# Lithographic Printing

**a brief Guide
from CPG**
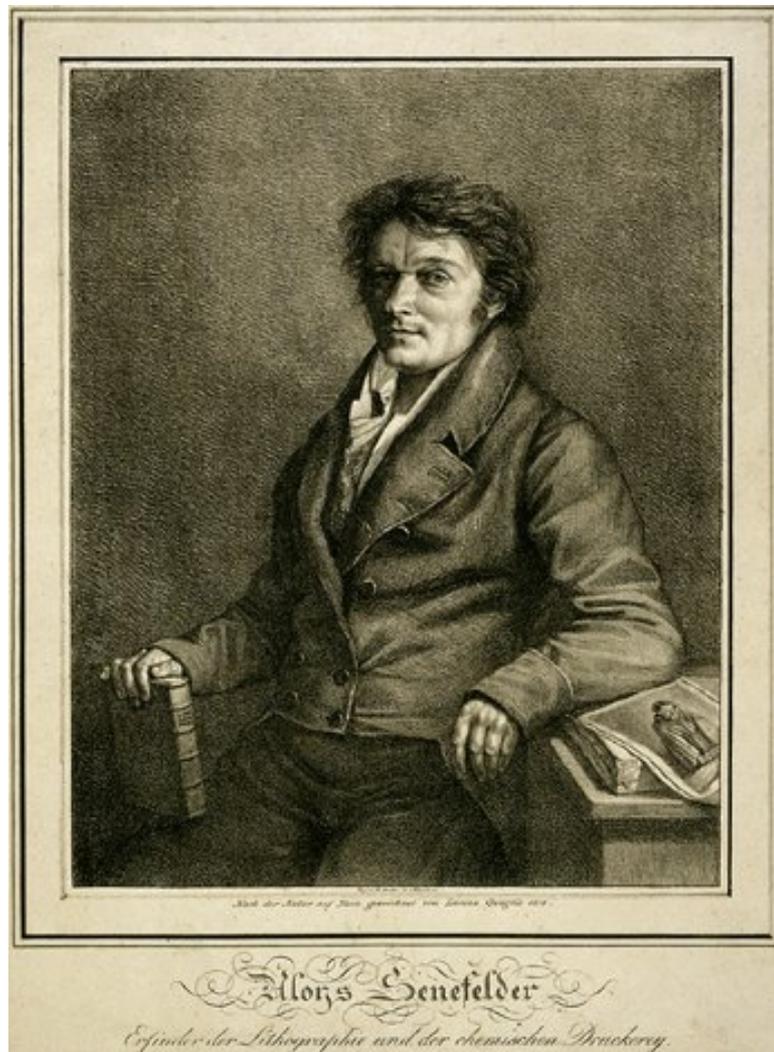


*This booklet was prepared for* ........................
*during a visit to CPG.*

An accompanying Terminology booklet is usually supplied to aid understanding of this document.

## LITHOGRAPHY and its origins.

What made Printing so important - why the big hoo-hah?

**The quick resume.**
It's worth remembering that before the development of the printing press and **moveable type** around **1439**, books were laboriously handwritten and illustrated by monks and scribes driven by the efforts of the Church to bring the Gospel to the people. Others soon grasped the importance of the written word and many more subjects were transcribed. **Johannes Gutenberg** started constructing printing machines based on wine and olive presses and invented **moveable type** so it became possible to produce multiple copies. Individual letters were moulded from a lead, tin and antimony alloy and re-used over and over again until they became worn out and had to be replaced. Illustrations were produced as **engravings** for assembling with the type and printing together instead of the work then passing to an illustrator to hand draw and paint each copy. This early system pressed its images into the paper and the text was made up of individual letters so it became known as **Letterpress**.
(**The Gutenberg Bible -** *printed 1450-54, of which around twenty copies survive, is the most treasured book in the Western World and Engraved illustration work is revered and collected)*
The idea of moveable letters, blocks, tiles and signs to print from was not a new one; it can be traced back to China and the middle of the eleventh Century but the technology used then made it an unmanageable process for large scale production. Re-useable letters never appeared in any commercial sense other than as wooden carved ones used for a while on poster work. Mankind's great benefit from the new system was that information and knowledge could be transferred to the printed word and thus become available to anyone who could read. Early works, because of the links with bibles and religious documents were in Latin. Even today many things like plants and animals have Latin names as well as their National language equivalent because they are more specific and aren't lost in translation. Once the craft became suitably developed, millions of books were produced throughout Europe in the first few years.
The man associated with **Printing in Britain** was **William Caxton**, a rich merchant with close links to the monarchy who in **1476** had the first Printing Press at Westminster. It is he who has responsibility for the introduction of this trade and the beginnings of standardisation of the English language. He is reputed to have retired from public life in order to work on his translations and printing and the fact that he was a merchant may mean that others printed his early work. It seems that he didn't start his own work until he was around fifty years of age.
Later, newspapers used multiple columns of type from machinery which was constructed to mould lines of type in one piece called a **Linotype slug**. This meant that many could work on setting the text simultaneously and changes could be readily carried out as News demands. Individual moveable letter text was then set on **monotype casting** machines and small late corrections were set and done by hand giving a greater flexibility and control. The basic body text was set on a keyboard that punched holes in a reel of paper tape which was later transferred to the Monotype Caster to convert the holes into the appropriate characters. Further developments improved quality, versatility and speed until more work on **Lithography** opened up a brand new area for the progress of the graphic arts. Printers no longer needed to press relief images into stocks and papers but used a flat surface to transfer them. The big drawback for early Letterpress printing was that the **formes** had to be produced back-to-front or **wrong reading** because images were printed directly onto the chosen stock. When **Offset Lithography** arrived, the whole printing scene took off once more and work was produced from **right reading** images.

**Alois Senefelder discovered lithography in 1798** as a process which relied on the fact that water and grease repel one another and he used this principle to form image and non image areas. He was a playwright who couldn't afford to publish his work, so he experimented with limestone

etching techniques until he realised that the basic principles alone could achieve his aims. Initially, in conjunction with the André family, he used the process to produce sheet music but soon saw the potential for commerce and the art world and by 1820 had patented a 'Guide to Lithography' which was translated into several languages.

   Artists were able to draw directly onto a flat, polished **limestone** (litho stone) surface with a greasy or waxy ink attracted to the dry stone surface. Wetting the stone prompted the absorption of water in the background area and its repulsion by the greasy image. Once ink was applied, it was repelled by the wet background and attracted to the image, so transferring a similar **mirror image** to any medium pressed onto it.

   This process is a **Plano** (flat) **graphic** (illustration) one and differs from previous methods which employed embossed or engraved **relief** images. Lithography had much less image wear than on relief images and this allowed for greater run lengths. Senefelder as we said originally used the process to print sheet music but it was soon employed for book illustrations, artist's prints, packaging, posters etc.

   Early examples of artists using lithography may be found in the work of **Delacroix** and **Gericault**. In the nineteenth century book and magazine illustrations continued to be dominated by wood engraving, however there are some examples of lithography being used to produce sumptuous colour illustrations. Among the most famous of these is 'The Grammar of Ornament' by **Owen Jones** (1856). **Digby Wyatt**, who assisted Jones, produced his own ornamental work in the 'Art of Illuminating' in 1860.
*(See also, John Nash: The Early Whistler by Wilfred Gibson. Printed by the Curwen Press)*


   Of all the artists who used lithography in the nineteenth century there were only a few who really exploited the process; among these were **Daumier** and **Toulouse Lautrec**. The introduction of metal plates, which gradually replaced Litho stones, allowed further development, particularly when combined with the photographic process. Fast running machinery and multicolour printing have moved the process into a new era where turn around times for jobs are very short.

   In the twentieth century **Offset Lithography** had replaced most other processes for printing on paper but some artists continued to use both stones and metal plates. Specialist work, such as plastic, continuous stationery, long run magazine and newspaper printing is still carried out by different processes. The peculiar demands of these processes ensure that their niche market remains detached from the general jobbing one.

   In the UK the **Curwen Press** has been an important centre for the development of lithography. Many artists, such as **John** and **Paul Nash** and **Henry Moore** have had their work printed by **Curwen**, who pioneered the printing of continuous tone images. Since the printmaking renaissance, instigated by **The Tamarind Institute** and other print workshops, many artists, such as **Frank Stella**, **James Rosenquist**, and **Jasper Johns** have used lithography in their work.
*(See also, Edward Bawden: Illustration for Fortnum and Mason)*


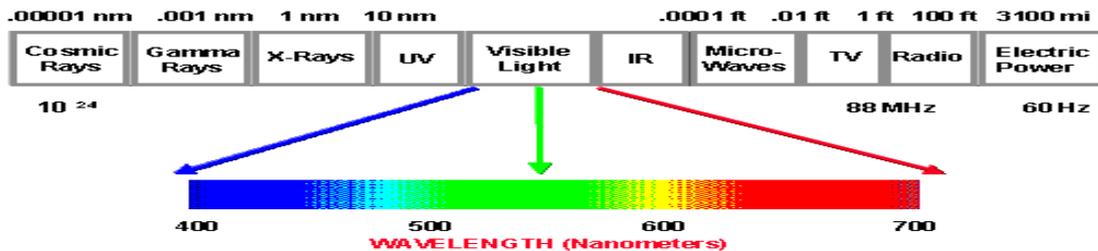## Understanding colour.

### What is colour?
A.   Something represented by the **Colour Spectrum.**

### So what is the colour spectrum?
A.   The modern understanding of colour which is currently referred to, originated in the discovery of the **spectral nature of light** by Isaac Newton in the 1600s. Newton had considered light to be a stream of particles and his experiments with prisms showed that white light could be split into individual colours. Furthermore, he noted that light of different colours had different refrangibility. Blue light is **refracted** more than red light, for example, when it passes from air into a medium of higher refractive index such as a prism. We now know that Newton's famous experiments demonstrated that light consists of energy of different wavelengths.

The eye is sensitive to a broad band of wavelengths with an approximate range of 350 - 750 nm, though the visible bandwidths represent only a small part of the full **electromagnetic spectrum**. Within the visible spectrum certain wavelengths give rise to certain visual sensations. The shorter wavelengths are perceived to be violet and blue and the longer ones red. It is important, however, to understand that the use of a term such as 'blue light' is for convenience only and that this use is not intended to contradict the fact that colour exists only in the mind.

