maintenance, sound colour management and production process control.*"
WOCG survey of AST users.

Key factors for success

Digital technologies require stricter discipline to correctly implement and maintain workflows if they are to deliver consistent results to higher expectations. This requires:

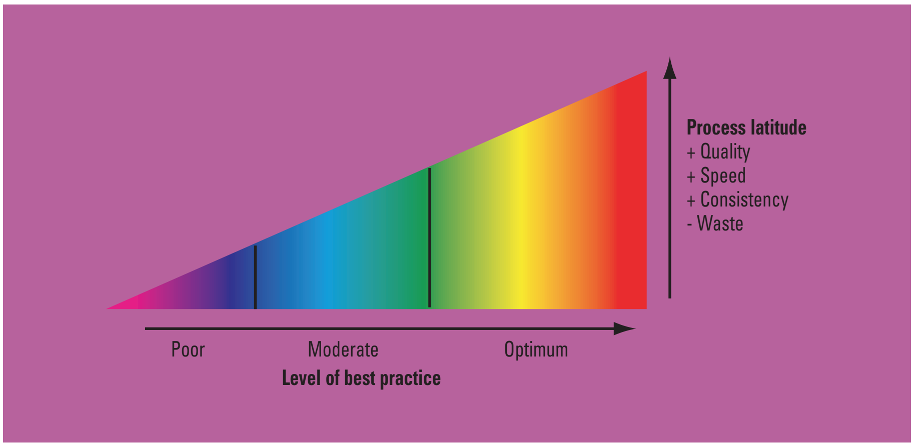
1. An integrated industrial manufacturing strategy that combines standardisation, process control and defined procedures is essential in achieving consistent high quality and productivity benefits.
2. Define a standard to be applied in each workflow process step.
3. All production equipment must be operating to specification. Effective maintenance, correct settings, and standard operating procedures are key success factors to ensure optimum quality and productivity (see guide N° 4 "Productivity Maintenance"). Regularly test the press to ensure it is operating to specification.
4. Understand the influence of consumables (ink, paper, blanket, etc) and select the optimum material combinations to achieve the standard. It is important to recalibrate press reproduction if consumables are changed.
5. Calibrate and optimise each process step to the defined standard.
6. Implement appropriate measurement solutions to maintain consistency in each process step. Printing is the biggest challenge, particularly TVI.
7. An optimised conventional AM workflow is the prerequisite to assess and introduce ASTs.
8. Experience from printers using ASTs shows that a key to success is the fidelity of the CTP system and printing plates.
9. Define and implement Standard Operating Procedures.
10. Use production data to monitor workflow performance.

Some Key Performance Indicators (KPIs) (Extract from "Process Controls Primer", Josef Marin, PIA/GATF 2005)
These KPIs are useful to help diagnose current performance and monitor process workflow improvements.
• Plate re-make rate (and why)
• Re-proofing rate (and why)
• Rate of colour match of proof to printed signature
• Printing consistency from job to job, shift to shift.

Multi-site printing

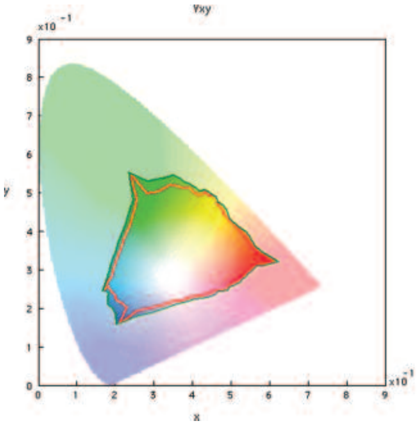
Achieving consistent and very similar printing results on print jobs produced at multiple sites by the same printer, or by multiple printers at multiple sites, is challenging and requires a very high level of process control and discipline. Unfortunately, no single standard is yet used by the world printing industry — North America tends to use its own regional approach, whilst the rest of the world tends to use ISO — however, there are many similarities between them. The aim of the Printing Across Borders cross-industry initiative is to encourage a move from "target-based" (press characterisation) standards to "goals-based" that define an "ideal" print appearance. In the meantime, experience suggests some best practices to help ensure consistent and similar printing results:

1. Good forward planning and communication between all partners in the workflow chain.
2. Use a single defined standard and colour management.
3. Use of the same colour bars at all sites.
4. Measurement instruments calibrated and aligned to each other (between plants/printers).
5. Calibrated print process (proofs, plates, press).
6. Correctly maintained and adjusted equipment, ensure that presses print to specification.
7. Use the same suppliers for consumables - paper, ink, dampening solution, plates, blankets, etc.
8. Use the same general approach to achieve good colour, including aim points and type of proofs.
9. Use production data to drive the colour process, provide feedback, monitor process and improvements, produce useful reports with agreed data definitions.
10. Frequent reviews to evaluate and discuss results, feedback and action plans.



Optimising the print process increases process latitude that will deliver significant benefits.

Colour Management



The colour gamut of the printing press is much smaller than the human visible gamut and generally smaller than hard copy proofs and monitor proofs.
Source Kodak Graphic Communications Group.

Colour management helps adjust and control the colour space differences between RGB monitor screens, digital proofing and the CMYK printing colour space that is largely defined by the substrate and the ink. Colour management assumes that all process components are consistent and stable – which is not the case. Therefore, it is only effective if each step of the entire production process is under control. The three keys for success are (1) using defined standards, (2) calibration and (3) process profiles.

1. Standards

Without effective standardisation and control, colour management cannot fulfil its objectives because it is process blind. A standard should provide an optimal average result related to a guideline that avoids extremes because it cannot reflect every variable. Normally, there is one specification to govern a specific operation and it defines the optimal process target values and tolerances for the technology and production conditions. Common standards are ISO 12647-3 (coldset newspapers) and ISO 12647-2 (sheetfed and heatset web) that are largely compatible with SNAP and SWOP used in North America. However, SWOP 2007 incorporates GRACoL's G7 Proof-to-Print Process that has replaced separate TVI values with a single grey balance aim point (CTP curves are adjusted to a predefined Neutral Print Density Curve for CMY balanced grey scale and a K-only scale). Printers requiring more comprehensive parameters and tighter tolerances can use proprietary (but open) process control such as System Brunner's GlobalStandard, whilst others use their own in-house systems developed to meet their specific needs.

Printers should select and correctly implement an industry standard that meets the needs of the customer, the printing company and the type of printing. Start with implementing key elements.

Most industry standards do not yet include AST specifications. Therefore, it is essential to establish a stable AM standard as a reference from which AST process control can be extrapolated (target density, CIELab values, and standardised ISO profiles may vary).

2. Calibration

The effectiveness of calibration is determined by the consistency and accuracy of the printing presses concerned. Calibration curves and profiles must be derived from presswork that is aligned to density and TVI standards and maintained within acceptable manufacturing tolerances. The platesetter output curves and digital proof settings are calibrated by these printing characteristics.

The most important factor is not just to nominate a standard but that the workflow conforms to it from job to job.

3. Profiles

The press has the smallest colour gamut in the system and should be used as the benchmark to which all other devices are calibrated. Calibrating a press to create an accurate printing profile must take into account all variables influencing final output, particularly the choice of paper, ink, screening and TAC. The influence of paper and ink will be captured in the press characterisation profile.

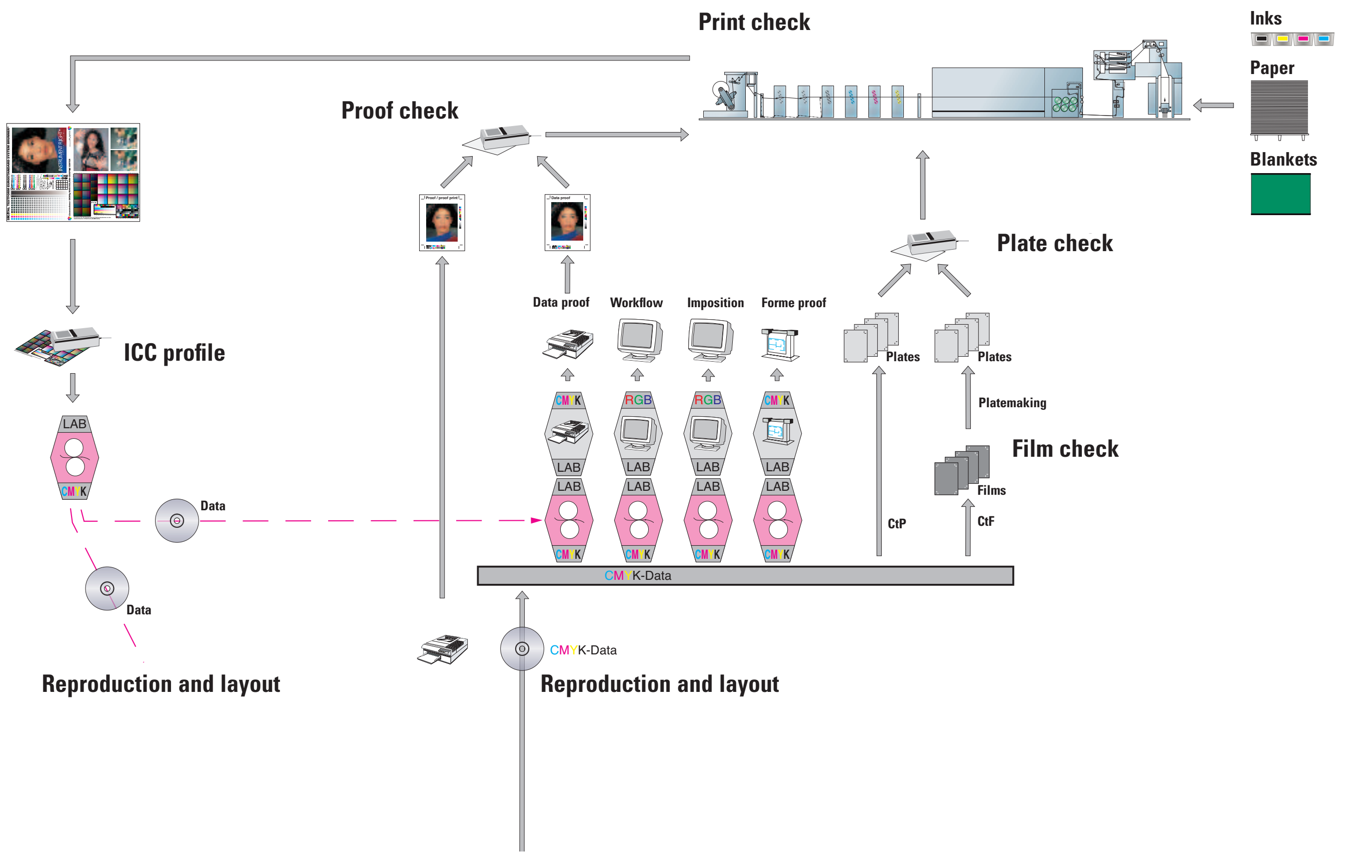
Many printers use International Colour Consortium (ICC) standards and techniques to ensure accurate and consistent output on different devices across the workflow, irrespective of location. Success requires correct implementation, calibration and characterisation. A shortcoming of ISO 12647-2 is that the specified paper grades are unrealistic for web offset printers.

The European Colour Initiative is developing ISO-based ICC profiles specifically for heatset paper grades.

Experienced users recommend closed loop colour control as an essential measuring and control device for quality and consistency control (other benefits include reduced waste and elimination of overinking, which contribute to rapid payback).

User experience of implementing ISO 12647-2

Summary from a major European printer with multiple printing plants — Jo Brunenberg, Senior Technology Consultant at Roto Smeets.



Objectives

- Need for same results at different locations, exchange of jobs
- Aim values needed for closed loop control systems
- Improve printing efficiency printing (cost savings/start-up waste)
- Improve process control
- Reduce dependence on the personal judgement of individual printers.

Positive results

- Clear aim values for all equipment at all locations
- Better colour reproduction with ECI ICC profiles
- Improved match between proof and print
- Improved printing stability with less waste
- Tools to analyse quality problems
- Fewer disputes with clients, with results closer to their expectations.

Difficulties

- Changes in ink formulation cause unexpected changes in behaviour
- Problems with TVI consistency on the run
- Variable papers behaviour and large variations within one paper class
- ISO standard and ICC profiles are not adequate for web offset papers - use ECI ICC profiles.

