



Print Media Academy

HEIDELBERG

Profi Tip Color Management

Foreword

DEAR READER,

Brilliant colors true to the original on a premium surface – that's what distinguishes a high-quality print product. Many elements in prepress and printing impact on a product's color fidelity. The various input and output units in a print shop's production process, consumables and other factors can cause deviations in color. A consistently employed color management system eliminates this problem. In this issue of Profi Tip we'll show you the most common sources of error and give you tips on color management. We're pleased to have caught your interest.

Sincerely yours,
the Team of the Print Media Academy



Print Media Academy

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What is Color Management?

The color management process enables an identical color impression to be produced error-free on various output units, such as monitors, proofers and printing presses.

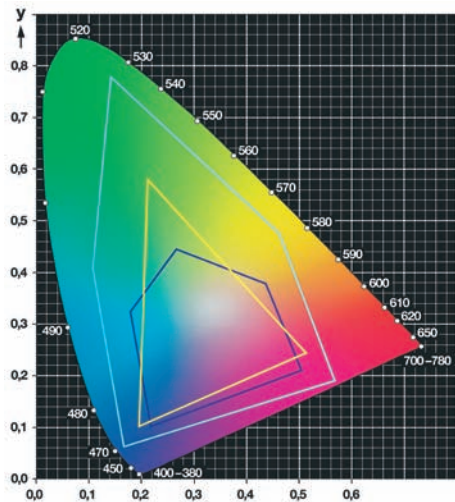


With a consistently employed color management system, a template made on any input unit can be reproduced virtually identically at any output unit. Color management systems can also harmonize a range of devices, such as scanners, digital cameras, monitors, printers, filmsetters and platesetters. The color is then shown according to the print conditions, for example.

- ① **THE PRINT RESULT IS AT THE HEART OF THE COLOR MANAGEMENT PROCESS, BECAUSE THE POSSIBILITY OF MAKING CORRECTIONS DIRECTLY AT THE PRINTING PRESS IS LIMITED.**

Color Ranges

The illustration shows different color ranges. Often colors cannot be displayed identically. Color management can adjust the color ranges.



Printing Standards

A uniform standard is needed as the basis for well-coordinated technical cooperation between client, prepress and press.

The Media Standard Print emerged as the result of an initiative launched by the German Printing and Media Industries Federation (bvdm).

ISO 12647 defines both the technical guidelines for digital printing data as well as the specifications and tolerance range for digital contact proofs.

Current documents on printing standards are available for download online:

- www.bvdm-online.de
- www.iso.org
- www.fogra.org
- www.color.org/japancolor.xalter
- www.gracol.com
- www.swop.org
- www.eci.org

Requirements

To ensure successful color management, certain requirements must be met and work steps followed beforehand:

1. Once an order has been accepted, the data must be checked:
 - Image resolution 304.8 dpi@150 lpi
 - Chromaticity 4c + possibly special colors
 - File format PDF X3
 - Fonts should be embedded
2. Printing plates are initially linearized:
 - Tonal values are transferred 1:1. 50% in the file corresponds to 50% on the printing plate.
3. Computer to plate (CtP) is recommended for an ideal transfer of tonal values.
4. An ideally set printing press and standardized work are essential! The printing press must be maintained and set according to Heidelberg guidelines.
5. The climate of the pressroom and paper storeroom must be kept constant.

The 8 Steps of the Color Management Process

Many factors contribute to successful color management – from consumables, through the test print and up to the monitoring results. This section looks at the individual elements and how to optimize processes step by step in order to achieve the desired end quality:

1. Choose consumables
2. Determine production conditions
3. Optimize prepress
4. Optimize the printing press
5. Print and evaluate test form
6. Calibrate processes
7. Generate ICC color profiles
8. Check color management procedures

① **ICC IS THE ABBREVIATION FOR THE INTERNATIONAL COLOR CONSORTIUM, A CONSORTIUM MADE UP OF MANY MANUFACTURERS OF GRAPHIC, IMAGE PROCESSING AND LAYOUT PROGRAMS. THE CONSORTIUM'S GOAL IS THE STANDARDIZATION OF COLOR MANAGEMENT SYSTEMS. AN ICC PROFILE (COLOR PROFILE) IS A STANDARDIZED DATA SET THAT DESCRIBES THE COLOR SPACE FOR COLOR INPUT OR COLOR REPRODUCTION UNITS SUCH AS SCANNERS, MONITORS AND PRINTERS.**

