Digital Prepress

'N' Scheme Syllabus

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DIGITAL PREPRESS

PREFACE

This book covers all the topics in a clear and organized format for the Second year Diploma in Printing Technology students as prescribed by the Directorate of Technical Education, Chennai, Tamilnadu. It is confidently believed that this book furnishes the students the necessary study material. The topics covered were neatly illustrated for better understanding of the students.

The book's step-by-step lessons in large, eye pleasing calligraphy make it suitable for both direct one-to-one tutoring and regular classroom use. The book is prepared in normal everyday English and is free from professional jargon characteristic of so many reading instruction books.

All of the lesson pages were carefully designed to eliminate distraction and to focus the pupil's full attention on the work at hand.

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DETAILED SYLLABUS

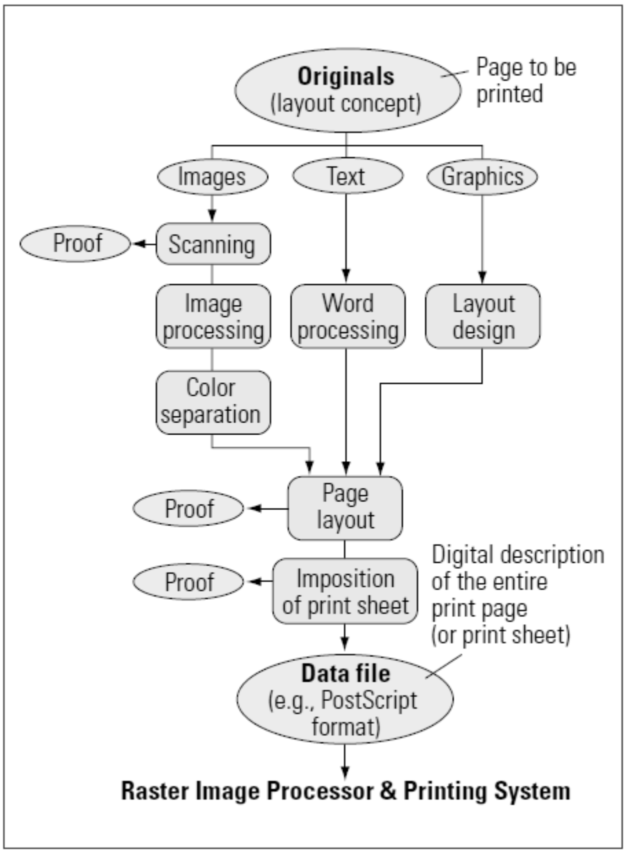
Unit	Name of the Topic	Hours
I	***Digital Prepress – Introduction*** 1.1 - Digital Description of the Printed page - Elements of Digital Page – Integration of Text, Images, Graphics, Layout and Prepress checklist. 1.2 - Dot Shapes – Round, square, elliptical and composite shapes, Amplitude Modulation /Frequency Modulation Screening - Difference between AM and FM screening and Benefits of FM screening. 1.3 - Input and Output Resolution, Image - dependent Effects and Corrections – Spreads and Chokes, Trapping, Moire and interference of dot pattern, Under Colour Removal, Gray Component Replacement, and Unsharp Masking Techniques. 1.4 - Desktop Publishing – Introduction to DTP, Components of DTP – Software – Pagination Software – Designing software – Image correction and editing software.	**17**
II	***Digital Photography & Digital Proofing*** 2.1 - Image capturing with Digital camera – Special features of Digital Camera – Tone Value Quantization, Focal length of lens and Aspect Ratio and Link up to a Computer. 2.2 - Charge Coupled Device and Complementary Metal Oxide Semiconductor - Definition and difference between CCD and CMOS. 2.3 - Scanner designs and models, Flat bed Scanners - Diagram, functions of scanners and advantages of flatbed scanner. 2.4 - Digitizing and Redigitizing - Various Redigitizing Techniques - Copy dot, Descreening and mixed mode. Digital Proofs and Press Proofs.	**18**
III	***Digital Image Assembly and Data Formats*** 3.1 - Page Assembly and Imposition - Digital assembly techniques of CTF and CTP. Imposition - Image register and alignment,	**18**

	Imposition plans - Sheet wise, Work and turn and Work and tumble. 3.2 - Raster Image Processor (RIP) - Workflow diagram – Interpreter, Renderer, Rasterizer and Bitmap. 3.3 - Data Formats - Bitmap & Vector, Applications of storage media - Data distribution, Archiving and Backup or transport.	
IV	***Colour Management*** 4.1 - Definition of Colour, Colour Management and Needs - Targets of Print Colour Management. 4.2 - CIE Chromaticity Diagram - CIE Lab Values. Colour perception and colorimetric description of colour. 4.3 - Image Reproduction Process using Colour Management - Implementing Colour Management, 4.4 - Diagram for Colour perception and the colorimetric description of colour and 3cs' of colour management.	**18**
V	***Computer to Plate systems*** 5.1 - Computer to Plate Systems – Advantage of CTP, Components of Computer to Plate system. 5.2 - Workflows - PDF and JDF - Portable Document Format, Job Definition Format and their advantages. Preflighting - Preflighting techniques, the process and preflighting checks. 5.3 - Lasers in CTP – UV, Violet, Thermal and Computer to plate technology for flexography, gravure and screen printing processes. 5.4 - Printing plates for Digital Imaging - Plates used in CTP - Silver halide plates, Photopolymer plates, Thermal plates, Inkjet plates - Automatic plate processor diagram and its functions.	**18**

UNIT - I : DIGITAL PREPRESS – INTRODUCTION

1.1 Digital Description of the Printed Page:

The extensive standardization and compatibility between systems (e.g., PC or Mac/Apple), software, and data formats used by the customer, the agency, and the prepress company allow for a division of the workflow. This division of work is also applicable to the jobs carried out within a print shop with a prepress stage included.



The purpose of the page layout is to create a digital page from individual elements such as text, graphics, and images, which contains all the information relevant for further processing

Elements of a digital page:

Text:

The text data are primarily prepared in “Word” format, which has virtually become the word processing standard, since it is most widely used and offers many professional tools. The text data are very rarely edited directly in Word; instead they are positioned and typographically edited in a layout program (e.g., QuarkXPress, InDesign, or PageMaker).

Images:

The picture objects of a printed product are usually available as *photograph*, *slide,* or *reflection copy*, and are scanned in, or digitized, for publication. The digital data are then available at a workstation for further processing (i. e., corrections of the image contents or geometry). In the mean time, further alternatives have been added to this classical procedure: for instance the principle of the *Photo CD*. A data file, for example stored on a Photo CD, containing original pictures that are already digitized.

As for the scanned image, these data can also be processed directly onto the workstation. Another alternative for image capturing is *digital photography.* This technology also avoids the traditional procedure of film development and image scanning. As soon as the data have been recorded into a digital camera, its contents can be processed at the workstation. Further, it is also possible to input image data directly from *image archives* (Photo Disc, Bavaria, Image Bank, or Mauritius, to name just a few).

These image archives have hundreds of thousands of pictures available and, increasingly, deliver the archived slides in digital form. Whenever you need a picture from an agency, for instance, you can download it onto your workstation to edit it in less than half an hour via ISDN data transfer. All these picture data are generally saved in TIFF format or – to save data transfer times – are compressed in JPEG format.

Graphics:

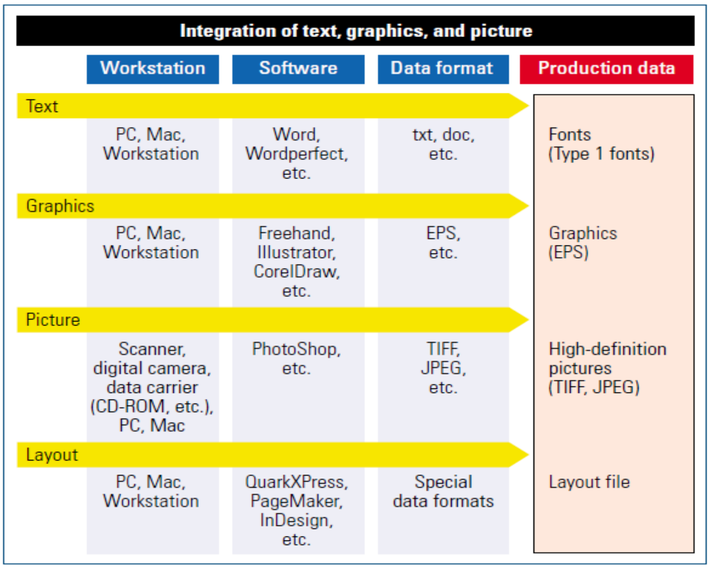
Graphics constitute the third main element of a printed page. They are generally generated in so-called *illustration programs* such as Freehand, Illustrator, or CorelDraw. These data are usually saved in the form of vector-based data files, which cannot be edited or positioned in a layout program. Therefore, these software programs offer an opportunity to save graphics or drawings in EPS format and make them available in the layout for geometric processing (scaling, cropping).

Layout:

Layout programs are software packages allowing for flexible, creative work and for integrating the elements (text, images, and graphics) on pages or a sequence of pages, or to position them on the page depending on the current job. Thus they have taken over a significant function of production. One particular layout program has virtually become a standard application: QuarkXPress. In 1999, a competitor appeared on the market: InDesign from Adobe. Another popular layout program is Page- Maker (formerly by Aldus, today Adobe), which is mostly used in offices.

The page components text, images, graphics, and layout, must be prepared and organized for further stages in processing (e.g., film production, platemaking, or printing), in order to avoid errors or breakdowns in the workflow. Although it is very important for the layout program to display all the components of the page (low resolution is sufficient), it is particularly vital for the system to be able to access the original resources for imaging. Therefore all the main files required for a job must be supplied in their original formats.

For production, a layout file is supplied that contains the definitions of special colors, or information regarding color separation, or regarding spreads and chokes. The pictures are available with it as high resolution files (e.g., 300 dpi scanning resolution) or at least as JPEG files and linked graphics as EPS files. Another important factor is that the original fonts (Type 1 fonts) of the layout file must be sent as type fonts.



The composition of the individual page segments using typical means such as hardware, software, and data format, as well as the generation of the necessary data files

Prepress checklist:

Prepress refers to everything that happens to make sure a job is correctly prepared for printing. When there are errors that could hold up the job on press. For trouble-free printing down the line, it is important to get design to be checked.

Prepress checklist is the series of questions related to job. This can vary according to the job and also industries. This list has a check box in front of each question and it is marked right or wrong by the proof reader or person doing preflight. If there is any corrections found in the proof that should be noted and again pass it to the designer for corrections.

Prepress Checklist: Digital Printing

CONTENT

- Spell check your entire document.
- Check all phone numbers, addresses, e-mail addresses, web sites, etc.
- Check all dates.
- Check all page numbering.

PAGE MECHANICS

- PAGE SIZE: Build your file to the finished size (i.e. if you need a 12” x 9” output size, don’t set up your document as 8.5” x 11”).

- BLEED: Include a 1/8” (.125”) bleed where required.
- FOLDS: Ensure all folds are accurately located in the fi le.
- BLANK PAGES: All blank pages in the document should be removed from the file, except those pages that are intentionally left blank.
- LIVE AREA: All text, logos, artwork and photos are at least 3/8” (.375”) away from all trim and fold edges.

IMAGES

- RESOLUTION: All photos should be 300ppi at their finished output size. Any line art images that are not vector based should be 600ppi at output size.

TYPE

- REVERSE TYPE: All ‘reverse’ text (light text on a dark background) should be at least 7 pt.

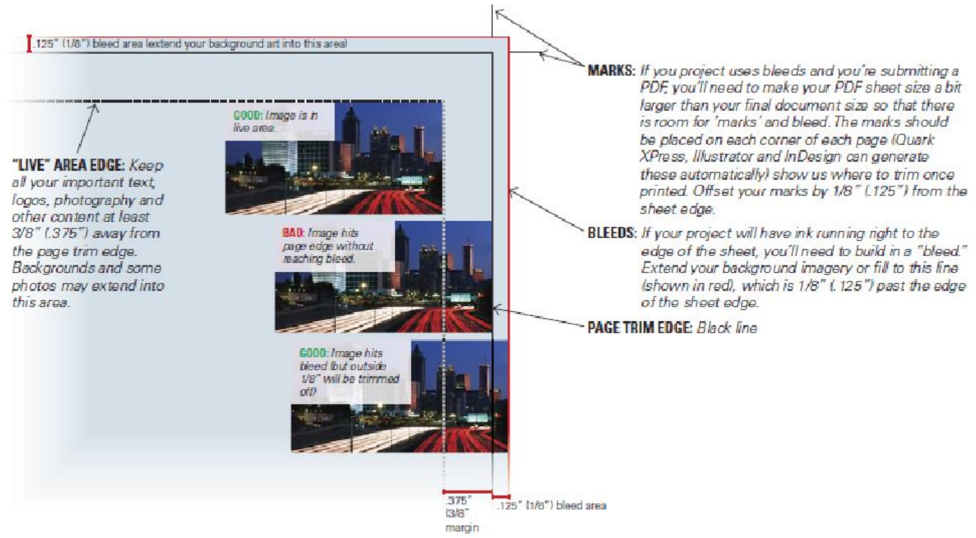
COLOUR

- BLACK/WHITE: Ensure that your file contains only information on the black channel. A file that “looks black/white” on screen is not necessarily truly black/ white in reality: it may contain rich blacks or RGB builds of black. Check carefully.
- PROCESS COLOUR: Ensure that your file (and linked images) is built as CMYK—not RGB or spot colour.

FILE FORMATS

We prefer PDF files. We CANNOT ACCEPT as press-ready any Microsoft, Corel, Quark or other formats. We can accept some of these files but they will incur charges to make them print-ready.