## electromagnetic spectrum

| .00001 nm | .001 nm | 1 nm | 10 nm | | .0001 ft | .01 ft | 1 ft | 100 ft | 3100 mi |
|---|---|---|---|---|---|---|---|---|---|
| Cosmic Rays | Gamma Rays | X-Rays | UV | Visible Light | IR | Micro-Waves | TV | Radio | Electric Power |

$10^{24}$                88 MHz       60 Hz

400        500        600        700

**WAVELENGTH (Nanometers)**

One of the biggest problems facing anyone trying to reproduce colour, particularly in the graphics industry, is that we all perceive things differently because of this sensation. Colour blindness in an individual, restricts their experience to a very narrow band, where some or all things are only seen as a grey-scaled image.

## The basic principles of detecting colour.

The **additive colour** principle applies when mixing **light** of different colours because the combination of two wavelengths creates the sensation of a third colour. This principle uses various amounts of **R**ed, **G**reen and **B**lue light to produce all other colours. It is the manner in which TV and computer screens use **additive colour** to display their (**RGB**) images.

To illustrate this, imagine three spotlights coloured, red, green and blue focused on a white wall; where blue and green overlap, cyan is produced, where blue and red overlap, magenta is produced and where red and green overlap yellow is produced. If all three overlap, red, green and blue lights produce what we see as total or white light. It is the emergence of these three energy wavelengths from the sun that creates daylight in our world and allows us to see. All image-capturing devices such as digital cameras, scanners and video cameras use the additive colour principle for work on their images.

green
00FF00

yellow
FFFF00

cyan
00FFFF

white
FFFFFF

red
FF0000

magenta
FF00FF

blue
0000FF
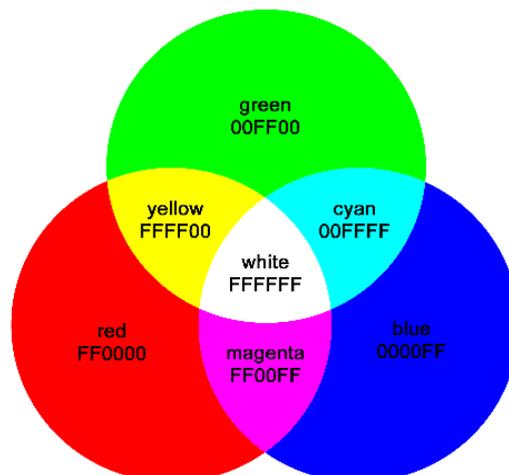
**The additive colour scheme.**

4

The **subtractive colour** system creates image by using colorants such as pigments or dyes to subtract portions of the white light illuminating an object and absorbing certain colour wavelengths whilst reflecting back the others. A red ball for example, has no colour or light energy of its own but simply reflects some wavelengths from white light. This causes us to see red because the ball absorbs most other wavelengths and induces the sensation of the reflected colour red. Colour wavelengths can be detected by the human eye, camera film and light sensitive instruments.

An object reflecting all appears white, whereas one which absorbs (subtracts) the illuminating light and reflects none back appears black. Painting, photography and all colour printing processes use the subtractive system to reproduce colour. In printing, coloured inks which act as filters, are used to subtract portions of the light shining on paper to produce other colours. Printing inks are transparent, allowing light to pass through them and reflect any unabsorbed light back to the viewer.



The offset printing process uses **C**yan, **M**agenta and **Y**ellow (which are the secondary additive colours) process colour inks and a fourth ink, **B**lack, designated '**K**' to avoid confusion with 'B' for Blue or Black. By overprinting one transparent printing ink with another the secondary subtractive colours produce **R**ed, **G**reen and **B**lue which are the additive primaries.
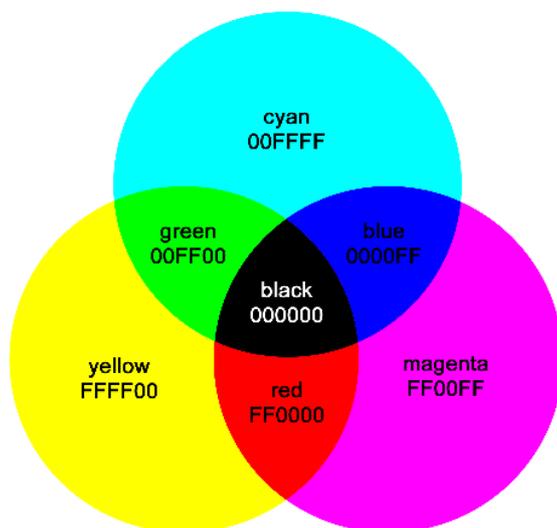


**The subtractive colour scheme.**

# Four-colour Process Printing.
## (The most common printing method for producing full-colour printing)

The vast majority of magazines and colour books are produced using the four-colour process. Originally, artwork and originals were colour separated photographically using filters to produce four printing plates, but today the work is carried out digitally. The four ink colours are **C**yan (blue), **M**agenta (red), **Y**ellow and **B**lack, often referred to as **CMYK,** where **K** is used to express the **Key** colour, avoiding the use **B** and confusing for Black or Blue. **CMY** overprinted produces a near black but it is not what is generally accepted as a true colour because outside factors such as stock and light source affect it. The **Key** colour is a valuable addition to the process because it enhances the picture detail, provides a basic text colour and 'Keys' in a truer black. Much of the body text in a document appears as black, so it is widely used here and for line-work illustration even if only in the form of **keylines** to contain other colours.

It is because Printing inks are **translucent**, that they can be **overprinted** and combined in a variety of different proportions to give such a wide range of colours. The colour variations are of course produced by the different screen values in an operating range; usually between 2% and 98%. These parameters are generally adequate as any screen using under 2% coverage is almost indiscernible and any over 98% become a virtual solid because of the pressure needed to print the dots. Printers call this action 'bottoming the grain' because it refers to the pressure needed in order to overcome imperfections in the paper. These imperfections are often caused by the grain direction or fibre make up of the stocks and leave low spots in the surface. Such imperfections are overcome by pressing the rubber blanket into them and so forcing the image to print down to these bottom areas (hence the term). High quality papers with better, thicker coatings and finishes are not so restrictive and can reproduce finer, lighter screens. They are subsequently more expensive and generally carry a higher **G**rammage per **S**quare **M**etre, which are critical factors in design choices.

Theoretically it is possible to produce an adequate range of colours using just **C**yan, **M**agenta and **Y**ellow and for a time Three-Colour-Process was a viable option from a standardised set of process inks in the 1480 colour range. In practice however, much better results are achieved with the addition of black, because it is used to strengthen the shadow areas, add detail and reduce the amount of **CMY** inks needed where black appears in a picture. Techniques in reprographics did at one time introduce a system of 'Under-Colour-Removal' to remove most of the primary colours beneath black and in so doing lower costs by reducing ink coverage. Modern software programmes take care of most colour issues within their retouching and colour adjustment panes.

Although the range of colours achieved from **CMYK** is adequate for most jobs, the process does have limitations. Many colours which are available as specials have no close equivalent in the four-colour process and would require a separate plate and an extra ink-mix to be reproduced. This additional cost is sometimes beyond the budget so it becomes a significant consideration in job design. When budget is a high design consideration, choosing an easily CMYK matched 'house' or 'logo' colour is paramount. It is not surprising therefore that Shell, BP, Kodak and British Gas to name but few, have done so. In some early design houses, Reflex Blue was avoided wherever possible because it is a difficult colour to work with.

It is not unusual, where an elaborate effect and/or extreme colour accuracy are required, to print in eight or more colours and there are presses which are capable of printing these in a single pass through the machine. Limited Edition Prints are expensive because they are generally produced from multiple colours in order to obtain tones that match the originals. This requires more stock to allow for higher wastage, multiple colour matching and the many inks needed to achieve a result. It is often the case that at the end of these print-runs, just a few perfect copies, printed under a very precise quality control may have been produced.

# Screening

**Half-toning** is needed for printing presses to produce the grey scale required to portray the variation of continuous toning as seen in a photograph. The press can only produce black from the black ink or cyan from cyan so there are no variations in these colours but by converting a continuous tone to halftone, an illusion of many shades is achieved. This is done by introducing a screen to break images up into dots of various sizes. Big dots show more colour than white paper areas and smaller dots cover less paper to appear as lighter shades. People in the printing trade use **Linen Testers** and magnifiers to enable them to check and see such things.

Before **image setters** were introduced, photographs were made into images for printing through the use of **halftone screening.** In this process, black and white photographs were placed on the copy board of a large camera and vacuumed up to a glass filter behind a screen. When the shot was taken, the resulting magnified image appeared to be made up of many individual dots and in normal viewing the appearance was that of a continuous tone like the original. In a black-and-white photograph for example, a group of large dots placed closely together appears black, a group of smaller dots with larger spaces between them produces a grey and a group of even smaller dots spaced widely apart appears almost white.

**Images following are magnified to allow easier understanding.**



**Grey Shades from 4 colours**

In the illustration above four colours have been used to produce a simple grey scale and the dot structure is clearly visible when magnified.

**Colour half-toning** is a more complex operation. With just the four colours; **C**yan, **M**agenta, **Y**ellow, **K**ey (Black), it is impossible to reproduce the thousands of colours in a photograph but by screening to half tone, the many combinations offer far more. Traditionally, as similarly described in **halftone screening** above, four different angled screens and three different coloured filters were used with a camera to split the image into the four colours required. With the advent of **4-colour screening** or **colour half-toning,** the graphics world opened up to extensive use of coloured diagrams, logos and pictures. The thousands of colours represented in a picture can be obtained to some degree of accuracy, from the **CMYK** screened format but what can never be achieved from this process is the vibrancy and luminosity displayed through a VDU or transparency. Printed work has no light passing through the image because it uses pigments to absorb some rays and reflect others, this leaves just the reflected light from the paper or medium used and these all vary.

Further complication arises from this fact that image capture and display devices use the additive colour principles and graphic arts the subtractive colour ones. **C**yan, **M**agenta and **Y**ellow are the colours produced by overlapping light beams of **R**ed, **G**reen and **B**lue which are the secondary additive colours. They are also the pigments used in four-colour printing and as the primary colours of the subtractive colour system cannot be compared in the same terms.

*Following, are 3 rectangles with a 20 percent **raster**[1] in them. The angle of the raster is set to 0, 22 and 45 degrees respectively. Look at the rectangles from a certain distance or close your eyes a shade and try to decide which of the 3 angles is the least obtrusive. ([1]A scanning pattern of parallel lines that form the display of an image projected on a cathode-ray tube of a television set or display screen)*
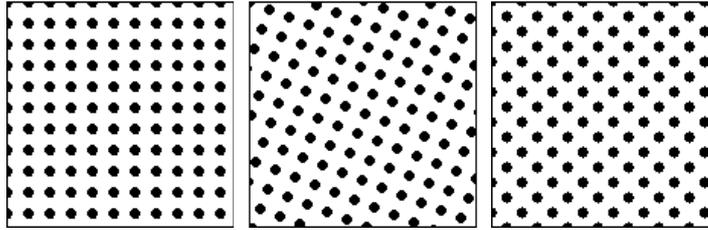
The human mind easily recognizes patterns based upon repetition, orientation and accentuation and we are programmed from first sight to recognise vertical and lateral lines by the very presence of the many examples encountered in everyday life. In the previous illustration, as the least obtrusive, 45° could be referred to as the **'master angle',** since it presents the flattest appearance to our eye (regardless of tile size) at both the centre and edges of the rectangle. As this angle is exactly halfway between the vertical and horizontal planes, the eye stops trying to view screen lines in these most fundamental alignments and perceives an overall image. At a suitable resolution to hide the dots in the screen, the black and white areas merge together to appear as greys with lighter having more white area than darker ones.

