ISOM/2000 recommendations for four colour printing

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What is 4-color printing - anyway?

❏ *4-color printing involves the use of four screens and four inks to reproduce the color of the original. This is referred to as process printing, or CMYK after the inks used.*

❏ *The primary colors cyan (C), magenta (M), and yellow (Y) combine in different intensities to create a wide spectrum of colors.*

❏ *For offset printing, colors are separated into cyan, magenta, and yellow halftone films. Also a film for black (K), that is created to correct flaws in cyan, magenta, and yellow ink, and to boost the blackness of the image.*

❏ *These films are used to make the four plates needed for 4-color offset printing. This is an industry-standard printing method.*

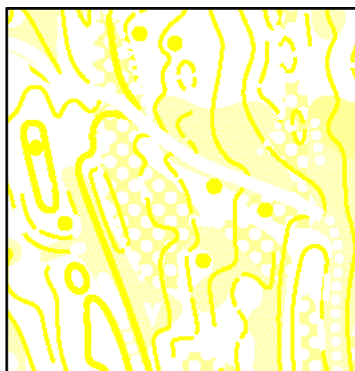❏ *CMYK is a widely used color system for computer printing devices.*
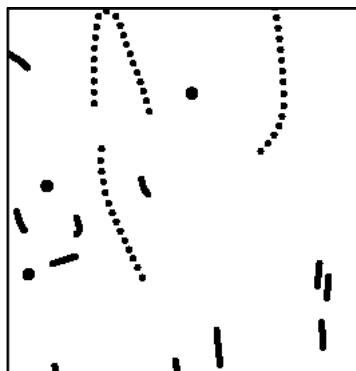
Cyan
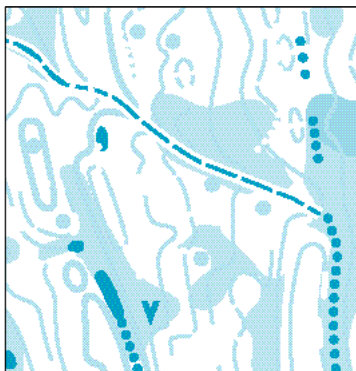
Magenta
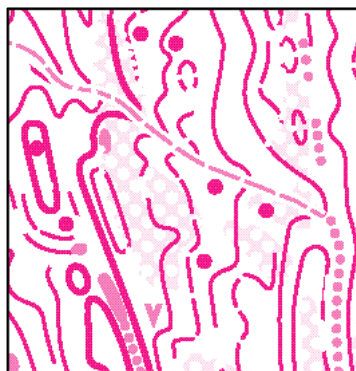
Yellow

Black

Final result

Situation today

❏ *The current ISOM*

    ❏ *Specifies offset printed maps using PMS spot colors.*

    ❏ *Other reproduction techniques are strictly not permitted.*

❏ *Use of other printing techniques growing rapidly*

    ❏ *4-color offset printing .*

    ❏ *Laser printing .*

    ❏ *Digital printing .*

    ❏ *Ink-jet printers and plotters .*

    ❏ *Color copiers .*

❏ *Quality*

    ❏ *Today only 4-color offset printing seems to achieve the quality level specified in the current ISOM.*

    ❏ *Technology is advancing rapidly. The same level of quality will be achieved with other techniques within the period of time the ISOM/2000 will last.*

New aspects

❏ **Computer printing technology**

    ❏ *Has opened for low-cost printing-on-demand and variable information printing*

    ❏ *Is suitable for small up-to-date editions printed for specific competitions with variable course overprinting*

❏ **Photographs, logos and advertisements in any color can easily be included in the map**

ISOM/2000 work

❏ **Status**

  ❏ **It is decided to include a 4-color printing recommendations in the ISOM/2000**

  ❏ **There are made two tests using offset printing with different screening techniques and parameters**