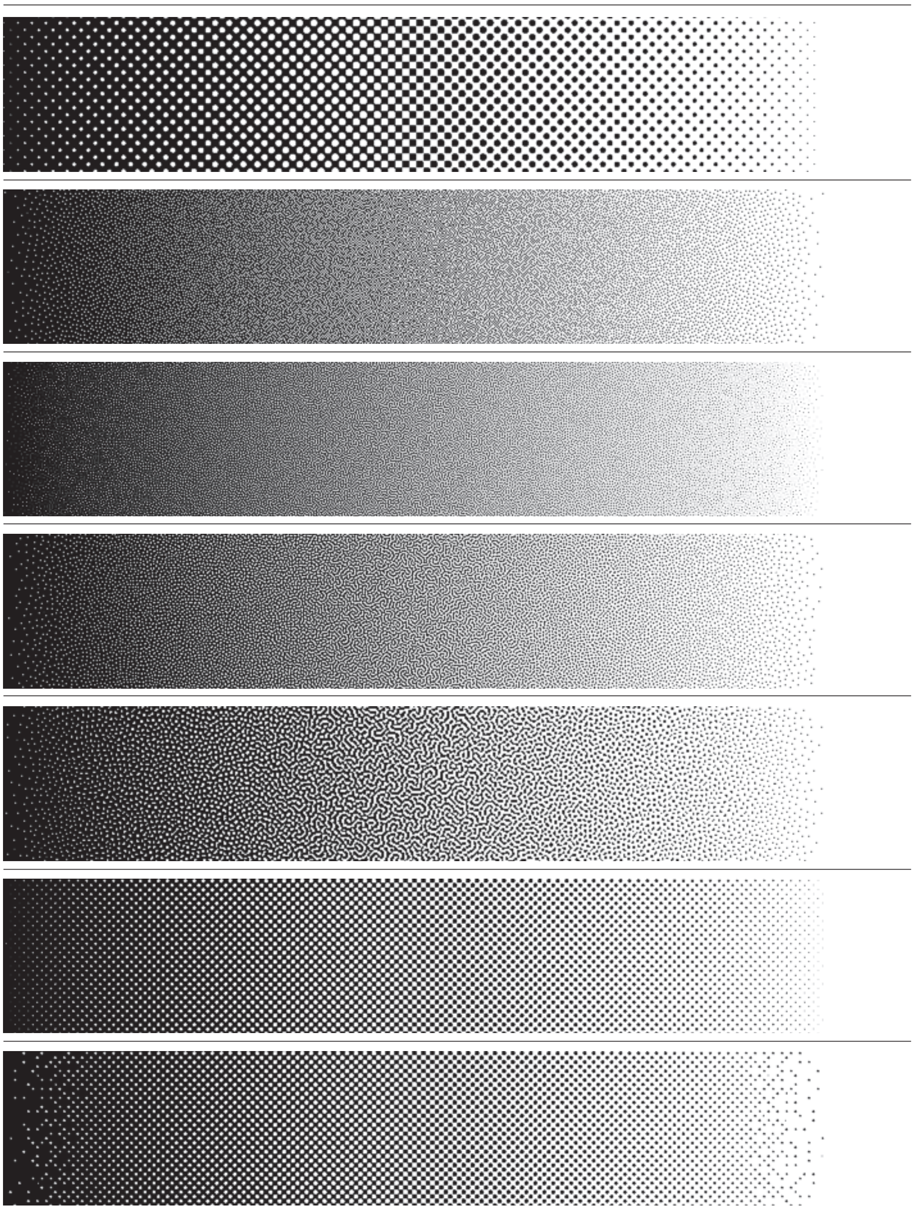
Key success factors

- Management support is vital
- Closed loop colour control systems on presses are a must
- Training is essential
- Correct application of plate curves
- Good co-operation between prepress, platemaking and printing specialists.

An ICC profile describes single standards and the quality of an entire workflow - including conversion from RGB to CMYK. Elements should be profiled using a specific method and measurement for each, from which an ICC profile can be created using a software programme.

Source manroland-System Brunner..

Screening Technologies



Conventional AM screen, 52 l/cm (150 lpi)

20 micron first-order FM screen or conventional stochastic screen

10 micron second-order FM screen, or hybrid FM screen.

20 micron second-order FM screen, or hybrid FM screen.

25 micron second-order FM screen, or hybrid FM screen.

High Frequency AM screen, 94 l/cm (240 lpi)

High Frequency Hybrid AM screen, or XM screen, 94 l/cm (240 lpi)

The vignettes in these figures are magnified by 800% and show a variety of different screening technologies. Maxtone and Staccato source files provided by Kodak GCG.

Conventional AM (Amplitude Modulation)

Conventional AM screens control tonality by varying the amplitude (size) of the dot. This system arranges dots on a square grid and every part of the image contains the same number of dots, with the grid at different angles for each colour. Colour and density are controlled by the size of the dots that can occupy from 0% to 100% of the area assigned them in the grid. Conventional AM screens are robust to use but produce visible patterns, compromise image fidelity and can result in loss of highlight detail.

This offset screening technique was almost unchanged for a century until the early 1990s when FM (Frequency Modulation) screening was commercialised to produce images with a higher resolution and greater detail than conventional AM halftone techniques. However, difficulty in transferring small dots from film to plate caused FM to be almost abandoned by 1996. The subsequent widespread adoption of CTP eliminated film transfer problems and led to the continuing development of ASTs.

What are Alternative Screening Technologies?

Alternative Screening Technologies may be AM, FM or a hybrid of some sort. Pixels are dispersed and generally organised into fine dots and structures that usually require greater process stability and resolution in prepress and printing than conventional AM. AST applications now range from very fine resolutions for sheetfed to coarser resolutions for newspaper printing. ASTs can reduce or even eliminate moiré and other visible screening anomalies, while rendering greater detail resolution than conventional AM screening; they also tend to reduce perceived colour shifts caused by misregister and web growth.

FM (Frequency Modulation) is the correct term for what was called stochastic screening, and includes different families of screens:

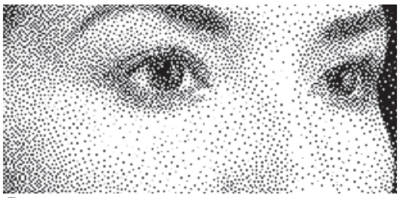
• **First-order FM** (Conventional FM, Stochastic): Dots are randomly dispersed to avoid moiré and related interference patterns. Tones are rendered by varying the spacing of equal sized dots that are dispersed as evenly as possible. However, inadvertent clumping in the midtones can lead to visible non-uniformities (grainy appearance and mottle) whilst the boost in detail can reduce apparent contrast and require image adjustment to compensate. Finer dots are required to improve visual uniformity but this reduces exposure latitude that makes implementation difficult because of the limitations of lithographic performance. There are no suitable first-order FM screens for web offset applications.

• **Second-order FM** and Hybrid FM: Dot structures are arranged in a random way to avoid moiré and related interference patterns. Tones are rendered by varying the spacing, shape and size of the dot structures. The shaping of the dot structures delivers good visual uniformity with dot sizes that provide sufficient exposure latitude. Typical applications for heatset use 25 micron and coarser resolutions that deliver suitable lithographic performance and acceptable visual acuity; coldset uses 35-40 microns.

Available products include: Kodak Staccato Screening Technology, Heidelberg Satin Screening, Artworks Organic Screening, Global Graphics HDS, Dainippon Screen RandotX, Spekta1, Spekta2, Fairdot Screening.
High lpi AM/Supercell AM: Dots are arranged on a grid, typically 80 l/cm (200 lpi) or finer, and tones are rendered by varying the dot size - larger dots produce darker tones and smaller dots produce lighter tones. Supercell techniques allocate pixels to different dots in a dispersed manner to preserve grey level intent and minimise visible anomalies. For heatset applications, rulings up to 94 l/cm (240 lpi) deliver quality, exposure latitude and lithographic performance similar to 25 micron FM screening. Applications in coldset are limited due to the fine highlight dots; however, newspaper CTP systems operating at 472 d/cm (1200 dpi) have larger highlight dots and might have success with 59 to 79 l/cm (150 to 200 lpi) screens..
Available products include: Kodak Turbo Screening and Prinergy AM screening, Fuji CoRes Screening, Heidelberg Prinect IS screening, Artworks Paragon Screening, Esko Graphics Highline Screening, Global Graphics HPS.

Hybrid AM/FM: This technology is the same as high lpi AM except that highlights and shadows are rendered with larger dots. Tones in the highlights are controlled in an FM fashion by removing or adding dots on the AM grid. This enables printers to overcome resolution limitations in platemaking and printing, while introducing minimal non-uniformities transitions. For heatset, rulings up to 94 l/cm (240 lpi) deliver quality, exposure latitude and lithographic performance similar to 25 micron FM screening - highlight and shadow dot sizes should be set between 20-30 microns. Newspaper applications range up to 69 l/cm (175 lpi) with highlight dot sizes set between 30-40 microns. Similar results can be achieved with other commercially available dot shapes by adjusting images or by applying tone correction curves to suit.


A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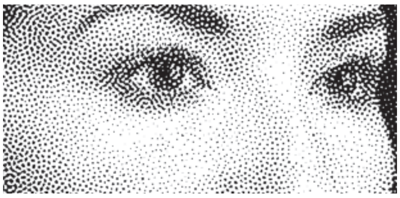
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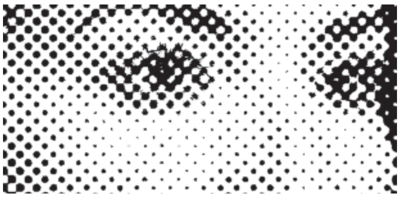
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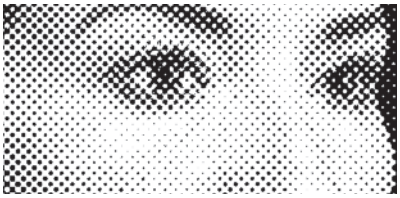
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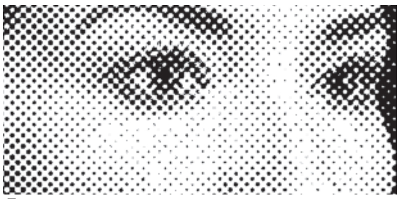
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The original image is shown screened using different screening technologies at 800% magnification. Maxtone and Staccato source files provided by Kodak GCG.

A- *Original image*
B- *30 micron first-order FM screen*
C- *25 micron second-order FM screen*
D- *53 l/cm (133 lpi) conventional AM screen*
E- *79 l/cm (200 lpi) high lpi AM screen*
F- *79 l/cm (200 lpi) high lpi Hybrid AM screen with 25 micron highlights*

Why use ASTs?

		AM	ASTs		
		Conventional	AM high lpi	Hybrid FM	Hybrid AM
1	Fine detail rendering	-	+	+	+
2	Smooth flat tones	-	+	-	-
3	Screen introduced moiré	-	-	+	-
4	Motif introduced moiré	-	-	+	-
5	Increased colour gamut *	-	+	+	+
6	Highlight clipping	+	-	+	+
7	Mid-tone rendering	-	+	+	+
8	Closing in shadow areas	+	-	+	+
9	Use of HiFi colour separations	-	-	+	-
10	Response on press to colour adjustment *	-	+	+	+
11	Plate run length *	+	-	+	+
12	Blanket piling *	+	-	-	-
13	Process sensitivity *	+	-	-	-
14	Ink consumption *	-	+	+	+

Better '+, Equal =, Poorer —

*AST screening is a tool that can provide significant benefits when compared to conventional AM. This comparison assumes that all screening types are optimised for press with appropriate calibrations applied. Note *ASTs of similar frequencies will have similar results. Finer screens amplify lithographic behaviour and process sensitivity. Source WOCG/Kodak GCG.*

ASTs for newspapers?
AST printing can improve the quality of newspaper printing by eliminating rosette patterns, reducing colour shifts in the images, and making ink/water balance and registration less critical. Some newspapers report reduced ink coverage that minimises show through and marking and improves drying because less ink is more uniformly distributed by smaller dots, which help solvents evaporate faster. The FM image, in spite of greater TVI, causes lower tonal variations during printing (WAN-IFRA Special Report 2.21).

1. Fine detail rendering: The micro dot structure of ASTs delivers finer grained images, which reduces the visible dot structure and, in some cases, creates an illusion of a continuous tone image. The dot structure tends to become invisible between 94 to 118 l/cm (240-300 lpi) or between 25-35 microns FM. Coarser screens can achieve similar results on newsprint (see page 12 for recommendations on dot size and resolution). FM fine screens are more uniformly dispersed and immune to producing anomalies in the dot structure. However, some CTP systems, plates and presses have difficulty rendering 1-5% highlight dots in fine AM screens.

2. Smooth flat tones: Smooth flat tones may contain visible patterns from rosettes and moiré with AM and Hybrid AM screens, or grain and mottle with FM and Hybrid FM. The visible results are subjective but can be influenced by the screening algorithm, the CTP, the plate and the lithographic process. AM tend to be smoother for AM and FM ASTs < 94 l/cm (240 lpi). FM tends to be smoother for AM and FM ASTs > 118 l/cm (300 lpi). Hybrid AM screens tend to have noisier highlights with visible degradation in highlight gradations

3. Screen introduced moiré: Moiré between separations, screen and subject matter, or between screen and device signature, is a function of the screen ruling and angle. Moiré cannot be eliminated by changing the dot shape — only FM does this. Hybrid AM/FM screens reduce the risk and visibility of moiré but does not eliminate it completely. Hybrid screens that are more FM based than AM have fewer moiré issues.

4. Motif introduced moiré: Moiré can occasionally be caused by a conflict of the patterns of the scan pixels and details in the original. These can be eliminated by using a higher scan resolution or by rotating the image relative to the scan. Finer AM and hybrid AM screens tend to show less subject moiré, but are not immune to visual interference patterns.

5. Increased colour gamut: GATF analysed colour gamut range of heatset using different screen types under controlled conditions. The results showed that the CIELab space of conventional AM 69 l/cm (175 lpi) is 7% greater than conventional AM 52 l/cm (133 lpi) screens, and is 11% higher with 25 micron AST screens. A parallel analysis showed that an AST screen could produce 50 more spot colours than a conventional AM 52 l/cm (133 lpi).

6. Highlight clipping: Highlight clipping in AM is more likely because dots can be as small as 10 microns. Small dots may not be adequately rendered by the CTP plate or press, or may wear out during the press run. FM resolutions of 25-35 microns enable printers to regulate better the size of the highlight dots. Hybrid AM also helps regulate highlight clipping.