Step 1: Choose Consumables



Consumables have a very large influence on the print result. Deciding on set materials creates a basis and defines the boundaries. Changing consumables produces new results, which may necessitate recalibration. Thorough planning is, therefore, required. Examples of consumables include:

- Printing stocks
- Inks
- Blankets and underlays
- Dampening solution (additional amount + IPA)
- Printing plates and development chemicals
- Proofing paper and ink

The consumables from the “Saphira Starter Kit Commercial Standard” have been specially qualified for Heidelberg machine acceptances, color management procedures and/or certifications according to the ISO 12647-2. The Heidelberg sales offices provide the Saphira Starter Kit for machine installation. For further information and availability in your country, please contact your local Heidelberg representative.

GRADES OF PAPER

The ISO 12647-2 standard defines the specifications for 5 different grades of paper.

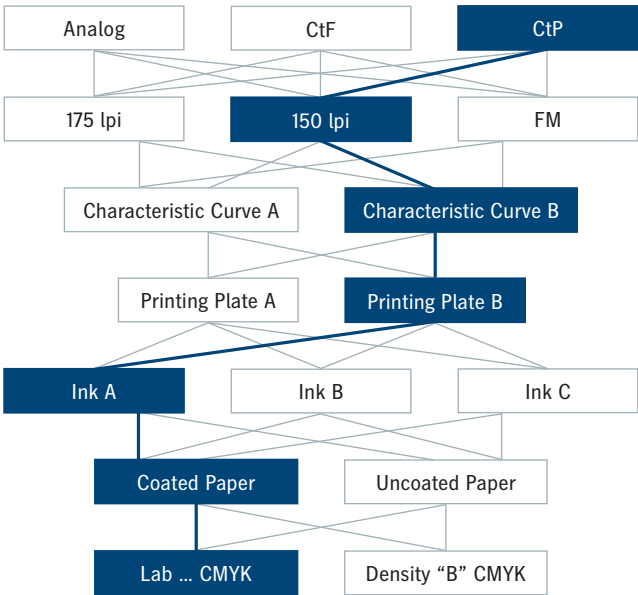
Paper Grade	Description
1	gloss coated, woodfree, 115 gsm
2	matt coated, woodfree, 115gsm
3	gloss coated, LWC*, 70 gsm
4	uncoated, white, 115 gsm
5	uncoated, slightly yellowish, 115 gsm

*LWC = light weight coated (web offset)

A MULTITUDE OF POSSIBILITIES

Different prepress and print processes as well as different materials all produce different results!

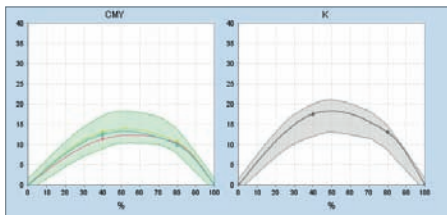
It is, therefore, essential to coordinate all processes and limit the options for coloring.



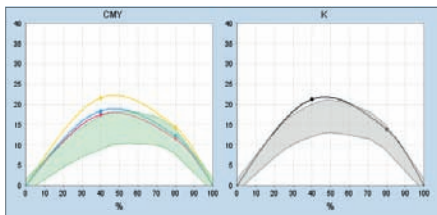
PRINTING PLATES

Different levels of dot gain can be generated depending on the water flow and ink absorption.

This can cause the color dimensions to lie within or outside the range of tolerance depending on the type of printing plate, even when the same ink is used.



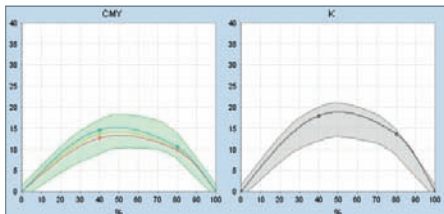
Printing plate type A: Color dimensions within the range of tolerance



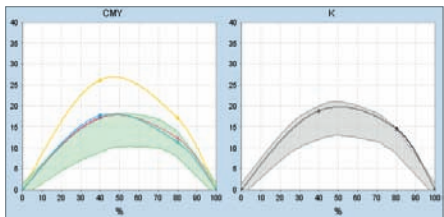
Printing plate type B: Color dimensions outside the range of tolerance

INKS

Different inks can generate different levels of dot gain. This can cause color dimensions to lie within or outside the range of tolerance depending on the ink that is used.



