The Irish Packaging Society
Affiliated to the Institute of Materials, Minerals and Mining

Diploma in Packaging Technology

Printing and Decoration of Packaging

Part 1

Presented by David Little

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Agenda

- **Part 1.**
- Printing and the functions of print
- Understanding colour
- Preparation for printing
- Colour Control
- **Part 2.**
- Common printing processes
- Other ways of decorating the pack
- Assuring quality
- Substrate and processes
- Judging print type

FOPT Chapter 4

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Printing

Definition:

To reproduce (text, pictures, etc), especially in large quantities, by applying ink to paper or other material by one of various processes.

(repeatable and controlled process, allowing for consistent quality)

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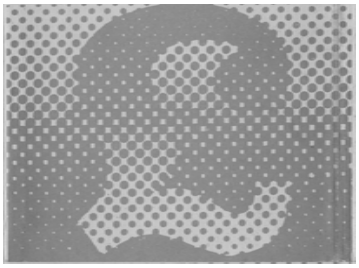

One colour halftone screen on grey paper

Simply put, it's Ink or no Ink

Images are created by applying ink or no ink, in specific areas to make up an image of line, halftone or full colour halftone structure.

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Image preparation as was…

In the past
Picture – Engraved plates, lino cuts, tone/line drawings,
Type - individual type hand set then monotype and linotype machines,

up to mid '80s
Lettraset headlines, phototype setting galleys, paste up layouts.
Artwork - Layered for each colour produced and photographed separately.
Separations – upright / table camera using photographic process with screens to create tone and separate plates for each colour. Produce bromides then a negative then exposed on to a light sensitive plate, one for each colour.

Around 1987 – DTP (desk top publishing). Producing galleys and drum scanners etc came in, with layout still being produced for camera seperation.

Around late '90's CTP started to appear with the big take up over the year 2000 where now virtually all Litho houses use CTP and most have in-house systems. Now direct to press is possible with some machines and Digital print is growing +..

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Why print?

- Information function
  - identify the product
  - meet legislation
  - provide instructions
- Selling function
  - attract the potential buyer
  - maintain brand identity
  - sell the product

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NPD

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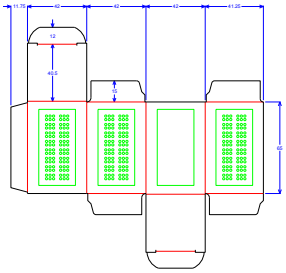
Pharma carton Keyline 1 up



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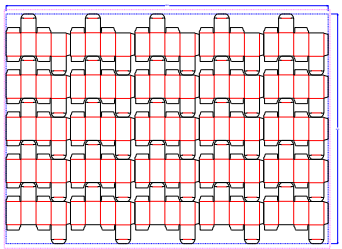
Stepped file

25 up



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Small RTE carton die

(Forme) 25 up

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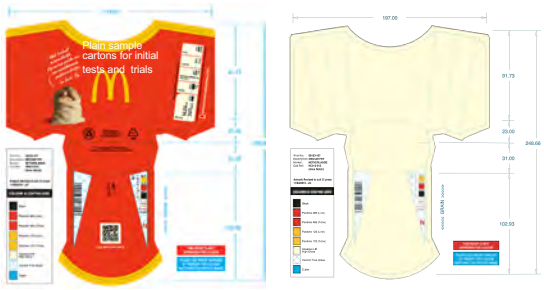
One-Up

(Artwork & Sample stage)



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Stepped File - 18 up

(Repro / Plate-making / Production)

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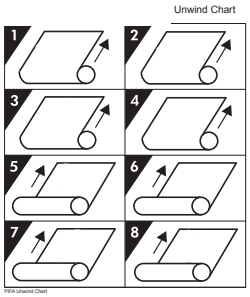
Unwind Chart
(Print direction reference codes for flexible film)



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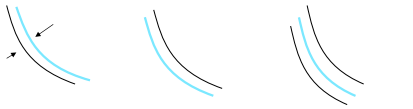
Printing ‘clear’ substrates / laminates



Reverse print
Film / Print

Surface print
Print / Film

Sandwich print
Film / Print /Film
Check solvent adhesive impact

Film / Adhesive / Print / Film
or
Film / Print / Adhesive / Film*
(*Clearer brighter image)

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Why special colours?

Balancing a fine laydown in one area and a heavy deposit in another, is difficult and can lead to print quality issues.
In flexo it is often better to split out special colours and separate line & tone to different print units, to get better results.
If varnish is required, it is treated as an additional colour.

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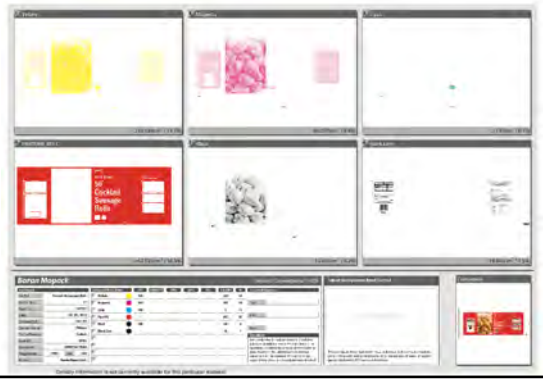
Print Separations



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Possible Artwork Issues

Drivers of additional cost & time

- Long slow approval loops, due to poor or incomplete copy.
- Spelling errors spotted in content of an approved file.
- Inconsistencies in the placement of components.
- Jobs not prepared for print showing additional colours?
- Jobs not prepared for Flexo, showing no spot colours.
- No spot colour reference or hard copy colour guide provided.

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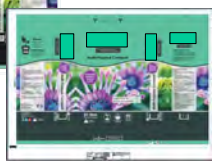
Example job and issues.

Original File

Main solid colours changed significantly, supplied as from process to spot and in shade (saturation and value).



Approved final GMG proof

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Amendments over 2-3 are wasteful and avoidable.