7. Midtone rendering: The majority of image detail is found in quarter-tones, midtones and three-quarter-tones. Fine AST screens better capture colour changes from one pixel to another because they have dots spaced more frequently.

8. Closing in shadow areas: Small dots in the shadows may fill in on the plate and/or press, causing maximum density at tone values below 100%. This may be caused by CTP, plate, press, or plate wear on press and can be avoided by using larger dots in the shadows such as with Hybrid AM and FM ASTs.

9. HiFi colour separations: Screens must be selected for 4, 5 or 6 process colours that do not produce visible anomalies such as moiré (AM and Hybrid AM), and mottle (FM and Hybrid FM). For practical purposes, FM related mottle is much less of a problem than with AM. Moiré from higher screen ruling AM and Hybrid AM is generally less visible than conventional AM. Care must be taken when selecting screen angles for 6-colour work using any AM and Hybrid AM screens - FM and Hybrid FM screens do not have restrictions on colour separation and screen assignments.

10. Response on press to colour adjustment: ASTs respond to colour adjustment in a similar manner to AM. However, ink does not accumulate on the finer AST dots when ink density is raised; instead, it accumulates on larger dot structures in the three-quarter-tones and shadows. This behaviour allows solid density adjustments that do not affect the midtones as much as with coarser AM screens. However, care must be taken when deviating from standard densities as this will upset tonal curve balance and may lead to emulsification, piling and other lithographic issues. The larger extreme shadow dots in FM keep the image open - unless the plate system is unable to render them onto the plate.

11. Plate run-life length: Finer screens use a greater percentage of small dots that are more susceptible to chemical, mechanical and lithographic wear. Long run plates, higher resolution CTP, and baked plates reduce the impact of wear.

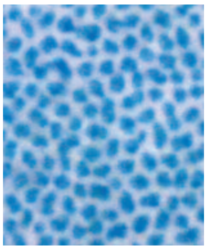
12. Blanket piling: Some printers experience increased blanket piling where poor ink adhesion on the paper leads to ink piling onto blankets further down the press. Thin ink films can lead to increased levels of fibre being picked off the paper and piling on the plate. This can be partially controlled by adjusting the ink/water balance on the first two units, avoiding excess ink density, improving ink flow and optimising dampening solution.

13. Process sensitivity: Fine screens are generally more sensitive to processing, exposure, laser condition, and lithographic variations. For 20 micron dots and screen rulings above 94 d/cm (240 lpi), the laser spot size should be 5 microns or finer to stay within a manufacturing tolerance of ±2% on the plate.

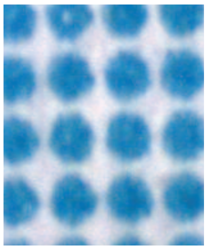
14. Ink consumption: This is a function of image coverage on the plate and ink film thickness but there is no clear industry consensus on how to measure ink consumption. The TVI compensation curves for ASTs reduce the coverage on the plate and less ink is transferred. The GATF 2004 comparative tests evaluated heatset ink consumption of different screen types under controlled conditions. The results showed that the conventional AM 69 l/cm (175 lpi) and 25 micron AST screens both used 15% less ink than conventional AM 52 l/cm (133 lpi) screens. The experience of some large AST users indicates savings of 10-15%. The use of densitometers or closed loop colour control reduces a natural tendency to overinking. The effective use of GCR and UCA can further reduce ink consumption.

TVI (dot gain)

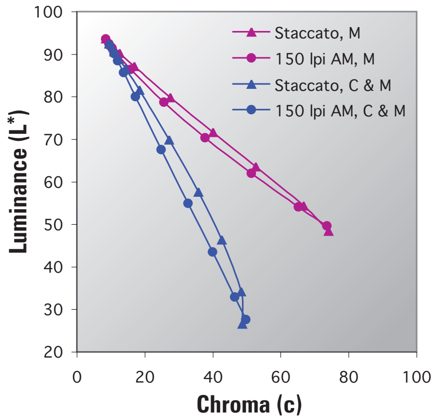
Conventional AM screen dots are equally spaced from each other and vary in size. AM screens produce even and smooth flat tones (especially for midtones) and are robust enough to withstand plate wear for long print runs with TVI that is predictable and generally lower than for ASTs. Finer screens have progressively more dot gain but this characteristic improves reproduction quality.



1



2



3

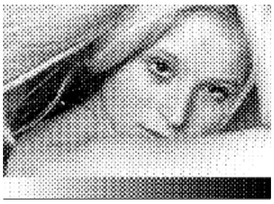
1- AST (Staccato) is shown here with a larger gamut when measured as a function of chroma and luminence. Source Kodak Graphic Communications Group.

2- Coarser traditional AM screens have less optical gain and therefore a slightly smaller gamut

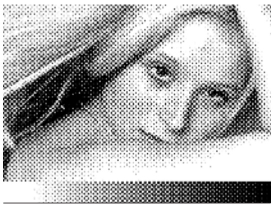
3- The current explanation of increased colour gamut is that the increased levels of optical gain with finer AST screens leads to increased dispersion of ink-filtered light in the paper substrate, reducing the ratio of grey component white light (RGB) being transmitted directly from the paper, thereby increasing the ratio of light being filtered through ink. The net effect is that the ratio of desired-to-undesired light transmitted actually increases, resulting in higher levels of Chroma.

Process controls

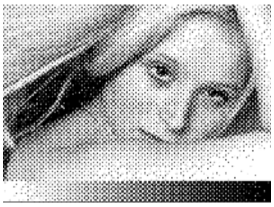
1



2



3



4

5

What size dot?

Paper and print process are the most significant influences on the practical use of different screen rulings/resolutions. The related levels of TVI and colour gamut can be characterised and used to align proofs and presswork to a common standard. Finer screens render image detail well and can lead to almost continuous tone quality. However, printers will have to correct increased levels of TVI by building and applying tone correction curves.

Before considering an AST it is essential that the optimal conventional AM screen sizes are used for the paper range printed.

Irrespective of the screening used, AST relies on reproducing many fine dots of similar size for at least part of the image. This has significant implications for process control on press. Finer screens render a greater percentage of the tonal range with fine dots. For example:

- A 28 micron dot is a 2.7% dot at 59 l/cm (150 lpi), 7% at 94 l/cm (240 lpi), 11% at 118 l/cm (300 lpi), 20% for 113 l/cm (400 lpi), 9% for 25 micron Staccato and 25% for 20 micron Staccato. Second order FM screens often have a minimum dot size (for example, Staccato 25 has 20 micron dots from 0-5% and Staccato 20 micron dots from 0-14%).
- In comparison, AM screens drop below 20 microns at 1.5% for 59 l/cm (150 lpi), 4% for 94 l/cm (240 lpi) and 6% for 118 l/cm (300 lpi).
- Hybrid AM screens behave more like FM because they set minimum dot sizes.

The reproduction of these highlight dots depends not only on paper and press conditions but very much on the fidelity and resolution of the plate and CTP laser system. The loss of 10 micron dots will clip the tonal range of the finer AM screens but not the FM because the dot size is restricted. The loss of 20 micron dots will impact both AM and FM screens unless coarser highlight dots are chosen.

Sheetfed presses are capable of holding 10 micron dots — if the CTP system and plate are capable of rendering high resolution single pixels that print, then fine screen AM ASTs can be used instead of hybrid AM AST. However, web presses struggle with single pixel dots and therefore Hybrid AST techniques (AM and FM) are preferable to maintain practical highlight dot sizes.

A few printers successfully print one level finer because they have invested in tighter process control. CTP and plate technology play a key role in the success of ASTs because higher resolution systems not only render smaller dots but also improve exposure and processing latitude that translates into increased stability and consistency.

The Screened images are shown at 400% magnification.

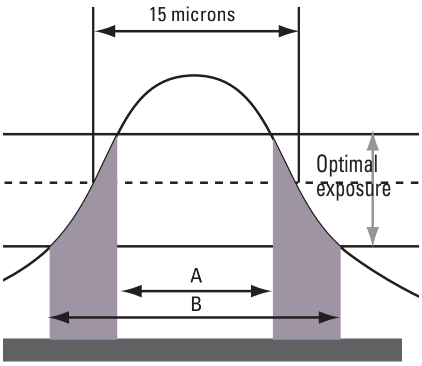
- ***1-*** *The original*
- ***2-*** *The CTP and Printing process needs enough resolution to reproduce the finest dots in an AST.*
- ***3-*** *If there are resolution limitations, the tonal range will be clipped and the integrity of the image will be compromised.*
- ***4-*** *Hybrid AM with larger dots can be used to reclaim lost highlights.*
- ***5-*** *Hybrid FM with larger dots can also be used to reclaim lost highlights. Source Kodak Graphic Communications Group.*

Suggested dot sizes for different processes and papers

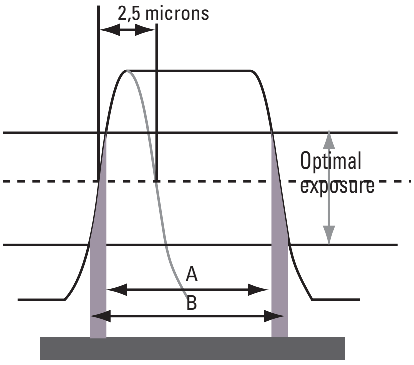
Process	Paper	AM AST	FM AST	
Sheetfed	Coated	118 l/cm (300 lpi),	20μ	
	Uncoated	118 l/cm (300 lpi),	20μ	
Heatset web offset	Coated	94 l/cm (240 lpi)	25 µm highlights	25-35μ
	Uncoated	79 l/cm (200 lpi)	30 µm highlights	35μ
Coldset web offset	Newsprint	69 l/cm (175 lpi)	35 µm highlights	35-45μ

Measure the smallest AM highlight dot that can be consistently reproduced on the press and then select the FM dot size accordingly.

It is crucial for printers using ASTs to stabilise TVI and compensate for additional gain. Experienced FM printers stress that TVI calibration is critical to getting maximum benefit and predictable results. For linear CTP systems, mid-tone gain for 20 micron FM, 25 micron FM and 118 d/cm (300 lpi) AM is 8–12% more than 59 l/cm (150 lpi). Coarser CTP lasers and lower resolution plates may cause additional gain in negative plates (write to the foreground) and additional loss in positive plates (write to the background) resulting in TVI differences of 0%–20% more than 59 l/cm (150 lpi). Systems exhibiting excessive gain are typically less stable and not suitable for 10 or 20 micron FM. Plate and imaging technologies vary in their AST capabilities and a good test is to measure TVI at 50% on plate and make sure it is 50 ± 4% - anything outside these values may lead to unstable gain and may be unsuitable.



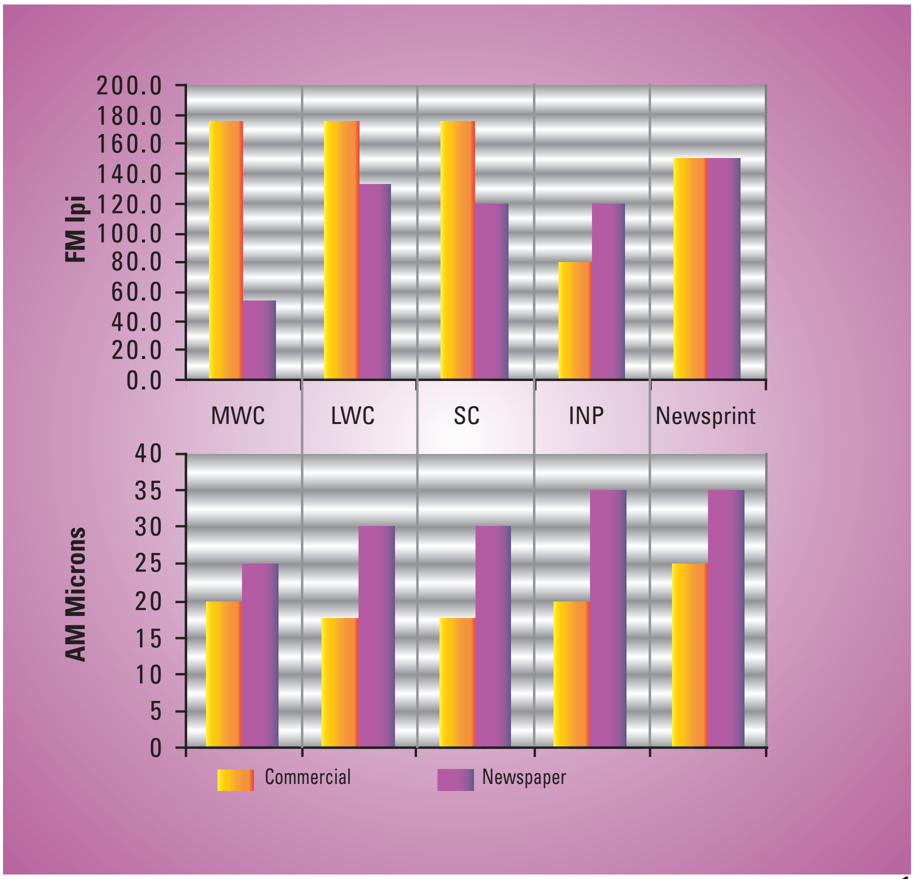
Conventional Resolution at 630 d/cm (1600 dpi). Source: Kodak CGC.