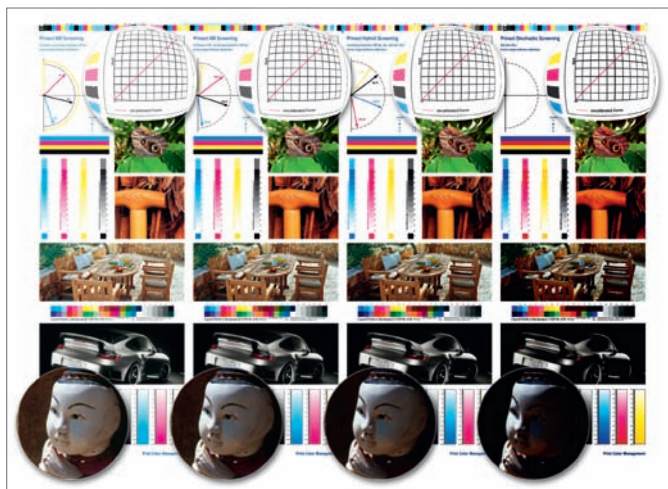
Ink type A: Color dimensions within the range of tolerance



Ink type B: Color dimensions outside the range of tolerance

SCREEN RULINGS

Different screen rulings produce different levels of dot gain during printing and thus different representations of an image.



IS Classic

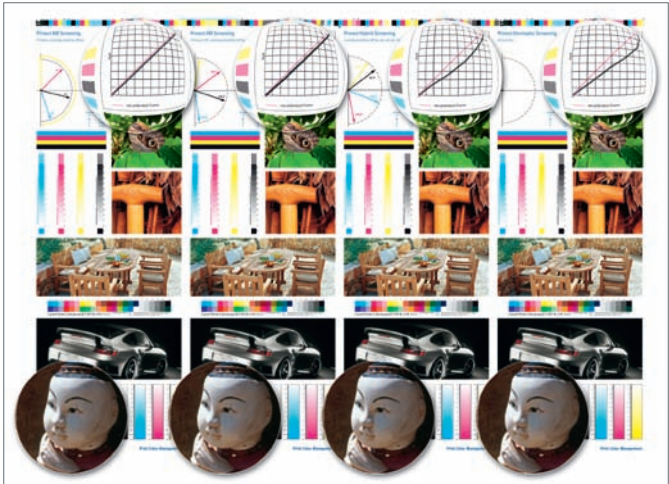
IS 7.5

Hybrid

Stochastic

Different screen rulings have to be calibrated differently in order to make the images match.

CtP technology allows you to easily adjust the plate characteristics so that the same tonal values can be reproduced in printing, independent of the screen rulings. This makes it possible to achieve a unified print image.



IS Classic

IS 7.5

Hybrid

Stochastic

Step 2: Determine Production Conditions

To ensure successful color management the production conditions must first be determined:

- Choose the ink (manufacturer, type)
- Define color standards incl. range of tolerance ($L^*a^*b^*$ values, dot gain, possibly density)
- Set order of colors (BCMY)
- Assign printing units (with more than 4 printing units)
- Set print speed for general production (set-up speed as close to printing speed as possible)
- Select inking unit temperature (normally approx. 82.4-86 °F [28-30 °C])
- Decide when sheets are to be pulled and measured (only once the printing press' production and the balance between ink and water are both stable)

- Select measuring device and procedure (we recommend choosing a measuring device that prevents mistakes caused by differences between the machines, for example. In case of uncertainty, an official and unbiased test center, such as Fogra, Ugra, bvdM, decides.)
- Set spectral test conditions (observer angle 2°, D50 illuminant, CIELAB color system, without polarizing filter, absolute white base)
- Set test conditions for density and dot gain (with polarizing filter, filter set, ISO status A, E, I or T, paper white base)
- Set test elements and aids (e.g. Ugra/Fogra media wedge, DPCO printing control strips, Mini Spots®)
- Set screen type (amplitude-modulated “AM”, frequency-modulated “FM”)
- Screen definition (lpi for AM screens, dot size for FM screens)
- Check viewing light (D50)

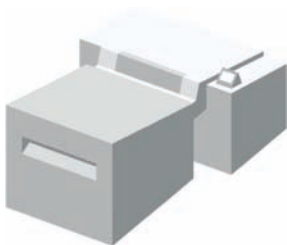
① EVEN IF WORK PROCESSES AND MATERIALS ARE OBVIOUS THEY SHOULD STILL BE DOCUMENTED AND MADE ACCESSIBLE FOR EVERYONE AT ALL TIMES.