Date	Amends
23/11/15	Urgent Job. Received an 'approved' Artwork File.
25/11/15	No spot colours. All shown as process, despite it being a Flexo job. File amended, but no spot colour references.
26/11/15	Text amends advised following first proof. Print File proof sent to Printer for advice.
8/12/15	Printer amends and awaiting physical bag sample for colour
10/12/15	Colour changes, reproof
11/12/15	Text amends, reproof
1512/15	Address changes, reproof
21/12/15	Text amends, reproof
22/12/15	Proof finally approved by Client
+ 29 Days	**At least 8 Amendment Loops**

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On screen approvals?

Not colour accurate.
Three screens all different.

Why colour accurate screens are important.

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Proof for Approval

Laser prints – give general idea, but are not correct for size or colour. OK for copy approval

Digital proofs – produced directly from the data. Correct for size and for the majority of colours, but not for metallics or varnishes

- photomechanical methods e.g. Dupont's Cromalin - require colour separated films
- DDCP Direct Digital Colour Proofing - for filmless systems
- GMG colour proofing system

Full colour wet proofs – made from digital printing plates, produced on a printing machine, using correct inks and substrate

DuPont Cromalin Largo 4406

Epson Stylus Pro WT7900 9 colours (White, Green, Orange, Vivid Light Magenta, Vivid Magenta, Yellow, Light Cyan, Cyan, Photo Black)

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3D visualisation

3d visualisation

- Creation of 3d mock-up's for conceptual approval.
- Helpful to check correct orientation of panels

Rotate to show front, back, side panels.

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What is colour?

- Wavelength of light emitted or reflected from an object
- Visible white light consists of electromagnetic radiation of various wavelengths
- From long to short wavelengths (700-400 nanometers) the colours are red, orange, yellow, green, blue, indigo, violet

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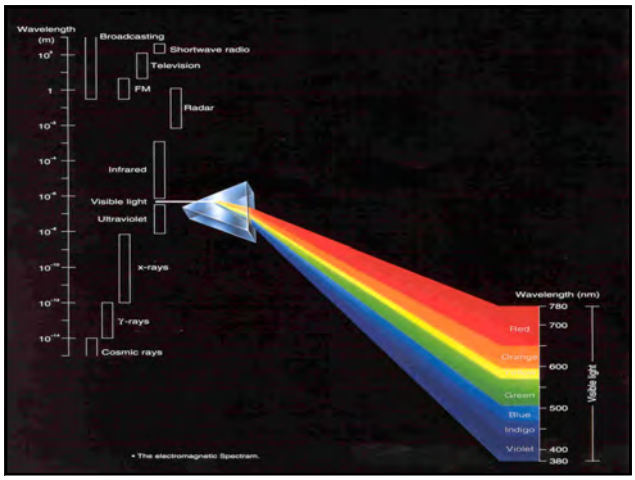

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Colour

Colour is the first thing recognised before shape, graphics and text. Therefore colour is the most important motivator of a purchasing decision.

Colour evokes an emotional response from the observer. Associated with moods feeling, places and things. Colours can be used describe emotions see Red, green with envy, warm colours cool colours etc.

- Colour can influence perception such as size, quality, value, flavour. So packaging design is therefore crucial in creating impression.
- Colour can have ethnic and social associations e.g. red green white - Italian, Green and orange – Indian.
- Some colours dominate supermarkets like reds browns and blues while for instance purple is mostly absent.

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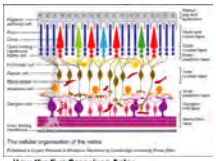
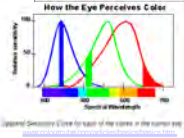
How do we see colour?

3-component theory of colour vision:

The human eye has receptors for three primary colours: red, green, blue: RGB

'All' colours are seen as mixtures of these 3 colours





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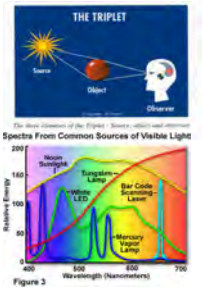
How do we see colour?

Our perception of colour is affected by:

- the surrounding light
- the object being viewed:
  - absorbance and reflectance
  - shape and smoothness
  - underlying/surrounding colour of printed items
  - angle of view
- the human eye
- the humanbrain



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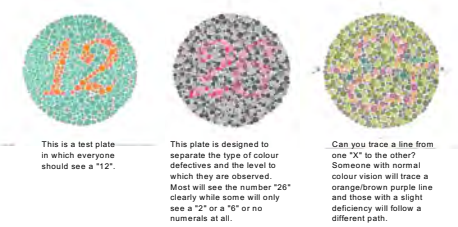
Colour blindness



This is a test plate in which everyone should see a "12".

This plate is designed to separate the type of colour defectives and the level to which they are observed. Most will see the number "26" clearly while some will only see a "2" or a "6" or no numerals at all.

Can you trace a line from one "X" to the other? Someone with normal colour vision will trace a orange/brown purple line and those with a slight deficiency will follow a different path.

A test for colour blindness can be seen at http://colorvisiontesting.com/ishihara.htm

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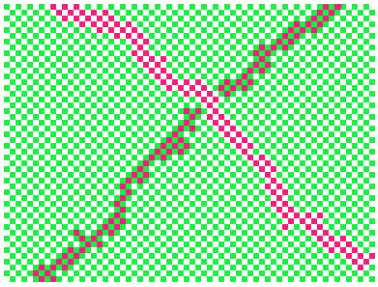
Colour Contrast

How many shades of green and red do you see?



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Colour Contrast

Most people see pink, red and two shades of green. Look closer and you will see there is only one shade of green and one of red in the picture.

The colour you see depends on which other colours are surrounding it.

Here, green next to red looks much darker than green next to white.

This effect seems to be due to 'lateral inhibition'. This is the mechanism that your eye and brain uses to make edges, outlines and colours more distinct. About 90% of this effect is due to cells in your eye.

This effect has been used for thousands of years by carpet makers to make apparently multi-coloured carpets from just a handful of different wools.

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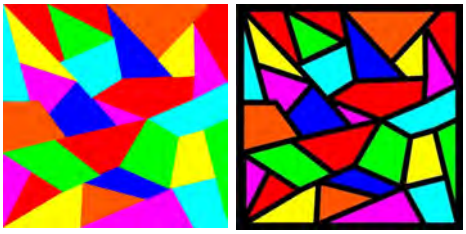
Colour Contrast



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Kaniza Illusion
What do you see?