Very High Resolution at 3780 d/cm (9600 dpi). Source: Kodak GCG.

Constraints on dot reproduction

Laser resolution dictates halftone stability and other measures of latitude in exposure and processing. The following diagrams show exposure thresholds for conventional (Gaussian) and very high resolution lasers. Conventional CTP laser spot sizes must be large enough to cover from one corner of a pixel to the other. At 945 d/cm (2400 dpi), this is approximately 16 microns or 630 d/cm (1600 dpi). High resolution lasers use a laser that is finer than the 945 d/cm (2400 dpi) raster. (SQUAREspot imaging technology uses a laser four times finer than the image pixel, making hard edged dots that are five times less susceptible to exposure and process variation than Gaussian CTP.)

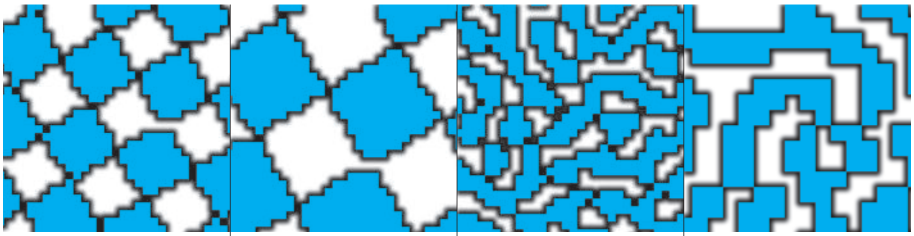


1

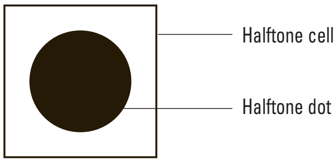
1- Both commercial and newspaper printers use comparatively finer screens for AST production (some of the newspaper printers also print heatset). Both groups of printers have more consistent use of AST screens for all paper grades than is the case for FM.
Source WOCG AST user survey.

Digital Tonal Reproduction & TVI

Tonal value increase is greater for finer ASTs because there are more dots and more dot edges. In this example, growth is the same for all dots, but TVI differs. 10.6% at 52 l/cm (150 lpi), 17.6% at 94 l/cm (240 lpi), 17.7% at 25 micron Staccato and 28.6% at 20 micron Staccato. Source Kodak GCG.



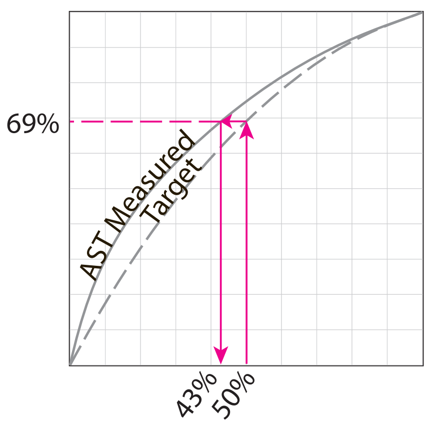
Digital tonal reproduction process involves a number of steps:
1. It begins with a digital file (PostScript or PDF) in which all tints are assigned a continuous tone percentage value between 0 and 100% that corresponds to a specific halftone structure.
2. The file is then converted into a bitmap by the screening engine of the RIP. The RIP converts the file by reading the percentage values defined in the file and creating a screen of halftone dots, each with a tint percentage value. For example, 50% means that 50% of the halftone cell area is covered by a halftone dot or dots scattered in a random pattern (FM).



3. The bitmap is output to plates or proofs where each halftone dot is imaged using a series of laser spots.
4. The press transfers the ink to the dot on the plate, which is then transferred to the blanket and finally onto the paper.

What is TVI (Tonal Value Increase)? TVI is a normal part of the print reproduction process. It is the difference between the specified tint value in the digital file and the measured value on output.

TVI in digital tone reproduction? TVI occurs when a digital file is converted to dots and rendered in a press or proof. The resulting tonal value does not always align with the intended tonal value. However, building tonal compensation curves will control the output tonal values to achieve desired results under a variety of printing conditions. It is important to understand that the specified tint value in the digital file is transformed during each rendering process, which causes changes in tone value that are reflected in the final printing — hence the necessity to build curves.
TVI happens in the process that converts a digital colour file to a visual tint rendered by ink onto paper. TVI is the absolute, not relative, increase in tonal value. For example, if a 50% tint specified in the file produces a dot structure that absorbs 69% of the light, then the tonal value (effective dot area) on the press sheet is considered to be 69% and the overall TVI is 19%.
The print characteristic is the graphic relationship between the tint values specified in the digital file and the tonal values (or effective dot area) on the proof and printed copy.
There are two types of TVI on halftone output: physical TVI and optical TVI. Tonal value or effective dot area, that is, the perceived tint on the press sheet or proof, includes both physical and optical TVI. It is a measure of the amount of light trapped by the dot on the sheet compared to that trapped by solid ink.



If the target tonal value for a 50% tint is 69% then the tonal value increase is 19%. If further measurements show that it takes a 43% AST tint to produce a 69% tone value, then the required tonal correction is to change 50% to 43%.

Physical TVI is a change in the physical size of the dots during tonal reproduction that can happen either during imaging and processing the plate or during printing.
Optical TVI is the increase in the amount of light trapped by a dot additional to its physical size. This is caused by light striking the white paper that is then diffused and subsequently absorbed by a nearby ink dot — rather than leave the paper. Light striking the inner edge of an ink dot is also scattered by the paper substrate with some of it straying beyond the dot and emerging through the paper. This diffusion of light causes a gradation of density on the outer edges of dots and beyond, absorbing more light than can be accounted for by the physical area of ink, making the measured dot effectively larger. The overall light absorbing effect of the dot — its physical size and optical TVI — is the tonal value.

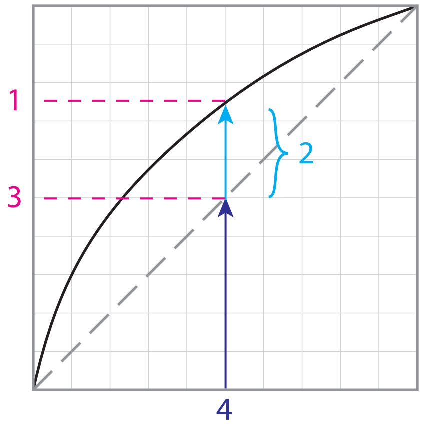
TVI and colour balance? The relationship between the four process colours is the key factor for a good production match on press. Research by System Brunner demonstrates that human perception is highly sensitive to technical deviations affecting the colour balance — particularly in midtones and grey areas. Divergent TVIs in the CMY process inks are the main reason for a shift of balance in printing. For ideal visual perception, the mid-tone balance deviations should not be larger than +/-2% in TVI between the highest and lowest values, but process variations in production are typically +/-4%. The gap between perception of colour deviations and the technical limits can be bridged with grey stabilisation (GCR). It is better to keep the neutral balance on a higher or lower level of TVI because human perception is less sensitive to changes in gradation (darker or lighter) than to colour balance shifts. (System Brunner GlobalStandard™ controls a neutral grey balance in the mid-tone area to define equal values of CMY TVI in each process colour as well as for 3-colour overprints.) Some newspaper black separations have different gain values than CMY and require a different curve for black to align the print contrast and TVI to desired values.

Grey balance: Stable grey balance is critical to consistent printing results from 4-colour process and begins with colour separation. It is defined (SWOP and GRACoL) as the CMY % dot ratio needed to make a neutral grey when the cyan tone value is 50%, magenta 40% and yellow 40%.

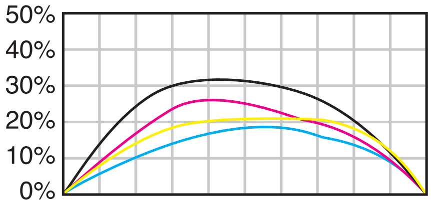
If grey is not in balance then check the ink sequence, ink/water ratio, packing. If this does not solve the problem GRACoL recommend adjusting Solid Ink Density (SID) of CMY to meet grey balance at the mid-tone.

Grey Colour Removal (GCR) is recommended to provide a greater visual tolerance to improve perceived printing consistency without visible changes to the colour (WAN-IFRA Special Report 2.16). GCR reduces CMY colours throughout the entire image and replaces it with black. The substitution of more expensive colour ink by black can reduce total ink costs; however, this reduces the ability to make visible colour adjustments on press. GCR is an element of the ISO standard for newspaper production.

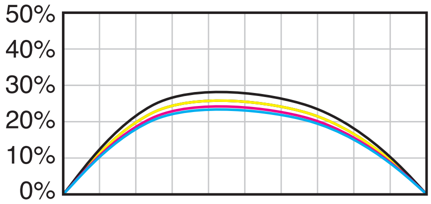
The higher the GCR applied to an image, the lower the TIC (Total Ink Coverage). As a result, the black ink alone may not be able to replace the density lost from removal of CMY and this may make printing dense black areas difficult. The solution is to use UCA (Under Colour Addition) to increase the amount of CMY in shadow areas of the image, which increases the neutral greys. Applying UCR will increase TIC for specifications such as SWOP or SNAP. Under Colour Removal (UCR) also reduces the amount of CMY in the shadow areas and increases the amount of black to reduce set-off and blocking that can occur with heavy ink coverage.



1: **Printed tone value of effective dot area (%) on the paper.**
2: **TVI (%)**
3: **Linear output specified in digital file equals tone value on printed sheet.**
4: **Tint value (%) specified in the digital file.**



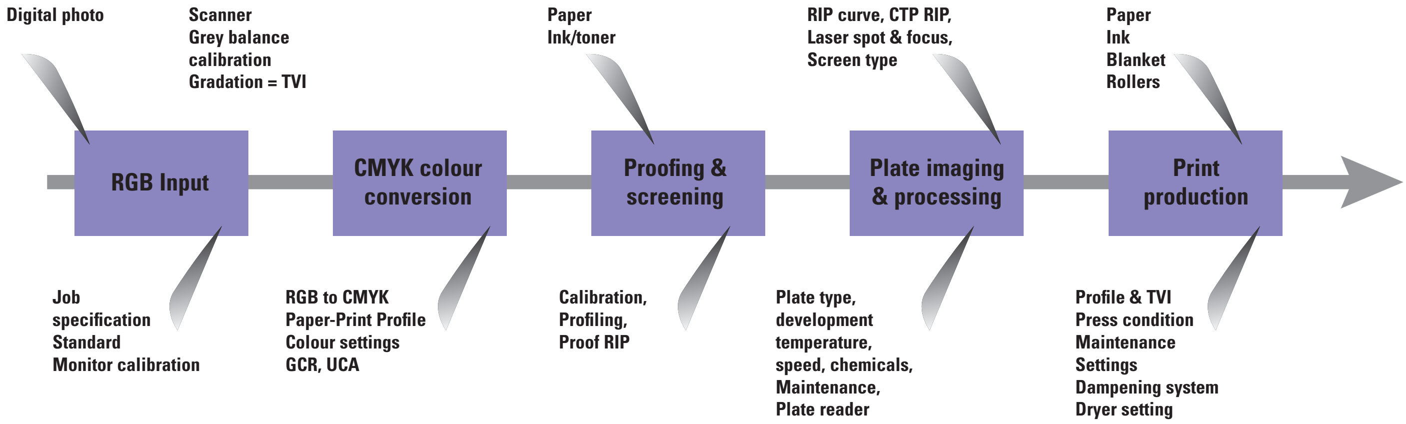
A



B

It is important for grey balance and stability that the tonal values of cyan, magenta and yellow channels be within 2% of each other.
A- *Tone Value Increase (TVI) out of balance*
B- *Tone Value Increase (TVI) in balance*

Optimise the process workflow



The foundation of process control is a colour managed workflow using a 3-step approach based on 3-Cs: Calibration, Characterisation (profiling) and Conversion (of colour). Reliability and repeatability of desired results depend on getting these steps right. In practice this should also include:

- What & how to measure at each step
- Identify key maintenance issues at each step.
- Identify key consumables issues at each step.

The goal is a balanced image that produces a standard grey balance from all plates when printed, which is essential for consistent printing. Production profiles are a form of condition monitoring of process quality. ASTs can be significantly influenced by the variables in the process chain that can lead to production problems. Therefore, effective and systematic standard operating and maintenance procedures are fundamental to success.

Achieving stable conventional AM screening should not require substantial changes in the current production processes — applying best practice and having the right tools to measure monitor and control output are fundamental requirements to improve quality and stability. This includes selection of consumables along with maintenance of the complete prepress and printing systems. This best practice should be soundly implemented and understood with the current AM process to provide the foundation to improve conventional AM quality; it is the prerequisite for implementation of AST.

Kodak Matchprint Inkjet Proofer.

Digital proofing & viewing

1

Digital ink proofing is now the dominant technology that is facilitating remote output and virtual (display monitor) systems. The proofing device's resolution, screen type and frequencies need to be compatible for the type of proof (creative, position or contract), the type of work, and the printing process.
The most reliable and freely available method to ensure continuity across the workflow chain is to calibrate digital proofing devices to a print standard with the specified values that can be achieved on press. Linearisation ensures that all input and output values are equivalent. Characterisation and linearisation should be made for each paper type and resolution setting, and recorded with other settings that affect printed results.