- PDF: Use PDF/x-1a or High Quality Press setting.
- BLEED: Include marks. Offset by 1.8” (.125”).
- NON-BLEED: No marks. Supply PDF at finished size.
- INDESIGN: Use ‘Package’ command and include fonts.
- ILLUSTRATOR: Outline all type (on a copy of the file), include all linked images.
- PHOTOSHOP: Flatten all layers (on a copy of the file). Save as PSD or TIFF



1.2 Dot Shapes:

Even in the days of conventional analog reproduction technology, printers experimented with numerous dot shapes in order to reduce incalculable dot gains, optimize color stability, and form an industrial standard.

In general terms, one can distinguish between the following basic dot shapes:

- Round dot
- Square dot
- Chain dot / Elliptical dot

In practice, it has not been possible to establish an ideal dot shape because applications and process techniques are often too diverse. For example, system A, which employs screening with square dots, may produce better print results than the screening with system B; but the latter system may produce a better chain dot than system A. This variation in print quality is attributed not only to the algorithms used for screening (like that in the various software-based, digital screening processes), but also to the technical hardware components for exposing the screened images.

Screening Processes:

The first attribute of a halftone pattern is the method by which it carries the information from the original to the eye of the viewer. There are two, fundamentally different, approaches by which a halftone pattern can simulate tonal information. One method is with an amplitude modulated pattern and the other is with a frequency modulated pattern.

An amplitude modulated (AM), or conventional, halftone is one where the frequency or periodicity of the pattern is fixed throughout the whole illustration. The detail is carried by the change in size of the individual dots in the pattern. Amplitude modulated halftones can be generated by photographic means such as contact screens or by electronic methods.

A frequency modulated (FM) halftone pattern, often referred to as stochastic or random screening, is one where the size of the individual elements of the pattern (dots) are fixed at the outset and the tonal representations are made by changing the numbers of the dots placed in any given area of the image.

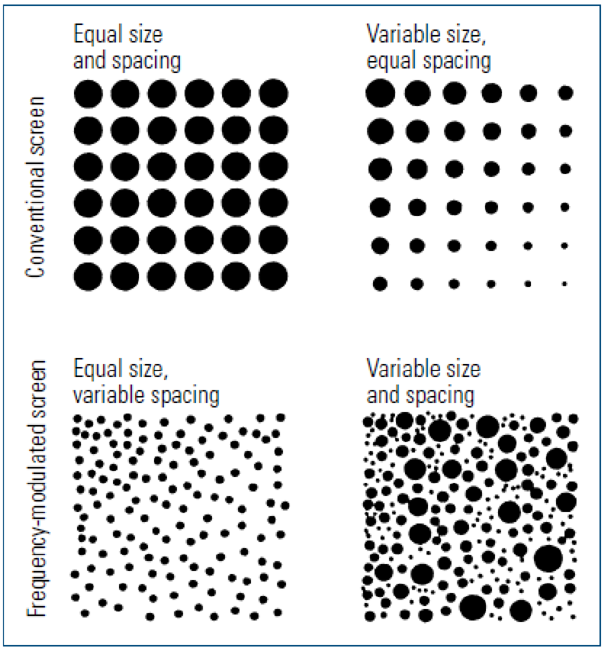


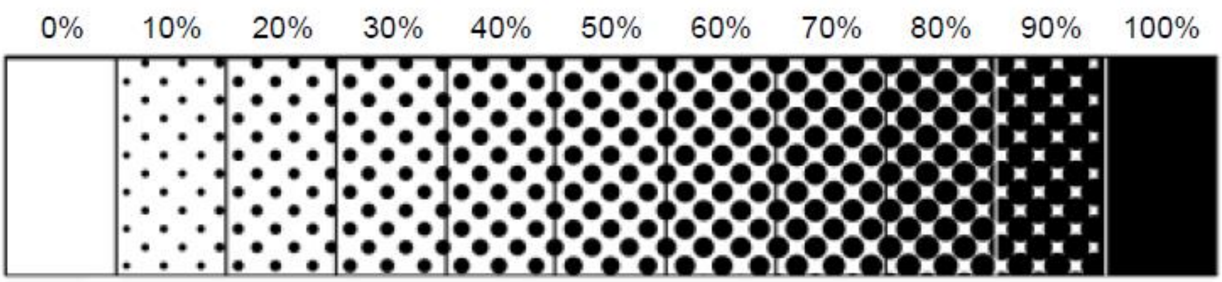
Fig. 1.4-34 Dot structures for the reproduction of tone values

Attributes of AM (conventional) screening:

There are four attributes of a conventional screen which must be understood if halftoning is to be commissioned or approved. They are:

- Dot percentage
- Dot shape
- Screen ruling
- Screen angle

In photographically produced halftones all the attributes above are set by the pattern on the contact screen.



Dot percentage scale (round dots)

Dot percentage:

The term 'dot percentage' is the means by which a fixed tonal value can be described. In a given area, such as one of the sections of the scale, if the whole area is taken to be 100%, the dot percentage describes the proportion of the square that is covered by black image. If, as you would find in the highlight end of the scale, only a small part of the square is covered by the halftone pattern, the dot percentage value for the square will be low, perhaps five or ten per cent. Conversely, at the shadow end of the scale the percentage coverage will be far higher, perhaps 80 or 90%. If the paper is unprinted it will have zero coverage; if there is complete coverage the halftone value is 100%.

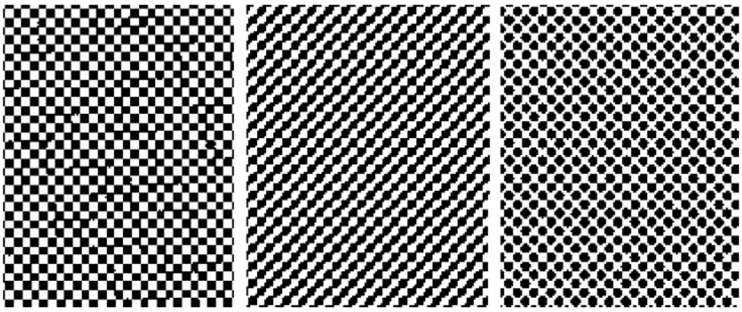
The dot percentage always refers to the image coverage on either the film or the printed result.

Dot shape:

The overall shape of a halftone dot determines some of its visual and printing characteristics. There are three main dot shapes in common use for printing – square, elliptical and round. The reason for choosing one shape, as opposed to another, is a combination of considerations including the purpose of the picture, the printing process and the substrate (paper, metal, film etc.).

Square dots are considered the most suitable for general purpose work in that they provide a compromise between rendering fine, sharp detail and smooth tonal transitions. However, they do suffer from the problem that at 50% values all four corners of a square dot link, simultaneously, to all the four dots surrounding it. This sudden link is visible as a step in what should be a smooth tone change.

Elliptical dots are more able to represent smoothly changing values in the mid-tones than are square dots, because their links to the surrounding dots do not happen in a single tone level. Across the long axis of the ellipse the dots will join at about 30%, but the short axis will not link until the coverage is up to 70%. The trade-off is that elliptical dots are more troublesome to control in difficult printing conditions and can produce visible 'chains' through the printed image. This is why another name for an elliptical dot is a chain dot. The most stable of the main dot shapes, particularly in relation to dot gain, are the round ones. Round dots would be the natural choice for newspaper printing because of the inherently high dot gain associated with cold set web offset printing on newsprint. But there is a trade-off in that it is difficult to keep detail open above 75% dot area coverage.



Square, elliptical and round dots.

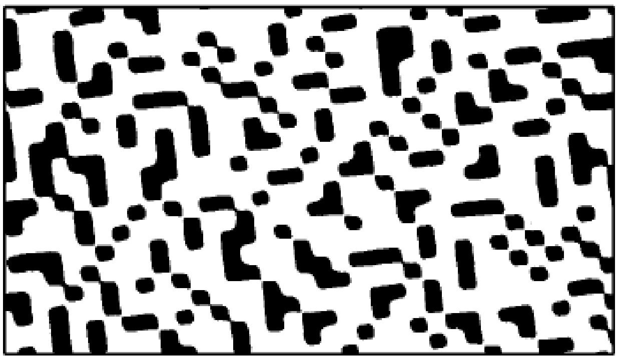
Frequency modulated (FM), stochastic or random screening:

In frequency modulated or random screening, the area of the smallest elements in the patterns, the spots, remains constant throughout the image. FM screening relies on the number of dots to simulate various tones. In much the same way that the choice of screen ruling in AM halftoning is influenced by the characteristics of the process and the substrate, so too is the choice of FM spot size. If the calculation of the position of the FM spots was truly random, there would be instances when regular patterns would become visible. The principle of stochastic sampling is that the algorithms, through which the calculations are taken, reduce the likelihood of regular patterns developing. The degree of randomness and the way that the individual spots join to form larger agglomerations in the image are quite different in each of the manufacturer's approaches to FM screening. There are many FM screening software's on the market. Some are available only as part of the raster image processor (RIP) software, others are free-standing programs. Examples include: Crystal Raster from Agfa, Diamond Screening from Linotype Hell, FullTone Screening from Scitex, Lazel Screening from Fuji, Monet from Barco, Harlequin's Dispersed Screening, UGRA/FOGRA's Velvet Screening and Vitec's Ornament Screening. Two different patterns.

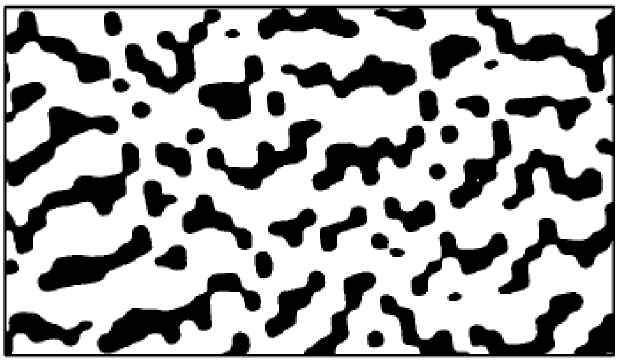
Table 3.5 Recommended FM spot sizes

Spot size (µm)	*Work or substrate type*
14	Offset litho premier quality on coated paper
21	Offset litho commercial quality colour printing
>28	Coldset offset litho newsprint
30–40	Flexographic reproduction

Table shows the minimum spot sizes (in microns) recommended for various categories of work



Agfa Crystal Raster



Scitex Full Tone

FM screening patterns

1.3 Input and Output Resolution - Scanning Frequency:

One obvious quality feature is the *image definition,* which can be determined at a deliberately low level in the original for artistic reasons, or it is limited by the resolution when scanning the original and transferring it to the film, plate, or substrate.

The original is scanned by either a digital camera or an input scanner. The image information is not transferred entirely, but only in accordance with a scanning pattern of a specified resolution and number of *tone value levels* or *gray levels*. The pattern consists of the smallest image elements resolved by the scanning device, the *pixels*. This word is a neologism created from “picture” and “element.”

In a similar way to radio and television, where the number of vibrations per second (i.e., a time frequency) is specified, the resolution of the pixel pattern can be specified by its *(spatial) frequency*, that is, the number of pixels per centimeter or inch. This is the *scanning frequency* (spatial frequency), also known as, scanning *resolution.*

The pixel pattern must be noticeably finer than the image detail. There is another important aspect for the selection of scanning frequency: the image data should use the minimum of memory space. It is a waste of time and money to pass unnecessarily large quantities of data through the production process. Doubling the scanning frequency quadruples the size of the file. A good compromise is reached between the reproduction of fine details and the size of the file, if the factor F in the following equation is given a value of two.

Scanning frequency (f_s) = F X magnification factor (M) X screen frequency (L)

If, for example, a 5.3 cm x 8 cm dia positive is to be printed the same size with a 60 lines screen (i.e., with a screen frequency of 60 lines/cm), the resultant scanning frequency (resolution) will be:

$$f_s = 2 \times 1 \times 60/\text{cm} = 120/\text{cm} \text{ (approx. 300 dpi)}$$

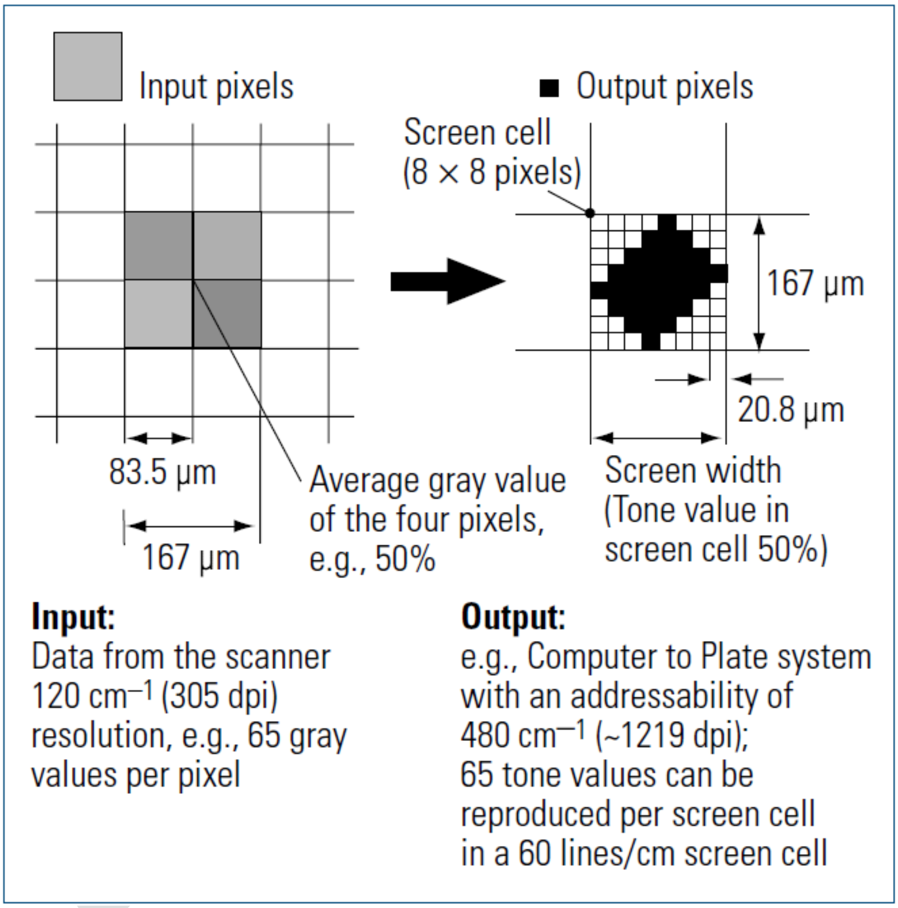
Under normal circumstances, each screen cell on the output side is assigned four input pixels, one pixel covering a quarter of the area (due to F = 2). The mean is found from the tone values (gray levels) recorded from the scanning of the four input pixels and the result is stored in the memory. The mean produced in this way balances the slight, equipment-related variations of the light sensor in the input scanner, and brings about a more even representation of smooth tint areas.