Most people see a triangle in front of three circles.

Your brain tries to make sense of this pattern by going for the most likely explanation. In this case it is a white triangle in front of 3 coloured circles.

Even when you know that the white triangle does not really exist, your brain still opts for it as the most likely explanation

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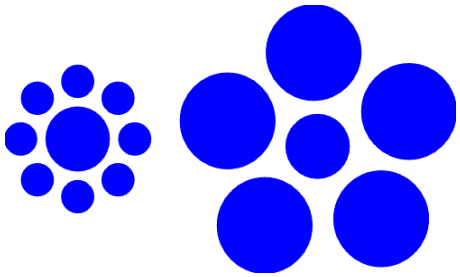
Which of the two inner circles is the larger? Measure and find out!



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- Our perception of colour is affected by:
  - the surrounding light
  - the object being viewed:
    - absorbance and reflectance
    - shape and smoothness
    - underlying/surrounding colour of printed items
    - angle of view
  - the human eye
  - the human brain

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Types of Image

- Text
- Line Drawing
- Continuous Tone (B&W - Grey scale)
- Solids
- Half Tone
  - PMS(Pantone Matching System)
  - Process Colours

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Preparation for printing

- Image assembly or setting:
  - brings together the illustrations, line work and text into one layout
  - uses prepared films or computer stored data
  - takes account of any bleed areas, folds, unwind direction, make up of finished pack
  - electronic image setters / DTP / now Macs
  - Output was plate-ready film – now CTP
  - Soon Direct to Press or Digital print

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Preparation for printing

- Platemaking
  - Now CTP - computer to plate
  - Transfer of image detail onto image carrier
  - Process differs between printing systems
  - Define colours required
    - Any special colours? + CMYK for process work 'pictures'
  - need one plate per colour plus extra plates for varnish or special requirements e.g cold seal adhesive
  - need to consider cost, quality and lead time

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Preparation for printing

- Colour proofing - opportunity to review and approve before printing
  - on final press
  - on proofing press
  - off-press proofing
    - photomechanical methods e.g. Dupont's Cromalin - require colour separated films
    - DDCP Direct Digital Colour Proofing - for filmless systems, Epsom, Iris, Kodak calibrated and run to standards – ISO, FOGRA, G7, GMG...

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What is colour?

- When specifying and checking colour

  - specify an agreed light source
  - use similar sizes of sample
  - take account of substrate differences when developing a range of products (or using LAB values)
  - for transparent containers, fill with the correct product to be used
  - make sure anyone responsible for colour matching and approval has been tested for colour blindness

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Colour printing

Primary colours - Red, Green, Blue

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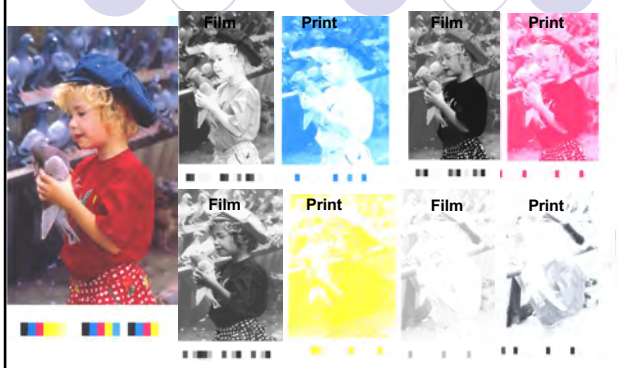
The Color Separation CMYK Scale



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Defining colour

- Hue:
  - dominant wavelength
- Lightness:
  - bright vs dark
- Saturation:
  - vivid vs dull

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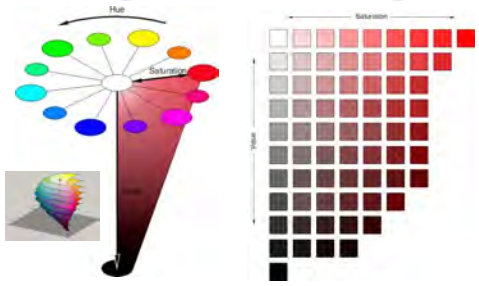

The wedge shows all of the saturation and value variations on this particular red.

At the top of the wedge, the lightest red runs from high saturation on the right to white on the left. Moving down the wedge, the reds get darker and the saturation range from right to left gets narrower.

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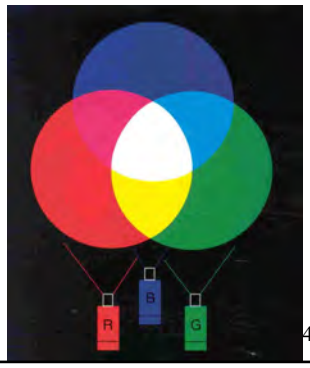
Additive colours - Primary colours



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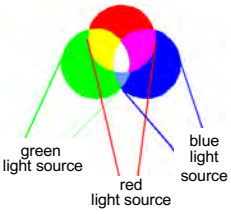
Additive Colour Mixing



- the colour is mixed in our eyes. We see at the same time various sources of light.
- primary colours are Red, Green and Blue (RGB)
- R+G+B = white
- Note: additive colour mixing does not necessarily need primary light sources. Objects or printed paper can be light sources.