Contract proofs

- Use a standard with profiles for proofing (e.g. ICC).
- Ideally made from the same PDF file and RIP that will be used by the CTP to make the plates.
- Incorporate a standardised colour bar using a certified proofing system with reproduction targets (TVI, ink density, etc.).
- Proofs should have the same colour gamut as the press, inks and paper that the job will be printed on.
- Viewing conditions for proof approval and printing should conform to ISO 3664 and D50 standards.
- Signed and dated by the customer for approval to print.

Other proofing best practice

- Digital proofing devices should be regularly calibrated and the condition of print heads checked daily.
- Virtual proof display screens need to be calibrated to ISO 12646 and used in approved viewing conditions — positioned away from incoming daylight, doors and windows.
- Proofs should be dated as their quality and colouration can deteriorate over time.
- Identified with job name, file identification.
- Type of proofing system.
- Use of the proof — creative, position only, or contract.

ASTs and proofing

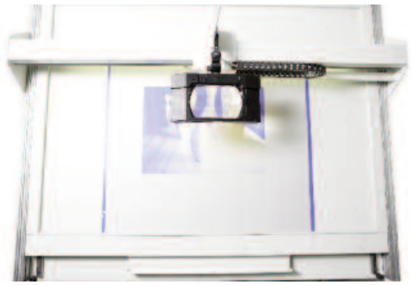
The chosen standard is not as important as the consistency, accuracy and alignment of the proof. Well aligned proofing and printing is a prerequisite for the adoption of ASTs. If the printer has trouble matching proof to print, then this needs to be resolved before introducing ASTs. Proofs should be within acceptable tolerance of the chosen standard, otherwise it will be difficult to troubleshoot any mismatches. The objective is for the printer to have a standard proof (and standard presswork) that can be easily characterised and relied upon as a reference base to work with ASTs.

1- Kodak Matchprint Virtual. Source Kodak Graphic Communications Group.

The importance of Premedia

10 Common problems with digital premedia files (GRACoL)

1. Wrong or missing fonts.
2. Banding.
3. Incomplete or corrupt files.
4. Excessive sizing/rotating of image files in the page layout programme.
5. Spot colours not converted to process colours or vice versa.
6. Wrong page size.
7. Low resolution images.
8. Inadequate bleeds.
9. Improper or incorrect trapping.
10. Improperly reformatted files.



1

***1-** Routine quality control and premedia best practices reduce errors and variation.*

"It's not the tools it is what you do with them. Surveys carried out in the US in 2003 and 2004 found that many generally accepted (premedia) working practices produce have very significant visual and measured variance in colour reproduction. These workflow differences can have a significant impact on colour reproduction and predictability because the magnitude of colour variance introduced at the early stages of production proves to be both difficult and costly to adjust at later stages. There is also a common, but mistaken, belief that colour management makes colours match between the monitor and the press — whereas its function is to make colour production more predictable."
Color Managing Premedia Production, Michael Robertson, RIT, GATFWorld Vol. 17/N° 6 12/2005.

It is the responsibility of the content originator to calibrate their monitors, scanners and cameras. When design agencies supply printers with images they should embed a working space profile into the image so that the printer's prepress department understands their intent and they should include information on the type of print process and paper. Good communication, workflow process understanding and submission of sample files are a good practice prior to the start of production. Colour management errors are high when moving from RGB to CMYK colour space for proofing and printing. The large RGB colour gamut needs to be compressed to the smaller CMYK gamut without compromising the colours in the image. Colours outside the CMYK gamut are replaced with colours that come closest to the printing device being used.

10 Premedia best practices for all workflows

1. Continuous tone rasterised images should be at least double the line screen size e.g. 118 for 59 l/cm screen (300 l/pi for 150 l/pi).
2. Bitmap files should be a minimum of 394 d/cm (1000 dpi).
3. Tiff or EPS files between 79-113 d/cm (200-400 dpi).
4. Image files should be supplied as RGB, or CMYK TIFF, or EPS files.
5. RGB images should have the camera's colour profile or an industry accepted working space profile assigned — Adobe98, ColorMatchRGB, or Prophoto — otherwise the file may need to be colour managed. Photoshop RGB images should always have embedded profiles and be set to Preserve Embedded Profiles.
6. CMYK images do not need a profile to be assigned and it is recommended to save images uncompressed and without embedded profiles.
7. PDF page files should adhere to industry standard PDF/X-1a or PDF/X-3 (file specification available from www.ghentpdfworkshop.org or www.Certifiedpdf.net.)
8. PDF files should have all fonts and high resolution images embedded in the page file — embedded high resolution images should not contain ICC profiles or PostScript Colour Management.
9. The paper type will determine the amount of UCR to be applied at the separation stage to achieve an acceptable level of Total Area Coverage (TAC).
10. Four rendering intents are defined by ICC and the output of an image file can look very different depending on which one is used (relative colorimetric, absolute colorimetric, perceptual and saturation). The rendering intent is not normally built into an ICC profile but applied by a colour management system. A good solution to communicate the intent is the Adobe Common Color Architecture that shares a single Color Setting File for all Creative Suite products and can contain both profiles and preferred colour settings. It is recommended that printers and prepress companies make these available on their websites and that designers use them ("Communicating your colour needs" - Julie Shaffer).

10 Premedia best practices for AST workflows

1. Scan images (or have original images supplied) at a resolution of 118 l/cm (300 dpi). Low resolution images - that are acceptable for conventional AM screening - do not take full advantage of the detail rendering capabilities of finer screens and may show pixilation artefacts such as stair casing in images with a lot of detail.

2. Ensure that workflow settings do not allow down-sampling of 118 l/cm+ (300 dpi) dpi images. (For example, ensure colour and greyscale image settings in Adobe Distiller (or equivalent) are set to no less than 118 l/cm (300 dpi) using bicubic down-sampling.)

3. Use loss-less image compression algorithms such as G4, LZW or Zip. Because fine screens can render fine detail such as compression artefacts, it is good practice to avoid image compression technologies such as JPEG. However, if JPEG compression is unavoidable then restrict settings to ensure maximum image quality (note: JPEG images should be compressed only once, because sequential compression of the same file will lose more detail and amplify any visible artefacts by-product). Save a JPEG image as a TIFF before editing to avoid losing additional data.

4. Use additional sharpening or Unsharp Masking (USM) for original images less than 118 l/cm (300 dpi) in resolution. ASTs render with greater detail and boosting USM is beneficial even for images of 118 l/cm (300 dpi) because fine ASTs can actually resolve unsharp masks on higher resolution files. When sharpening, use slightly coarser settings than for conventional screens because fine settings can inadvertently boost the appearance of noise or graininess in the image. Test different settings to find which is optimal for a specific workflow.

5. Leave images at full tonal range and do not clip or adjust shadows and highlights in order to compensate for press behaviour because tonal calibration curves are much better suited for this. Compressing the tonal range of images prior to applying tonal calibration may result in the further loss of shadow or highlight detail, or will flatten the overall image.

6. Fine ASTs resolve both intentional and unwanted detail; therefore, careful attention should be given to such things as photographic grain, which may be a desired effect or may be invisible until rendered with a fine screen.

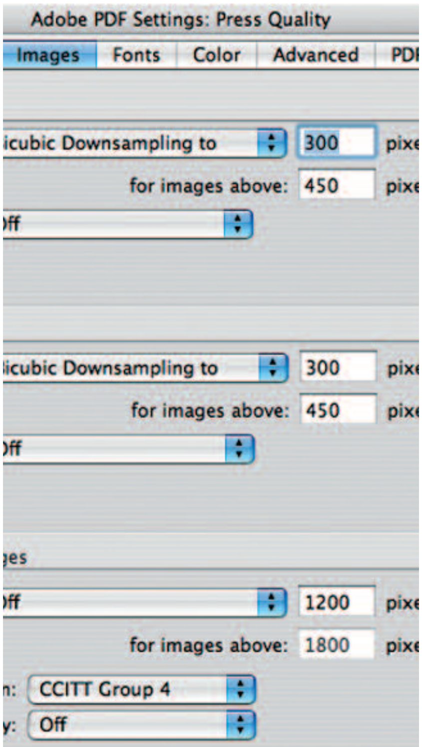
7. It is important to ensure quality of the separations because unwanted tone jumps or discontinuities in the smooth gradations may be rendered more visible by ASTs.

8. Fine screens and ASTs are less forgiving with separation artefacts such as CMY transitions to K caused by overzealous use of GCR and UCR. Grey balance measurements, colour management and experimentation are critical if extreme UCR and GCR settings are to be used for ink saving or colour stability.

9. Subtle moiré in digital images can be introduced at the scanning or photographic stage and may only become apparent when fine screens capture the subtle moiré detail embedded in the image. This phenomenon is difficult to predict but pay close attention to those images susceptible to subject moiré, such as fabric, textile or architectural patterns.

10. Ensure origination files are preflighted to avoid downstream production problems.

These guidelines are aimed at creating the conditions in prepress that will maximise print quality using ASTs. Success with finer screens requires processes that are standardised, stable and in control. Generally ASTs work well with industry standard practices in preparing images, files and pages, and in applying colour management and separation. The following guidelines improve on industry standard techniques to allow AST printers to focus on scanning and preparing images to enhance their image quality and printing.



Ensure colour and greyscale image settings in Adobe Distiller are set to no less than 118 l/cm (300 dpi) using bicubic down-sampling.

Profiles

Calibrating a press to create an accurate printing profile must take into account all variables influencing final output. The goal is to enable consistent printing to a given standard and tolerances by producing a standard grey balance from all plates when printed.

Paper and ink characteristics must be embedded in the press profile — the choice of paper determines the amount of ink that can be used.

Normally a single printing profile for all presses in a plant should be produced providing that all presses are printing within a common tolerance range. Presses need to be correctly set up and maintained and periodically measured to ensure that they are within tolerance.

Adjusting the platesetter profile to compensate for an out-of-tolerance press is a poor quality practice that should only be used as a temporary emergency solution.

Making a specific profile for every press is counter productive to good industrial manufacturing because it undermines flexibility to print jobs on different presses, complicates colour management, and causes quality variations.

Systematic approach

1. Assess press: A printing press is a moving target with a tendency to change pressures, densities, ink emulsification, register and other variables — it is therefore essential to control key variables if the press is to be capable of consistent reproduction.

• Choose and use consumables that optimise reproduction quality. Never change more than one consumable at a time. Re-run the test form to check impact on the press profile where appropriate.

• Check that press settings conform to specifications and that operating components are maintained in good condition.

• Assess the printing performance by running a test form (WAN-IFRA, GATF, etc). Determine the minimum size of dot reproducible on all presses. Any anomaly on the press needs to be fixed.

• Make a profile only when press is in a steady state because this will determine process accuracy and, from this, what tolerances can be consistently achieved. It is recommended to record for every test the values of SID, TVI, grey balance, overprint trap, dampening solution pH, conductivity and water temperature. A change to one variable can affect colour and/or productivity — charting performance allows quick identification of which variable(s) are out of standard.

2. Linear test plates: Using correct exposure power and processing conditions create a set of test plates using a suitable test form with NO compensation curves applied. The linear plates should be imaged using the screen ruling of the paper specified in the standard being used.

Caution — some thermal plates are linear (like film) whilst others are non-linear. Measure plates to ensure that the dot area is within an acceptable range. Many printers find that linearised plates provide the most intuitive baseline for quality assurance. (This has to be taken into consideration when implementing tonal compensation curves. It is important that plate curve measurements are made and that plate curves are kept the same for all colours in this set up procedure. This will provide a neutral input from the plate that does not cause confusion with the deviations in colour balance derived from a press influence.)

CTP platesetters are usually pre-calibrated to reproduce exactly the same % tone value specified in the origination file. However, CTP linear output is not optimum on press because of the absence of the TVI gain/loss that was a feature of the analogue film process. The printed result is much sharper, which makes colour matching extremely difficult. For this reason, the straight linear line is curved to alter the output information to create the required TVI gain/loss. Normally, CTP positive plates, when imaged at 50%, have a negative TVI of –3% to 0%; whereas negative plates have a positive TVI of 2-3%" (or tonal value between 47-50% for positive plates; 52-53% for negative plates). The linear plate calibration allows identification of the printing characteristics of a press for a given set of paper, ink, and blankets.

3. Printing: Run the set of linear plates under standard printing conditions to the SID and print contrast specified in the standard. Measure cross sheet evenness of SID and grey balance and adjust until deviation between ink key intervals is a small as possible. Once densities are stable, print 500 revolutions at typical production speed to provide sufficient copies to identify cyclic effects within the press. It is unlikely that the target TVI of the standard will be achieved because the plates are completely linear.

4. Measurement and evaluation: Measure 20 samples (from the beginning, middle and end of the 500 copy run) to identify the print curve required. Measure the 50% dot for CMYK and determine the difference in TVI between the test sheet and the selected standard. (The 50% dot is used because it has the largest perimeter and will exhibit most TVI with highest fluctuation on press.) If the deviations between the TVI from the press and those specified are beyond the tolerance of the standard, then the printing units need corrective maintenance to bring them back into tolerance.

5. Average the results of the measured tone values: Adjust plate calibration if needed.
If there is an anomaly on the press test form (e.g. one colour not coherent) the press should be adjusted — not the profile.

6. Set up the RIP and workflow to apply the new curves.

7. Make a second press run (repeat N° 3): Confirm that the tonal compensation curves are being correctly applied and results are to the specified standard.

8. Re-profile periodically: Effective process control requires that the equipment should be periodically controlled — particularly after changes to key elements like rollers, using different blanket type, etc.