  ❏ **Some sample maps made with other techniques are studied**

  ❏ **A first draft of the 4-color printing recommendations is now ready**

The challenges

❏ *To write a generic recommendation*
  - ❏ *Should not be hardware or software dependant.*
  - ❏ *Should regulate colors, screening and overprinting techniques in general*
  - ❏ *Should not exclude use of new technology suited for orienteering map reproduction - like laser printers*

❏ *Should not introduce a lower level of quality, therefore*
  - ❏ *4-color offset printing is (still) recommended*
  - ❏ *Other printing devices can be used if the map legibility and colour appearance can be proven to be equal to or better than the result of offset printing*

The recommendation includes

❏ *Color settings*
   ❏ *CMYK equivalents for PMS spot colors (inks)*
❏ *Screens*
   ❏ *Traditional halftone screens*
      ❏ *Frequency*
      ❏ *Angles*
   ❏ *Stochastic screens*
❏ *Printing order*
❏ *Overprinting*

PMS-colors to CMYK

❏ **Solid PMS-colors can not be translated to CMYK - only simulated**

❏ **Some simulations are quite close to the solid color standard while other colors are not**

❏ **The result of the simulation is varying from one device to another and from one paper quality to another**

ISOM/2000
Inks - CMYK equivalents

❏ **CMYK equivalents to PMS spot colors (inks) recommended:**

Color	PMS	Cyan	Magenta	Yellow	Black
Black	Process black				100 %
Brown	471		56 %	100 %	18 %
Yellow	136		27 %	79 %	
	122		18 %	83 %	
	129		15 %	76 %	
Blue	299	87 %	18 %		
Green	361	76 %		91 %	
Grey	428				23 %
	427				11 %
Violet	Purple		100 %		

ISOM/2000
Colors - CMYK equivalents

Color	%	PMS	O	Cyan	Magenta	Yellow	Black
Purple	100 %	Purple	Y		100 %		
Purple 50%	50 %				50 %		
Purple 20%	20 %				20 %		
All color separations				100 %	100 %	100 %	100 %
Black		Process black	Y				100 %
Street infill					28 %	50 %	9 %
Street borderlines							100 %
Blue			Y	87 %	18 %		
Blue 50%	50 %			44 %	9 %		
Blue 20%	20 %			17 %	4 %		
Brown			Y		56 %	100 %	18 %
Yellow100%/Green 50%				38 %	27 %	100 %	.
White for green							
Green		361		76 %		91 %	
Green 60%	60 %			46 %		55 %	
Green 30%	30 %			23 %		27 %	
Brown 50%	50 %				28 %	50 %	9 %
White for yellow							
Yellow		136			27 %	79 %	
Yellow 50%	50 %				14 %	40 %	
Gray		428					23 %

Halftone screens

❏ **Characteristics**
  - ❏ **Gray level**
  - ❏ **Dot frequency (lpi)**
  - ❏ **Screen angle**