Scanning resolution must not be too fine; otherwise unnecessarily large files will have to be processed, leading to unnecessarily increased production time. The “*screen frequency*” is sometimes referred to as *screen ruling*.

The metric unit of scanning or screen frequencies is usually 1/cm or cm^{-1}, more rarely dpcm. Often used is the US-based “dpi” as an abbreviation of “dots per inch.”

If the demands imposed on the image definition are not very exacting, and it is rather minimal memory requirement that is being striven for, a lower value than F = 2 can be used in the equation mentioned above (e.g., F = 1.4), and a lower resolution is used for scanning.

If an image is to be output on film, plate, or directly on a print substrate, the *dot shape, screen frequency,* and *screen angles* must be specified first. Since the dots to be written are made up of individual pixels (except in gravure printing), the pixel size must also be specified. Like scanning resolution for the input, we speak of *output* or *addressing frequency* (in short: *addressability*). Depending on the output device, values ranging from 197 cm^{-1} (500 dpi) to 1000 cm^{-1} (2540 dpi) and above are typical; the output resolution of simple electro photographic office printers is usually only 118/cm (300 dpi).



Transformation of scanner data into halftone dots for digital film or plate imaging

Several considerations must be taken into account when the *output frequency is being selected*:

1. The value must be chosen so that it is high enough to be able to reproduce the desired dot shape at an adequate accuracy.
2. The number of reproducible tone value levels must be sufficiently large for no stages ("breaks") to become visible with extended banding.

3. The imaging time (output time) should be as short as possible; too high an output frequency extends it unnecessarily.

As is illustrated by the three examples, about 10 X 10 pixels are needed to create an acceptable *dot shape*. This means that the output frequency should be approximately 10 times larger than the frequency of the periodic screen. The factor of 10 also results from a second consideration: the *number of reproducible tone values* increases considerably in line with the output frequency. It is obvious that it is only possible to plot as many tone value levels as output pixels fit in a screen cell.

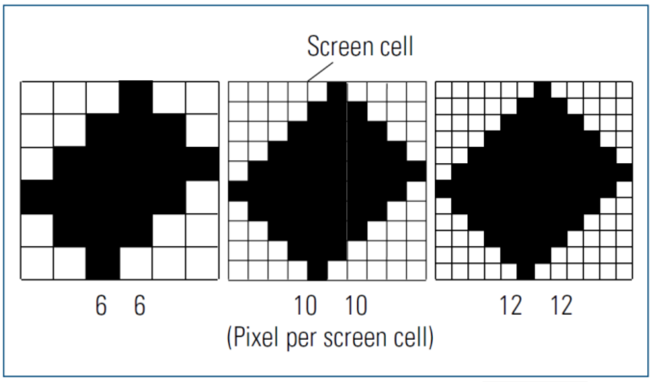
If the blank paper is taken into account as a tone value, the number of reproducible tone values (gray values) is:

$$\left.\begin{matrix}\text{Number of}\\ \text{tone values}\end{matrix}\right\} = 1 + \left(\frac{\text{output frequency}}{\text{screen frequency}}\right)^2$$

It was assumed that only one gray level (i. e., two gray values) can be represented per picture element (pixel). The eye cannot distinguish many more than 100 tone value levels. Therefore it is sufficient for the screen cell to contain 10 * 10 pixels. This then produces 101 different values with a hundred steps of 1% each.

	Screen frequency (smallest dot)	**Tone value range**
Commercial offset Europe	60 cm^{-1} (152 lpi) (20 µm)	3% to 97%
Commercial offset Japan	70 cm^{-1} (178 lpi) (20 µm)	3% to 97%
Web offset periodicals USA (SWOP)	52 cm^{-1} (132 lpi) (around 20 µm)	2(4)% to 97%
Newspaper printing (offset)	34 cm^{-1} to 48 cm^{-1} (25 µm to 40 µm)	3% to 85%
Business forms printing	52 cm^{-1} to 60 cm^{-1} (20 µm)	3% to 97%
Gravure printing	70 cm^{-1} (178 lpi)	5% to 95%
Flexography	40 cm^{-1} to 60 cm^{-1} (around 30 µm)	5% to 95%
Screen printing	30 cm^{-1} to 40 cm^{-1} (80 µm)	3% to 94%
	6 cm^{-1} to 29 cm^{-1}	10% to 90%

Screen frequencies, tone value ranges and minimum dot diameters for typical printing conditions and processes



Dot structure with varying addressability (output frequency) of the output device (tone value 50%)

In the example, the screen is imaged with a screen frequency of 60/cm, therefore the output frequency does not have to be higher than 600/cm (1524 dpi).

The screen frequency should not be higher than is absolutely necessary. Extremely *fine screens* (e.g., with 120 cm, 305 lpi) are often required on the creative front, since photo-like reproduction holds its own fascination. However, very fine screens may also entail a loss of quality, because the transfer to the printing plate is more unstable and the variations during the print run are higher, not to mention the higher costs of plate making. If the output frequency is restricted to a low value by the equipment, e.g., to 600cm (240 dpi), there are less than 100 reproducible tone value levels for screen frequencies greater than 60cm. Accordingly an image setter would only be able to reproduce 26 tone values for an extremely fine screen of 120 cm. To be able to reach 100 levels here, an output device with an output frequency (addressability) of at least 1200 cm (480 dpi) would be needed. Depending on the image, losses of quality may occur if there are less than 100 tone value levels, and the gradations may show visible steps (also known as banding).

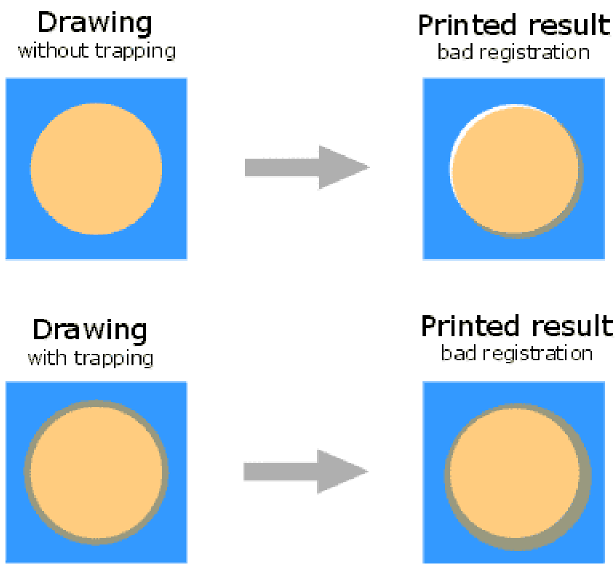
Image-dependent Effects and Corrections:

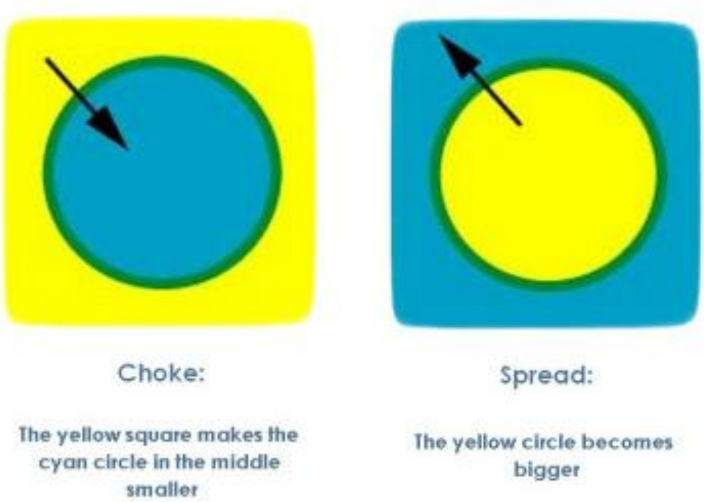
Chokes/Spreads (Trapping):

When a substrate passes through the press at high speed, paper distortions, register differences, or other factors may cause “geometric, local shifting” of separated colors, which become visible to the human eye as unsightly “white gaps”. On sharp contours in particular (e.g., a red dot on a black background or in a black surrounding) this may lead to the white substrate showing through. These “gaps” are not a problem specific to printing, but to prepress. Whenever colored elements with a sharp edge definition are combined, this effect can occur.

For this reason, the *adjacent color areas are spread* (made larger). It is usually the lighter form that is spread. The programs used here draw a (virtual) line around the object. Since the extent of spreading needed also depends on the substrate and screen used, the values mentioned below can only be approximate values. With a 60 lines/cm screen, trapping should be between 0.1 and 0.2 mm, with a 33 lines/cm screen between 0.2 and 0.4 mm. Since the extent of trapping depends on the respective printing conditions, it should take place as late in the process chain as possible (the same applies to the decision on the screen program for output).

Trapping must unconditionally not be done twice, once in prepress or at the customer's and a second time at the printer's. Fine elements would fill in and detail rendering would be impaired.





Choking is used when the background is lighter than the foreground. To make a black area appear "deeper," the black area is often printed on a 40% cyan screen. If this area is broken by a reverse type (white on black), cyan might become visible in the edge areas. To counteract this effect, the corresponding area is "choked"; that is, the cyan area is made smaller. The term "trapping" is also used to describe the ink acceptance behavior when printing one ink film on top of another ink film.

Moiré:

Moiré effects can occur wherever two or more *periodic screen patterns* are unfavorably superimposed resulting in coarse regular patterns. One of the most common reasons is that a regular structure was already present in the original, as is the case with already screened originals or the patterns of fabrics (from which the word moiré originates). These interference patterns are avoided by selecting a suitable angle during the screening process or by using special filters when editing the image. However, moiré effects may also occur during exposure, depending on the screening program used. Usually the latter shortcoming has nothing to do with the data supply but must be attributed to the output unit. With frequency-modulated screening no moiré effects occur.

Chromatic and Achromatic composition:

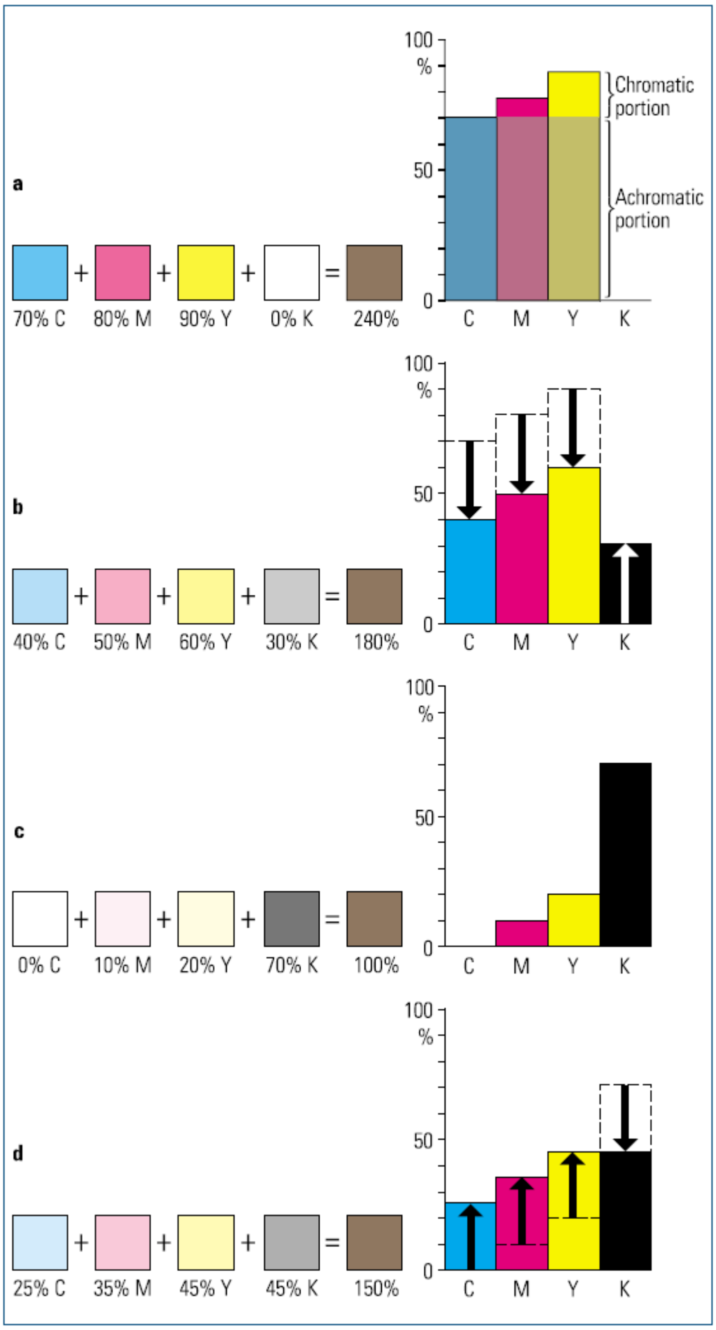
The Color Black

The color black has already been mentioned as a constituent of the CMYK color system, but no concrete data was given for *determining the color separation of black*, as it is shown in figure 1.4-19. Essentially, black is used in multicolor printing to reduce the technological expense of printing three chromatic colors to create black or a gray value by the direct use of black ink, to cut down on the use of expensive high-quality chromatic inks and also, primarily, in order to stabilize the printing process, that is, to make it less sensitive to variations in the individual colors.