Good printing requires measurement of SID, grey balance, TVI, dot gain, print contrast and trap. This means that a colour bar should be included in order to measure them. Colour bars are test targets that help monitor quality on every job.

Measuring devices

Reflection densitometer: Measures absorbed light and is used is to calculate the screen density, TVI, ink film thickness density in solids, grey balance, print contrast and trapping. However, this device is colour blind and relies on filters and software to identify and measure colours.

Spectrophotometer: A more flexible device that measures light reflection over the whole range of visible wavelengths to provide an accurate definition and analysis of colour. They can be used to produce ICC profiles for monitors and printing, measure control strips, and colour deviations (indicated as ΔE^*ab) between a digital proof and printed sheet; they can also be used as a densitometer because measurements can be recalculated to density values.

Colorimeter: Low cost device using filters and software. It reads and expresses CIELab value to verify colour gamut (preferred in ISO 12647 standards and for measuring ICC profiles); also used to calibrate and characterise monitors.

Some printers use spectrophotometers to measure any variations in new batches of ink and plates on delivery to avoid surprises during production. Some CTP systems automate this measuring.

Dotmeter: Special device to measure screen density on printing plates to ensure that they are correctly exposed and processed and within correct tolerances. These are essential to calibrate and linearise a CTP device.

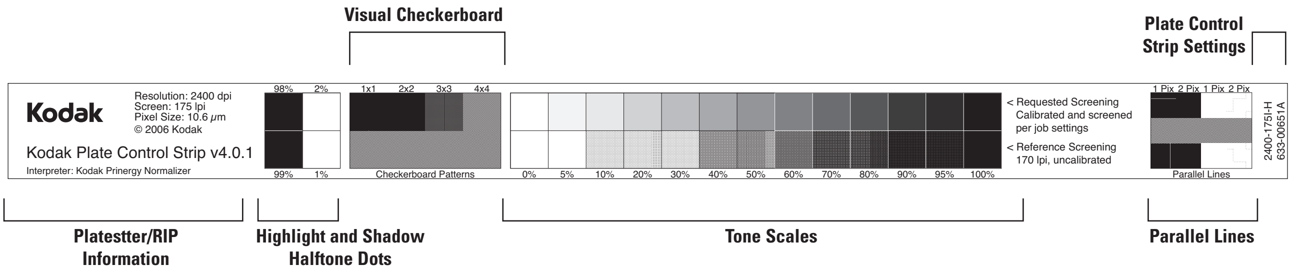
Not all dot meters can predictably measure all types of ASTs or some of the new process-less plates that have very low contrast; therefore, it is important to verify that the right tool is being used.

Caution, using conventional densitometers for this purpose is not recommended because of the low contrast on CTP plates.

Not all measuring devices work in the same way, e.g. with or without polarising filters, measuring angles. Therefore, it is essential that all devices used in the print plant are coherent.

Measuring instruments can only produce accurate values if they are regularly calibrated to the supplier's recommendations. Similarly, lamps and filters need periodic replacement

Platemaking



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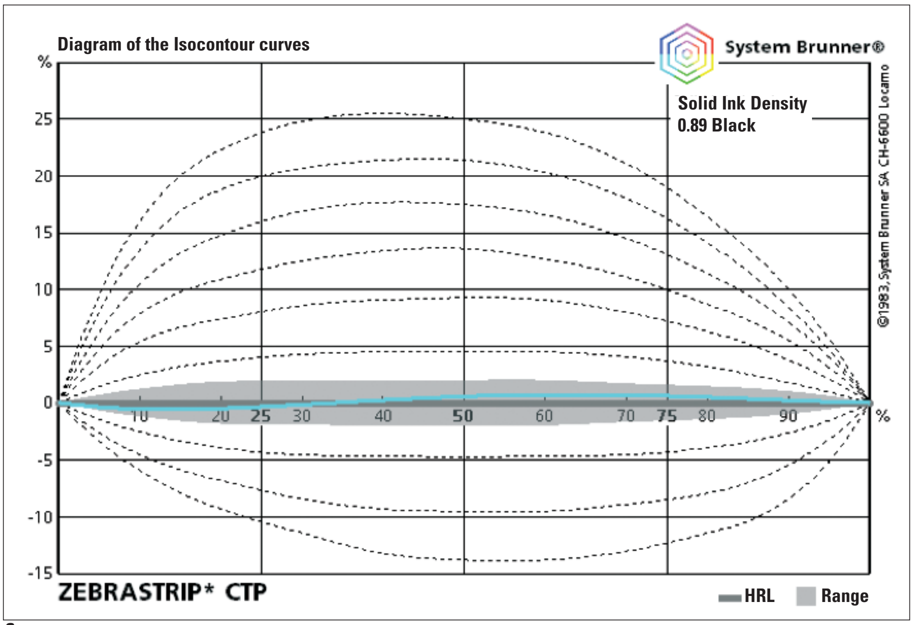

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2

Tools required to measure dot area on the plate:

- Digital plate control strip
- Plate dot reader

These tools provide specific tone values and the means by which to measure them to enable plate linearisation, monitoring and the implementation of tonal compensation curves.

Controlled imaging and processing in CTP is essential to maintain high and repeatable quality in the final printed product. The plate must transport the desired images with the correct tonal compensations curves to the press. These are derived from press optimised values for SID, TVI and grey balance to avoid manipulation or compensation of SID's on press. It is important that the process control ensures that SID standards are usable within the normal tolerances.

Platemaking methods

- Use qualified plate media for the platesetter, see information from the plate or imaging device manufacturer.
- Correct exposure values within manufacturer's recommendation.
- Correct processing conditions within manufacturer's recommendation
- Measurement of the tonal range
- Apply tonal compensation curves to meet required TVI standards for the press.

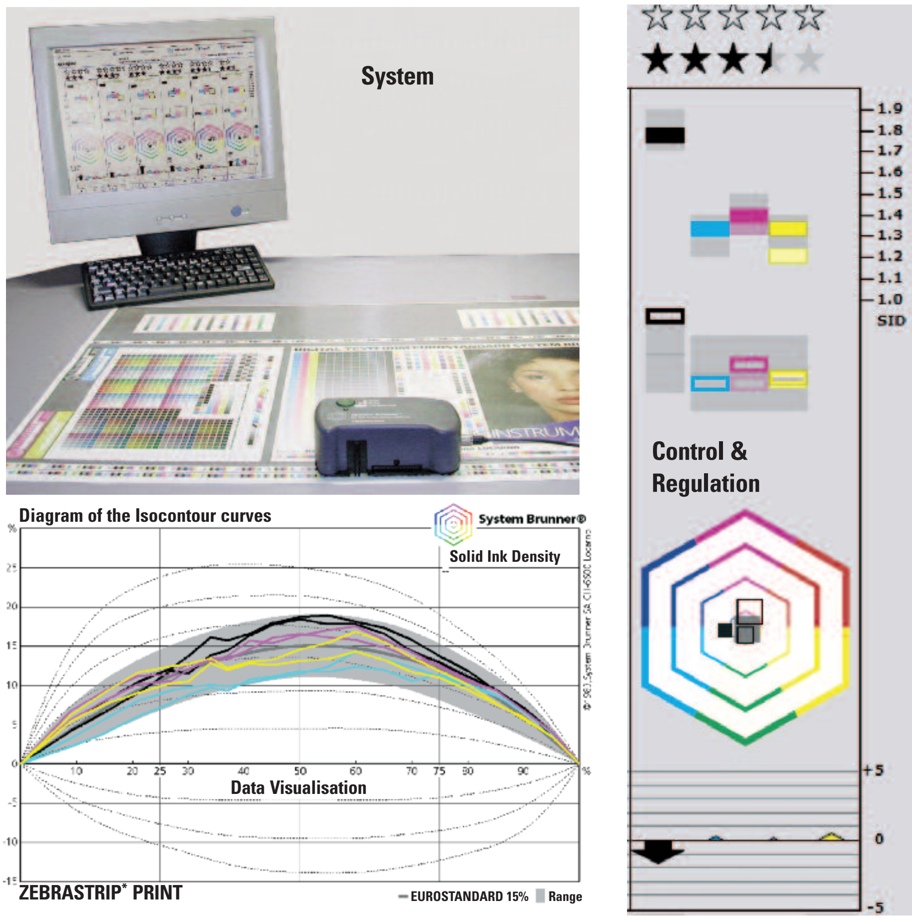
Place a digital control strip on every plate. Position them in the plate bend if they cannot be printed in the image area.

1- *Plate Control Strip is imaged on to plates and used to validate and monitor RIP data, applied screening, tonal values, tone curves and imaging uniformity.* Source Kodak GCG.

2- *Kodak Magnus 800 Quantum Thermal Platesetter.* Source Kodak GCG.

3- *Plate curve visualisation. Source: System Brunner Isocontour diagram©.*

Printing



More sophisticated systems measure SID, TVI, grey balance and other parameters. Source System Brunner.

Printing tools required to measure SID, TVI and grey balance:

- Suitable digital printing test form for calibration of the press.
- Digital print control strips for production runs
- Suitable spectrophotometer or densitometer or closed loop colour control system incorporating the measuring device.

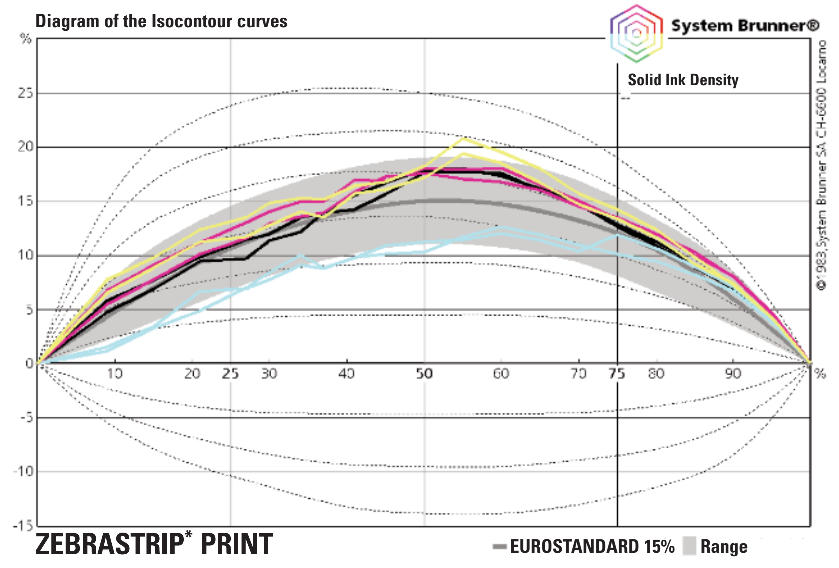
Printing Methods to apply

- Measure SID to recognised standards
- Measure TVI to recognised standards
- Measure grey balance (if measurement system allows)
- Use digital test form for press profiling.
- Standardise consumables including blankets, inks, dampening solution etc.

Press characterisation should not be considered as a one-off event for initial set up and should be repeated at set intervals to provide monitoring of stability and, in addition, after maintenance, or changes of consumables, that can impact on press reproduction.

Print characteristic curves

1- In this example, YMK have similar curves and are in the required tolerance. The cyan curve has a much lower TVI and is just dropping out of the lower end of the tolerance range. This kind of response is unstable and the right correction is crucial to ensure a valid set up and consistency (stable control of SID, TVI and grey balance). A decision has to be made here: Is a tonal curve adjustment made to bring the cyan curve in line with YMK? The cause is more likely to be found within the press if a balanced set of curves was established through plate measurement.



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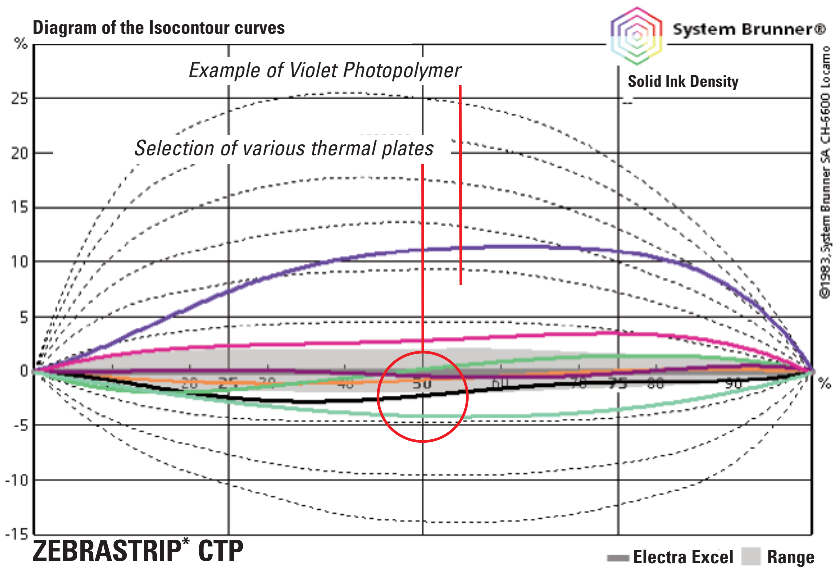
2- CTP plates curves
Each plate type has its own inherent tonal reproduction at the correct working exposure and processing conditions.