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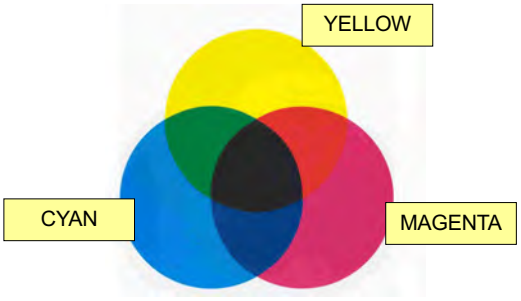
Secondary (Subtractive) colours



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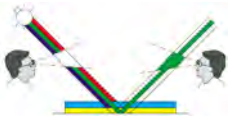
Subtractive Colour Mixing



- the colour is a result of absorbing (subtracting) some parts of the spectrum by a coloured object or surface (e.g. printed paper)
- secondary colours are Cyan, Magenta, Yellow (CMY)
- A mixture of C,M,Y = “black”

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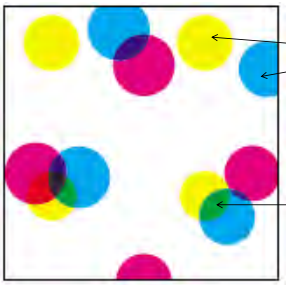
Colour mixture on printed paper is subtractive and additive



additive colour mixing

subtractive colour mixing

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Color Separation

The repro technician used colour filters to separate the copy into the colors cyan, magenta and yellow.

Table Camera

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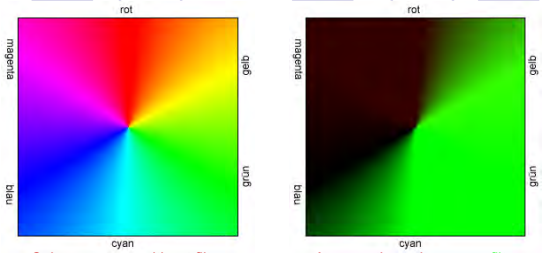
The Effect of Filters



Color spectrum without filters

As seen through a green filter

The fundamental principle is that a filter brightens its own color and darkens the tones opposite it in the color circle (the so-called complementary colors).
Therebye removing a colour, allowing for separations to be made.

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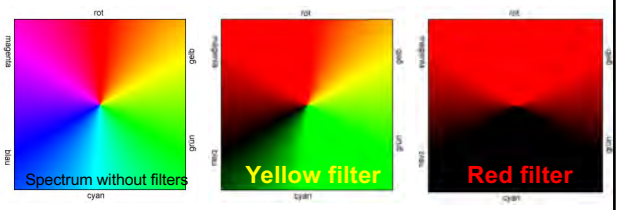
The Effect of Filters



Filters have very different effects:
Look at the fundamental differences between yellow and red filters in the two examples above.

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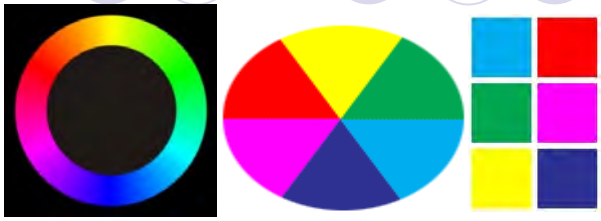
Complementary Colors



Color circle

The six-part color circle

Complementary colors

The complementary colors lie opposite each other in the color circle.

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Complementary Colours

One creates the complementary colour to a basic colour by mixing the two other basic colours.

(additive color mixing)

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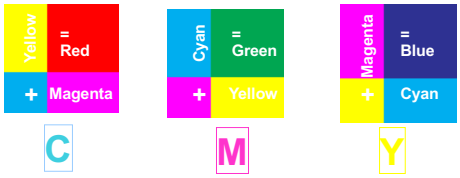
Complementary Colours

One creates the complementary colour to a secondary colour by mixing the two other secondary colours.



(subtractive color mixing)

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Preparation for printing

- Colour separation:
  - separate the original into its primary colours by photographing through colour filters
  - identify how the original colours can be reproduced using CMYK
  - electronic scanners reduce colour separation time dramatically, or now repro software.
  - output either a set of films, one for each printing colour – or now a RIPped file CTP device and possibly a CIP 3 or 4 (JDF) file for the press set up and production.

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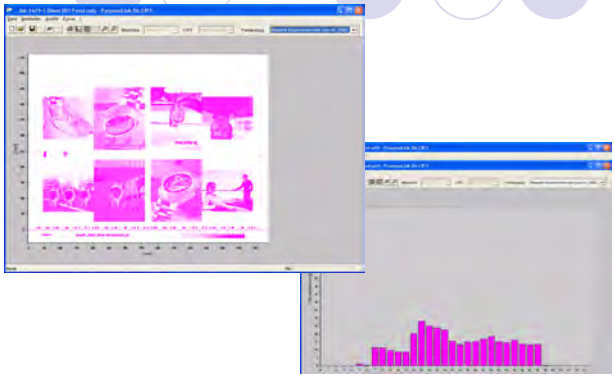
Automatic calculation of the area coverage from the CIP3 data



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Colour printing

- Primary colours - Red, Green, Blue
- Secondary colours - Cyan, Magenta, Yellow or process primary colours
- Combinations of CMY = 'any' colour
- In practice, a key colour is used, normally black
- CMYK process printing
- See page 82.5 B

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Colour printing

CMYK 4 colour printing (used mostly in commercial print)
CMYK + special colours (used mostly in packaging)
Hexachrome: CMYK + orange + green (or blue) – e.g. FM6 or other systems
Hi-fi systems - up to 12 colours
But the desired effect V's total cost

Where does the designation K for Black come from?

CMYK stands for Cyan (turquoise), Magenta (deep purplish red), Yellow and Key (the key color Black)
Essentially, this key color *K* is not used as a color as such but only to darken colors. The term "Key" is used for Black to prevent misunderstandings because "B" for Black would be confused with "Blue".
Among other things, black printing ink is needed because although theoretically black can be produced by overprinting the three other colors, in practice this does not work because the colorants used for cyan, magenta and yellow are not perfect secondary colors.

Another benefit of printing black as an additional color is UCR - undercolour removal in a picture, allowing less of the CMY ink to be used and avoid possible ink trapping issues.

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CMYK colour mixing – Repro of files

In theory we only need 3 primary colours for mixing all perceivable colours .
In printing practise C + M + Y is not enough.

Various combination of CMYK can actually get you to the same colour.
The decision is dependent on the repro approach, the standards used, the print process and printer.

70%	20%	70%	20%	Target
85%	30%	85%	0%	
80%	28%	80%	5%	

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Benefits of Centralised Repro

Centralising Repro

& supplying Print Ready Files.