There are several methods for controlling the black color separation, that is, for supplementing *chromatic composition* using the colors cyan, magenta, and yellow with the fourth color, black:

- chromatic composition with Under Color Removal (UCR),
- *achromatic composition* (or GCR: gray component reduction), and
- achromatic composition with chromatic color addition (UCA).

Fig. 1.4-24
Examples of determining the color separation for black using the multicolor printing of brown as an example.
a Chromatic composition;
b Chromatic composition with under color removal (UCR);
c Achromatic composition (or GCR: gray component reduction);
d Achromatic composition with chromatic color addition (UCA)
Note: The chart serves to explain the principle and does not represent a metrologically accurate reproduction [1.4-8]



Chromatic Composition:

In chromatic composition all the hues (color tones) are built up from the chromatic base colors (process colors) cyan (C), magenta (M), and yellow (Y). Black (K) may possibly be used, if at all, to support the image shadows and to improve the contours. Dark hues are created by the appropriate mixing of the three chromatic base colors.

If cyan, for example, is to be printed darker, equal portions (via changing the tone values) of magenta and yellow are added according to the desired blackness value, but these portions must be less than the portion of cyan. These portions of magenta and yellow mix with the correspondingly equal portion of cyan to form black thus are darkening the remaining portion of cyan. This will be made clear by means of an example. The brown shown in figure 1.4-24a was built up in chromatic composition from 70% cyan, 80% magenta, and 90% yellow, a total area coverage therefore of 240%. Black was not used. But because of the high portions of chromatic colors, the color balance is not easy to maintain.

The chromatic composition of the brown shown in figure 1.4-24a comprises a chromatic portion and an achromatic one. The achromatic portion consists of 70% cyan, 70% magenta, and 70% yellow, which create a hue very close to gray when overprinting. Only the remaining 10% magenta and 20% yellow form the chromatic portion.

Chromatic Composition with Under Color Removal:

Under Color Removal (UCR) is a variant of chromatic composition, in which a part of the achromatic portion is replaced by black. Assume that in the example (fig. 1.4-24) there is to be a *30% UCR* of the used brown. To this end, the achromatic portion composed from cyan, magenta, and yellow is reduced from 70% by 30% and replaced by the corresponding black portion. As a result of this the area coverage is no longer 240%, but only 180% with the same apparent hue. This greatly simplifies the printer's task, because the danger of offsetting (the printed image is reflected in the pile on the reverse side of the sheet above; see sec. 1.7) is reduced and the color balance is easier to maintain (fig. 1.4-24b).

Achromatic Composition:

Unlike chromatic composition, in achromatic composition in principle *all* achromatic portions are replaced by black (GCR: gray component reduction). Therefore, the blackening of chromatic color shades is no longer done by means of complementary color, but solely by black. The brown shown as an example (fig. 1.4-24c) consists in achromatic composition of only magenta, yellow, and black. The area coverage is a total of only 100%.As a result of this, the color portions of cyan, magenta, and yellow can be noticeably reduced in all images and hues; the printing process becomes more stable, the ink acceptance (trapping) behavior noticeably improved.

Achromatic Composition with Chromatic Color Addition.

Chromatic color addition (UCA Under Color Addition) is a variant of achromatic composition. To support neutral image shadows, if the density of the neutral black printing ink is insufficient, portions of cyan, magenta, and yellow are again added to the achromatic composition and reduced in the black (e.g., 25% in the example in accordance with fig. 1.4-24d). This type of image composition is widely used now and has proved its worth in practice. Image quality and print quality can be harmonized to each other very satisfactorily by this means.

Undercolour removal (UCR) and Grey Component Replacement (GCR):

There are other reasons for adding black. By means of a technique known as undercolour removal (UCR), it is possible to replace proportions of the three process inks in the neutral and near-neutral areas of an image with one ink the black. UCR is the reduction of cyan, yellow and magenta dot areas in correct proportion to one another, as determined by the grey balance characteristic where all these are present, and printing the appropriate amount of black instead.

UCR is the process of diminishing the amount of cyan magenta and yellow ink in dark neutral gray areas and replace it with a longer density black printer that carry more detail. UCR lowers the total percentage of ink coverage in this areas suggesting that the percentage of apparent ink trap can be increased and dot gain can be reduced.

The term under color removal is derived from the historically used color sequence of yellow , magenta cyan and black where by a three color gray component under the black is removed and replaced with the black ink.

Advantages:

1. Black brings out better detail and contrast in the photograph than is possible with process colors. Black will make the white appear and will add density. Resulting in improved contrast in the shadow areas. Higher contrast also increases the image areas.
2. A substantial amount of the process colors removed from areas where black is to printed allows better ink trapping during press run.
3. Process colors are more expensive than black. substituting three process colors with the cheaper black makes under color removal more economical
4. With under color removal the total deposit of ink on paper is much less, and as such the ink set off problem is reduced.
5. Drying time is also reduced through the use of under color removal.
6. Because of the use of black, balancing the other three colors is less critical.

Gray Component Replacement (GCR):

Gray Component Replacement (GCR) is a further implementation of the principle reducing the gray component from all colors in a reproduction (not just the neutrals) and replacing them with black ink.

The gray component replacement is some times referred by other names. Including achromatic color removal, achromatic, bichromatic color reproduction, binary primary, binary primary plus black, complementary color removal full scale UCR integrated color removal or two color and black.

The use of gray component replacement (GCR) is a refinement of and sophisticated variations of under color removal. The graying contaminates or weakest color ink could be reduced or removed in proportion to the other two pigments and be replaced with black ink.

Gray Component Replacement substitutes black for gray components throughout a reproduction including colored areas.

Both these techniques help in avoiding marking and set - off difficulties associated with high areas of ink coverage. Control of the printing process is also made less difficult since it becomes less sensitive to changes in balance between the colors. This is particularly useful in reproducing originals containing large areas of near neutral color. The addition of black makes the theory and practice of color reproduction some what more complex because for many colors in a reproduction it means there is no unique mixture of colors which will reproduce them. How ever it is essential to think of a production in terms of a three colour mixture in order to obtain correct hue and saturation rendition of colors. The black is added to achieve first optimum rendition of darkness it is considered only second for use in replacing the process inks in grays or grayish colors. If this is not done properly adding black can seriously detract from a reproduction.

Advantages of GCR:

1. Color ink consumption is reduced.
2. Because of less ink film thickness, faster make ready and less paper wastages are achieved.
3. Because of less ink on paper, lighter paper is suited to print materials, which would have required heavier stock.
4. Because of less ink on paper drying expense is also reduced.

Technological advantages:

1. Dot gain fluctuations are generally less critical because grays primarily made with ink.
2. Moiré patterns, particularly common to four color browns are eliminated because shades are made with two colors and black. However in some colors patterns are reported to be more prominent.
3. The producible colour space is better, colors darkened with black show the changes in tonal range better compared to hue shifts caused when a third primary colour is used for darkening.
4. The effects of metamerism seen by viewing the points under different lighting conditions are minimized because black is not affected by metamerism.

Unsharp masking (USM):

Feature offered on most scanners which by deliberately lowering the background resolution in pre-defined local areas increases the sharpness of detail in these areas. The use of the unsharp masking (USM) control on scanners or in manipulation software should not be considered an answer to the problem of an inadequately focused original. The operator is faced with a three pronged dilemma. With an unsharp original, any enlargement makes the fault more apparent. Unsharp masking will help, within limits, to enhance the apparent sharpness. Enlargement makes grain more apparent. Unsharp masking also makes grain more apparent, it 'enhances' the grain as well as the image detail. A compromise route must be chosen between these factors to produce a commercial result.

Unsharp masking (USM), may be scanner related or it may be applied post-scanning by colour conversion or editing software. Unsharp masking is a means by which an image can be made to appear sharper by enhancing the micro contrast of detail edges. When colour separations were made using cameras, one of the stages of achieving this effect was to make an unsharp version of the image into a mask – hence the name. With a digital image, a similar effect can be achieved by sampling and modifying the values of the pixels. Some degree of unsharp masking is required to re-establish original levels of sharpness which, inevitably, will have been softened by the process of scanning itself. So, USM is a necessary part of scanning, but it cannot make an out-of-focus photograph look sharp.

Original image

Unsharp mask image

Unsharp masking (USM) is used it make the details of the original copy appear sharper. When done properly, unsharp masking can make a particular part of an original unsharp masking work by increasing the density differences at tonal edges (Where lighter tones touch the darker tones) of the original copy. The light areas become less dense and the darker areas become denser. Unsharp masking can be done with conventional photographic colour separation by exposing an original through an unsharp mask specially made for those original and electronic colour scanners by modifying the electrical signals.

The colour separator must carefully control the amount of unsharp masking. Too much can produce more scratches in the emulsion of an original.

Applying the Unsharp Mask filter

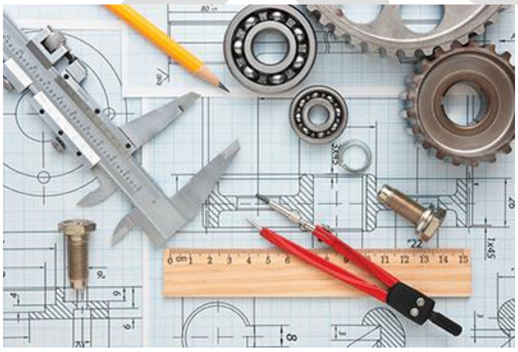
In order to do its job of sharpening, the Unsharp Mask filter increases the contrast between adjacent pixels. To control the level of contrast, you will choose settings for three variables: Amount, Radius, and Threshold.

For an image that is 2000 x 3000 pixels or larger, try using these values:

Soft-edged subjects, such as landscapes	Amount 100–150%, Radius 1–1.5, Threshold 6–10
Portraits	Amount 100–120%, Radius 1–2, Threshold 4–6, or to the point that skin areas begin to look smoother
Buildings, objects, etc., for which contrast is a priority	Amount 150–200% or higher, Radius 1.5–3, Threshold 0–3

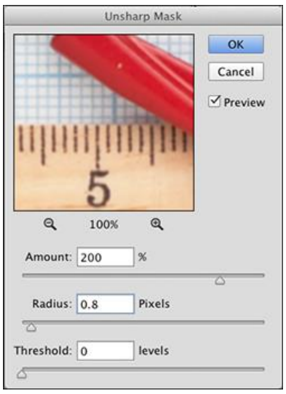
To apply the Unsharp Mask filter:

1. Choose a zoom level of 50–100% for your image.
2. Duplicate an image layer (Ctrl-J/Cmd-J),A then right-click the duplicate layer and choose **Convert to Smart Object**.



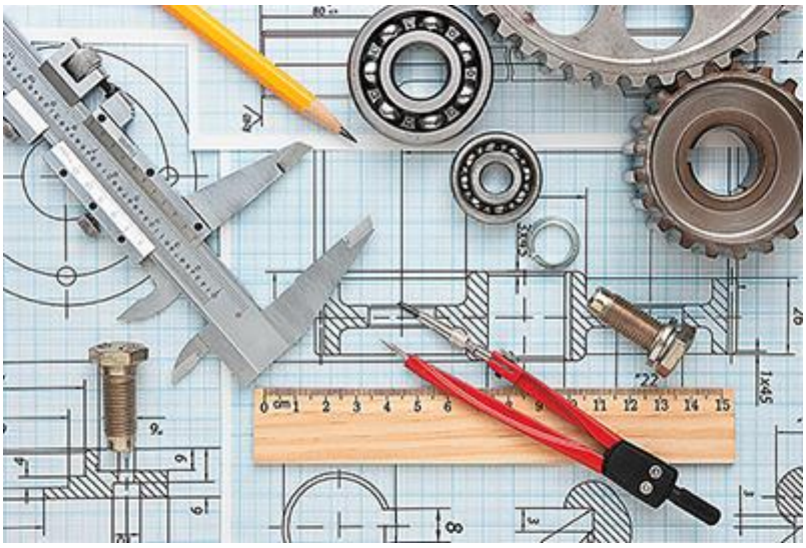
A *This original 300 ppi image is slightly blurry.*

1. With the Smart Object layer selected, choose Filter > Sharpen > **Unsharp Mask**.
2. In the dialog, choose an **Amount** percentage to control how much the contrast will be increased.B For some recommended settings, see the sidebar on this page.



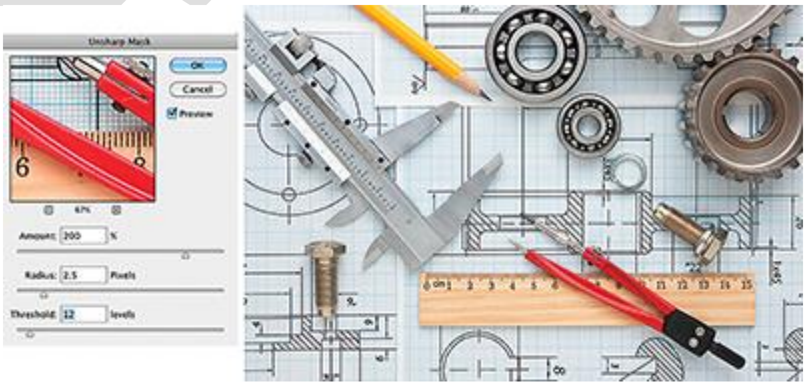
B *A high Amount value and a low Radius value for the Unsharp Mask filter barely sharpened the image.*

3. The **Radius** setting controls how many neighboring pixels around high-contrast edges the filter affects. When setting a value, consider the pixel count of the image and its subject matter. The higher the pixel count, the higher the Radius value needed.C For a low-contrast image that contains large, simple objects and smooth transitions, try a high Radius of 2; for an intricate, high-contrast image that contains many sharp transitions, try a lower Radius of around 1.