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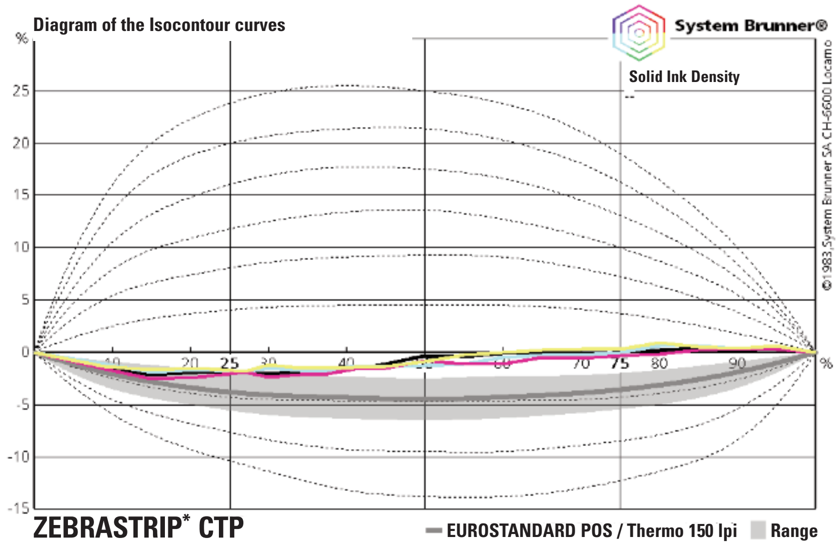
The TVI for each printing colour is examined to characterise the performance of each colour. The overall tonal value (effective dot area) is not considered until later.
The target is to bring the curves for each colour as close to the centre of the tolerance as possible. The tolerance window is set so that if the TVI deviations are within these limits then the grey balance is not severely affected. This assumes that SIDs are within specified tolerances.

Only implement new plate curves based on controlled data and qualified printing conditions.



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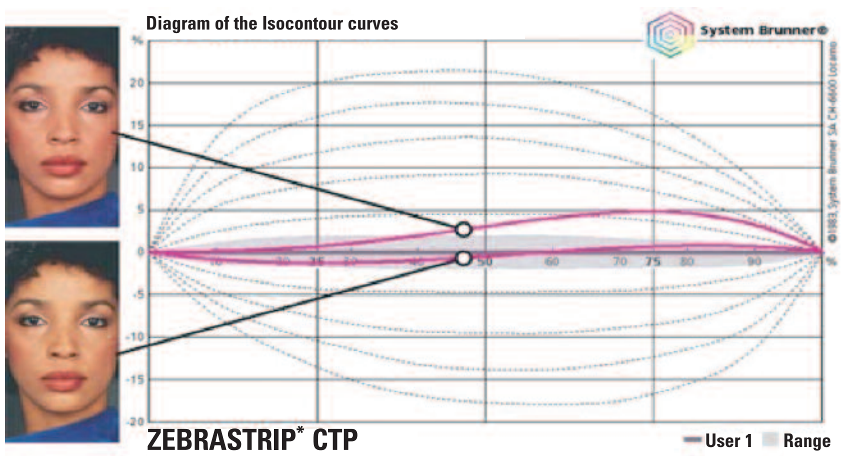
1- CTP plates curves
In this example the plate type produces an almost linear output, this result can be considered as a balanced set of plate curves as there is little or no deviation between them.



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2- CTP plates curves
This example shows what happens in printing when a plate curve is out of tolerance. The magenta curve has deviated from the linear position and this clearly influences colour balance in the printed sheet.

Key influences on quality

Maintenance is a key quality parameter	FREQUENCY	Daily	Weekly	months 1	3	6	12	Related problems Quality	Slow	Stop	Safety
Prepress											
Check plate setter calibration				✔				Q		✋	
Check plate setter image quality		✔						Q		✋	
Plate setter maintenance			✔					Q		✋	
- Check & Clean rollers		✔						Q		✋	
- Check air filters			✔					Q		✋	
Plate production line											
Check & Clean plate punch dies			✔					Q		✋	
Check chemistry activity		✔						Q		✋	
Change developer			✔	✔				Q			
Check finisher		✔						Q		✋	
Clean processor rollers		✔						Q		✋	
Replace processor filters			✔	✔				Q		✋	
Check processor chiller			✔					Q		✋	
Check baking oven				✔				Q		✋	⚠
Ink and dampening systems											
Ink supply (pump and piping)				✔				Q	◔		
Ink supply (pump line filters)			✔			✔		Q			
Check incoming water quality			✔					Q			
Dampening fountain unit		✔									
Clean dampening system, change filters			✔					Q	◔	✋	
Refresh dampening water			✔					Q	◔	✋	
Inking and damping rollers											
Hardness and visual surface check					✔			Q			
Roller setting check				✔				Q			
Roller cleaning		✔						Q			
Roller decalcifying			✔					Q			
Roller deep cleaning			✔					Q			
Bearing check					✔			Q		✋	
Blankets											
Clean blankets at end of run and inspect		✔						Q		✋	
Use correct washing solvents								Q			
Check blanket-packing thickness on press					✔			Q			
Replace blanket and packing correctly						✔		Q			⚠
Tension correctly								Q			⚠
Printing unit											
Colour register system: Clean sensor		✔						Q		✋	
Buzzle wheels & Web guide rollers: Clean			✔					Q			
Guard grids, clean and check safety				✔				Q			⚠
Printing couple: Check and set				✔							
- Check gap ink fountain and film roller								Q			
- Strip width inking & dampening roller								Q			
- Ink blade setting								Q			
Fountain blade: Check setting				✔				Q			
Check bearer ring pre-tension						✔		Q			
Cooling systems											
Clean water filters			✔					Q		✋	
Check rotary unions				✔				Q			
Compare temperature with setpoints			✔					Q	◔		
Vent system & refill						✔		Q		✋	
Clean cooling tower/condenser					✔			Q	◔		⚠
Complete system service							✔	Q	◔	✋	⚠
Heatset dryers											
Clean optical pyrometer				✔				Q	◔		
Clean dryer nozzles				✔				Q	◔		
Remove paper debris & clean screens			✔					Q	◔	✋	⚠
Chill rolls: Clean cylinder surfaces		✔	✔					Q			
- Check cylinders for wear & damage						✔		Q			
- Check pressure roller & pneumatic setting				✔				Q			
- Internal scale removal from cylinders							✔	Q			

The chart highlights the relationship between maintenance and quality (and related issues). Systematic maintenance and equipment setting are essential to ensure optimum quality from the production system. If press presetting systems are to deliver efficient results they require continuous and rigorous maintenance of inking and dampening systems. For more details see Guide No. 4 “Productivity Maintenance”.

Consumables

An essential best practice is that all consumable materials should be optimised as a system (ink, dampening solution, blankets, paper, plates). Accreditation is the ideal approach between suppliers to ensure that certain combinations of products will work in a certain way after mutual testing to establish their interactions during printing. For example, a set of inks with a certain press with controlled dampening solution, blankets and other press consumables would be tested and then individual suppliers would agree that the combination will behave in a predictable manner under specified performance at specified conditions.

Simply changing consumables will not improve AST results. Key issues are to select the correct screen size, control piling (adding IPA does not solve this) and ensuring that printing is neutral to the selected screens.

Influence of Prepress

Influence of Imaging

Laser resolution affects precision and consistency of dot and pixel formation. Higher resolution lasers produce harder edged dots that resist changes in chemistry life and dot wear on press

Influence of processor settings

Imaging: Use accredited CTP platesetters and thermal plate combinations. Ensure regular monitoring of power output of platesetter and preventive maintenance.

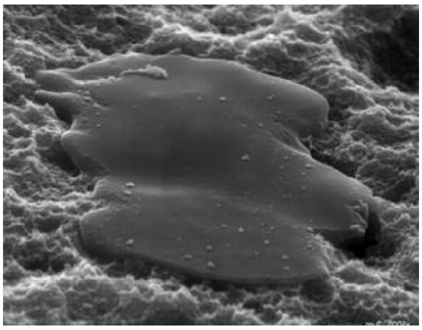
Plates: Should be high resolution with sharp, reliable and even dot reproduction to output flat and even tints. Thermal CTP plates are recommended because of their high-resolution capability - the hardness of their dots gives greater control of the reproduction curve and prevents dot sharpening on press.

Check the plate thickness with a micrometer because a thicker or thinner plate causes more or less pressure to the blanket that can affect TVI.

Influence of developer

Processing: Use accredited processors and chemistry with tight control of developer temperature and dwell time. Due to the sensitivity of fine AST dots during processing it may be necessary to increase replenishment and change developer more frequently than would be expected with conventional AM screening.

Baking plates: It is recommended to bake plates to increase their on-press stability by reducing the sharpening of fine AST dots - this ensures the dot remains the same size throughout the press run. Unbaked plates will give increased dot sharpening on press and will ultimately result in shorter run lengths than with conventional AM screens.



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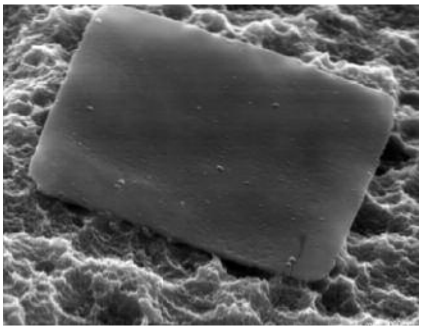

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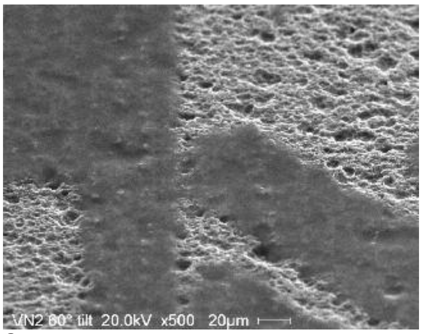

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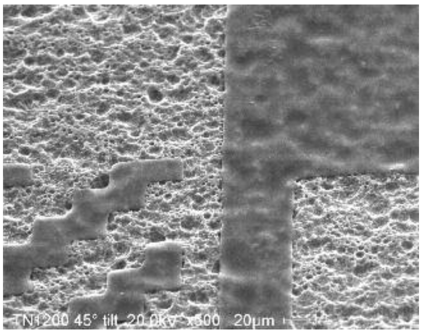
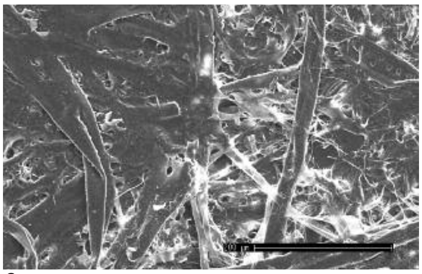


4

1- *2400dpi conventional CTP with 16 micron laser.*
2- *2400dpi SQUAREspot CTP with a 2.5 micron laser.*
3- *Microphotograph of violet plate.*
4- *Microphotograph of thermal plate. Source Kodak GCG.*



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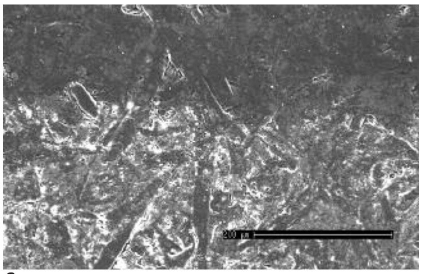

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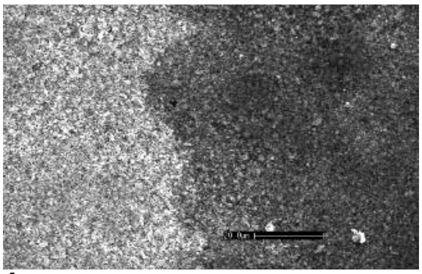

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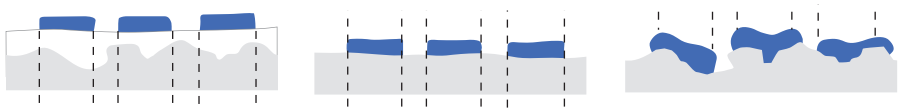
Influence of Paper

Dot increase



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Paper has the single largest factor impacting on print quality. The whiteness and smoothness of the paper largely determines the colour gamut and there is a direct correlation with TVI and achievable print density to paper surface smoothness and porosity.

Influence of Inks

The ink system needs good all-round printability with a consistent wet ink transfer to keep blankets clean throughout the run to reduce piling and plate build-up. The increased surface area of water-to-ink on the plate requires effective control of the emulsion with good water holdout. Even if the "working" ink contains some emulsified dampening solution it must still retain a correct rheology and tack to provide good transfer and trap. The wet-ink/water balance is a result of the controlled emulsion and is crucial to keeping printing clean and to help limit linting and piling. Optimum results can be achieved by using an ink with a good balance between pigment, resins and varnish to provide good ink transfer and water balance. This avoids overloading the ink with too much pigment. The process colours require well balanced strengths to avoid one colour excessively carrying too much, or too little, ink on the fine AST dots.
In general, AST screening is usually less forgiving on press and to processing deviations. Some printers experience increased blanket piling, particularly in web applications, because the overall ink film weight is lower — this in turn can shorten plate life.

Use a standardised ink (ISO 2846-2 is intended to ensure that similar colours are obtained in sets of process inks of different origins if printed with the same ink film thickness) on an optimised press to avoid emulsification and to provide better printing tolerance.

Recalibrate the process if the ink is changed as this can cause a difference of up to 5% according to WAN-IFRA (check correct target density, TVI and black reference).

