



Johann Bauer
Screen Centre;
Training Program

COLOUR

PAD PRINTING

Working with screen films is a very common process for many pad printers – that is to say, when they need to screen elements after exposure of the line motive onto the plate.

A uniform, full surface colour print should be achieved by that type of process with any colour shade. Here screening is used as an aid, but is not supposed to be visible. However, in this article “4-colour process pad printing” we intend to address quite a different topic: Printing of coloured photos by pad printing process. In some industries, such as the toys industry, technology has been commonly used for many years. Actually every pad printer, who has a 4-colour printing equipment, can offer 4-colour process prints.

Pad printing is a printing technology, which can reproduce high quality coloured images as this process allows printing many screen lines. The four colour process inks are always printed wet-in-wet, always dried or cured after the final colour print allowing a quick production.



Additive colour mixing (RGB)



Subtractive colour mixing (CMYK)

4-COLOUR PROCESS PAD PRINTING

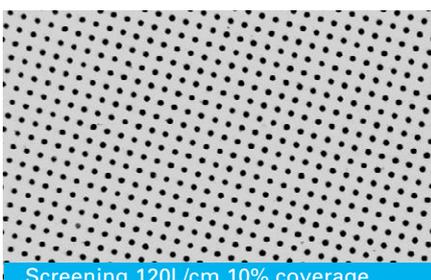
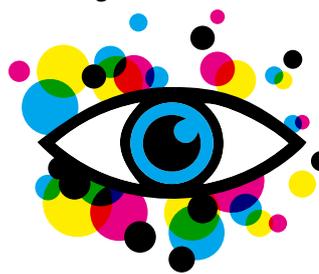
Generally process printing is used to depict so-called halftones by printing technology. You can reproduce various degrees of brightness in one printing step with one single colour shade.

Process technology is making use of this and transforms the colour shades of varying brightness into many quite small dots. The human eye will perceive those dots as an even surface. Depending on the

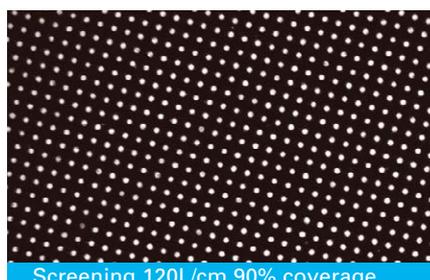
tonal value to be reproduced these halftone dots have various diameters (or numbers on a defined surface). Even though only one

colour shade is applied, there will be various degrees of colour brightness due to the coverage of the printed surface with printing ink. Coloured images are reproduced by

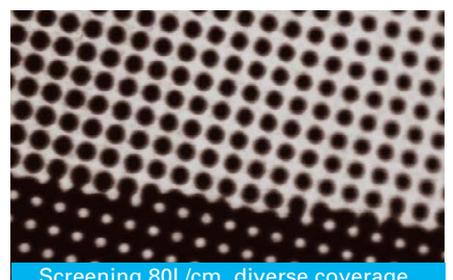
4-colour process based on the regularities of additive (RGB) and subtractive (CMYK) colour mixing.



Screening 120L/cm 10% coverage



Screening 120L/cm 90% coverage



Screening 80L/cm, diverse coverage

Today, transfer from sample image to print is a digital process, the "Colour Management", a process enabling a safe colour reproduction of the sample to the printed image.

The result of that process is the division of the colours of the image into four colour ranges and various degrees of brightness. These data are then converted into halftone dots and can be exposed as screen films.

Taking into consideration the specific printing conditions you can also make a binding colour proof. A direct comparison of the print with the original picture is not recommended, as for technical reasons certain deviations between original and print cannot

be avoided. Also it does not help using a print out from any digital printer as sample. The four screen films are used to expose 4 plates. Then you can print using three specific highly transparent colour shades – cyan/magenta/yellow – and black.

These colour shades are also called halftone colours/scale colours/process colours or:

CMYK Process Inks

- C = Cyan** = process blue
- M = Magenta** = process red
- Y = Yellow** = process yellow
- K = Key** = process black

The shades of these printing inks are adjusted according process standard offset printing (PSO), ISO 12647-2.

HALFTONE SCREENS

There are two ways to screen the images, the AM screen (amplitude modulated) and FM screen (frequency modulated).