❏ **Limitations**
  - ❏ **Grid frequency**
  - ❏ **MoirØ patterns**

10% dots   50% dots   78% dots

gray levels = (dpi / lpi)†+ 1

Recorder grid

Halftone dot

Halftone cell
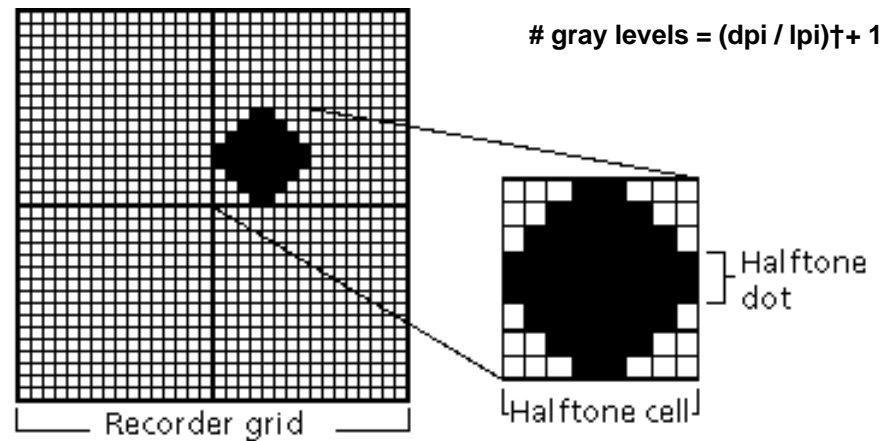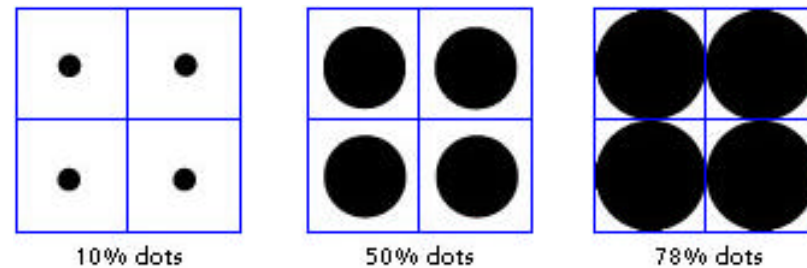
MoirØ patterns

❑ **A pattern that may form when screens of differing angles or frequency are overlayed. This is a common consideration in four color process printing.**
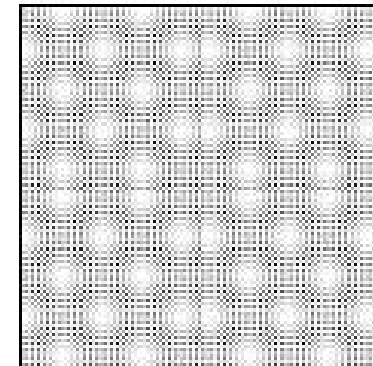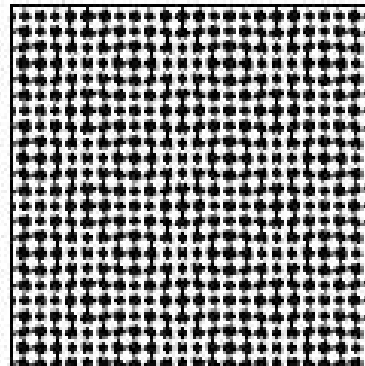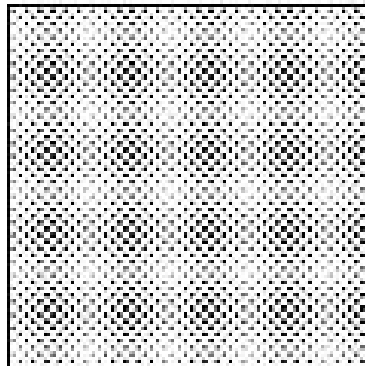
Screen angles

❏ **When printing screens over screens, the printer has to be careful to avoid moirØ patterns**

❏ **To achieve this, the screen angles for each color must vary by 30°. Black is always at 45°, so the other screens would have to be printed at 15°, 75° and 105°**

❏ **However, the fourth color would have the same angle as the first - which won't work**

❏ **One color screen must be out of 30° variance with the rest, so yellow is printed at 0°. (Yellow is much lighter than the other colors and the moirØ it creates is less noticeable.)**
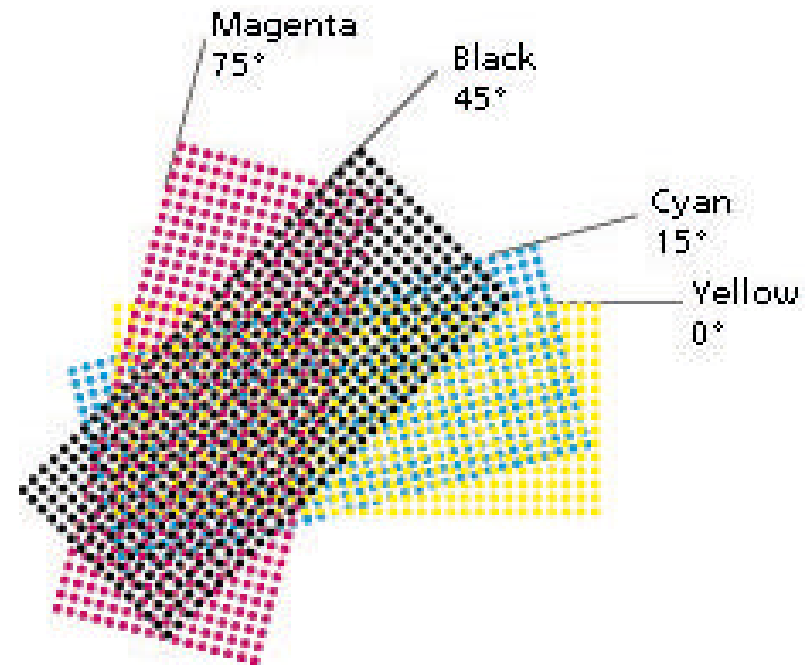
Benefits of stochastic screening