General Benefits

- Direct Control
- Transparent costs, not hidden nor amortised, no mark ups.
- Opportunity to renegotiate price with Printers
- No 3rd party repro
- Fit for purpose files
- Focus on what's best, not what suits the Printer best.
- Less Speed v's Quality issues
- Integrity of data as Centalised

Technical Benefits

- Consistent approach
- Common system / RIP – no letter drop offs, text reflows etc.
- Better, more accurate proofs
- Improved Control
- No pantones from process. Consistent handling of say 3 colour blacks or neutral greys, and Under colour removal.
- Min dot, min text

miller GRAPHICS GROUP

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CMYK process printing

- Graphic illustrations are achieved by printing dots in each of the four process colours
- Juxtaposition of dots fools the eye into seeing a range of shades
- Dot size determines quality of illustration - the smaller the dots the finer the shading
- Measured in:
  - dpi dots per inch or dots per cm
  - lines per inch or lines per cm
  - Typical line counts are 90, 120, 133, 150, 175, 220, 240 lpi depend on the market, the process, the press and the substrate

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CMYK process printing

- Juxtaposition of dots fools the eye into seeing a range of shades

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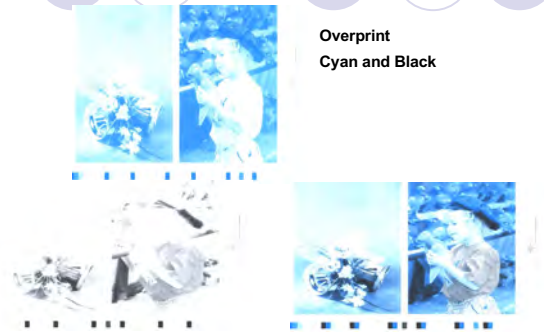
The Color Separation CMYK Scale

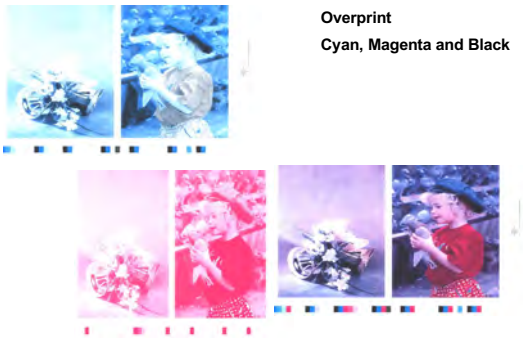


Overprint

Cyan and Black

64

The Color Separation CMYK Scale

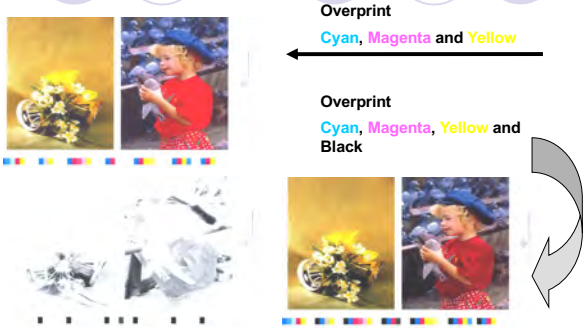


Overprint

Cyan, Magenta and Black

65

The Color Separation CMYK Scale



Overprint

Cyan, Magenta and Yellow

Overprint

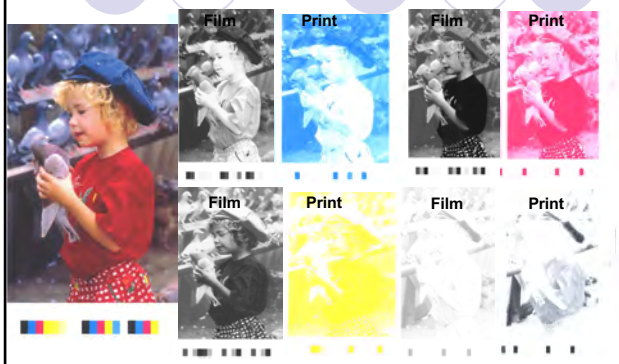
Cyan, Magenta, Yellow and Black

66

The Color Separation CMYK

67

The Color Separation CMYK Scale



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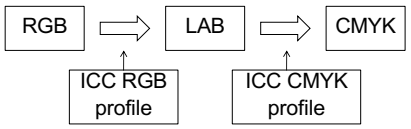
Why Colour Management?

69

What is Colour Management doing?

The RGB and CMYK numbers we use for representing colours in digital devices are **ambiguous**

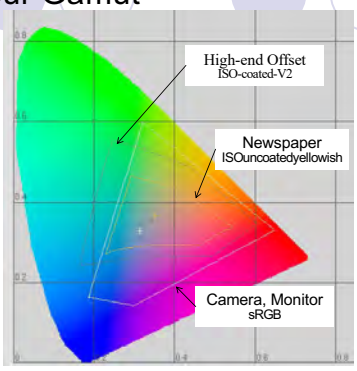
Colour Management deals with **unambiguous** numbers. It attaches a specific colour appearance to otherwise ambiguous RGB or CMYK numbers. The key to this are the **Lab colour space** and **ICC profiles.**



In color management, an ICC profile is a set of data that characterizes a color input or output device, or a color space, according to standards promulgated by the **International Color Consortium** (ICC). Profiles describe the color attributes of a particular device or viewing requirement by defining a mapping between the device source or target color space and a profile connection space (PCS). This PCS is either CIELAB (L*a*b*) or CIEXYZ.
Every device that captures or displays color can be profiled.

70

Colour Gamut



71

Colour measurement instruments

A densitometer measures density. A densitometer is a basic quality-control measurement device optimized for photographic and printing applications. A densitometer measures the amount of light reflected or transmitted by a sample, then reports density or dot percent. The instrument does very little post processing of data.

A colorimeter measures a sample, then (from this data) computes LAB values. To calculate LAB, the instrument internally processes the measured data with a number of mathematical functions including one that represents human vision and another that represents a standard light source. The mathematical processing of data converts the basic light measurement into LAB. Colorimeters are light, compact, reliable, inexpensive devices. In color management, they are most commonly used to measure computer monitors.