For pad printing mostly the AM screen is used.

Typical pad printing images are small, thus there is mostly a small distance between eye and print (<40 cm). One should not be able to see the single halftone dots from that distance, thus printers should work with a screen line distance of more than 60 lines/cm. The AM screen offers various geometric forms: round, square (or chess board), elliptic (or chain) dots. For pad prints the round dot form is primarily used.

4-COLOUR PROCESS PAD PRINTING

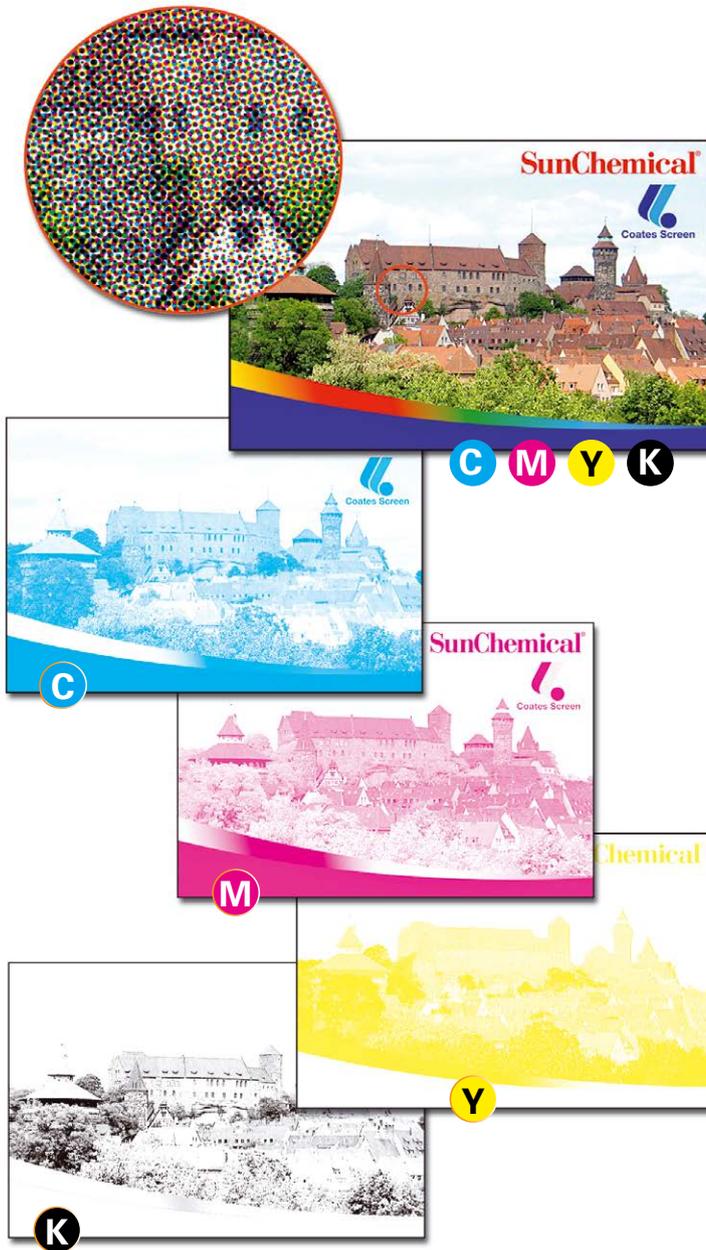
AM SCREEN (amplitude modulated):



Periodic screen structure, uniform dot form, uniform dot distances. Screen line distance (screen fineness) is measured in lines per centimetre. Thus, a halftone screen of 120 will have 120 dots on a linear distance of 1 centimetre. The tonal values to be printed are achieved by the diameter of the halftone dots. The larger the diameter of the dots is, the higher will be the percentage of covered area, and the darker the tonal value. If you have a covered area of 50-70%, the halftone dots have contact to each other and are situated as dots, which become smaller and smaller, like "isles" in the surrounding colour surface.

FM SCREEN (frequency modulated):

Non-periodic screen structure, various types. This is scarcely used for pad printing applications.