❏ **In general**

  ❏ *Screen angles and moirØ patterns are eliminated*

  ❏ *Greater image detail is provided*

  ❏ *The lack of screen rulings and screen angles leads to a significant improvement in image quality*

❏ **Maps**

  ❏ *Improved legibility for thin lines - especially for contours*

  ❏ *Improved legibility for small objects*

Stochastic screening

❏ *Stochastic screening involves imaging dots on film using special randomizing software.*

❏ *The software uses mathematical expressions to statistically evaluate and randomly distribute pixels under a fixed set of parameters.*

❏ *Stochastic uses random dot placement, hence varying spacing between dots. Dots are the same size and shape in most versions.*

ISOM/2000
Halftone screen recommendations

❏ **Frequency**

    To ensure good legibility for thin lines and small details
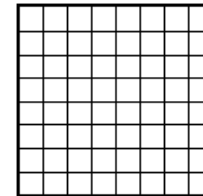
    ❏ *60 l/cm or 160 lpi*

❏ **Angles**

    To avoid moirØ patterns:

    ❏ *Cyan   15°*

    ❏ *Magenta   75°*

    ❏ *Yellow   0°*

    ❏ *Black   45°*

❏ **Stochastic screens recommended**

    ❏ *Where available*

Magenta 75°
Black 45°
Cyan 15°
Yellow 0°
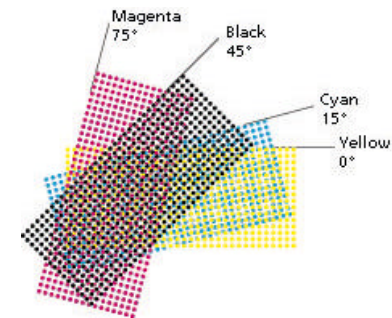
ISOM/2000
Printing order recommendations

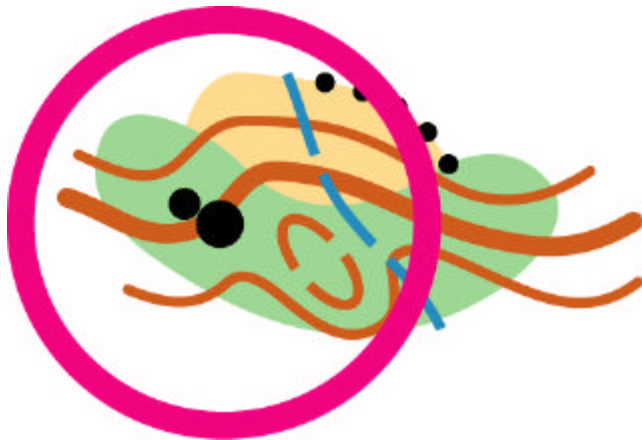❏ **When overprinting is applied the appearance of colours is dependent on the printing order**

❏ **In 4-colour orienteering map printing the printing order should therefore be:**

