Printing: How it works

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There are four methods by which people have traditionally made multiple impressions of an image from one surface to another. Each has advantages and disadvantages and each still has a specific purpose but, in commercial terms, the past three decades have seen the gradual decline of all but one method. Nearly all printing is now carried out through a Lithographic process, perhaps the least understood of the four.



1. Relief

Ink is applied to any raised surface, then that surface is pressed onto the paper (or other material).

Lino-cuts and potato-prints are probably the examples that we all know best.

The method is a direct print, the result is therefore a mirror image of the original surface.

The commercial version of this method, called Letterpress, was used in nearly all publication printing until the mid 20th century. In the newspaper industry, the method was called 'hot-metal' as pages were constructed using blocks of lead and strips of individual metal letters. Every letter, in every typeface, at every size had to be placed, by hand into 'forms', in reverse.

2. Gravure

Only really used for reproducing fine lines and pictures, gravure (or etching) could be described as being the opposite of relief. The surface (often copper or a similar, soft metal) is engraved with lines and pits. Ink is applied and remains in these pits. Paper is then applied, under pressure and the ink is absorbed.

3. Stencil

Screen printing is the commercial use of this method. Most commonly used for applying ink to any surface other than paper (fabric, glass, plastics etc), but is also used for large areas of solid colour, varnishes or metallic ink (for scratch-cards etc). A stencil is held in place on a fine mesh (originally silk, hence silk-screen). Ink is applied to the mesh and squeezed through the stencil onto the surface below.

4. Lithographic

Nearly all commercial printing is lithographic; Originally the printing surface was a polished stone (Lithos being Greek for stone); modern techniques use a combination of photographic processes and computer technology.

Commercial lithography

Lithography uses the principle that oil and water repel each other. The method is this:

1. **An oil-based substance is applied to a surface (the plate) in the areas that are to be printed.**
2. **Water is applied across the surface and is repelled by the printing area.**
3. **Ink is floated onto the surface and sticks to those areas without water.**
4. **The surface is the offered up to paper and the ink is transferred.**
5. **In the commercial process, an extra (off-setting) process is introduced, so that the image is printed onto a rubber 'blanket' and then transferred onto the paper.**

THE BASICS

- **ONLY ONE COLOUR IS PRINTED AT A TIME (ALTHOUGH MANY CAN BE PRINTED IN QUICK SUCCESSION)**
- **ONLY SOLID COLOURS ARE PRINTED – NOT GRADUATIONS, SHADES OR TINTS. ANY AREA THAT LOOKS LIKE A TINT IS ACTUALLY A SERIES OF DOTS THAT FOOL THE EYE INTO SEEING A LIGHTER SHADE.**
- **PRINTING INKS ARE TRANSLUCENT; COLOUR MIXES ARE ACHIEVED BY PRINTING ONE ONTO ANOTHER.**
- **THE HUMAN EYE CAN SEE MANY MILLIONS OF COLOURS. MOST 'FULL-COLOUR' PRINTING IS DONE WITH JUST 4 INKS.**

COLOUR

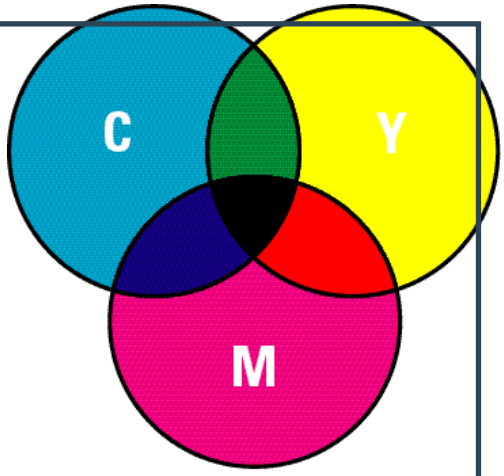
PRINTING COLOURS

Although there are different standards for colour printing inks and processes this document concentrates on the four standard colours that all printers use to create a 'full-colour' range.

Those four colours are:
CYAN, MAGENTA, YELLOW, BLACK - CMYK

The coloured inks are translucent and could be printed in any order. The four inks are printed on top of each other and combine to create a mix.
The CMYK system (like all pigment based systems) is additive. When the three primaries cyan, magenta, and yellow are mixed they make black.