Ink transfer on press is the most critical lithographic challenge to implementing ASTs. The ink must flow well to work on small dots that do not transfer well if the ink is stiff. Correct operating temperature has a major influence.

Dampening solutions

Dampening systems are continually contaminated from paper and ink particles, organic pollution and blanket washing solvents. A poor quality solution causes difficult ink/water balance, higher chemistry costs, environmental problems, debris build-up on rollers, plate and blanket cylinders.

Ensure the right combination of ink and dampening solution to match the press, papers, IPA level and water quality at each plant.

Check daily the pH because it influences the printing process and ensure good routine maintenance practices are used.

There are some differences between heatset and coldset dampening solutions because different dampening systems are used on each press class; also, some European heatset printers continue to use IPA. However, dampening solutions can be formulated to work with the ink to better control blanket washing cycles, improve transfer properties, and protect against corrosion.

***1-** The more even and dense the surface the better the dot coherence. Source UPM.*

When the ink wets the surface it spreads and sets in different ways. Printed ink spreads and penetrates more into rough and porous paper surfaces.
***2-** Ink on the surface of newsprint.*
***3-** Ink on the surface of SC paper.*
***4-** Ink on the surface of LWC paper. Source: SCA.*

Printing unit

It is essential to bring the press into an optimum and stable condition.

Do not adjust plate curves to compensate for poor press conditions. This is only justifiable to respond to a temporary press problem. See Guide 4 for detailed maintenance procedures. Ink presetting systems will not achieve uniform target density across the printed image unless the ink key zero settings are correctly calibrated to ensure that the calculated settings accurately produce the expected ink blade opening. The ink dampening solution must consistently lock up to the same position for zero settings to be accurate; and the ductor and water settings should be either standardised or controlled by the presetting programme. Some systems automatically correct non-linear curves to the % coverage for ink key settings. If not, then test plates should be printed and their image files processed to preset the ink keys, these settings are then adjusted to achieve uniform density at target value across the printing width for each colour. Optimum performance requires periodic evaluation of preset performance. Good ink rollers condition and setting are obviously essential for consistent high quality.

Influence of Blankets

The blanket is central to good offset printing and requires careful selection, packing, tensioning and cleaning to ensure printing quality, durability and minimum press down time. Excellent print quality requires a blanket that combines good registration and an accurate dot reproduction. The feed between web printing units is critical for registration. Depending on the press, feeding of the blanket can be positive, negative or neutral in relative terms. Accurate transfer of the ink/water emulsion at each cylinder revolution has to be high to prevent ink piling. This is significantly influenced by the surface roughness of the blanket which for heatset is typically between 0,9 to 1,4 µ. and coldset 1,3-1,9. This type of morphology helps keep a film of water on the blanket surface to optimise ink/water balance consistency. Using fine screens may cause piling from negative ink build up which can have adverse effects on blanket life.

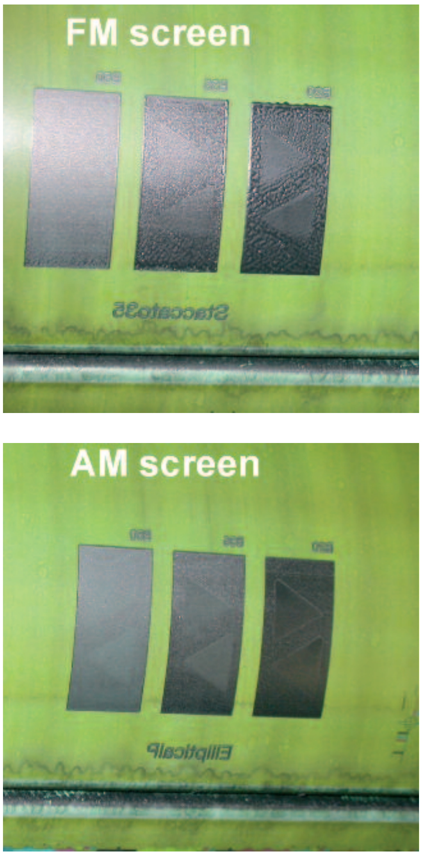
Select the blanket best suited to the specific production requirements with the help of the press manufacturer and blanket supplier(s).

Re-profile the press if the blanket type or manufacturer is changed because this may have an impact on reproduction characteristics.

See Guide 4 for blanket maintenance procedures.

Negative blanket piling: Non-image piling (and back trapping) tends to increase with fine screens and may increase blanket consumption. The formation of piling on the blanket causes loss of tonal value as the build up of ink and paper components in the blanket's non-printing areas can lead to the formation of a "crater" around the halftone dot that reduces its size. The blanket is then no longer capable of transferring the ink to the areas of the dot to be printed. The original slightly sharp halftone dot outline gradually becomes smaller with much more pronounced edges. The tonal value of the AM or FM screen surface is therefore considerably reduced. Changing the screen does not solve this problem.

The remedy is to adjust the ink/water balance on the first two units.



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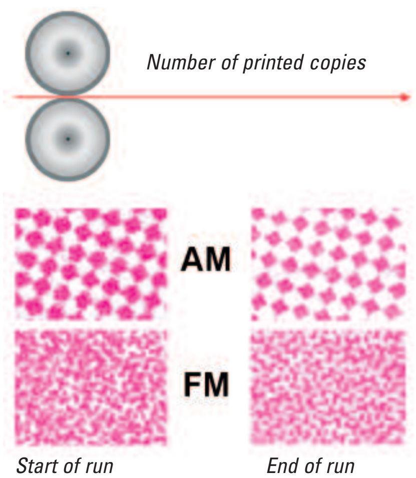

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***1-** Printing blanket showing the differences between FM and AM screening.*
Source Trelleborg.

***2-** Non-image piling tends to increase with fine screens. The remedy is to adjust the ink/water balance on the first two units.*
Source manroland.

Evaluating an AST technology to conventional AM?

There are significant differences between Alternative Screening Technologies (first and second generation FM, AM/FM hybrid, etc.) and it is recommended that potential users test different types to ascertain which is best suited to their typical print jobs and specific production conditions.

Objectives: When evaluating the economic viability of ASTs the incremental business value and savings should be weighed against the technical requirements and costs of printing with ASTs. Assess if either different conventional AM screens or an alternative AST will:
A- Improve perceived print quality and reliability of output
B- Provide a competitive advantage
C- Improve financial performance.

Parameters to test correctly include:
1 Audit current AM workflow: Run test forms under full production conditions & tolerances.
2 Remedy errors if required: If the result is inadequate then optimise process and controls. Only when OK move to next step.
3 Create a test form: Select images that are representative of work normally printed. Some image types have different impact reproduction when using AST.
4 Test print form using current AM screen: Different AM screen rulings (current, finer and coarser).
5 Test print form AST: Run with different resolutions.
6 Assess results current AM AST: Qualitative and quantitative.
- Objective measurements using correctly calibrated instruments.
- Subjective perception panels (cross selection of staff, customers, advertisers). Multiple panels in different global locations during the same week.
- Identify any changes to process to sustain printing consistency and productivity

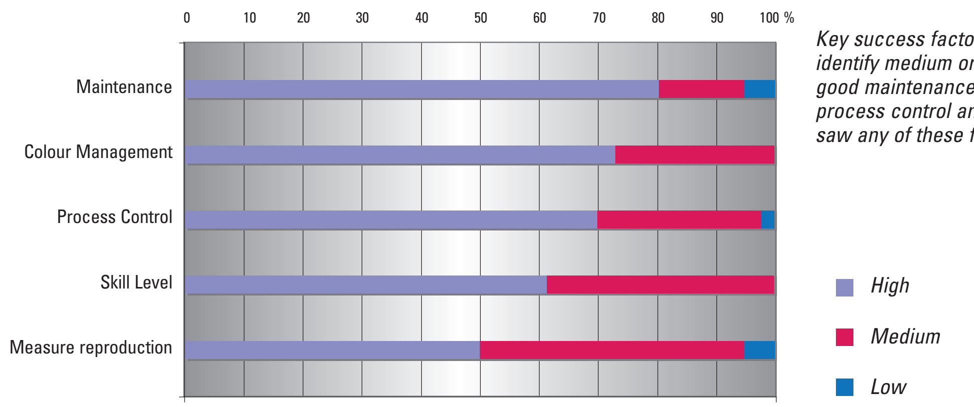
The comparison process
- Must be transparent and clear for all stakeholders.
- Identify any potential roadblocks for overall success.
- Identify the optimum solution for the business (and its customers).
- Permit a decision on quantitative data and other information to identify the right technical solution.

How to:
- Ensure long-term sustainability and success of the defined technical solution.
- Implement selected technology without any major “upsets” to any other area of production.

AST Industry experience

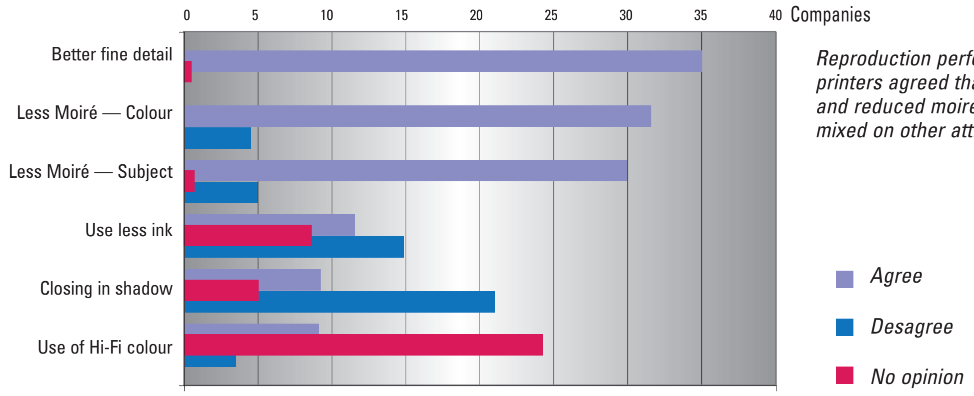
WOCG surveyed 35 AST users (77% heatset, 23 % newspaper) to better understand their experience. Most responding companies have been using AST for over two years, predominantly for publications, advertising catalogues and directories.

Criteria for successful use of FM?



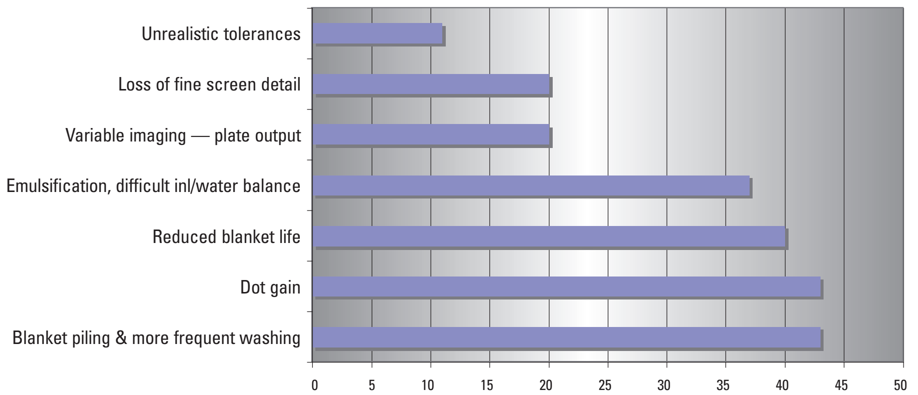
Key success factors: Almost all AST users identify medium or high criteria for success as good maintenance, colour management, process control and skill level. Less than 5% saw any of these factors as of low importance.

Claims for FM reproduction



Reproduction performance: Almost all surveyed printers agreed that AST gives better fine detail and reduced moiré. Responses were more mixed on other attributes.

Frequent FM production problems?



Production challenges: The use of AST requires attention to cause blanket-related problems. TVI and ink/water balance are related issues — over half of the printers use alcohol in their dampening solutions with concentrations varying from 2-13%.

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.
www.kodak.com

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.
www.man-roland.com

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.
www.megtec.com

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.
www.mullermartini.com

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.
www.nittoeurope.com, www.permacel.com, www.nitto.co.jp

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.
www.quadtechworld.com

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.
www.sca.com, www.publicationpapers.sca.com

Sun Chemical is the world's largest producer of printing inks and pigments. It is a leading provider of materials to packaging, publication, coatings, plastics, cosmetics, and other industrial markets. With annual sales over $3 billion and 12 500 employees, Sun Chemical supports customers around the world and operates 300 facilities throughout North America, Europe, Latin America and the Caribbean. The Sun Chemical Group of companies includes such well-known names as Coates Lorilleux, Gibbon, Hartmann, Kohl & Madden, Swale, Usher-Walker and US Ink.
www.sunchemical.com. www.dic.co.jp

Trelleborg Printing Blankets is a product area within Trelleborg Coated Systems. Trelleborg is a global industrial group whose leading positions are based on advanced polymer technology and in-depth applications know-how. Trelleborg develops high-performance solutions that seal, damp and protect in demanding industrial environments. Trelleborg is represented in the printing industry with its brands Vulcan™ and Rollin™. With the market knowledge grown over many years combined with innovative technology, patented processes, vertical integration and total quality management, servicing 60 countries on five continents, both brands can be considered among market leaders worldwide, providing offset printing blankets for the web, sheetfed, newspaper, business forms, metal decorating and packaging markets. Its European production sites are certified with ISO 9001, ISO 14001 and EMAS certifications.
www.trelleborg.com