At the edge of a square cut image (which is still the most common in graphic arts) the 45° angle trims perfectly in line with the cut and offers no odd edge effects. The 0° angle leaves a small white line at both the bottom and right hand side; the 75° raster leaves holes near the edges where there is no data, but the 45° raster offers just a uniform pattern.

Even if a screen angle of 45° is ideal in most cases, this does not mean that we can print each one of the four colours at this angle. Firstly, the overprinting of each on top of one another would produce a brownish black and secondly, to offset each as **colour shift** would result in screen clashes and extreme colour variations. The image below shows just 2 colours at the same angle with a slight offset. Any deviation from that shown would result in extreme colour change and is therefore impractical. **Colour shifts** are less likely to happen if each colour is printed at a different screen angle, but they are not the only reason why different colours are not printed at the same one.

*In this example below one of the colours has shifted (this could be deliberate or the result of a number of things including paper movement):  at the same time we have changed size a little. The pattern effect is clearly visible, as it would be on the actual print and a black screen added to this would be hard pressed to avoid clash and the resulting image distortion.*
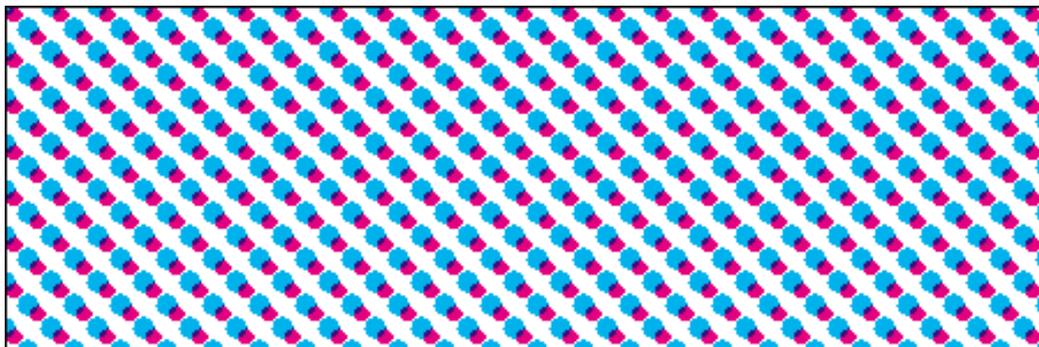


**Colour shift.**
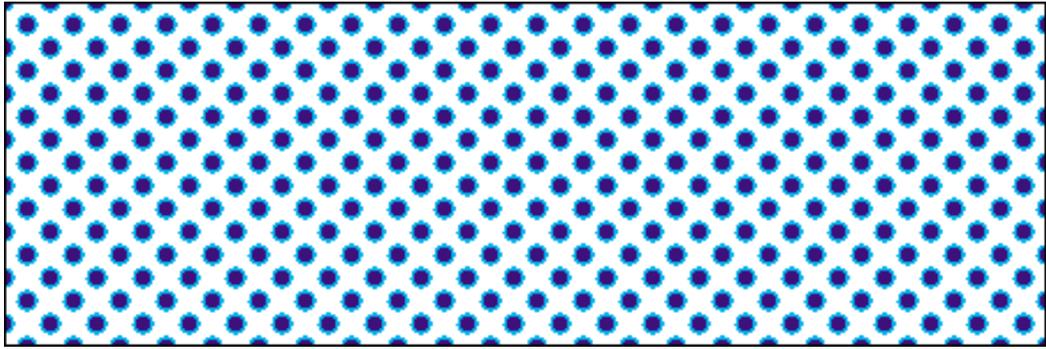
**Overprinting colours.**

*The above illustration shows magenta overprinted with cyan as derived from same angle screening. It produces dark centred spots with a cyan halo but has an effect of darkening. In the one below however, the colour shift has produced a blocking pattern, creating a highly visible criss-cross effect which will be clearly visible in the final print.*
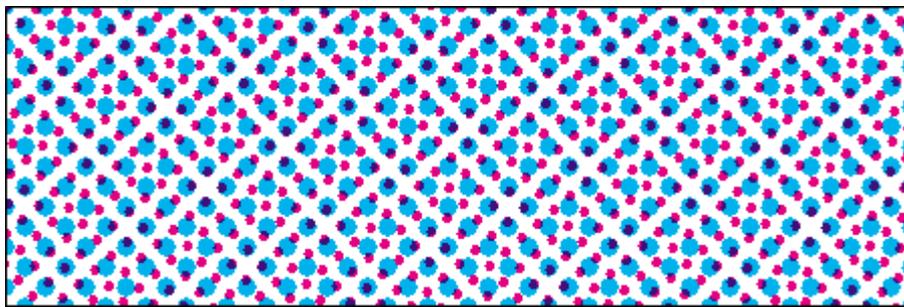


**Screen clash.**

Such screen interference as above is called a [1]**moiré pattern** ([1]pronounced more, with the letter A = more A). It is often apparent on VDUs and TVs when the lines of the display clash with some images in the picture on screen.  Moiré appears when roof tiles, striped shirts or chequered patterns are present on screen. As a result, pictures of TVs or VDUs are not usually reproduced with their screen displays 'as is'. Their on-screen pictures are generally created independently and the two are put together at the assembly stage to avoid clashes.

By preventing the angle clashes, moiré patterning is kept to a minimum in the end print and a more acceptable **rosette** is visible under magnification. This image, because of its symmetry and uniformity, does not detract from the overall view but allows the eye to convert the dots and colours into an apparently continuous tone similar to a photograph or painted original.
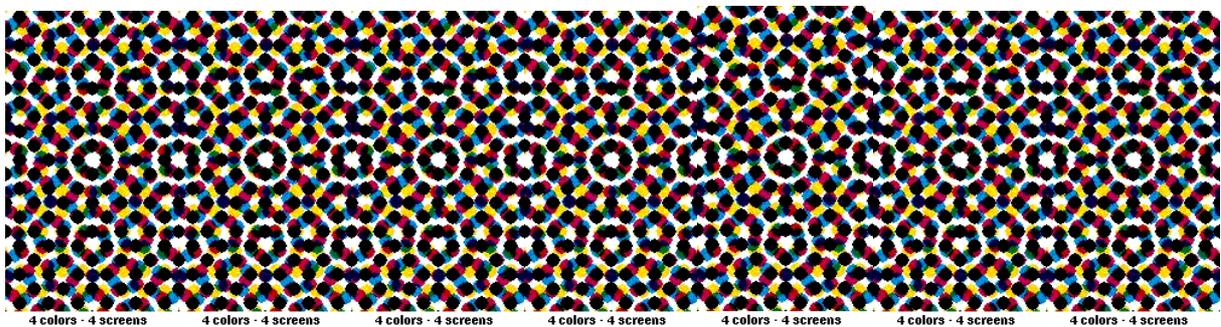


**Rosette pattern.**

*The illustration shows an **open** or **clear centred rosette**, as opposed to a **closed** or **dot centred rosette**, which allows a little less tolerance in printing. Both commonly appear in lithographic print.*

Books have been written about **moiré** and the mathematics behind it but we need only know that it should be avoided. Studies have shown that this can be achieved and minimized when colour screens are offset 30° from each other. For this reason, the most standard angle combinations are 15°, 45°, 75° and 90°. With only three chances to lay screens at a 30° offset there is inevitably a clash between the colours at 75° and 90°, so yellow which is the hardest to see, is placed at 90° within 15° of the magenta or cyan at 75° so the clash is almost invisible.

*Note: Angle sets essentially repeat every 90° and the 0° angle is very easy for the eye to see, even in a fairly tight screen ruling. Our everyday world is full of horizontal and vertical lines which are programmed into our recognition system though they are not clearly visible if yellow is the colour used at that angle.*
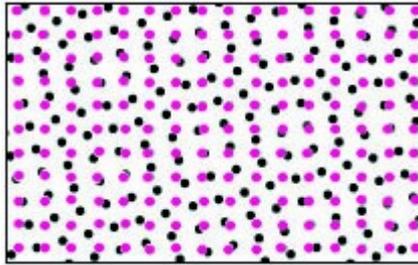


**Example of Moiré**

## Dot Patterns.

Breaking the image into a series of dots solves the dilemma of how to reproduce tones, but creates problems of its own because the eye detects patterns quickly. For example, this grid forms a noticeable pattern of alternating black and white "lines" running at 90° angles which is not desirable in the finished print because it detracts from the overall image.
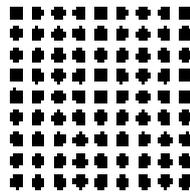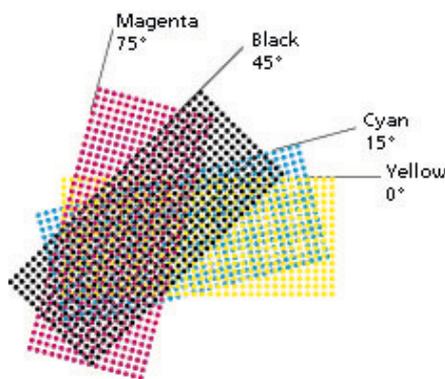


**90°/0° Screen Angle**

One way to decrease visibility of the screen and line patterns is to rotate the angle to the one which the eye sees least readily and that angle is 45°.
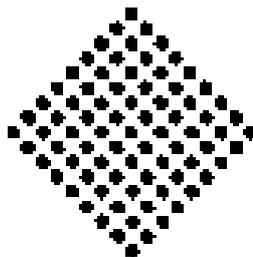


**45° Screen Angle**

The dot pattern is still visible at 45° but the stark upright and horizontal lines have gone and the image will soften even further as a result of its reduction to print screen ruling. This angle is generally used for single colour screening in order to replicate the continuous tones of originals and hide the dots. Top quality work is often produced on the higher grade stocks which allow the use of finer screens. It follows that printing with smaller dots makes them harder to see but there is always a point where other problems are created.