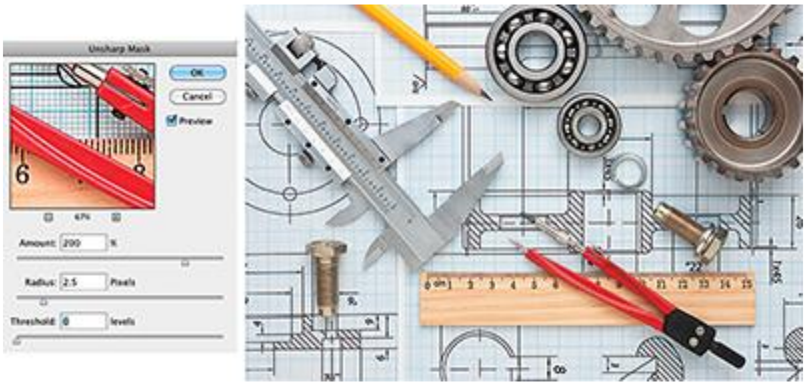
C *A high Radius value of 4.0, on the other hand, produced ugly halos around the numerals on the ruler and on the blue lines of the graph paper.*

4. Choose a **Threshold** value to establish how different in value an area of pixels must be from an adjacent area for it to be affected by the filter.A Start with a Threshold value of 0 (to sharpen the entire image), then increase it gradually. At a Threshold of 5–10, high-contrast areas will be sharpened and areas of lesser contrast will be sharpened much less. When increasing the Threshold, you can also increase the Amount and Radius to sharpen edges. A proper Threshold setting will prevent the filter from oversharpening low-contrast areas.



A *At a high Threshold value of 12, the Unsharp Mask filter sharpened only the high-contrast edges. The lower-contrast (light blue) lines on the graph paper remained blurry.*

5. Click OK.B To adjust the filter settings at any time, double-click the Unsharp Mask listing on the Layers panel.



B *A low Threshold value of 0–1 worked better for this image because it contains a lot of flat surfaces, hard edges, and fine lines.*

UNIT - II : DIGITAL PHOTOGRAPHY & DIGITAL PROOFING

2.1 Digital camera:

A digital camera is a lot like a traditional film camera, but with one major exception: rather than store photos as images on film, it saves as a digital data. An electronic photosensitive sensor captures light that enters the digital camera, and then saves the image data on to a removable storage device called a memory card.

To access images stored on a digital camera's memory card, connect the camera to the computer. Then view and edit images on the computer screen and print the images through the printer or at a commercial photo lab.

Elements of digital camera:

View finder:

This hole is to compose photos, or use it instead of the LCD screen.

Mode dials:

This dial toggles between the camera's main operating modes, such as photo, video and play back.

Shutter button:

This button is used to take photo.

Lens:

This piece of glass focuses the light that enters the camera and projects it onto the sensor.

Flash:

This bulb emits a flash of light to illuminate dark scenes.

Settings button:

These buttons toggle between specific shooting modes, such as flash or no flash.

Menu button:

This turns the LCD into an on-screen menu that makes to access the camera's other features.

LCD screen:

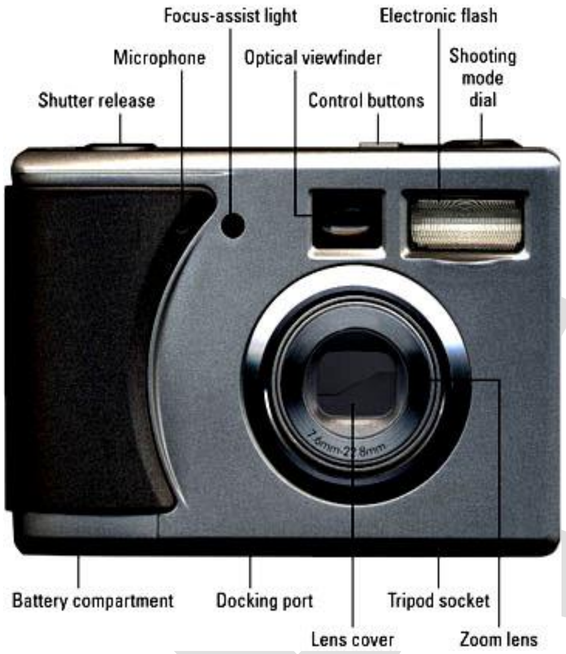
This small color screen shows the photo before shooting.

Power and storage components:

This includes, ports for A or C power adapters and USB cables and a chamber to hold batteries and a memory card.

Internal electronics:

These include an image sensor, internal memory and other built in electronic components.



How digital cameras work

Digital cameras look very much like ordinary film cameras but they work in a completely different way. When you press the button to take a photograph with a digital camera, an aperture opens at the front of the camera and light streams in through the lens. So far, it's just the same as a film camera. From this point on, however, everything is different. There is no film in a digital camera. Instead, there is a piece of electronic equipment that captures the incoming light rays and turns them into electrical signals. This light detector is one of two types, either a **charge-coupled device (CCD)** or a **CMOS image sensor**.

If you've ever looked at a television screen close up, you will have noticed that the picture is made up of millions of tiny colored dots or squares called **pixels**. Laptop LCD computer screens also make up their images using pixels, although they are often much too small to see. In a television or computer screen, electronic equipment switches all these colored pixels on and off very quickly. Light from the screen travels out to your eyes and your brain is fooled into see a large, moving picture.

In a digital camera, exactly the opposite happens. Light from the thing you are photographing zooms into the camera lens. This incoming "picture" hits the image sensor chip, which breaks it up into millions of pixels. The sensor measures the color and brightness of each pixel and stores it as a number. Your digital photograph is effectively an enormously long string of numbers describing the exact details of each pixel it contains.

Special Features of Digital Cameras:

Tone Value Quantization:

Alongside resolution, the tone value quantization also has an influence on the potential image quality. The lower limit for a good *tonal graduation* for the image capture is 256 gray levels, corresponding to 8 bits. How many bits are required for all three partial colors is often also given, coming to 24 bits (or 3 bytes) in this example. With the availability of faster computers and better storage capacity, cameras with a higher tonal range are also offered. Values above 12 bit/color (4096 gray levels) do not, however, offer any further improvement in graduation even for “difficult” scenes.

Focal Length of the Lenses:

In conventional photography the focal length of the lenses is normally set to the format of the film. With 35 mm cameras the shot area is 24 mm x 36 mm, 50mm is viewed as a standard focal length. Mathematically, this corresponds to the shot area diagonal multiplied by a factor of approximately 1.2.Many digital cameras in the lower price category possess an area sensor with a diagonal of less than 10 mm. The standard focal length of these cameras is then less than 12mm. At the other end of the focal length scale are cameras with an attached digital unit, whose standard focal length can be in excess of 70 mm. Since users of analog photography are used to handling standard focal lengths of 50 mm and above, they must often revise their thinking when using a digital camera, which may have a standard focal length of just 10 mm. For a portrait photograph a focal length of 15 mm is sufficient, and 50 mm represents a “teetotal length.” With these short focal lengths it is difficult to make wide-angle lenses with even shorter focal lengths as shortening the focal length is not always possible.

Aspect Ratio:

Having used 35 mm cameras, most people are used to the aspect ratio of 2:3. Yet many digital cameras, especially those in the lower performance bracket, tend to use the television format of 3:4.With higher resolution cameras (over a million pixels), however, there is virtually no standard aspect ratio. Several manufacturers use sensors with an aspect ratio of 1:1 while others offer the photographic format of 2:3. Between these two, practically every permutation is available, including the television format of 3:4.

Link-up to a Computer:

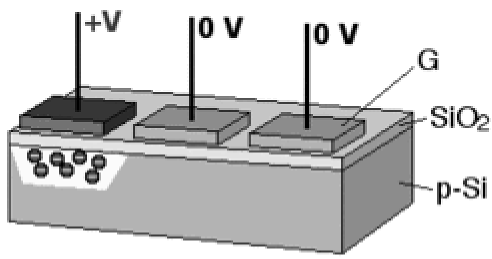
The clear advantage of digital photography is that the image data can be digitally processed immediately. This means the data must be transferred to a computer, either directly when taking the picture or at the latest for processing. There are two basic possibilities here, either intermediate storage on a data carrier fitted in the camera or direct transfer to a computer after each shot. The PCMCIA card (Personal Computer Memory Card International Association) has become established as a good means of data storage for cameras. It is an electronic storage device in the shape of a credit card with a standard interface for transmission to the computer. For direct transfer, a standard interface such as SCSI (Small Computer System Interface) or a plug-in card is suitable. A serial interface offers a slightly slower data transfer. For the following image processing, special image processing programs or plug-ins are available for standard applications.

2.2 CCD & CMOS:

A **Charge-Coupled Device**, or CCD, is a collection of tiny light sensitive diodes, which convert photons (light) into electrons (electrical charge). It is basically an array of closely-spaced metal-oxide-semiconductor (MOS) diodes that can store and transfer information using packets of electric charge, or charge packets. Applying the proper sequence of voltage pulses (clock signals) to a CCD biases the array of MOS diodes into the deep depletion region where the charge packets may be moved in a controlled manner across the semiconductor substrate. Some people also refer to a CCD's MOS diodes as 'MOS capacitors.

There are two basic types of CCD, namely, the surface channel CCD (SCCD) and the buried channel CCD (BCCD). Charge is stored and transferred at the semiconductor surface in the SCCD, while in the BCCD, the charge packets are stored and transferred in the bulk semiconductor below the surface.

Basics of operation:



The charge packets (electrons, blue) are collected in potential wells (yellow) created by applying positive voltage at the gate electrodes (G). Applying positive voltage to the gate electrode in the correct sequence transfers the charge packets.

In a CCD for capturing images, there is a photoactive region (an epitaxial layer of silicon), and a transmission region made out of a shift register (the CCD, properly speaking).

An image is projected through a lens onto the capacitor array (the photoactive region), causing each capacitor to accumulate an electric charge proportional to the light intensity at that location. A one-dimensional array, used in line-scan cameras, captures a single slice of the image, while a two-dimensional array, used in video and still cameras, captures a two-dimensional picture corresponding to the scene projected onto the focal plane of the sensor. Once the array has been exposed to the image, a control circuit causes each capacitor to transfer its contents to its neighbor (operating as a shift register). The last capacitor in the array dumps its charge into a charge amplifier, which converts the charge into a voltage. By repeating this process, the controlling circuit converts the entire contents of the array in the semiconductor to a sequence of voltages. In a digital device, these voltages are then sampled, digitized, and usually stored in memory; in an analog device (such as an analog video camera), they are processed into a continuous analog signal (e.g. by feeding the output of the charge amplifier into a low-pass filter) which is then processed and fed out to other circuits for transmission, recording, or other processing.

CCD Applications:

Their main use is in photography, where CCD image sensors are found in virtually all digital cameras and scanners. Astronomers were early adopters of CCDs because they are up to one hundred times more sensitive than photographic film. However, they need to be cooled to temperatures well below zero to reduce thermally generated charges that cause errors. CCDs are also used in other fields such as electron microscopy, spectroscopy, and fluroscopy. They can also be found in night vision equipment.

CMOS, otherwise known as complementary metal-oxide semiconductor is a type of technology that is used to construct integrated circuits. These semiconductors use both positive polarity (PMOS) and negative polarity (NMOS) circuits. This is beneficial because only one of the circuit types is on at any given time. This results in less power being needed in comparison to chips that have only one type of transistor. Since they rely on less power, CMOS chips have become incredibly attractive when building portable computers or other devices that require a stronger battery life. However, even personal computers contain a battery-powered CMOS memory to keep the data, time and system setup specifications kept in case the computer is unplugged or lose electricity.

The complementary metal-oxide semiconductor (CMOS) sensor consists of millions of pixel sensors, each of which includes a photodetector. As light enters the camera through the lens, it strikes the CMOS sensor, which causes each photodetector to accumulate an electric charge based on the amount of light that strikes it. The digital camera then converts the charge to pixels that make up the photo.

CMOS uses a slightly different technology from CCD, another type of image sensor found in digital cameras. CMOS is becoming the more popular type of technology because of its low power consumption and speed.

CCD vs CMOS:

Today, most digital still cameras use either a CCD image sensor or a CMOS sensor. Both types of sensor accomplish the same task of capturing light and converting it into electrical signals.

A CCD image sensor is an analog device. When light strikes the chip it is held as a small electrical charge in each photo sensor. The charges are converted to voltage one pixel at a time as they are read from the chip. Additional circuitry in the camera converts the voltage into digital information.

A CMOS imaging chip is a type of active pixel sensor made using the CMOS semiconductor process. Extra circuitry next to each photo sensor converts the light energy to a voltage. Additional circuitry on the chip may be included to convert the voltage to digital data.

Neither technology has a clear advantage in image quality. On one hand, CCD sensors are more susceptible to vertical smear from bright light sources when the sensor is overloaded; high-end frame transfer CCDs in turn do not suffer from this problem. On the other hand, CMOS sensors are susceptible to undesired effects that come as a result of rolling shutter.