Step 3: Optimize Prepress

Make sure that the CtP printing plate is imaged by the platesetter's recording unit using the right energy values and corresponding speed.

Following this, and depending on the system, the platesetter is linearized. This ensures that the exact same dot size is on the plate as was in the digital data.

The same applies to filmsetters. The target result is a "linear" film with sufficient density. If a printshop only uses its own CtP plates, no further steps are necessary and the first linear imaged plate set with corresponding test form can be released.



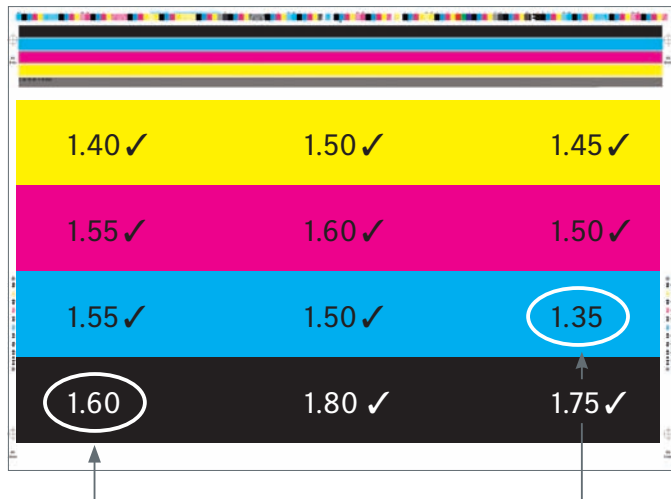
Step 4: Optimize the Printing Press

The first prerequisite for an optimized printing press is standard settings according to the operating manual. The following should apply:

- Well-maintained rollers (clean and velvety surface)
- Inking units adjusted
- Basic setting for oscillators (tolerance for ink fading max. 10%)
- Dampening units correctly adjusted (see next page)
- Pre-dampening and post-dampening phases reduced to a minimum
- Dampening solution checked and possibly replaced
- Smearing point of individual units determined
- Attention paid to an even smearing edge at the plate edge
- A set type of blanket used in the printshop
- Pressure between plate and blanket at 0.1 to max. 0.13
- Pressure between blanket and impression cylinder set according to surface of printing stock; excessive pressure must be avoided

ADJUSTING DAMPENING UNITS

The adjustment of the dampening unit can be checked using a simple test form. The coloring of each individual color with the same color profile should remain the same across the entire sheet. The range of tolerance for density should be 0.15 at most. If deviations are too high, the dampening units must be optimized accordingly.



- ① **TOO MUCH DAMPENING SOLUTION, USUALLY ON THE EDGE OF THE PRINTING PLATE, AUTOMATICALLY LEADS TO A LOWER DENSITY.**

Step 5

Print and Evaluate Test Form

Once all the prerequisites for consumables, production conditions and machines are fulfilled, it is time to print the test form:

- The first goal is to achieve the prescribed standard $L^*a^*b^*$ values in the full tone fields of the test form and the print control strips. Continue printing until the best possible value is achieved. At least 200 sheets should be produced with the same consistent result. The sheets then need to dry.
- After drying (30-60 minutes for coated paper) the sheets are measured again. The specifications generally refer to dry values, since only these can be measured by the end consumer.
- If the measured results correspond to the specified value as closely as possible when dry, too, the tonal values (printing characteristics) can be taken from one of the sheets. If this is not the case, a series of sheets with different thicknesses of ink can be created. In order to avoid measurement mistakes and material defects, multiple sheets should always be measured on multiple spots.
- The measured values are then noted or saved automatically on a PC or Mac with an online connection.
- Measurement conditions must be observed (see page 17).

underinked

ok

overinked

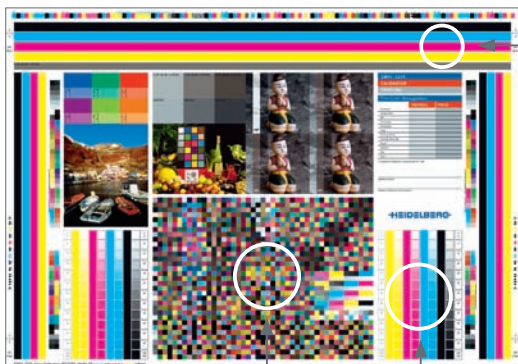


Printed sheet with lateral ink fading for determining the ideal coloration value

- ① **IN ORDER TO DETERMINE THE APPROPRIATE TARGET VALUES (WET/DRY) THE PRINTER CAN SIMPLY CREATE A LATERAL INK FADING “STAIRCASE” ON A SINGLE PRINTED SHEET INSTEAD OF AN ELABORATE A SERIES OF SHEETS WITH DIFFERENT THICKNESSES OF INK. HE CAN THEN DETERMINE AND TAKE THE IDEAL VALUE FROM THE SINGLE SHEET.**

EVALUATE PRINTED TEST FORM/ RECORD DATA

When evaluating the printed test form the following parameters should be considered/checked:



Solid fields: Even coloring according to the standard $L^*a^*b^*$ values from the full tones on the print control strips.