Whilst colours which are laid to the screen angles shown are seen as the normal set pattern it is not unusual for printers to change them to suit the type of work they produce. Placing the magenta at 45° is a move to assist in avoiding visible screening in flesh tones because of its higher presence but monochrome and two colour printing almost always place the black at that angle because of its high visibility. The broken-edge effects caused by angles that are not equal to either 45° or 0° is minimized when pictures are key-lined as it masks the problem. Although this is a very good solution, modern designers may prefer the use of vignettes[1] ([1]*shading off gradually at the edges to leave no definite line)* and the fading and merging of screens.

**Traditional Screen Angles**

*The visible clash between the cyan and yellow screens is always present at the angles shown but is imperceptible under normal printing conditions.*

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*WHAT FOLLOWS IN THE NEXT SECTION MAY OR MAY NOT INTEREST YOU… BUT IT MAY HELP YOU UNDERSTAND. WHATEVER YOUR CHOICE - TO READ OR NOT - PLEASE DON'T GET BOGGED DOWN IN THE TECHNOLOGY - YOU CAN JUST SKIP TO THE PART ON OFFSET LITHOGRAPHY ON PAGE 16 … IF YOU PREFER.*

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**THE REAL ANORAKS STUFF follows, for those of us who require an insight to the work done by the 'Boys & Girls in the Science & Technology Departments'.**

### Why So Much Fuss About Screening?
A.     Unwanted lines and spaces in pictures spoil the effect - we don't want either.

### But haven't we done that?
A.     In conventional screening things took care of themselves because the grid was placed between the original and the camera but this is not so now that we use electronic screen generation.

## Where do we go next then?

A.  So far, the rules for producing high-quality output seem clear:

- Use halftone screens to break images into a series of dots in order to replicate continuous colour tones.
- to avoid moiré, rotate the halftone screens to different angles.

## So as long as we use the conventional angles we should have trouble-free output, right?

A.  Unfortunately, wrong, because electronic screening cannot always achieve the conventional angles, though methods including ESCOR II screening from 'PREPRESS', have been developed to help reproduce these angles as closely as possible.

The trouble stems from the interaction of the screen frequency and resolution grids of the imagesetter in the formation of halftone cells. You specify the screen frequency and angle you want when you generate the colour separation files using a software application such as Adobe Photoshop. Each separation file contains data that tells the image recorder when to activate and deactivate its laser beam, creating the imagesetter spots that make up the final image.

To continue with our previous analogy, think of each halftone screen as a grid that is superimposed on the image recorder resolution grid.



Halftone screen          Resolution grid
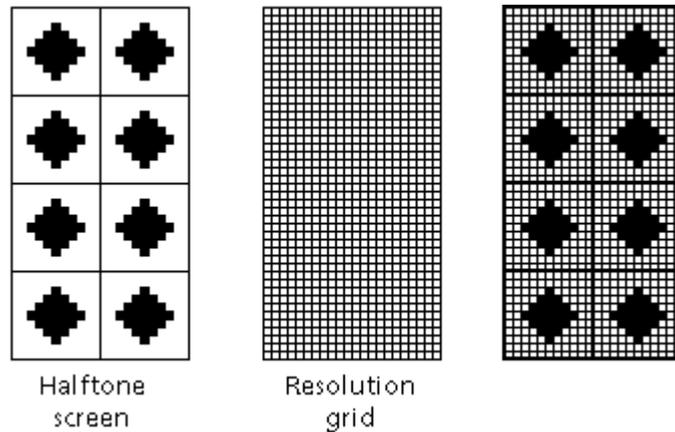
**Halftone Dots and the Imagesetter Grid**

The halftone screen above represents the yellow colour separation, usually printed at a 90° angle and so easily aligned with that grid. All the edges of the halftone cells with their dots contained within them align with the columns created by the resolution grid. In contrast, the other halftone screens (cyan, magenta, and black) are rotated at angles that do not overlap the resolution grid so neatly. The next illustration shows the Magenta screen, usually at 75° to the resolution grid and some halftone dots don't fall on the intersections where they can be plotted.
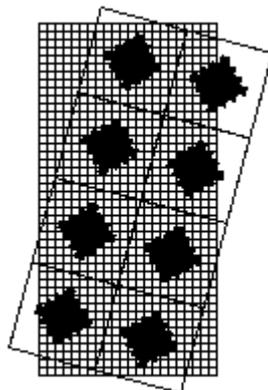
**Magenta Screen Angle**
The Black image with its 45° is easily plotted whereas the Magenta at 75° and cyan at 15° are not so.

## Do you remember drawing angles on graph paper in a maths class?

A.      Yes. Then this will indicate the problem. The conventional angle for the black halftone screen is 45° so we'll use that angle as an example. You align your protractor on the graph paper and mark the origin and the 45° angle, then use a rule to join the two points.
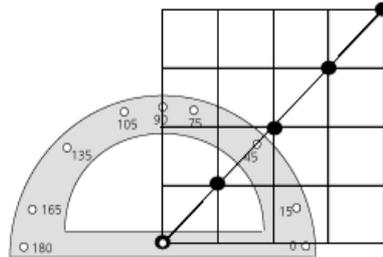


**Drawing an Angle**

A resolution grid placed over the work easily shows how the imagesetter will fix the spot points created by intersecting locations. It can only place spots at these points, which on the 45° screen fall neatly along the locations on the resolution grid.
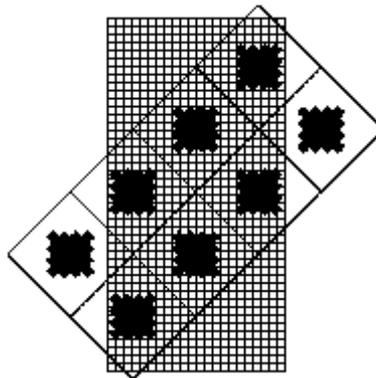


**Black Screen Angle**

By contrast, the 15° and 75° shown below under the same grid, present a different picture as the plotting points do not fall on grid intersections.
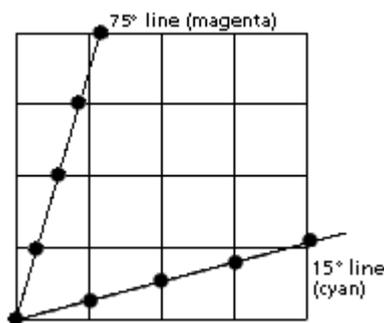


**Cyan and Magenta Screen Angles**

The large dots show what would be required for the imagesetter to plot at the 15° and 75° angles on grid rulings. However, it can only plot at the intersections and cannot activate the

laser at other locations: the result is a failure to reproduce the angle precisely. Because the angle cannot be imaged exactly, the plotting of the spots that make up the final image is not precisely correct. On a single screen, this may not be a problem, but when you combine four colour separations, even minute discrepancies can lead to moiré and colour shift; the two things we need to avoid.

## Solutions to screening problems.

In order to avoid or correct the positioning problems encountered by electronic plotting, something in the process must change; be it the screen frequency, angle, or resolution. The resolution grid is fixed because it is created mechanically in the imagesetter, so changes must occur elsewhere; in the screen frequency and/or the screen angle. We know that screen angles must be precise to avoid moiré but solutions developed to date to adjust the screen angle and line frequency include:

- Irrational tangent screening
- Rational tangent screening
- Supercells
- Advanced screening technologies

## Irrational tangent screening.

Irrational tangent screening tries to achieve the requested angles and screen frequencies as closely as possible, putting emphasis on the screen angle. Calculations to find the most precise frequency/angle combination could go on indefinitely so the irrational tangent screening algorithm calculates very closely and then assumes a small round-off error.

In visual terms, this screening method does not require the halftone cells to fall in a straight line along the resolution grid, but to provide the exact overall requested angle it introduces a correction factor into the halftone dot positioning. Instead of producing an absolutely straight edge, irrational tangent screening adjusts the line between imagesetter spot locations to ensure the intersection points are met. This strategy gives the algorithm the freedom to choose from any number of screen frequency/angle combinations to provide the overall requested effect.
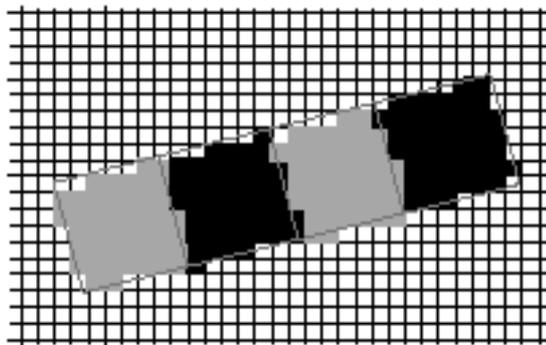


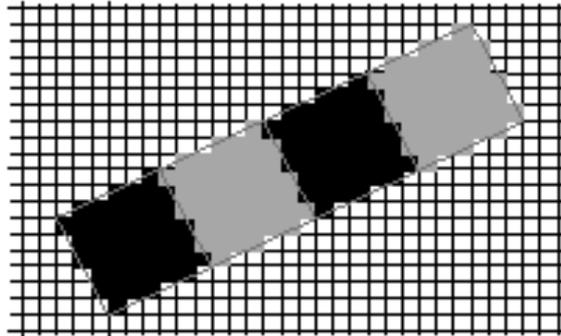**Irrational Tangent Screening**

In the diagram above, the dotted lines indicate the desired plotting points with grey and black showing the actual borders of the "dots" in jagged form. Because of the specific calculations required to determine an exact irrational tangent angle, every one is unique. This means that every row of dots in the image, at least for cyan and magenta screens, requires a

separate calculation. As a result of these individual calculations, the system provides a large number of choices in angles, screen frequency, and resolution combinations but it takes up huge amounts of computer memory and time.

## Rational tangent screening.

Rational tangent screening assumes that only the 45° and 90° (or 0°) angles can be achieved precisely and that the 15° and 75° angles are not achievable. Therefore, rational tangent screening substitutes screen angle/frequency pairs that make the edges of the halftone cells fall neatly on the edges of the resolution grid, creating a straight line.



**Rational Tangent Screening**

Again, the dotted lines indicate the intended placing for the correct angle and grey and black show the extremities of the actual 'dots'. This method yields a precise angle, but places a constraint on the number of frequency/angle pairs you can use. To minimize errors that may arise from non-intersection areas, rational tangent screening creates groups of halftone cells called supercells and makes sure that their corners intersect the resolution grid at suitable address points where the imagesetter can plot image.