Note: due to the impurities of the pigments used in printing, a separate black is always printed which acts as a key (hence K) as well as defining the other colours.

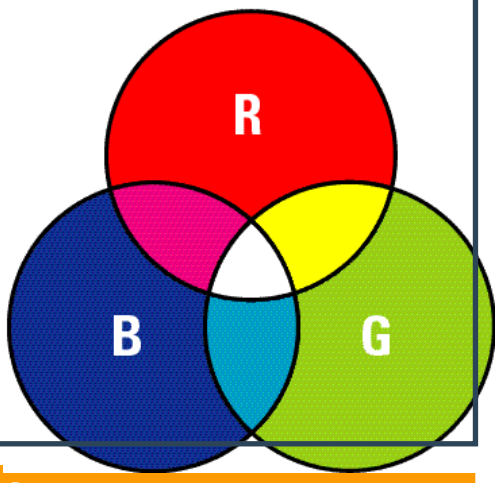


SCREEN DISPLAY COLOURS

Computer screens (and scanners) work in a completely different way, which makes difficult the process of accurately translating from one to another. Screens work with light; three sets of coloured light combine to form pure white light.

Those three colours are
RED, GREEN, BLUE - RGB

The exact reverse of the additive process, the use of light is subtractive – the more colours are added, the lighter the result.



Converting pictures for print

Photographs and illustrations are (in printing terms) referred to as continuous tone; as colour merges seamlessly from one area to another with millions of varying shades and hues. Because it is impossible to print those millions of varying colours, the image needs to be translated into a series of coloured dots (dots of cyan, magenta, yellow and black) that will fool the eye into seeing a close approximation of those varying tones.

Traditionally this process (screening) would have been done mechanically, using high resolution scanning cameras, photographic processes, coloured lenses and screens of different sized dots, at different angles.

But with the advances of desk-top computing, nearly everyone now has the technology to 'input' pictures.

Inputting pictures is actually an intermediate stage, which converts the continuous tone image into digital data, via RGB filters on a scanner. Data is stored mathematically as pixels (measured in lines-per-inch) - each pixel of the screen is given a position, and a mathematical colour value (which varies greatly, depending on the 'depth' of the screen).

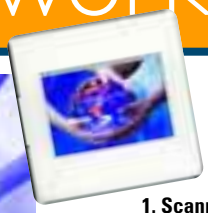
That digital data then needs to be re-converted for 'output'; changing from RGB into CMYK - with one output per colour, all comprised of dots - measured in dots-per-inch (dpi)

See over for illustrations of the conversion process...

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1. Scanning and input
image is converted from continuous tone, into pixels, via RGB filters

2. Design type and other elements are applied




3. Artwork / platemaking
An output device converts the computer pixels into artwork - either directly to plate, or to film or bromide (for manual plate-making).



This is how the plates look, if printed in their respective colours



4. Print
Each colour is printed in succession.



C | **C + M** | **C + M + Y** | **C + M + Y + K**

Output is a pattern of black dots



5. Finishing
The job is trimmed and packed

ARTWORK IS NOT A WORK OF ART

Artwork is a very specific term, with a very specific (although often misunderstood) definition.

Because only one colour is printed at a time and only solid colours are printed, each constituent colour is turned into black, to allow for it to be photographically transferred at each stage of the process. This or these black constituent part(s) are collectively called artwork.

To add to the confusion, each individual colour separation is referred to as a plate (the word has its origins in the photographic process) but the word plate is also used to desrcibe the printing medium.

Traditionally the colour separations would have been made by hand, by a highly skilled draftsman or art-worker. Today, though there is still much that needs checking and adjusting, the process has been almost entirely automated by computers.

Plates and platemaking

The printing medium for each colour is the plate. Plates are thin sheets of metal, which are bent around circular drums on the printing press (allowing rapid application of ink and water, as the drum spins).

Plates are made either directly from an output device, or by hand from films (acetate sheets) that act as stencils using UV light and light sensitive, coated plates.