CMOS can potentially be implemented with fewer components, use less power, and/or provide faster readout than CCDs. CCD is a more mature technology and is in most respects the equal of CMOS. CMOS sensors are less expensive to manufacture than CCD sensors.

Hybrid CCD/CMOS architecture, sold under the name "sCMOS", consists of CMOS readout integrated circuits (ROICs) that are bump bonded to a CCD imaging substrate – a technology that was developed for infrared staring arrays and now adapted to silicon-based detector technology.

Another approach is to utilize the very fine dimensions available in modern CMOS technology to implement a CCD like structure entirely in CMOS technology. This can be achieved by separating individual poly-silcion gates by a very small gap. These hybrid sensors are still in the research phase, and can potentially harness the benefits of both the CCDs and the CMOS imagers.

Two important characteristics of CMOS devices are high noise immunity and low static power consumption.

Uses for CMOS:

Since its patent in 1967 by Frank Wanlass, CMOS has seen a great many implementations throughout the technology world. Some of those implementations are:

- Microprocessors
- Microcontrollers
- Static RAM
- Image sensors
- Data converters
- Certain transceivers

2.3 Scanner Designs and Models Scanners

For years, and almost decades, the choice of scanner for the graphic industry was limited to *drum scanners*. Today there is a range of technologies available. *Flatbed scanners* predominate in terms of number, and increased demands have resulted in a renewed proliferation of scanners. Today there are good value flat-bed scanners for DIN A4 format, powerful flat-bed scanners for formats significantly larger than DIN A3, drum scanners ranging from table-top units to high end vertical scanners, as well as so-called "*copy dot scanners"* for redigitizing analog and screened originals. Besides these there is an increasing number of special scanners for transparencies (slides and larger format transparent originals) and OCR scanners (Optical Character Recognition) for reading in text data. Scanners may therefore be differentiated according to design and technical performance as well as special functions.

Suitability of Scanners

Type of Original	Scanner type: Drum scanner	Scanner type: Flat-bed scanner	Function: Color (generally)	Function: 35 mm slide	Function: Redigitizing	Function: OCR (documents)
Reflection	●	●	●		●	●
Transparent	●	●	●	●	●	
Color	●	●	●	●	▲	
Continuous tone	●	●	●	●	▲	
Black and white	●	●	▲		●	●
Line art	●	●	▲		●	●
Printed original	●	●	▲		●	
Flexible original	●	●	▲			
Rigid original		●	▲			
3-D original		●	▲			
Format > A3	●	●	▲		●	

● applies ▲ possible

Table 3.2-4 Scanner types and their use

Scanner Types

- drum scanners (horizontal, vertical, or inclined drum arrangement)
- flat-bed scanners (desktop scanners, XY scanners)

Functions

- color scanners
- slide and APS scanners (Advanced Photo System)
- OCR scanners (OCR Optical Character Recognition)
- redigitizing scanners

Designs

The various types of scanner are suited to a greater or lesser extent to a particular task. Which type of device is suitable for which task must be determined with the aid of an individual requirement profile:

- What type of original is to be processed?
- Are the originals flat or three-dimensional?
- Are the originals flexible or rigid?
- What is their format?
- By how much do the images need to be magnified?
- Are the originals mainly transparent or reflective/opaque (slides or photographic prints)?
- Are the originals predominantly black and white or colored?
- Do the originals have clearly defined lines and areas (line art originals)?
- Are they continuous-tone images, such as photographs, with gray tones or colors that merge smoothly into one another?
- Are the originals already printed?
- How are the recorded data going to be used and further processed?

Important factors in this decision besides the device's function are its user friendliness, software functions, robustness, and reliability.

In the printing industry the choice falls mainly on scanners offering great versatility of application as well as high quality. Besides having the capability of reproducing *transparent and reflective originals,* the format is also important, as is the capability to record a wide tonal range (especially shadow areas of color slides) and density ranges of at least 3.5. Well-designed software may also offer interesting functions such as the conversion of color negatives into positive images or the direct transformation of RGB data into CMYK for four-color printing. The ability to produce a considerable enlargement of colored images that are rich in detail without any visible loss of quality is reserved largely for the professional high resolution flat-bed or drum scanner.

Redigitizing or *copy dot scanners* are particularly suitable or redigitizing already screened films by scanning a bitmap of the existing halftone dots at suitably high resolution.

Transparency scanners are mainly used to scan large numbers of color slides (framed or unframed). This type of scanner is made exclusively for this purpose (or also for scanning color negatives).

OCR flat-bed scanners with the appropriate software are eminently suited to scanning printed text into a word processing program. Even though there are only a few black-and-white scanners, such scanners are designed primarily for recording gray scale images (continuous- tone images), line art originals, or documents.

Flat-bed Scanners:

Elements of a scanner:

1. Charged couple device (CCD) array
2. Mirror
3. Scan head
4. Glass plate
5. Lamp
6. Lens
7. Cover
8. Filter
9. Stabilizer bar
10. Belt
11. Power supply
12. Interface port
13. Control circuitry
14. Close up of the CCD array
15. Stepper motor

Image capturing techniques:

Scanner:

The following are the steps to be followed in scanning:

1. The document is placed on the glass plate and the cover is closed. The inside of the cover in most scanners is flat white, although a few are black. The cover provides a uniform background that the scanner software can use as a reference point for determining the size of the document being scanned. Most flat bed scanners allow the cover to be removed for scanning a bulky object, such as a page in a thick book.
2. A lamp is used to illuminate the document. The lamp in newer scanners is either a Cold Cathode Fluorescent Lamp (CCFL) or a Xenon lamp, while older scanners may have a standard fluorescent lamp.
3. The entire mechanism (mirrors, lens, filter and CCD array) make up the scan head. The scan head is moved slowly across the document by a belt that is attached to a stepper motor. The scan head is attached to a stabilizer bar to

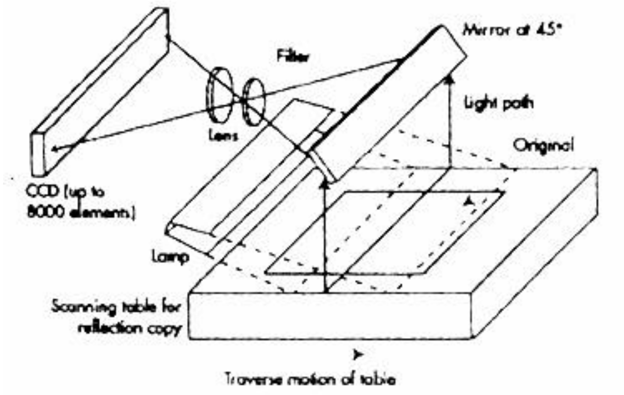
ensure that there is no wobble or deviation in the pass. Pass means that the scan head has completed a single complete scan of the document.

4. The image of the document is reflected by an angled mirror to another mirror. In some scanners, there are only two mirrors while others use a three mirror approach. Each mirror is slightly curved to focus the image it reflects onto a smaller surface.
5. The last mirror reflects the image onto a lens. The lens focuses the image through a filter on the CCD array.
6. The filter and lens arrangement vary based on the scanner. Some scanners use a three pass scanning method. Each pass uses a different color filter (red, green or blue) between the lens and CCD array. After the three passes are completed, the scanner software assembles the three filtered images into a single full color image.

The core component of the scanner is the CCD array. CCD is the most common technology for an image capture in scanners. CCD is a collection of tiny light sensitive diodes, which converts photons (light) into electrons (electrical charge). These diodes are called photo sites. Briefly, each photo site is sensitive to light, the brighter the light that hits single photo site, the greater the electrical charge that will accumulate at that site.

CCD elements (charge-coupled semiconductor elements) are used in flat-bed scanners. The performance of these elements is so high that flat-bed scanners are beginning to achieve the quality of drum scanners. Up until just recently flat-bed scanners were clearly at a disadvantage compared to drum scanners, particularly in converting high density values. CCD scanners are still not able to achieve the resolution and density values of drum scanners – in particular they do not pick up the finest nuances of color in the very dark shadow areas of transparent originals – but in practice today's flat-bed scanners can easily satisfy the quality and productivity requirements of many applications.

Flat-bed scanners contain a linear CCD array consisting of several thousand CCD elements (e.g., 8000 per color channel) arranged on a chip. The originals to be scanned are placed on a copy glass and illuminated with a fluorescent or halogen light source. Transparent originals are illuminated evenly from above, while opaque originals are illuminated from below. When scanning with flat-bed scanners, the light source and sensors move across the image in order to measure and record the color values. The scanned line of the image is projected via optical elements (lens systems) onto the light sensitive CCD array and recorded. Powerful flat-bed scanners for the professional market function according to so-called *XY technology*.



Flat bed scanner

This means that the projection characteristics of the optics are adjusted to the size of the original to make maximum use of the receiver unit in the CCD so that the best possible resolution is achieved. Optimized beam direction systems during scanning reduce the number of optical components and thus the system dependent tolerances which occur. CCD flat-bed scanners are used for both DTP applications and professional prepress. Apart from placing the originals in the scanner, the operation of a flat-bed scanner involves using a standard image-editing program or a special workstation containing the scanner software.

Operator-friendly software user interfaces for controlling flat-bed scanners require only minimal training, since the optimal color balance and image density are calculated automatically. High-end flat-bed scanners are available with a wide range of performance and can capture both opaque and transparent originals, while simpler equipment often requires peripheral devices in order to scan transparent originals. An important advantage flat-bed scanners have over drum scanners is that originals on rigid materials of any thickness may be scanned, such as books or page layouts mounted on board.

2.4 Digitizing and Redigitizing:

Digitizing Originals (Scanner):

As late as about 1970 repro cameras of varying construction (horizontal and vertical) were still regarded as the only devices that could be used for repro jobs. Supplies of different film materials were stocked for this purpose: masking films and continuous-tone films for four-color separations, fast reacting films for screening color separations and direct screening, duplicating and contact material for converting the exposed negative to film positive for platemaking, etchable films for color lithography, and finally, stripping films that allowed final corrections to be made without the need to recopy whole pages.

Since the entry of electronics into repro technology “expertless repro” has become a discussion point. Following the introduction of electronically controlled vertical repro cameras in the early 1970s, industry experts were already forecasting that from then on anyone could be trained to operate a camera in next to no time and would be able to produce the same results as highly trained experts. However, in the first phase of electronic reproduction these forecasts came to nothing, as the diversity of repro work still required too much know-how from the camera operator.

This was all the more true for the powerful repro scanners which dominated color reproduction in the ’70s and ’80s. Working with these scanners required just as much experience as thorough training. This technical development did have a massive influence on the personnel structure, however. As scanners replaced cameras, the need for repro photographers diminished by the same amount; a new type of profession arose: scanner operators. As electronic image processing gradually became established, lithography also took place at the computer, followed in the mid-’80s by the integration of text and images.

Since then the market has come to be dominated by a totally different generation of scanners. Reproduction or “scanning-in” became just as popularized as typesetting had already become through desktop publishing. The possibility of using software to integrate the knowledge of whole generations of repro experts and lithographers into the hardware and software components of so-called “one-button scanners” and their driver programs has been accompanied by a change not only in the qualifications required of the operators but also in the work processes in this area. There has also been a shift in the places where repro is carried out.

In an era of rapid communication, scans or image data bases emanate from the repro department as well as the customer, agency, CD-ROM, or the internet. In this “mixed company” there is an even greater need for a functioning color management system. This means that all the scanners and image-processing stations should be calibrated and the profiles for subsequent processes should be known.

Redigitizing:

Scanners play a central role in all digital processes in prepress. The redigitizing scanner is particularly important in computer to plate workflow since it is only with the aid of such scanning systems that existing analog films can be converted into data files for digital processing. It is true that redigitizing is an additional expense requiring the utmost precision, yet it is not normally appreciated by the customer. So that this processing step, which is absolutely essential for end to- end digital production, is cost effective, it is mainly businesses with mixed production that use color separation scanners (drum and flat-bed) with a special added function. Often films for possible repeat jobs, which were produced with computer to film units, are archived, and the data are no longer available. In this case scanners are used to digitize these analog data carriers, for example to drive a computer to plate unit or to amend the content at a workstation.

Various *redigitizing techniques* are employed for the different types of film masters supplied:

• ***Copy dot*** gives a high resolution scan for line structures, where the halftone dots present in the master are scanned 1:1 as a bitmap. Manipulations of the image content are not possible with this technology.

• ***Descreening*** is reverting a screened master into a continuous-tone file. This method gives good color quality and allows corrections to be made to color and content. It must be noted that the edges of text or graphics in the design tend to appear unclear.

• The so-called ***mixed mode*** allows the two processes above to be combined: the color information for the cyan, magenta, and yellow is stored as a continuous-tone file, while the black separation, which gives the contrast, is computed at the output stage as a bitmap file. Both drum and flat-bed scanners are used for redigitizing.

Digital Proof:

Just as with on-press proofs, which are printed on production presses or on special presses based on the same printing technology as production presses, proofs (printed on special proofing printers and presses) have the task of visualizing originals to examine layout, text, image, and color. The proof should be a perfect sample of the later print run. Various paper qualities and printing processes should be taken into account. The ideal conditions for a proof would be to use the same press, same paper, and same ink.

However, the question of cost and time constraints severely limits the demand for this perfect scenario. The broader the range of application of a proof, the more comprehensive the requirements. Such demands often stretch from the presentation through color-reliable proofs right up to the proof that serves as a “contract proof” (it can be used as evidence in legal disputes). The demands on a proof therefore vary quite significantly. For this reason, the market offers proof systems that can reproduce an original at various rendering qualities in accordance with the color print of the production run.

Selecting the optimal system means balancing costs and benefits and analyzing what is to be expected from a proof:

- reproduction of the complete page contents and/or sheet,
- color reliability (visually similar or color-true),
- reproduction of the screen structure (and the halftone dot arrangement) which is used for the
- production run,
- same substrate surface and sheet size as used for production,
- time required to produce the proof is acceptable,
- Job-specific cost situation.