The most sophisticated color measurement instrument is a spectrophotometer. A spectrophotometer measures the spectrum of a sample, reporting the reflectance or transmittance of a sample at regular intervals. The spectrum is the most complete description of a color, and can be used to calculate all other measurements, such as density and LAB. Thus, a spectrophotometer can do the job of a colorimeter and a densitometer.

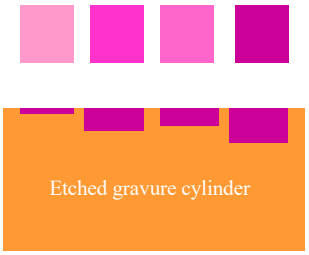
72

Quality Control - Checking density against the OK sheet or house density or proof or last job (stored settings)

73

Density -measures amount / thickness of ink deposit

More or less ink changes the colour...



Ink densities vary with stock and ink supplier and can vary with process & press.

G7
C 1.45 +/- 0.10
M 1.45 +/- 0.10
Y 1.0 +/- 0.07
K 1.7 + 0.2 - 0.05

uncoated
C-90
M-90
Y-90
K-125

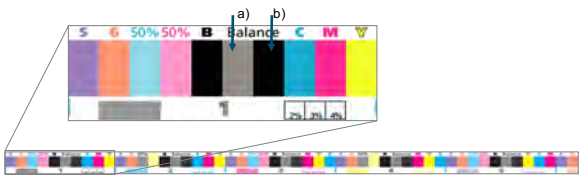
coated
C-125
M-125
Y-110
K-160

74

Test Strip

Color control with gray balance

1. Measuring of the balance patches: a) C (50%) + M + Y (both 41%)
   b) C + M + Y (each 100%)
2. Measuring of the midtone patches (50%-patches)
3. Measuring of the solid tone patches (CMYK and up to two special colors)



75

Grey balance - from CMY

76

What colour is R=188, G=0, B=0 ?

77

It depends on the RGB device

R = 188
G = 0
B = 0

78

What colour is

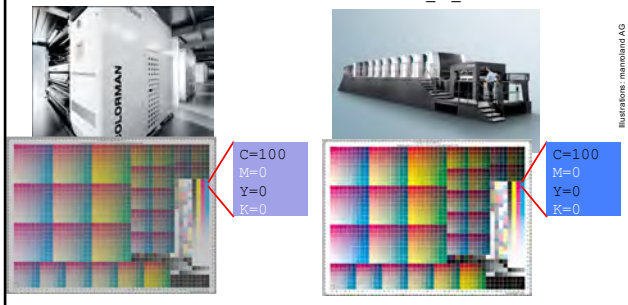
C=100% M=0% Y=0% K=0% ?

79

It depends on the printing process

Newspaper web offset
ISO uncoatedyellowish.icc

Sheetfed offset
ISO coated_v2_eci.icc



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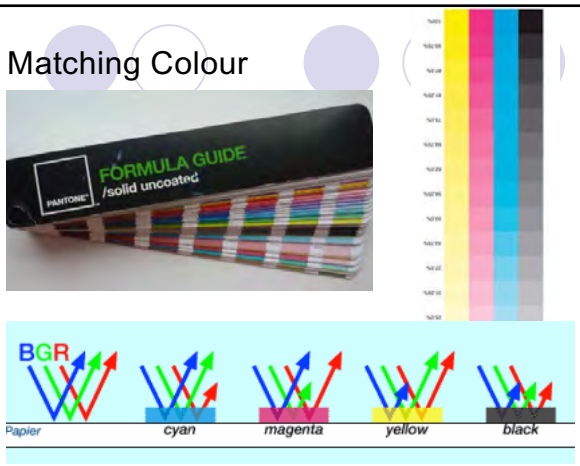
Control Techniques

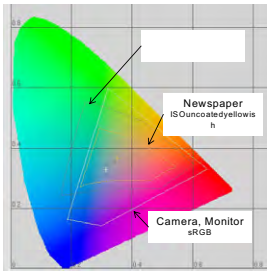
81

Matching Colour



82

Colour Gamut



83

Measuring colour

Densitometer
- Measures the thickness of the ink deposit and it's colour value.

Spectrophotometer
- Has multiple sensors sensitive to a wide range of different wavelengths
- Displays a spectral reflectance graph in addition to L*a*b* values

84

Density - measures amount / thickness of ink deposit

More or less ink changes the colour...

Thicknesss of the ink deposit impacts on the colour value.

Ink densities vary with stock and ink supplier and can vary with Print Company, process & press.

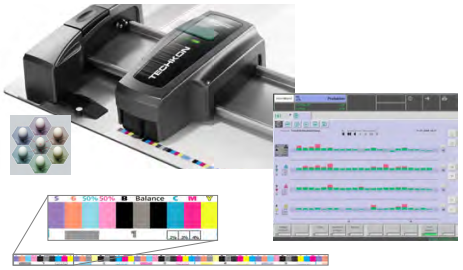
G7
C 1.45 +/- 0.10
M 1.45 +/- 0.10
Y 1.0 +/- 0.07
K 1.7 + 0.2 - 0.05

uncoated
C-90
M-90
Y-90
K-125

coated
C-125
M-125
Y-110
K-160

85

Quality Control - Checking density against the OK sheet or house density or proof or last job (stored settings)



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Colour targets

Matching and measuring colour

Special Colours
Pantone colour PMS reference:
Pantone book or digital colour library.

PRESS SET UP				
SEQUENCE & DECK	COLOUR	DENSITY	ANILOX	ANILOX ID
2 - DECK 3	CYAN	1.40	1050 X 4.00	AB165163
3 - DECK 4	MAGENTA	1.42	1050 X 4.00	AB64667
4 - DECK 5	YELLOW	1.05	1050 X 4.00	AB64668
1 - DECK 2	BLACK	1.35	900 X 3.8	TBA

Density
Measurement of the thickness of the ink film.
Less ink = a lighter shade.