    1. *Yellow*

    2. *Cyan*

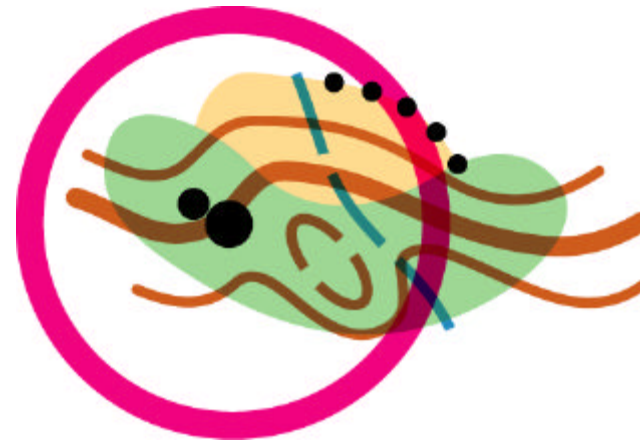   3. *Magenta*

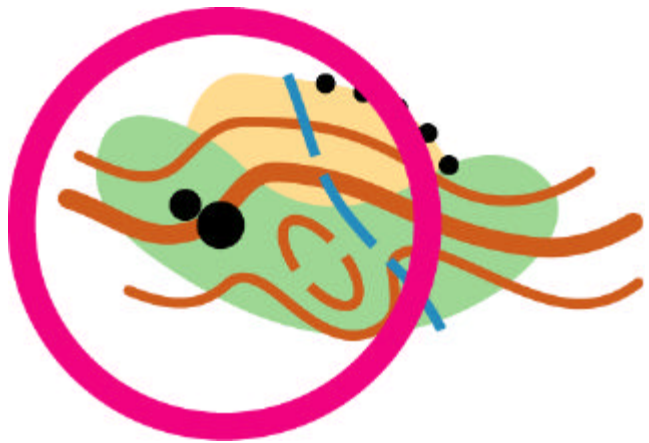   4. *Black*

Overprinting

❏ **Overprinting**

    ❏ *Make overlapping printing inks appear transparent*

*Underlying information
erased in all separations*

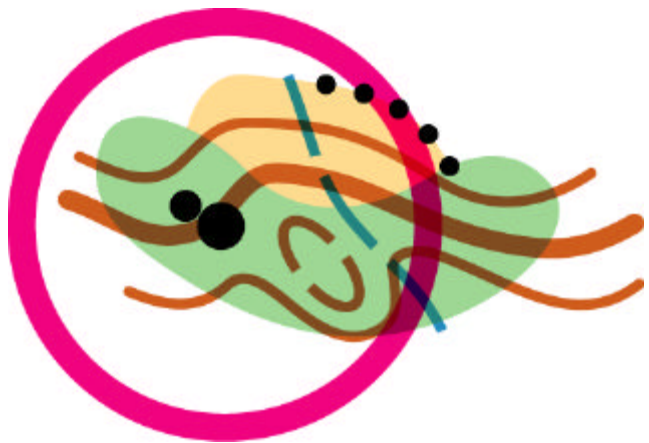*Underlying information
not erased in other separations*

Underlying information erased in all separations

Underlying information not erased in other separations

K

Information lost

C

M

Information kept

Y

ISOM/2000
Overprinting recommendations

❑ **Purpose**

  ❑ *Optimise legibility - remove as little information as possible*

  ❑ *Colour appearance as close to traditional PMS printing as possible*

❑ **Overprinting should be used for**

  ✓ *100 % Violet*

  ✓ *100 % Black*

  ✓ *100 % Brown*

  ✓ *100 % Blue*

Further work

❏ **Current 4-color printing recommendations**
  - ❏ *Is a first draft*
  - ❏ *Is a matter of further discussions*

❏ **Testing - so far**
  - ❏ *The two test prints (6&6b) - different implementations using Ocad mapping software and offset printing*
  - ❏ *How to implement the recommendations with other mapping software and printing devices?*

❏ **Further tests are recommended**
  - ❏ *Some more tests with various technology should be made*
  - ❏ *When, who and how?*