## Supercells.

In this illustration, the heavy line denotes the supercell made up of 64 halftone cells; each of which contains a number of imagesetter spots, depending on the line frequency and resolution.
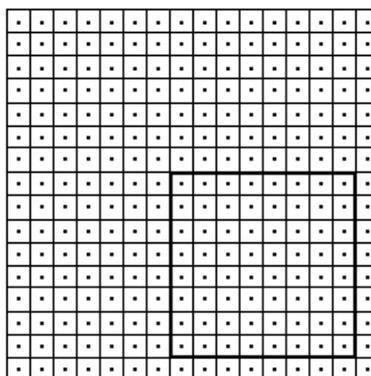


**Supercell**

To create its supercell, the imagesetter builds an electronic screen as a pattern of tiles. It does this by calculating angle and frequency in relation to the imagesetter grid and making a tile containing halftone dot locations. These tiles are replicated throughout the image and the resulting screen determines where imagesetter spots can be created. The spots then form

halftone dots of a size dependant on the image itself, with large ones for the darker areas and small for the lighter tones.

In the supercell method of generating rational screens, these tiles are simply made larger to allow 'errors in calculation'[1] to be spread over a larger area ([1]points at which the imagesetter cannot plot dots). For example, the tile for a requested screen might turn out to be 13.5 imagesetter spots in each dimension, but as the recorder can't create half spots the supercell screening algorithm builds a tile of 27 by 27.

Using these processes, supercell screening calculates sets of angles and frequencies that match the traditional ones for the 45° and 90° and come very close to matching the 75° and 15° screens. Because this technique uses the same data for each halftone cell, it is less computer-intensive and faster than irrational tangent screening.

## Advanced Screening Technologies.

Several companies have developed advanced methods of dealing with the complex issue of outputting high-quality colour separations. ESCOR II screening from PREPRESS, described in their Imagesetter Screening Technology Report, uses advanced algorithms to image high-quality colour separations free of unwanted moiré.

As an option available with ESCOR II screening, ESCOR-FM screening, described in the Stochastic Screening technology report, allows you to use a different screening technology than the one described. The conventional screening described is called amplitude modulation (AM) screening because the amplitude, or size, of the dots is varied to simulate different shades of grey. In frequency modulated (FM) screening, the number of dots is varied, but the dots remain the same size. (This approach was similar to 'radio wave' technology where AM varied wave size and thus strength and FM varied the frequency.)

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## Offset lithography.
### (This became the most widely used commercial printing technique.)

The basic working principle of **Offset Lithography** relies on the fact that oil and water do not readily mix. A litho printing plate has non-image areas, which attract water and images that attract oil (ink). During printing, the plate is dampened so that the greasy ink is rejected by the wet non-image areas and attracted to the image areas.

Artwork is produced or copied digitally with graphic design software and passed to an **Imagesetter** to convert it to the data for **Computer to Plate** (**CTP**) output.

For pages to appear in the correct order, allowing for the desired binding method, care must be taken at the image production stage to position the content correctly on each plate. There are a variety of methods employed in this **imposition** that are determined by the number of pages and type of job. Small leaflets and brochures are generally fairly simple to finish, whereas presentation work with pop-ups, throw-outs and such, make greater demands on production techniques. At this stage, imposition software is used to assemble each set of images so that the printed sheet can be 'finished' with a minimum of effort.

For example: a sixteen page (16pp), A5, 'self-cover' brochure is easily dealt with on a 170gsm stock by print, fold, saddle-stitch, trim and pack. Increase the stock weight to 250gsm and each 4pp may need creasing and the bulking may cause 'throw out' or 'creep' on the centre sections. Attending to these demands means much more work, time and money are needed.

When printing with more than one colour there is a separated image for each one used so jobs with four colour process images and two special colours require six plates. Each set of data is sent to the **Imagesetter** to make a printing plate by burning laser images onto the surface.

Plates are generally manufactured from aluminium and have one side anodised and grained to facilitate the fixing of the coating. This coating is then exposed to a laser beam to change either the image or background before processing. The finished plate has non-image

areas, which absorb moisture and repel ink, with images which attract ink and repel water. The flexible plates are attached to the plate cylinders and kept moist throughout so that ink only adheres to images and other areas are kept clean.

During every cycle of the press, the image is first dampened then inked, before being transferred to a rubber surfaced blanket cylinder. The image on the blanket is a **wrong-reading** one but transfer from blanket to the paper, turns it back **right-reading**. This **indirect** method is the **offset**, after which the process is named. The blanket's flexibility both preserves the delicate plate and conforms to the surface of the printing stock.

Printing presses can either be fed with paper one sheet at a time as **Sheet fed** or from a large roll or **Web**. **Web printing** is normally the reserve of large scale, long run work such as magazines, newspapers and catalogues. After printing, the sheets are taken for **finishing**, which could involve some or all of the following – laminating, UV varnishing, foil blocking, embossing, folding, cutting and creasing, and finally **binding** together and trimming to make the **finished** job. On modern newspaper and magazine presses, web technology and sophisticated in-line processes can provide a finished article that is folded, gathered, stitched, trimmed and wrapped in a polythene sleeve.

During the finishing process, a variety of methods can be used to secure all the parts into one document. Most common of these are **saddle stitching**, **perfect binding** and **wire-o binding**. The production of 'hard case' or 'case bound' books is normally treated as a specialist task and handled by a suitable printer. These jobs have sections sewn together and then sewn and stuck into their covers which often carry a dust jacket. (Further details are given on a separate document under the heading 'Folding Guide')

## A simple production process follows:

1.	Original artwork - photos, drawings, paintings, illustrations etc … are scanned or digital images are provided and assembled with text at a computer terminal.

2.	All elements are combined into a document using page make-up and imposition software for positioning into an image for plating.
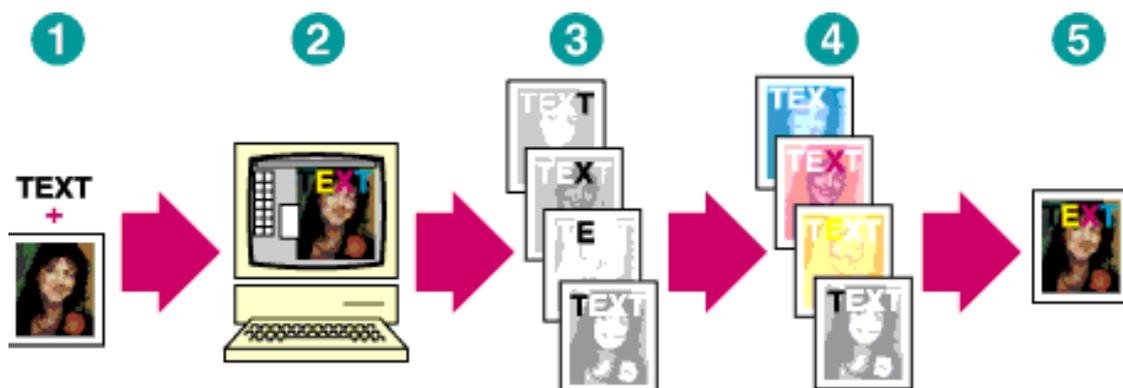


3.	Conventional working used full sized films, output using a high-resolution Imagesetter (positives or negatives); more recently, **Computer To Plate** is output through a **R**asterising **I**mage **P**rocessor or **RIP,** to a laser plate processor.

4.	Printing plates made from films used a photochemical process and were light sensitive, so when exposed to UV light through the films, non-image areas became soluble. Plate coating in this process washed off in the chemical bath, leaving just the image areas. CTP first used laser technology to soften the non-image or harden the image before chemically processing in a similar manner. Some of the latest process free methods have non-image softened by moisture,

made tacky by ink and stripped off onto the first few sheets of paper under impression. This eliminates the need for harmful chemicals and the power consumption required for process heating, cooling and drying.

5.      The flexible plates are attached to the plate cylinders of a litho press and the job is printed in its various colours.

        The printing process is illustrated in the diagram below.
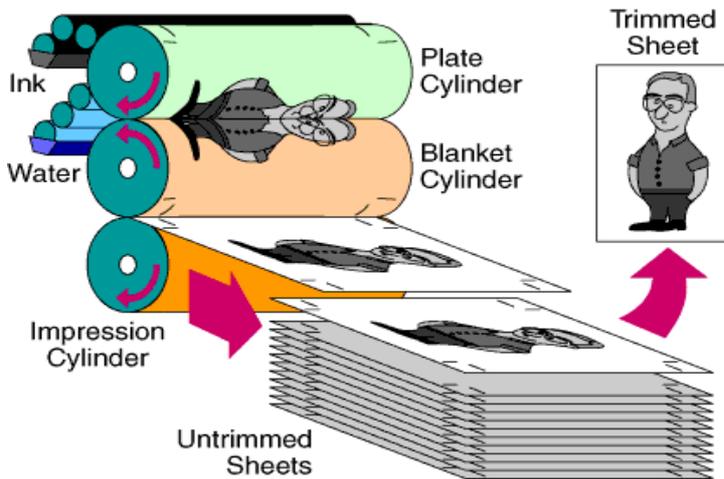


6.      Completed printed work is taken for any additional outworking before passing to the finisher for final assembly, trimming, packing and despatch.


## Special Colours.

        The reproduction of colour in the printing and digital media fields poses major problems because it is not possible to reproduce what is seen. A modern **VDU** may display 16 million colours in **true colour** but many are outside the printing spectrum. Digital media produces colour in **RGB** (additive format) and this then has to be rendered into **CMYK** (subtractive format) for transfer onto the printing stock.
        Luminescence and hue are greatly affected by the stock, so this exacerbates the problem and makes the use of special colours a must for more accurate colour reproduction. Some **Corporate colours** used as **Logo types** and **House colours** are deliberately chosen from those which have close **CMYK** matches in order to avoid the need for additional **special colours**. **Special colours** are produced as separately mixed inks from a commercially available colour range such as **Pantone** or **Focaltone** which are also commonly used in **Two Colour Printing**.  In a few rare cases a colour swatch, piece of material or tile will be given to the printer as a colour guide and this is often sent to the ink manufacturer to match. This is particularly useful when repeat printings or large quantities are needed.
        It is not unusual, where an elaborate effect is required, to print in six or more colours and some presses in use are capable of printing many different plates in a single run through the machine, but this is specialist work and therefore very expensive. Good examples of this type of work are **Limited Edition Prints**, which can use 16-20 colours and therefore cost hundreds or thousands of pounds for each copy.
        Something to consider when choosing for Company Logos or 'House' colours is that those with no close **CMYK** equivalent need special inks which are subsequently much more costly to

produce when used with **Four Colour** reproduction. If a colour chosen from the **Pantone** range has no acceptable **CMYK** equivalent then there is an ongoing expense of the extra working.

The fact that there are differences between the digital image and reproduction of the printed work poses further problems when proofing. Laser and inkjet images are not easily transferred in **CMYK** so more sophisticated models of printer now use 7, 8 or 9 colours to enhance and boost colour rendition. Some colours are equally as hard to produce here as in the printed image.