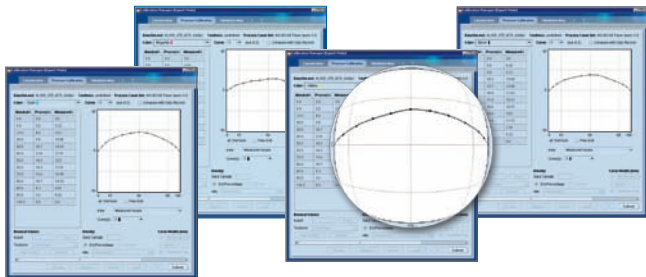
ICC color profile:
Measuring the color values for the printing press' "fingerprint"

Screen percentage fields:
Determination of dot gain

- ① **WHEN PRINTING THE TEST FORM, THE PRINTER SHOULD MAKE SURE THAT THE PRINTING PRESS IS WARMED UP, THAT HE PRINTS AT THE POINT OF SMEARING AND THAT THE REGISTER IS EXACTLY ACCURATE.**

Step 6: Calibrate Processes

When calibrating processes, the dot size on the plate is adjusted to match the desired result in printing. A CMY value of 40% results in a dot gain of 13% or a total value of 53%.



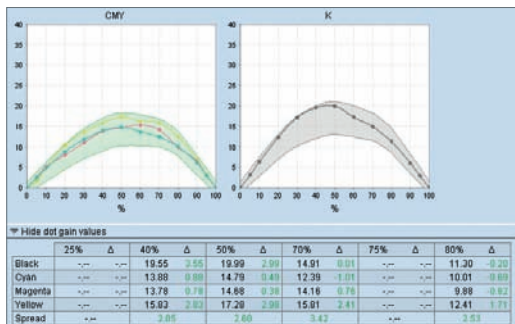
Screenshots from the "Prinect Calibration Tool" show the calibration curves for BCMY.

Corrections to the dot size on the CtP plate are carried out on the raster image processor (RIP) = printing plate calibration/process calibration.

- ① **DOT GAIN IS DEFINED AS THE DIFFERENCE BETWEEN THE SCREEN TONAL VALUES ON THE FILM OR DATA AND THE TONAL VALUES IN PRINTING. DOT GAIN IS INFLUENCED PRIMARILY BY SCREEN RULINGS, PAPER SURFACE, INK RHEOLOGY, THE BLANKET, PRESSURE AND WETTING OF THE PLATE.**

The test values from the printed test form are compared to the specified values. In doing so, it is particularly important to pay attention to the gray axis. The maximum spread allowed for CMY is 5%.

A neutral gray balance must be maintained; tonal values should be targeted according to the specifications of the ISO 12647-2.

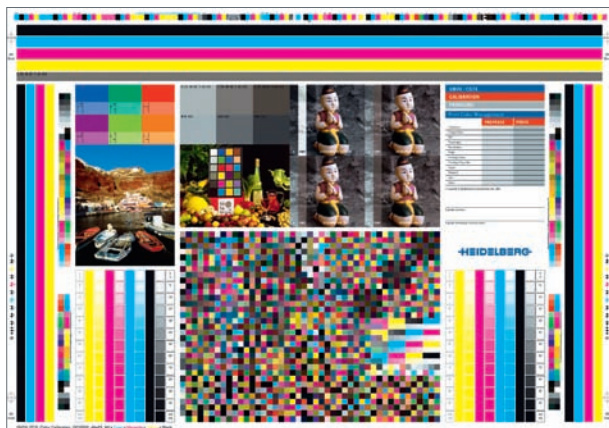


Gray balance recommendations from DIN 12647

Quarter tone	C 25 %	M 18 %	Y 18 %
Middle tone	C 50 %	M 40 %	Y 40 %
Three quarter tone	C 75 %	M 64 %	Y 64 %

Step 7: Generate an ICC Color Profile

A test chart for determining the ICC profiles can be spectrophotometrically measured from the previously printed test form (with corrected dot gains). In doing so, it is important to make sure that the average value from multiple sheets is used. The ECI 2002 or IT8 7.4 is a suitable test chart.