Digital Proofing Processes:

Digital proofing processes are used to output a digital data set to create the most accurate possible simulation of the printed product to be produced. In most cases the most important factor is that the proof visually matches the later print quality (color proof, see below for definition).

Special printing parameters (e.g., dot structures) can only be reproduced in line with the print run using special proofing processes (true proof, screen proof). The digital proof is of central importance for digital imaging printing systems (e.g., Direct Imaging System: Quick master DI, Heidelberg,). Films, which usually form the basis for proof manufacture with analog proofing processes, are no longer produced during the course of production. Prior to imaging the printing plates within the press a check must be performed to assess whether the quality of the data is in line with the commissioned product. Digital proofing systems can at the outset be classified into two basic process variants based on intended use and quality required:

- Soft proof,
- Hard proof.

Soft Proof:

Soft proof describes the simulation of the print result on a *monitor*. If previous soft proof applications were simply a display of the image in color to check for completeness and the status of the print file, significantly improved color reliability has been achieved since the arrival of the PDF data format and additional software applications (Viewer) in combination with *color management systems*. The color reliability of images on the monitor depends heavily on the viewing conditions, and colors do not always match those of the printed copies. While the color-reliable representation of the image on the screen normally requires a darkened room, a sample print must be viewed under standard light conditions close to daylight (e.g., D50). Although a few compromises have to be made from the virtually perfect simulation of the later print quality on the monitor, soft proofs offer interesting, forward-looking solutions for the cooperation between customers and service providers in reproduction technology. In so-called "*remote proof*" applications, files can be sent rapidly via global networks and later print runs simulated on site with the customer. Color management systems perform a key function when implementing this kind of production scenario. Solutions that have already been realized, display the trend towards image assessment on the monitor. The next print job can be inspected on the press monitor, where it is possible to zoom in to the level of the halftone data for checking the dot structure (screen proof).

Hard Proof:

Hard proofs can be further divided into five general classifications, which are described below.

Classification	Rendering quality: Content (text and image) black and white	Content (text and image) Color (visual impression ok)	Content + Color (color-true)	Content + Color + Screen structure	Type of ink: Special	Type of ink: Production run	Type of paper: Special	Type of paper: Production run	Sheet size: Individual pages (A3, 2 pages A4)	Sheet size: Entire print sheet (8 pages)	Expenditure: Costs	Expenditure: Time
Soft proof (on color monitor)	✗	✗	✗	✗	✗				✗		"free of charge"	immediately
Hard proof												
Blueprint	✗				✗		✗		✗	✗	low	reasonable
Imposition proof		✗			✗		✗		✗	✗	ok	reasonable
Color proof			✗		✗	(✗)	✗		✗	✗	acceptable	slow
Screen proof (true proof)				✗	✗	(✗)	✗	(✗)	✗	(✗)	high	slow
Press proof				✗		✗		✗		✗	high	very slow

Digital proofing processes (Rendering quality and expenditure)

Blueprint:

To gain an initial overview of the *contents, imposition layout, and completeness* of a data set to be printed, a *single-color* blueprint can be created. The term, which is confusing in this context, originates from conventional platemaking. Here a so-called "Ozalid/diazo copy" (which is monochrome and blue due to the process involved) is produced after assembly and offers information about the completeness of the pages, their position on the sheet, and the imposition layout. In digital printing technology this technical context no longer exists. Blueprint has become a generic term.

Imposition Proof (Layout Proof):

In order to gain a *color impression (but not color reliable)* of the file with the same aim as a blueprint (checking the contents and position of the image elements), a layout can be created. Today, blueprint and layout proofing are applications ideally suited to reasonably priced *large-format printers* and are normally equipped with ink jet printing units. Due to the universal and device-neutral addressability with the Post- Script page description language, the original printing data can be output via a multitude of printing systems (typically assigned to the "large format printer" category) with the most diverse of quality parameters (resolution, gray levels, type of paper, quality of color).

Color Proof:

In practice, the process most commonly understood under the term digital proofing is "color proof." In the printing industry and in the context of high quality prints, this proof provides the *color-reliable/color- true reproduction* of the contents of the file intended for printing. More and more standard printing systems are being used for this, such as ink jet printers (four-page (A4+) format) or thermal sublimation printers (two-page format) in combination with powerful color management systems. The color proofs created in this way serve as a guideline (reference) for the printer in charge of the production run. While it is possible to work predominantly with small page formats in the creative phase, it is desirable both for printing and for finishing carrying out an inspection of the full-size original or the original digital file in the full-size print format. Reliability is the most important aspect here. As a rule, robust systems with low follow-up costs are obviously preferred in such circumstances. The decision as to whether the proofing system is toner-, ink-, or foil (color donor) - based must be made on the merits of each individual case.

Screen Proof (True Proof):

If the *screen structures* of the later printing procedure can also be simulated using a digital printing process, the term *screen proof* is used (also true proof since, with this level of quality, reproducing the dot structure too, this proof is the closest to that in the print run).Among other things, information about the screen structure enables the printing expert to recognize changes to the tone value and the color shifts associated with this or to see the effects of color register deviations early on. Targeted access to the transfer characteristic curve can be made if necessary. The effects of halftone dot, screen angle, and screen frequency are reproduced in the screen proof and show the print quality of multicolor overprinting.

Raster-dependent effects such as smoothness, grade and range of tonal gradations, and *moiré or rosette patterns* can be recognized prior to print production and, if necessary, be assessed together with the customer. The use of PostScript databases for screen proofs represents an inherent source of error. Since the dot structure is generally not yet a component of the Post- Script file, the electronic dot generator in the PostScript interpreter of the proof device must create the same halftone dots as the RIP of the imaging unit for film or plate exposure. This means that the RIP of the film or plate imagesetter or of the computer to press system also controls the proof printer. Only in this way can identical dot shapes and screen angles be guaranteed.

Several vendors offer special *proof systems* for creating a “true proof”/screen proof. The proof is produced via color donors and thermal transfer (ablation) onto *intermediate carriers* or onto the *substrate* used for the print run. Both systems are imagesetter-like devices with which the image motifs can be reproduced in every detail including their color, screen definition, and screen angles. The systems are designed for four A4+ pages (A2-oversize) as well as for eight A4+ pages. The unit is a *multi-function system*. It can be used to create screen proofs and for digital printing to image plates (computer to plate) when using the same RIP. The true proof systems named use color foils that are to be processed in separate units (laminators), transferred from intermediate carriers onto production paper and/or laminated, either to protect the proof or to give it the appearance of the surface structure of production paper.

Press Proof:

A *press proof* is a *test print* of the data directly in a printing press. This can be the press for the production run or a comparable press (using the same print technology) prepared especially for proof purposes. Short runs of 50 or 100 copies can be produced more cost-effectively than with other color proof processes. The individual proof is, however, hardly economically justifiable.

UNIT - III : DIGITAL IMAGE ASSEMBLY AND DATA FORMATS

3.1 Page assembly and imposition:

Sheet Assembly and Imposition:

The manual assembly of a sheet from page sections and page elements, as well as the combining and positioning of several pages on a print sheet in the format corresponding to the press, is a time-consuming, cost-intensive, and sometimes uncertain stage within the production chain from conception to print. Cost-efficiency and a high level of production certainty are important in all areas of printing production.

The move from the manual light table to sheet assembly on the digital screen, assisted by imposition software, should both reduce costs and streamline the workflow. It makes no difference to the workflow whether the imposed pages are then placed on a large format film imagesetter or transferred directly to image an offset printing plate (computer to film or to plate).

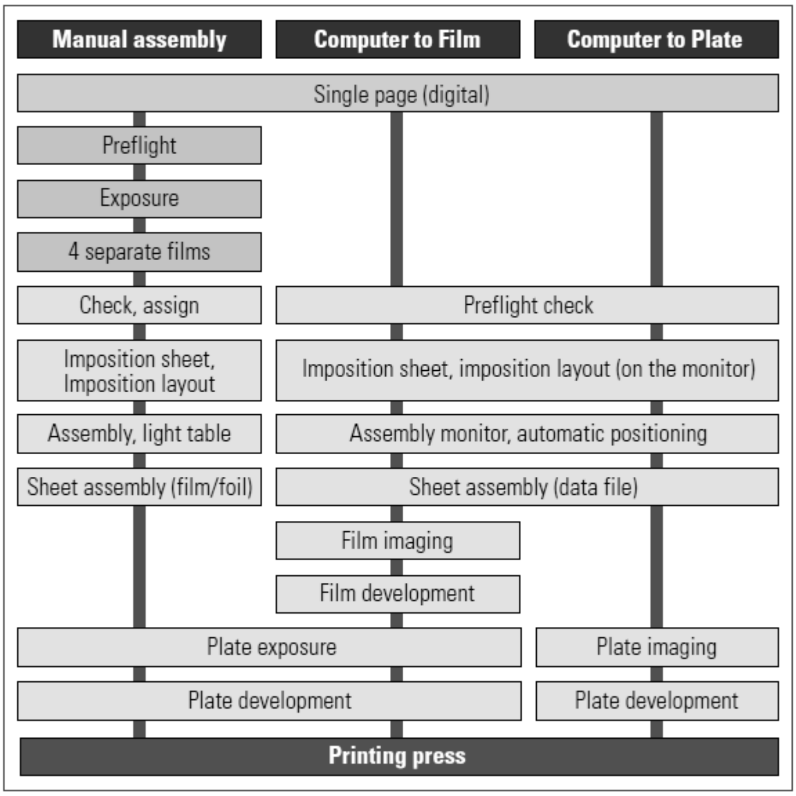
Page Make-up and Sheet Assembly:

Only a few years ago, editorial staff, authors, or agents still glued paper and image proofs onto assembly sheets (*page composition*/layout with text, graphics, and picture elements) and gave them to the composition room with page proof corrections. At this stage it was not just the line spacing that changed. Images had to be enlarged, reduced, and reproduced again.

At the beginning of the 1980s, text and picture integration was introduced and reduced the amount of manual work. Going backwards and forwards with masks, positives, negatives, copying in, and copying out quickly came to an end, and manual composition lost ground. The composition of complete pages was increasingly carried out on Macs and PCs but the process did not yet extend to whole sheets. Assembly copying machines did, however, rationalize some stages of *sheet assembly* (arrangement of several pages on the print sheet) in the '80s.

The machines were equipped with imposition programs that were exceptionally capable for their time. These machines positioned the full-page film (and also the assembled page film) automatically and in the right sequence on the printing plate and then exposed this plate section. This equipment, which is still in use today, is also used in *step-and-repeat copying*. Only a single film is needed in these step-and-repeat copying systems to produce x number of identical copies (multiple-ups) on the plate.

Digital assembly techniques of CTF and CTP:



Manual sheet assembly compared with digital assembly techniques for computer to film and computer to plate

Imposition:

Arranging the individual pages on a print sheet, taking the folding layout and finishing into account. (The arrangement of text, graphics and images within one page is called page layout/make-up.)

Register:

1. Positional accuracy of the print images on the front and reverse side of a print sheet in relation to one another. In perfecting the term perfecting register is also used.

2. In multicolor printing the position of the color separations relative to one another (color register).

3. Term used for the positional accuracy of the color separations on the printed product with reference to the outer edges of the sheet or web section. Circumferential register is used for the direction in which the substrate runs, for example the plate cylinder revolves; lateral register is at right angles to it.

Image register & alignment:

An imposition plan should consider the mechanism of sheet travel through the press. Lithographic presses, which are more precise than offset duplicators, align sheets against the leading edge and one side. This alignment can be critical to image registration and alignment, particularly if the paper is not precisely square.

Gripper edge. Before each sheet passes between the press cylinders, it is stopped momentarily and its leading edge is aligned with the press grippers, which pull the sheet into the press. The leading edge of the sheet is therefore called the gripper edge and is the most precise line of head-to-tail alignment. Due to its importance to registration and alignment, printers commonly mark the gripper edge on imposition diagrams with an “x.”

Side guide. As the sheet passes from the in feed toward the gripper edge, it is jogged toward one side of the press against a side guide, the most precise edge of side-to-side alignment on the sheet. Printers commonly mark the side guide edge with a short straight line.

Imposition plans:

Imposition:

In the Production of a book, booklet or magazine, a printer prints several pages at a time on a single sheet of paper. All the type pages that are to be printed on one side of the sheet must be printed in such a way that when printer and folded the pages appear in sequence. This arrangement of pages is called imposition.

Each printed sheet is called a signature, and in folding we get a section. Sections are gathered, collated and bound together to obtain a book. The simplest signature can be two pages, one leaf printed on both sides. They can range from 4 to 64 pages ordinarily or multiples of 4.

Deciding on the kind of imposition:

There are a number of imposition schemes to suit the great variety of works. In any case the choice of the particular schemes depends of a number of factors.

1. Size of paper, size of sheet to be printed and the machine size.
2. Amount of materials that are available.
3. Total number of pages that will from the finished book.
4. The number of folds.
5. The method of folding by hand or by machine.
6. The kind of binding; side or stitching, or sewing.

It is essential to known while deciding a imposition scheme weather the pages are to be guillotined clean or whether a trim is required between pages to allow for folding or blending. Allowance must also be made in book work for trim and thus the positioning of pages on a press plate to give correct page sequence. Accurate and even margins are essential. Knowing the scheme of imposition it is advantages and disadvantages, a printer can be avoid unnecessary delay, missing of publication date, extra impression etc.