## Printing at CPG.

Reprographics work at CPG begins with clients supplying documents and graphics images at various stages of production for converting into print ready formats through the **Trueflow** workflow system. We collate **Mac** and **PC** created files and copy with these graphics images, then distil and assemble using all the current working and assembly software *(Quark, PageMaker, In Design, PhotoShop etc)* before files are **Ripped** for plating. Jobs are then processed through the **Mac's** digital **Computer to Plate (CTP)** programme and output through the software. Files created here are previewed, then used for proofing and/or output to plate for **machine proofing** or printing once the job is **passed for press (PFP)**.

The **Raster Image Processor (RIP)** has the job of interpreting a page description language such as **Postscript** in a rasterised format, at the resolution and of the media type required for use in a printer or image setter. *(See screening notes.)* **RIP** can describe the hardware and/or software used. In our case, a **Trueflow RIP** transfers ripped files from a **Mac** to a **PC** where they are further processed for the **PT-R4300 Plate setter**. The digital files are used to write the images to lasers for transfer to a plate but also write an ink control **CIP** file for colour control on the machine. The **CIP** software produces a **PPF (Print Production Format)** file which is read by the printing machine and converted into data for automatic ink duct settings. When combined with press sheet scanning, accuracy, quality control and operation speeds are thus improved by its use.

Our industry increasingly uses **P**ortable **D**ocument **F**iles **(PDF)** as they remain stable and virtually tamper proof as '**wysiwyg**' files. They are undoubtedly a preferred file type for printers to receive, frequently however, jobs are not passed round in this format but require extensive adjustments at our **MAC** terminals. Work here can involve anything from setting and design of **rough copy**, to **scanning** and **page make up**. Problems can arise here when different versions of assembly software are used and documents have to be 'back-saved' to a previous one. This can create character and formatting recognition problems from one version to another giving incorrect character assignations and copy dropouts. If this happens and is not spotted before printing, a reprint is often the only solution.

Work can be output for proofing as **PDF** (sent over the web), **digital laser** (from high-end inkjet machines) or **wet proof** (machine proofed): all is dependent on supply of **print ready files,** or constrained by budget and/or schedule. **Laser proofing** systems have improved their quality immensely over recent years and our **GMG** software allows us to reproduce fairly accurate **4-colour** images at **FOGRA** approved standards from a seven colour laser printer. **Pantones** and **specials** are impossible to produce unless they fall within the normal **CMYK** tint values and should be viewed for content only at this stage. Their colour accuracy is then achieved by reference to the **Pantone** colour sample book.

A **PDF** has its obvious merits but the safest method of proofing where budget and time allow currently remains the **wet machine proof**. Once **copy checks** are finalised from these proofs, it only remains to **print** and **finish** the job. Ink on paper is critical in that it shows up any limitations regarding resolution, legibility, contrast, brightness, colour discrepancies and stock quality. Error is further minimised if a **dummy** is made up from the proofs to check finishing capabilities, so this should be encouraged wherever possible. There is little point in having a beautifully printed job that doesn't work due to positioning, trimming or imposition error and dummies will highlight these problems.

# The Trueflow system.

The **Trueflow** system uses Mac/PC created files and copy, which have been **ripped** through in their assembled format for plate processing. A **4300 Plate setter** then uses **32 laser diodes** to bounce their beams from a mirror onto a plate clamped on a half-ton drum spinning at about 1,000 rpm. The accuracy demanded to plot images deploys the mirror as the crucial setting point, rather than setting the 32 lasers independently, which would prove a much more complex task. Plotting the image is critical here if problems are to be avoided (see the screening notes) in the four colour screens.

**Protocol holes** are punched into the plate when it is clamped in the machine to ensure that image registration is kept throughout the process. The technology uses the lasers for thermal softening of the plate coatings in the non-image area and removal by passing through a processor. A combination of developer to dissolve, water to clean and gum to protect, allows the coating to be stripped off all but the image. Latest developments in this technology demand less chemicals and significant reductions in our water and power usage.

A greasy, ink receptive coating is left for the image and all else remains an anodised, water retentive background which repels ink. The anodised surface, due to its irregular make up, employs the surface tension of water to aid its spread and coverage of the non image, which results in the repulsion of the greasy ink. Any moisture on the image is conversely pulled into droplets which are easily removed by the damping rollers, leaving a dry, greasy, ink attracting surface.

With each press revolution **dampers** wet the background before **inking rollers** coat the images with the appropriate colour for transfer to and from the **rubber blanket**. Offsetting the image in this manner ensures that the final print is **right reading** and gives our process its label of **Offset Lithography**.

In its early days, **offset lithography** had limited usage because unlike direct printing, which transferred ink from image to paper, the ink film had to be split once from plate to blanket and again from blanket to stock. Adding more pigment to increase colour density just caused further drying and transfer problems elsewhere but chemists soon rectified this and continue to improve and enhance their products. The oils which make up the vehicle base of ink are now less harmful to the environment; being vegetable based and not petro-chemical. With paper manufacturers using less bleach and coatings but more recycled and replenishable fibre, efforts to become a greener industry are taken very seriously.

Introducing water to paper as we do is not ideal because fibres readily expand in width after absorbing moisture and this can cause **colour shift** (see screening notes p.8). Transfer to and from the **rubber blanket** is another area where the print can be distorted by spreading under pressure and causing **dot gain**. This phenomenon always occurs and a **dot gain** of between 15% and 20% is common so efforts to keep dot gain low is something to be applauded and practised by all printers. Quality levels at **CPG** are maintained by constantly checking the printed work against the European proofing standards – FOGRA.

Setting tight parameters for these checks allows room for small deviations which are not critical to the final print and ensure better **Quality Control**. There are many tools available to implement this and a good starting point is the use of a **printed colour bar**.

A **COLOUR BAR** can be made up of a number of useful components which enable and simplify accurate **Quality Control.** Hopefully these will have been explained in detail during your visit but in brief terms those often employed are:

1.  **Neutral Greys** of monochrome (black) and multi-tone (C-M-Y) - for visual colour match and balance.
2.  **Density blocks** of solid monochrome C, M, Y, and K - for density reading colour control using a Densitometer in the Pressroom.
3.  **Star targets** overprinting in 4 colours - for print movement/distortion checks.
4.  **Mu lines** (small six box of differing micron lines) - for visual image quality check.

5.      **Tint boxes** (various values) - for dot measurement.
6.      **Opposed rulings** (horizontal and vertical ruled boxes) - for checking print quality and machine accuracy.

There is a plate for each colour in the printed job and as mentioned in other parts of this résumé, four colour printing cannot produce every colour at an acceptable hue from a 4-screen breakdown. This demands that some **Special Colours** be printed separately from their own plate and may involve the extra cost of a second pass through the press. Much of our media is currently produced on **silk** and **satin** paper which means that some pigments are left as deposits on the surface. This tendency leads to ink transfer, marking and scuffing problems that are overcome by coating with a thin layer of sealer/varnish. In some cases this is applied from an extra plate in the printing process, unless additional work like 're-moist' gumming' is to take place, in which case a water based seal is applied as a separate working. Our latest press provides us with an option to coat each sheet with a water-based layer instead of sheet sealing from a separate plate.

## Print finishing.

Preceding notes roughly explain the actual printing process and mention further work which may be required at print finishing. It should be noted here, that printers generally use papers from the **SRA** range (see the paper sizes p.25) because they allow margins for gripping, print information, folding and trimming (This can be seen if you have a printed sheet enclosed in your presentation pack). Any number of additional operations may be undertaken before the flat printed sheets are taken for finishing.

Studying a folded, printed sheet clearly indicates the importance of placing things in the right place - the **imposition** and bulkiness of the stock used will also have an effect if **saddle stitching** is the preferred binding method. As **saddle stitching** involves **insetting** one section within another it means that each additional four page increases the thickness of the document at its spine and this **bulking** moves the centre pages further from the spine than the outer ones. It may mean that images on each page have to be moved into the spine in increasing amounts to compensate this **drift**, **creep**, or **throw-out** effect. It is important that designers are aware of the effects of **bulking** before they start, so that page content, stock weights and quality are details factored into plans at the outset.

Any additional work is usually carried out by a specialised company because it has become impractical for all but the largest printers to carry in-house production of these processes. Operations may involve **lamination**, **UV coating**, **gold blocking** or **embossing** before printed sheets are ready for finishing and much of the advertising work also demands use of complicated **cutting** and **creasing** formes. Assembly of these products often ends with hand work, performed by an army of skilled outworkers. Pockets and such require accurate hand positioning and fixing with double-sided sticky tape and inserts can only be added after this assembly.

The general jobbing market is more likely to involve folding, stitching and trimming work. When a job consists of few pages and a separate cover it is divided into **signatures** (sections), which are **folded and insetted** one inside another. Wire stitches (normally 2) hold sections/cover together before cutting down to size on a **three-knife trimmer**, *(which cuts excess paper from all (3) but the spine edge)* or single cutting on a **Guillotine**.

**Folding**, **insetting** and **saddle-stitching** sections are done by specialist machinery which can be set up in variety of combinations suitable to individual jobs. It is at this point in production that the importance of correct positioning (the **Imposition**) becomes apparent. Any print has to appear in the right place on the page and in the correct order of pages. The details are predetermined and used in the imposition software at the **MAC** terminals before each job is ripped into a **TIFF** file.

A job using thicker stock or made up of a greater number of pages (generally above 64) may be impractical to **saddle-stitch** and better to **perfect bind**. This technique involves a

gathering of printed sections one on-top-of another, with a separate cover drawn around and glued at the spine. **Impositions** for the two finishing methods change enormously because sections are not only **collated** (assembled) differently, but there is also an extra 3mm trim allowance on the spine of each **perfect bound** page. Here, the extra trim is ground off to leave an uneven surface to which glue adheres and thus binds on the cover.

Folded sections are placed in order at the various **stations** on the finishing machine and automatically assembled prior to the stitching or gluing required. **Saddle stitching** is named thus because each section is picked up by machine suction and dropped over a guide plate or **saddle**. The middle section straddles the guide plate and all others, including the cover, are dropped over one another before the wires or stitches are inserted through the spine.

For **perfect binding**, sections are assembled one on top of another and clamped before the grind off, glue and cover are applied. This work is commonly carried out on a **Müller Martini** machine with around 16 **work stations**, which could include **loose insert gluers**, **reverse throw-out feeders**, **guillotining** and in-line **shrink wrapping**. Machinery can be built to perform almost any task and finishing equipment is often designed to suit particular job requirement by adding or omitting certain components.