COLOUR DATA				
CIE L*a*b*	CYAN	MAGENTA	YELLOW	BLACK
L*	56.10	50.95	94.53	24.00
a*	-39.33	77.62	-6.49	3.07
b*	-49.71	8.98	108.37	10.07

L*a*b* value
Position on the colour tree.
It is like a GPS reference, for colour.

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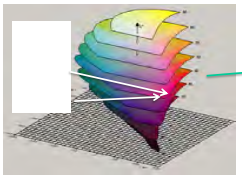
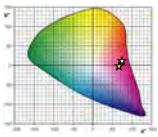
L*a*b* Colour Space (tree)





- cross-section L=50
- L = Lightness 0-100
- a-axis extends from green to red
- b-axis extends from blue to yellow

88

Control Techniques

89

Creating a new Special Colour Standard
for a new Brand on various substrates.

Main Ink Pigment Manufacturers, Sun, Flint, Huber.
Sun Chemicals have 60% of Worldwide market share.

Create Drawdowns of each special colour printed to the appropriate standard using the appropriate printing process, on the appropriate substrate.

- Litho - Fogra 39
- Flexo - MG Generic Flexo standard
- Gravure - Pack Space Standard

The Drawdowns can show the colour in line and tone with the LAB values and the ink recipe, so any ink manufacturer can replicate.
Sun for instance would also provide an SAP code for ordering from them.

These Drawdowns are then used to match special colours on press and can be used to create a digitised colour library for Designers & Artworkers.

90

Checking colour

When specifying and checking colour

- specify an agreed light source
  - CIE Standards
    - Standard daylight D65 (6500K), D50 (5000K)
    - Incandescant (A) – std light bulb
    - Fluorescent (F) – TL84
- use similar sizes of sample
- take account of substrate differences when developing a range of products
- for transparent containers, fill with the correct product to be used
- make sure anyone responsible for colour matching and approval has been tested for colour blindness

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Print verification and in-line real-time QC systems

ColorCert (and other systems)

Print verification software to quantify print quality management and report KPI'S in real time.

- Spot errors and trends in production
- Capture colour data and trends
- Continuous data capture across all shifts
- Capture, control and monitor press efficiencies
- Export a monthly print quality report

OpenColor continuous fingerprint data

- Control overprints colour on colour
- Capture colour data and trends
- Mini wedge within waste area of every job becomes a fingerprint to capture spectral data.
- No more fingerprinting, ever.

92

Working with new:

Packaging Design
Brand Product
Printer

(Managing Repro)

93

Launching a new range

(high end, high volume)

Now that you have the colour, the structure, the substrate and the design approved, how do we ensure the print / colour quality is consistent?

Chose a Printer. The more Printers and Substrates involved, the greater the possibilities for variability. Good planning, good Repro and a centralised pre-press process will help.

Then you need to know how the various presses involved print.

94

Fingerprinting the press

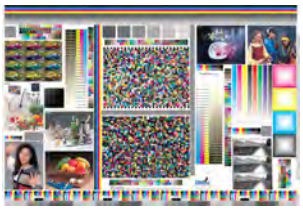
- Press profile

Gives the printer a benchmark

Gives the repro house data

- Density reading
- Contrast figures
- Dot gain

Helps provide consistency



95

Printer's Spec

(can be different for each supplier, can be used to vet and equalize print providers)

Print Process / Substrate?
How many colours?
Colour Sequence / Densities?
Press Dot Gain / Fingerprint results?

Barcode Information – Min Mag / BWR

Separation Requirements - <> Dot / Screen / Hybrid

Grip / Trap

Text Min Pos. / Neg.

Bleed Requirements

Print Furniture – Microdots / Control Strips etc
Digital File Formats – ESKO, Ai, PDF, PS, Artpro

96

Image trapping or grip

Used to avoid register issues and white lines between images. Particularly important with Flexo.

The more accurate the process and press, the less trapping (or grip) required.

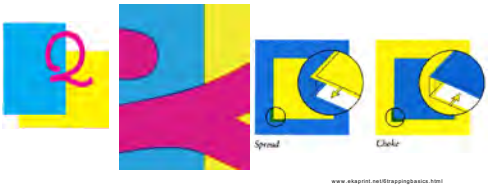
97

Trapping

http://indesignsecrets.com/indesigns-trapping-in-a-composite-pdf.php

Trapping

Trapping of two or more colours refers to over /underprint at interface of the two or more



www.ekaprint.net/trappingbasics.html

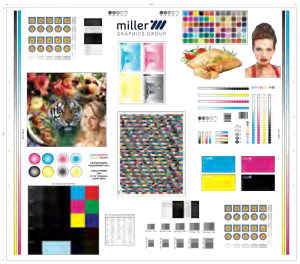
98

Creating a press profile often requires a Fingerprint.

All presses are different and can give different results:

- Make
- Models
- Age
- Technology
- Maintenance
- Printer
- Process control
- Repro approach

A fingerprint creates a profile of that individual press, to help achieve a consistent print result.



99

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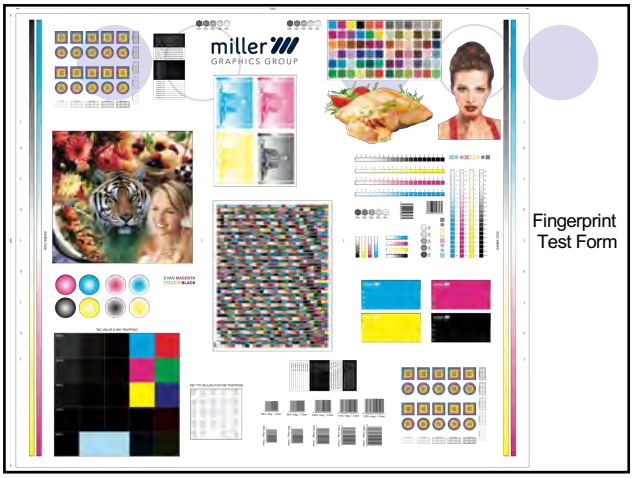
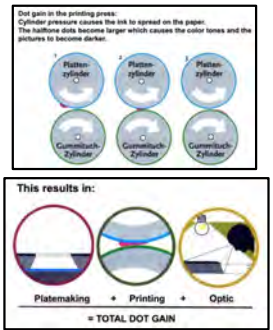
100