When the tonal values correspond to the standard, the color fields on the test form (ECI 2002) are measured with a spectrophotometer. A profile generating program (e.g. Prinect® Color Tool) uses the values to create an ICC color profile. During proof calibration, the same test chart is displayed on the proof device and measured accordingly. An ICC profile is thus generated.

The monitor should also be calibrated. In this case, the hardware calibration serves to achieve optimum results. Calibrating tools are provided by manufacturers of measuring devices and monitors, such as GretagMacbeth, X-Rite, EIZO, NEC...

The calibrated monitor can later be checked for color fidelity using a monitor certification tool (for example UDACT from Ugra). The result is:

- Color-binding proofs
- True-to-color display on the calibrated monitor
- Color separations optimized for printing



COLOR MANAGEMENT APPLICATION

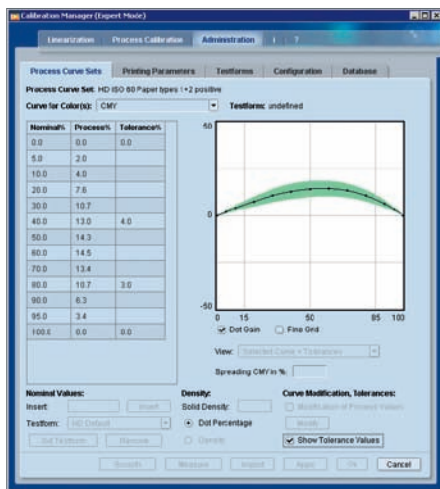
The created ICC profiles (for proof and print) are saved in the RIP. This means that the proof device reproduces the exact same color space as in offset printing, thus creating a true-to-color proof for the printing press (usually using ISO profiles but possibly based on the fingerprint). This proof can then be used as a reference.



Step 8: Check Color Management Procedures

After entering the values into the RIP's calibrating program on the CtP unit, the results should be monitored:

- Image the test form with the adjusted values
- Always image the entire plate set even if individual colors have not been adjusted!
- Carry out the machine print proof according to set consumables and production conditions
- Measure tonal values and adhere to tolerances



Screenshot from the "Prinect Calibration Tool" shows the range of tolerance for CMY.

Good Results Thanks to Color Management

The goal of this procedure is achieved when as little as possible needs to be set or changed on the printing press. The whole purpose of color management is a consistently reproducible and comparable quality.

- True-to-color proofs



- True-to-color display on the calibrated monitor



- Color separations optimized for printing



Color management as the basis for high quality and reproducibility.

Consistent Quality

Printing ink can change from batch to batch, the dampening solution can have a different impact, and conditions change even within a run. It is, therefore, important to consciously address these changes.

The print result should be checked at regular intervals. One of the most important criteria for this check is dot gain, because this plays a decisive role in influencing the gray balance and thus the overall print image. When changing the batch of ink or the printing substrate, a dot gain test is indispensable.

Corresponding control elements (mini spots) or the tonal value fields of the print control strips should be used in the process. More fields result in a more reliable analysis.

In the event of very different levels of dot gain despite ideal printing press settings, the process calibration should be adjusted in prepress. This should only be done once a trend chart across multiple orders confirms the result and need for adjustment.

① **HEIDELBERG OFFERS ITS “PRINT COLOR MANAGEMENT” SERVICE IN MANY COUNTRIES. HEIDELBERG PRESS AND PREPRESS EXPERTS HELP WITH THE STANDARDIZATION PROCESS IN PRINTSHOPS.**

Standardized Workflow



ICC profile Process calibration



Proofing



Printing

Output



Consumables
Ink/paper/...



Proofing





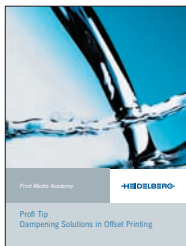
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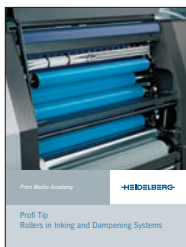
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Offset Printing

*Feuchtmittel im
Offsetdruck*



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in the Pressroom

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Rollers in
Inking and
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*Walzen in
Farb- und
Feuchtwerk*



Coating, Drying
and Powdering

*Lackieren,
Trocknen und
Pudern*



Color
Management

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