In some cases, particularly where loose-leaves are preferred, the chosen finishing method may be **Wire-O Binding**. In these circumstances, **pre-trimmed** sheets or leaves are gathered in the correct order before small rectangular holes are punched out on the **spine** edge. Each copy is then placed into a machine which inserts a continuous wire giving the appearance of ring bindings. Sizes can be adjusted to suit individual needs and there is often a limited choice of plastic coated, coloured wires.

**Hard case sewn binding** is a completely separate undertaking which involves the **gathering** of the book **sections** one on another and stitching together before sewing onto ribbons which are pasted and sealed into a hard cover. This cover often has a printed covering stuck around it and a **dust jacket** round that to protect the contents. As this is such an uncommon finishing process in the general jobbing market it is only performed by a few specialist operators.

## Printing in the digital age.

### Printing at home.

With the advent of 'all-in-one' equipment for home use, the scanning, assembly and output of multicolour work has become commonplace, as individuals print their own stationery, invites and such. A little experience and understanding of Printing and Computer Technology means that 'Desktop Publishing' is literally at one's fingertips and as individuals we have all benefited from the digital era.

### The World-Wide-Web.

Much can be gleaned from various web sites to enhance photography and music and others offer work that can be downloaded for print for a small charge. It's said that if you look hard enough you can find anything there and if that's not quite true at present it seems it soon will be.

### The effects on The Trade.

The most immediate effect that Desktop Publishing had was the loss of work within the Trade. There is a further downside to this in that having used the technology as a starting point; some then come into the professional graphics trade with little or no understanding of the ground rules. Making it up as you go along and overcoming the problems may be very rewarding for an individual but the long term effects within the industry are not good. These problems are often costly but avoidable and the customer is the last to want to pay. Whilst it would be impertinent for printers to suggest that their customers are wrong, especially as design preferences are subjective, adhering to basic principles does standardise and make for better working practices.

An often forgotten rule is the one where the first and subsequent odd folios are normally right-hand pages and even ones are conversely left-hand. Because we work reading left to right, the front cover is often supplied as page 2 where it appears on the right of a cover pair, with the back cover left-hand and page 1. In this situation there are immediate pagination problems for saddle stitching because the next folio, a left hand page, is either p3 cover or the first page of text (p1). By changing left/right defaults, the first page of text becomes a left-hand page, when it should be produced as a single which eventually pairs up with the last one in saddle stitched imposition. Unless the work is a self-cover job where all pages run concurrently, it is better to treat the cover as a separate article with outside/inside front and back pages.

Financial and green issues lead us to avoid blank pages though the odd one here and there could resolve pagination issues. Even on the gathered work of perfect or sewn binding it is much easier to work with sections where the first page is an odd folio because this is the norm.

### Competing.

In an ever shrinking market it is necessary for designers and printers to offer more or set themselves apart in order to attract business, so this has an effect on styles and working practice. The results are often to complicate production as the trade follows the trend in an effort to maintain a modern image. Books without folios may be aesthetically pleasing but only add to the difficulties experienced in tight production schedules when dummies are made and sheets folded and finished. Managers don't object to being given more work as long as there is no additional cost and time to absorb, unfortunately this is often not the case.

### The challenge.

One drawback in colour visualisation is that many people expect to see an accurate printed reproduction of the images perceived on their VDU and this is plainly not possible. Good origination and printing will always show its failure to reproduce the vibrancy and luminosity of RGB because these colours are light generated through their imaging systems. The printed image is conversely one which subtracts certain colour wavelengths and has no light other than that which it reflects. *(The colour principles in the* **'Understanding colour'** *document explain how this works).* Though the reprographics world strives endlessly to enhance and improve its end product there is at present no comparison between the two systems.

### The Compromise.

Whilst our American cousins like to approach and promote printing from a scientific standing it is generally accepted in the UK that working environments have a big say in print production. Much of what we do is therefore seen as a compromise to overcome production issues. Our core factor being that we generally only print four colours but create the illusion of many more by turning continuous tone originals into screened prints. This does not mean that we abandon a scientific approach to our problems but that we adapt and develop techniques to use within our factories and print rooms. When we introduce new equipment we have to take on its needs, which in the case of our plate-setter is a controlled temperature and humidity.

Manufacturers of clothes washing products have added substances (blue whiteners) which helped to reflect the ultra-violet part of the light spectrum and make their 'whites' brighter. Similarly, in printed reproduction work, black solids are often 'underpinned' with a cyan tint to give added depth and lustre to the colour and lamination, gloss varnishing and spot UV varnishing are all methods of adding shine and lustre to the finished print.

Adding water to a process involving paper is not ideal but it is a major component in Lithography so we must use it. Similarly the double compression of an image transferred from plate to blanket then paper is not conducive to good printing but it must be done to

allow right reading to right reading by the offset process. We overcome the results of these combined 'bad practises' by building 'dot gain curves' into the software used to process the jobs. The technology allows us to measure the difference between the generated and printed dots then minimise that difference by a reduction at source.

The introduction of a fourth colour (black) into the reproduction of colour work was in itself a big step in the improvement and use of screens to assimilate the continuous tone of photographic work. Printing's ability to reproduce multiple copies of the written word meant that knowledge and information became available to the masses but the Digital Age has put much of that just a 'press of the button' away. One can find almost anything on the Web if searching hard and long enough but some of us still prefer the tangibility of a book in our hands.

**The Green agenda.**

We already have a process-free plate system and vegetable-oil based inks as ways to attack green issues but with a need to preserve the Rainforest and save trees generally, there has been a big demand to recycle paper waste and have 'The paperless Office'. This has created a further reduction in the demand for printed matter and many companies now send electronic Christmas cards to cut paper usage. Much is changing rapidly so who knows where our industry will go?

Manufacturers and users alike are conscious of a need to reduce their carbon footprint and thus greener credentials are an ongoing issue at the forefront of production techniques. The most immediate effect in the print room has been that the introduction of greener stocks has brought a lower quality printing surface and its consequent ink transfer and drying problems. Fortunately modern technology is rapidly providing solutions to these issues.

## The ISO paper concept.



$$1 : \sqrt{2} = \sqrt{2} : 2$$
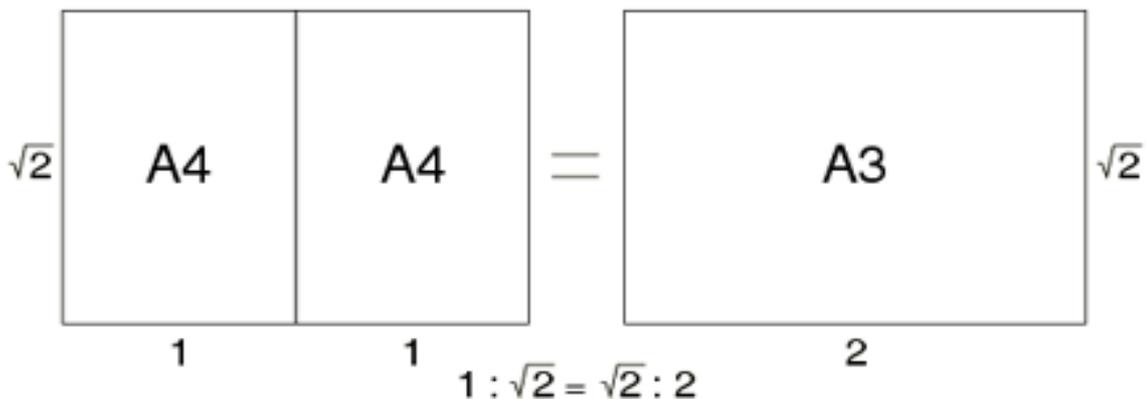
In the **ISO** paper size system, which is the most common in Europe, the height-to-width ratio of all pages is the square root of two (1.4142 : 1). In other words, the width and the height of a page relate to each other like the side and the diagonal measurements of a square. This provides a unique property which means that when a sheet is cut in two by dividing on the long edge, the resulting halves have the same proportions as the original. A sheet of A4 when halved thus gives you two sheets of A5 and all A-size papers have the same proportions when rounded to the nearest millimetre. The standard benchmark in this series is A0 (841mm x 1189mm) which just happens to be one square metre in area. Paper is qualified by these criteria

and so the paper substance is generally measured and sold in **G**rams per **S**quare **M**etre or **GSM**. Quality is a separate issue dependant on the fillings, sizing and coatings used in manufacture.
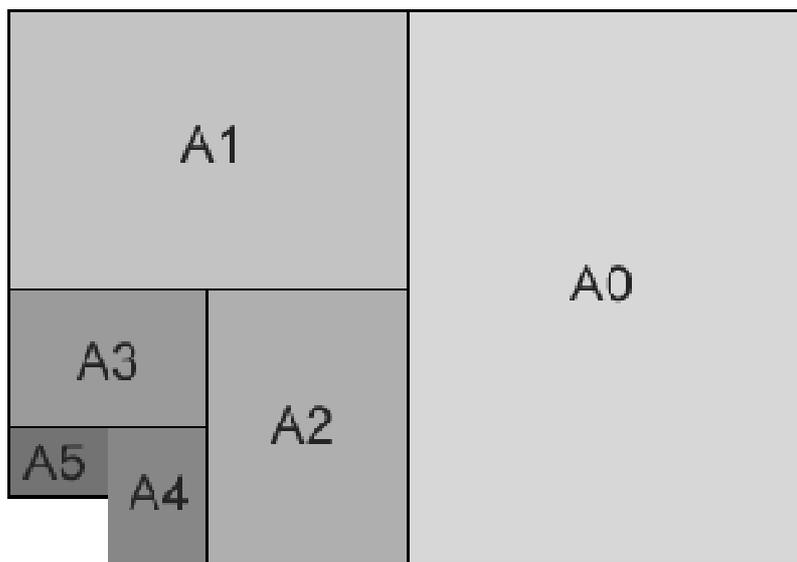


**The A series paper concept ensures that the ratio off the long to the short edge remains constant.**

|  |  | B Series Formats | | C Series Formats | |
|---|---|---|---|---|---|
| 4A0 | 1682 × 2378 | – | – | – | – |
| 2A0 | 1189 × 1682 | – | – | – | – |
| **A0** | **841 × 1189** | B0 | 1000 × 1414 | C0 | 917 × 1297 |
| A1 | 594 × 841 | B1 | 707 × 1000 | C1 | 648 × 917 |
| A2 | 420 × 594 | B2 | 500 × 707 | C2 | 458 × 648 |
| A3 | 297 × 420 | B3 | 353 × 500 | C3 | 324 × 458 |
| **A4** | **210 × 297** | B4 | 250 × 353 | C4 | 229 × 324 |
| A5 | 148 × 210 | B5 | 176 × 250 | C5 | 162 × 229 |
| A6 | 105 × 148 | B6 | 125 × 176 | C6 | 114 × 162 |
| A7 | 74 × 105 | B7 | 88 × 125 | C7 | 81 × 114 |
| A8 | 52 × 74 | B8 | 62 × 88 | C8 | 57 × 81 |
| A9 | 37 × 52 | B9 | 44 × 62 | C9 | 40 × 57 |
| A10 | 26 × 37 | B10 | 31 × 44 | C10 | 28 × 40 |

The B series provides intermediates for the A sizes though they are used much less often.
As shown under envelopes, C series sizes are applied.