A > FILMS:

Basically, high quality films are required for process printing. Films should be exposed using professional reproduction exposure equipment. For pad printing usually positive side-inverted, layer side with SEMIMAT surface and exact, sharp-edged halftone dots with sufficient black (Optical density $D > 3.60$).

Screen fineness: Basically, printed in a range of 60 to 120 lines per centimetre, sometimes even 150 lines per centimetre.

B > TONAL VALUE RANGE:

Range of brightness degrees which can be printed. The brightest tonal value of pad printing applications should not be below a covered area of 10%. The darkest tonal value should not be above 90%. A screen film for pad printing should also never have solid tone areas, i.e. 100 % as the plate will not be re-screened.

C > DOT REPRODUCTION LINE:

In process printing a lot of smallest dots are printed next to each other with very small distances. A screen fineness of 120 lines per centimetre will result in dot diameters of 20 to 40 micrometers! Theoretically the given brightness values of a photo should be transferred to the printed

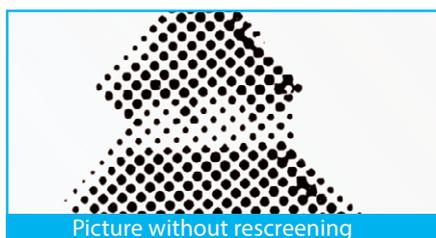


image 1:1. This, however, is not the case! No printing process will reproduce tonal value 1:1.



EXAMPLE:

Offset printing technology prints the tonal process values in a medium tonal range with a tonal increase of 10 – 15%. Brighter or darker tonal values will have less increase. Thus, you print “too much”, the image will be too dark. Therefore, the percental area coverage of these tonal values (process dots) is revised (-10 to -15%) accordingly, transferred to the offset plate to achieve identicalness of printed image and proof. Offset printing technology has a standard correction, see PSO, ISO 12647-2). Profiles/printing lines are defined depending on printing equipment, substrate etc.

The pad printing process results in brighter tonal values < 50% area coverage, meaning tonal value decline and tonal values > 50% resulting in tonal value increase. Basically, pad printers could assert these tonal value changes. (Tonal value changes also depend on local printing conditions). A test print with process prints with different tonal values (10%, 20%, 30% etc.) should be made.

These different prints are then measured with a densitometer to determine the difference of tonal values of master image and print. Then you can carry out the correction of sample/films.

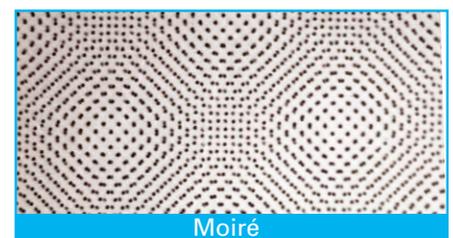
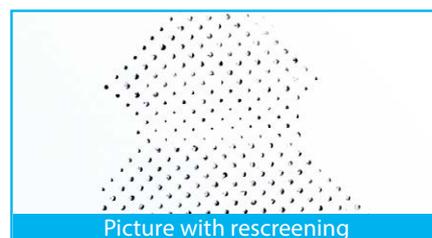
D > PRINT FORM/Production of Cliches

There should be no re-screening of the plate as the image in the plate is already screened and a second screening would result in problems like loss of tonal value and moiré effects.

As there is no re-screening there will be no second exposure, which is usually applied to adjust cliché depth. Therefore, the exposure time of the first exposure (usually 2 minutes with tubular exposure units) should be adjusted. To a certain extent cliché depths of process motives correlate to the process dot diameters. Guide values are cliché depths between 24 and 30 μ measured in a dark tonal value range with an area coverage of approx. 80%. With tubular exposure units process fineness of up to 120 lines/cm can be achieved.

For process lines >120 to 150 lines/cm exposure units with medium pressure Hg-lamps are recommended.

See pictures below:



E > PRINTING FORM

As already mentioned before, special process colours are required for four-colour process printing. These process colour shades are available in all ink ranges of Coates Screen Inks. Colour shade codes are 180 process yellow, 181 process red, 182 process blue. Process black usually is N50 or 65. For availability of process colours please refer to section colour shades of our product data sheets.

Due to the variety of factors influencing the pad process these colour shades have quite a high colour density. Pad printers can adjust brightness of these colour shades by adding transparent paste (-TP) subject to local printing conditions.