Fingerprint Test Form

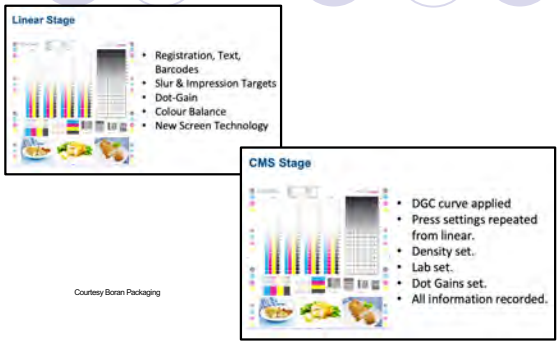
101

Dot Gain



102

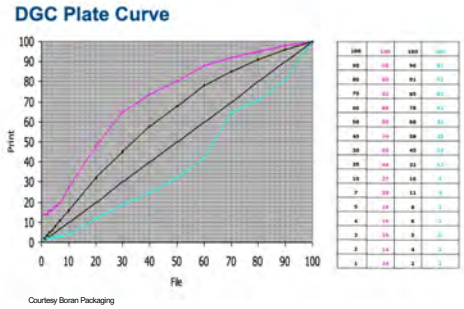
Linear stage & Colour Management System Stage



Courtesy Boran Packaging

103

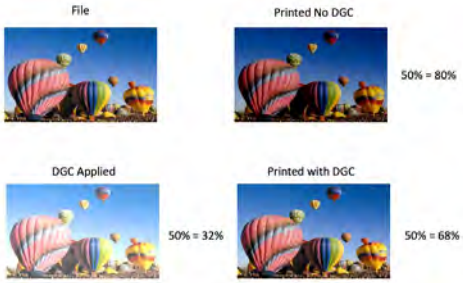
Dot gain curve



Courtesy Boran Packaging

104

Dot Gain
DGC applied



Courtesy Boran Packaging

105

Fingerprint report output (Flexo)

PRESS SET UP				
SEQUENCE & DECK	COLOUR	DENSITY	ANILOX	ANILOX ID
2 - DECK 3	CYAN	1.40	1050 X 4.00	AB165163
3 - DECK 4	MAGENTA	1.42	1050 X 4.00	AB64667
4 - DECK 5	YELLOW	1.05	1050 X 4.00	AB64668
1 - DECK 2	BLACK	1.35	900 X 3.8	TBA

COLOUR DATA				
CIE L*a*b*	CYAN	MAGENTA	YELLOW	BLACK
L*	56.10	50.95	94.53	24.00
a*	-39.33	77.62	-6.49	3.07
b*	-49.71	8.98	108.37	10.07

106

Dot gain

PRESS CHARACTERISTICS						
Input Values	C	M	Y	K	AVERAGE	GAIN
	1.40	1.42	1.05	1.35		
100	100	100	100	100	100.00	0.00
95	98	97	98	100	98.25	3.25
90	93	91	94	99	94.25	4.25
80	89	86	86	93	88.50	8.50
70	82	80	74	84	80.00	10.00
60	74	72	69	76	72.75	12.75
50	64	64	62	64	63.50	13.50
40	54	53	45	52	51.00	11.00
30	41	40	32	38	37.75	7.75
20	28	28	26	26	27.00	7.00
10	18	18	17	15	17.00	7.00
5	12	13	12	12	12.25	7.25
3	11	12	13	10	11.50	8.50
2	10	10	10	8	9.50	7.50
1.6	9	10	9	8	9.00	7.40
1.2	8	10	11	12	10.25	9.05

Target 50
>36.5 = 50

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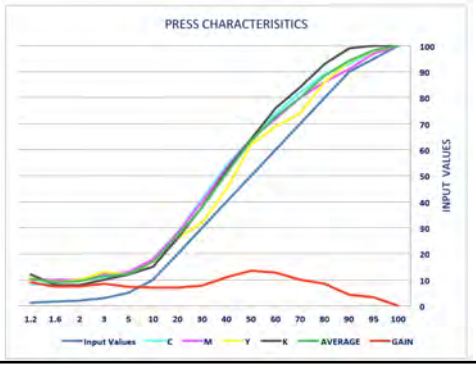
Dot gain curve



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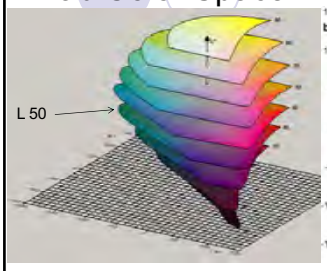
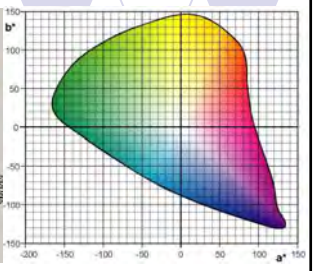
Lab Color Space





- Lab colour solid
- L (Lightness) extends from 0 to 100

- cross-section by L=50
- a-axis extends from green to red
- b-axis extends from blue to yellow

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Colour Difference ΔE

Delta E

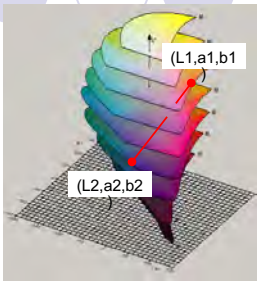
ΔE is the length of the geometrical distance (Euclidian distance) in the Lab coordinate system.

For 2 colours (L1,a1,b1) and (L2,a2,b2):

$$\Delta E = \sqrt{[(L1-L2)^2 + (a1-a2)^2 + (b1-b2)^2]}$$

A Delta E of 2 in Litho or 5 (for example) can be used as an acceptable deviation from the chosen target colour in Flexo.

Whiteness of substrate / paperboard needs to be calibrated and represented on the GMG proof, for good visual and Lab comparison.



Example of base material
Two samples of same board different reels DE 1
Board sample to uncalibrated proof paper DE 6
Board sample to matched proof background DE 2

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Thank you
Any Questions

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