Printers require paper with extra space for printing information, colour bars, trims and machine grip so they generally use stocks from the SRA or supplementary range.

| SRA0 | 1280 | x | 900 |
|------|------|---|-----|
| SRA1 | 900 | x | 640 |
| SRA2 | 640 | x | 450 |
| SRA3 | 450 | x | 320 |
| SRA4 | 320 | x | 225 |

**Sizes here are rounded to the nearest millimetre.**

## Identification cards.

ISO 7180 specifies three formats for ID cards:
- ID – 1      85.60      x      53.98
- ID – 2      105      x      74 (A7)
- ID – 3      125      x      88 (B7)

ID-1 is the common format for banking cards (0.76 mm thick) and is also widely used for business cards and driver's licences. Some people prefer A8 (74 × 52 mm) for business cards. The standard passport format is B7 (= ID-3), the German ID card has A7 (= ID-2) format and the European Union driver's licence is an ID-1 card.

Copying machines designed for ISO paper sizes usually provide special keys for the more frequently needed magnification factors;

| 71% | √ 0.5 | A3 → A4 |
|-----|-------|---------|
| 84% | √(√ 0.5) | B4 → A4 |
| 119% | √(√ 2) | A4 → B4 (also B5 → A4) |
| 141% | √ 2 | A4 → A3 (also A5 → A4) |

Conversion rates are as follows: -

| to<br>from | A0 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 |
|------|-----|------|------|------|------|------|--------|-------|--------|-------|--------|
| A0 | 100% | 71% | 50% | 35% | 25% | 18% | 12.50% | 8.80% | 6.20% | 4.40% | 3.10% |
| A1 | 141% | 100% | 71% | 50% | 35% | 25% | 18% | 12.50% | 8.80% | 6.20% | 4.40% |
| A2 | 200% | 141% | 100% | 71% | 50% | 35% | 25% | 18% | 12.50% | 8.80% | 6.20% |
| A3 | 283% | 200% | 141% | 100% | 71% | 50% | 35% | 25% | 18% | 12.50% | 8.80% |
| A4 | 400% | 283% | 200% | 141% | 100% | 71% | 50% | 35% | 25% | 18% | 12.50% |
| A5 | 566% | 400% | 283% | 200% | 141% | 100% | 71% | 50% | 35% | 25% | 18% |
| A6 | 800% | 566% | 400% | 283% | 200% | 141% | 100% | 71% | 50% | 35% | 25% |
| A7 | 1131% | 800% | 566% | 400% | 283% | 200% | 141% | 100% | 71% | 50% | 35% |
| A8 | 1600% | 1131% | 800% | 566% | 400% | 283% | 200% | 141% | 100% | 71% | 50% |
| A9 | 2263% | 1600% | 1131% | 800% | 566% | 400% | 283% | 200% | 141% | 100% | 71% |
| A10 | 3200% | 2263% | 1600% | 1131% | 800% | 566% | 400% | 283% | 200% | 141% | 100% |

Exact conversions of both measurements are not always possible but that is because the proportional values are to be maintained.

## The envelope.

The two kinds of envelope that printers commonly refer to (shown below) are pockets which seal on their short edge and wallets which fasten on the long edge. The styles chosen are often part of the design concept so this will affect the preferred choice for each job.
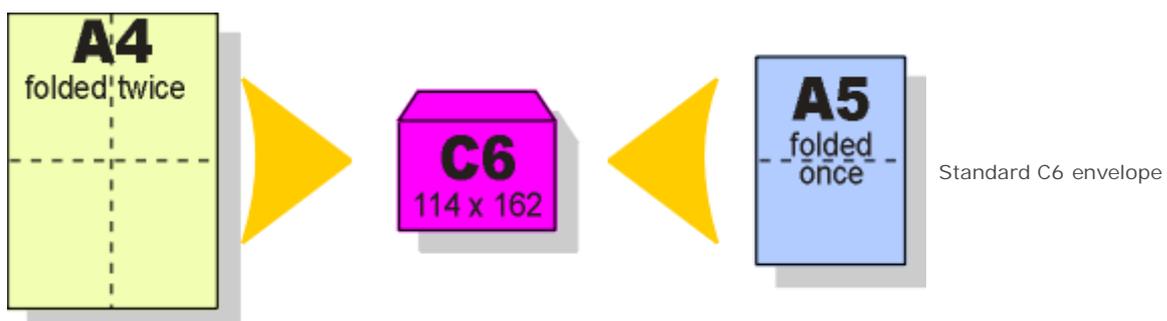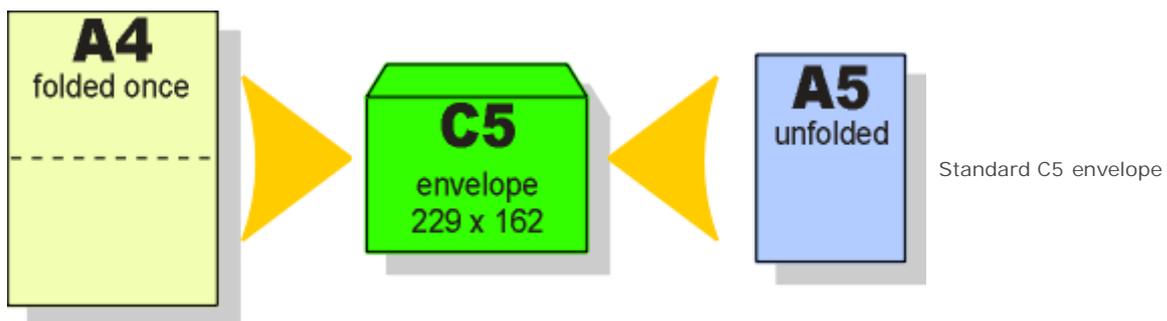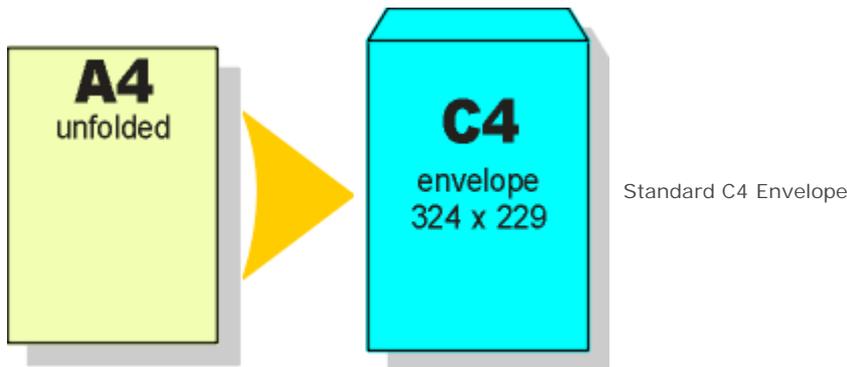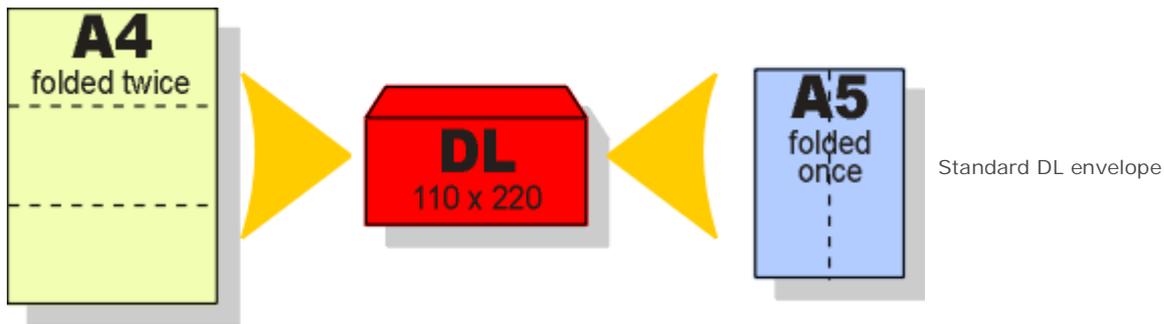


Pocket envelope



Wallet envelope

In the illustrations below the C size envelope is indicated with its common use for insert displayed either side. Royal Mail requirements are always to be considered as non-conformation may carry increased costs.



Standard C4 Envelope



Standard C5 envelope



Standard C6 envelope

Standard DL envelope

## Dummies.

To steal a previous quote; "there is little point in having a beautifully printed job that doesn't work due to positioning, trimming or imposition error but dummies will highlight these problems". Dummies are invaluable aids for turning print concepts into jobs, particularly when made up using the actual materials preferred. Not only do they make it easier for presentations to clients but also show possible problem areas such as bulking, cracking, line-ups, positioning etc .... There is the added benefit of being able to estimate mailing costs from weight and check printability with the supplier.

When starting out it is important to identify the information needed to produce the dummy so here are a few pointers;

**1**.	**State clearly what the job comprises** [e.g. 16pp text saddle stitched in a 4pp Cover with a 90mm non-capacity, single glue pocket at the foot of p3. Portrait. Make slots and insert 85mm x 55mm landscape business card into pocket 10mm from foot and foredge]

**2**.	**Detail individual size requirements** [e.g. Cover - 303mm x 215mm to take A4 inserts. Text - A4 centred top to bottom on cover]

**3**.	**Specify exact materials of each component** [e.g. Cover and Business card - 350gsm Lumi silk. Text -170gsm Lumi silk]

**NOTES.**
a. Dummies produced on weights above 170 gsm probably need scoring along their folds.
b. Scoring from the outside creates a debossed ridge along the fold which gives a clean, smooth edge when folded inward.
c. When heavyweight stocks are used the score will take up more. The reduction in dimensions should be allowed for.
d. If the contents are too bulky for a single fold, a double fold is needed to create a boxed spine (3mm minimum).
e. Additional score lines may be added to reduce pressure on the spine of the dummy and to keep pages in place. This is called the 'guard' and is often seen on perfect bound jobs.

IT IS INTENDEED THAT THESE NOTES PROVIDE A USEFUL POINT OF REFERENCE AND WE ARE HAPPY TO BE CONTACTED TO ASSIST OR ADVISE YOUR FUTURE PROJECT NEEDS.