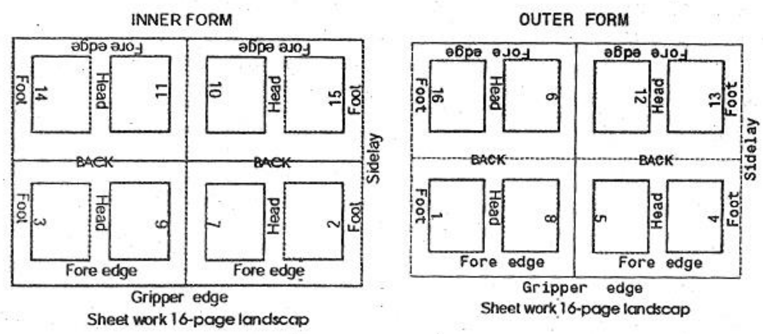
Kinds of Imposition:

There are two basic types of imposition schemes:

1. Full sheet work (or) sheet work
2. Half sheet work

Full Sheet Work:

Half of the pages in a signature are printed on one side of the sheet and other half of the pages act as the sheet. This is also called sheet wise imposition and is preferred by number of printers.



Full Sheet Work

There are both advantages and disadvantages in using this scheme.

- Two forms are required at a time; a main signature and sub signature
- Gives one copy
- Extra material are required for the make ready of two forms
- Number of folds increase
- This scheme is suitable when there are a great number of pages and the sheet is thin enough to several times without spoiling

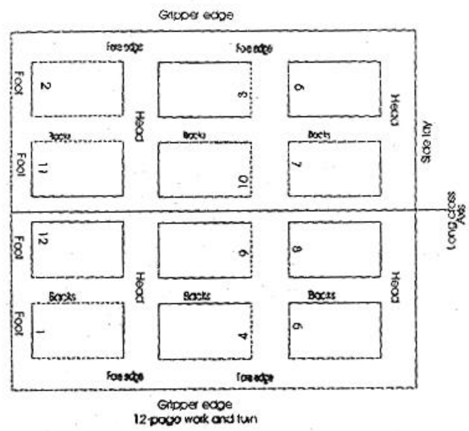
Half Sheet Work:

All pages of a signature are printed on one side of sheet and the sheet is then turned over to print on the other side. So in this scheme, half the number of copies are printed first and then turned over backed than the sheet is cut apart to form two signatures or copies.

The advantages and disadvantages of this scheme depend on the particular type of job.

- Only one form is used for a signature.
- Two copies are obtained; after backing up the sheet is cut into identical copies.
- All pages in the signature are imposed at a time.

- An extra cutting operation is needed.
- Fewer materials are required.
- Numbers of folds are less; suitable for thick sheets that cannot be folded many times.



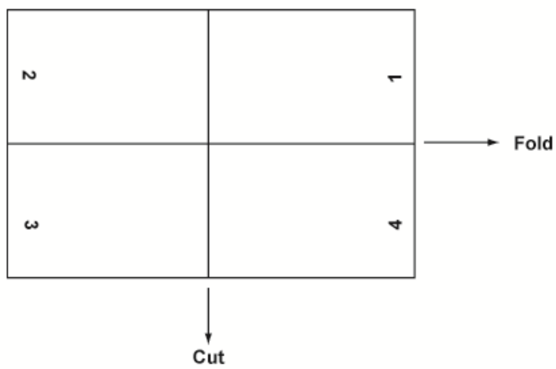
Half Sheet Work

Half sheet work has three various depending on the turning of the sheet to back it up:

- Work and turn
- Work and tumble
- Work and twist

Work and Turn:

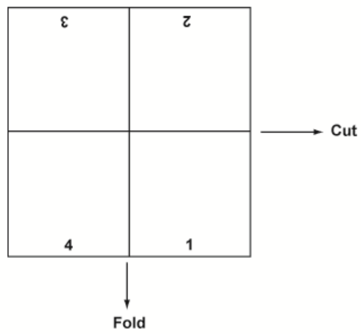
The sheet is turned so that the right side becomes left, while the gripper remains the same. This is used much more than the scheme of sheet work.



Work and Turn

Work and Tumble:

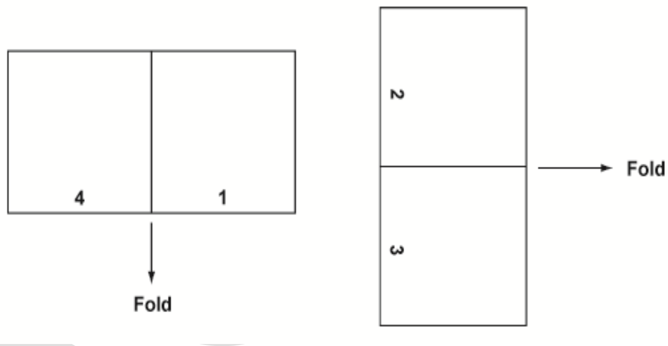
The sheet is turned so that the back edge becomes the gripper edge when the sheet is printed on second side. 12 pages work adopt this scheme. Of the two long sides of sheet, one is used as gripper while printing one side; when the second side is printed the other long side becomes the gripper to obtain correct pagination.



Work and Tumble

Work and Twist:

In the work and twist type, all edges turned or twisted. In a job where it is essential to rule sheet vertically and horizontally this type of imposition is followed. Instead of cutting and rearranging the cross rules, the vertical rules are printed first and the sheet is twisted to print across the first ruling.



Work and Twist

Full-Sheet Output:

Modern *imposition* programs offer virtually any imposition pattern in prepress. Communication and consultation from accepting the order up to the binding is as essential as ever in spite of all the automation. The technological development that has taken place in the area of film imagesetters and computer to plate systems has rendered the working methods outlined unnecessary. Powerful output devices, coupled with special software programs have made it possible to have an integrated process for single-color and multicolor jobs. The move towards large-format film and plate imagesetters, which has been increasing since the beginning of the '90s, is becoming ever stronger. The market for *imposition software* has also grown accordingly. Producing entire sheets through large-format laser imagesetters is not only of technological interest but is also of economic significance as a result of rationalizing the workflow and saving material. For example, when printing eight made-up pages it is not necessary to expose the individual pages. The use of material is consequently more effective and more economical.

The ability to image entire sheets onto film or plate raises questions not only of technical feasibility but also of economically viable production methods. It will be some time before computer to…systems and technologies become fully established in the market, since it is the organizational problems, and not technical feasibility, that play the decisive role in the restructuring of workflows. It is not so much the reluctance of businesses to use the computer to plate technology but rather the inconsistency of the workflow that is holding up the process. Computer to plate and computer to press require a completely digital workflow but the original copies are still being delivered to the industry in different forms and formats and only very few in digital form. In practice it is impossible to do without a mixed process in the short-term. This means that businesses cannot fully utilize the cost savings associated with a computer to plate system and still have to rely on conventional production for the time being.

Full-Sheet Production in the Workflow:

For businesses that are in a position to set up a digital or analog/manual workflow and have an influence on the nature of the original copy, there is potential for rationalization. By employing powerful multi-page imagesetters it is possible to adopt the method of using imposition films or imaged printing plates. In view of the wide variety of equipment and materials available, businesses have to decide which technologies to invest in for the short or medium term:

• Large-format film imagesetters (*computer to film*), which require the use of film material and the necessary chemicals: With this system only complete sheets are made up and copied onto the printing plate.

• *Computer to plate* systems (CtP), where film developing and assembly are not necessary.

There is a whole range of jobs that can use the complete CtP workflow. Periodicals are an often mentioned exception, where all editorial pieces can be assembled into complete pages and sheets as digital data. Imposition can also be carried out digitally for these pages. However, pages or page sections (e.g., advertisements) that are delivered as films have to be assembled manually. Computer to film (CtF) is the ideal procedure for this application.

There are alternative solutions for this *hybrid method* (analog and digital production or digital and analog originals for the whole sheet) through so-called *copy dot scanners* which enable a *digitization* or *redigitization* of sets of film. They allow the data, which is stored analog on film, to be integrated into the digital process chain. This does mean additional investment in an appropriate scanner and it takes time, which can rarely be charged for separately in the customer’s bill. If, however, the workflow can be guaranteed by redigitizing the film and a cost saving is achieved, then an investment can very quickly pay off.

Types of Imposition Programs:

The software tools that have become known as imposition programs also have to fulfill the requirements mentioned above. They are divided into two categories:

1. Programs that are designed to be *device-independent* and can be used with every publishing equipment/ system.

2. Programs that have been *integrated* by the manufacturers of prepress systems *into their own workflow*. The first category contains programs such as: INposition (DK&A), Imposition Publisher (Farrukh Systems), Presswise (ScenicSoft), Strip It (One Vision), Preps (ScenicSoft), and Impostrip (Ultimate). The second category of imposition programs are those that are offered by companies such as Agfa, Barco, Heidelberg, Krause, Scangraphic, and Screen as part of their workflow management in a product line. These programs include hardware configurations such as servers, imposition stations, RIP, and film imagesetters (CtF) or CtP systems. There are also solutions available from companies such as Scitex, which has integrated a standard program (Preps by ScenicSoft) into its own workflow.Heidelberg also enables the integration of the software mentioned above into the Prinergy workflow as do the firms Creo, Fuji, Intergraph, Scitex, and Xerox. Businesses that decide on the last two variants know for certain that the workflow will follow a logical concept. The responsibility for the individual processes is also then controlled by one party. Otherwise, companies have to implement the digital sheet assemblies by themselves and adapt it to the existing configuration.

Imposition through Software:

With manual working methods, sheet assembly of standard products and complex assembly of multicolored products often cause bottlenecks during print production. Even if a great deal of time is spent on achieving a precise register and correct arrangement of page and sheet elements, it is difficult to avoid the usual imposition errors (e.g., slight movements of register due to parallax). Preparation jobs such as sorting and cutting the individual films also take up time and are potential sources of errors. By contrast, *digital sheet assembly* on the screen offers a higher register precision. It also helps to avoid mistakes by program-supported assembly. Digital imposition raises the quality of the print production, reduces the costs of material, space, and machines, and helps to resolve bottlenecks in production.

The *imposition programs* available on the market make it possible to combine traditional manual sheet imposition with the user-friendliness of publishing software and to replace the manual procedure with a digital command chain. The first priority of programs is to simplify and safeguard repeated tasks. Libraries of *imposition layouts* that come with the programs can be used for standard jobs. After appropriate modification they can also be used for special orders. Almost all programs also take into account the finishing work to be carried out on the product. These programs automatically adapt the lip and the binder's creep occurring with saddle-stitching depending on the paper weight, and correct the lateral distortion caused by folding.

Imposition through Imposition studio 4.5 software:

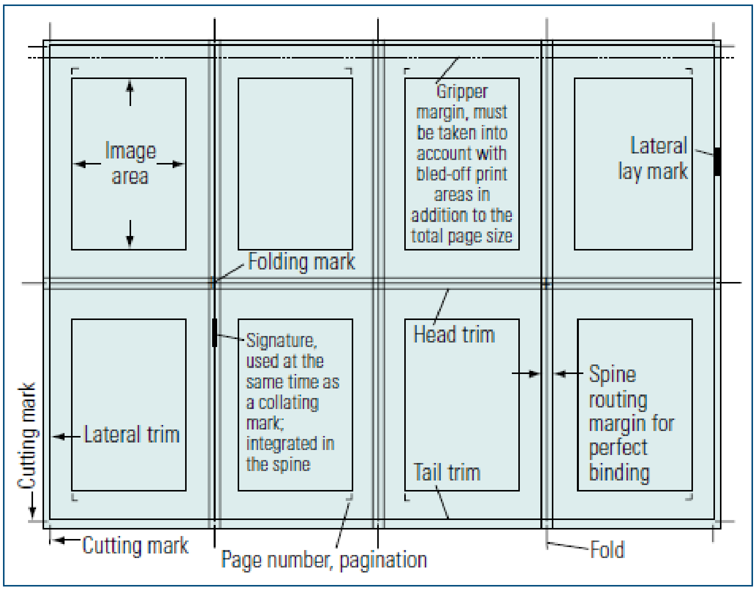
1. The pages are designed in Adobe Indesign or any other page layout programs.
2. The designed file is export to PDF.
3. Open Imposition studio 4.5 software.
4. Choose Open to template or Create a new imposition layout.
5. After creating the layout, open the PDF link set up.
6. Choose Import PDF and select the exported PDF file and click open
7. In add pages dialog box, preview files and click OK.
8. In PDF link set up dialog box, select the file and save/update.
9. Choose output PDF and in dialog box PDF output option – signatures are selected, Batch PDF output option and in options – slug lines are changed and choose Output PDF.
10. Now the imposition is done automatically as per the layout and prepared as a PDF file.
11. Now this output of PDF file is sent for an output device for imaging.

8 Pages imposition sheet:

The Imposition Sheet and the Imposition Layout:

Imposition means the correct assembly of pages for a layout with, for example, 4,8,16, or 32 pages. Two basic working materials are required to manufacture the printing plate: the imposition sheet and the imposition layout, which depends on the type of folding to follow. The imposition sheet and the imposition layout can only be employed when the most appropriate production method from a technical and economic viewpoint has been determined.

The *imposition sheet* shows the positions of the sections to be printed, the distances between the pages, from the middle of the sheet, from the binding edge (fold), and from the edges of the sheet. It also takes into account information such as the position of the gripper edge and shows where the different markings should be made that are needed for printing and subsequent sheet finishing, such as lay markers, signature titles, collating marks, or cutting marks as well as the register marks and print control strips that are required for printing. The imposition sheet must sometimes also contain information on the position of a numbering unit or perforation. Signatures and collating marks are indispensable for processing book blocks, to produce the correct sequence of sheets, sheet sections and binding sections. The alignment/lay marks are particularly important because they mark the direction in which the sheet runs into the folding machine. This establishes the location, alignment, and direction of the first fold and all the subsequent folds. It is also important for electronic imposition for the imposition sheet to contain all the information on measurements.



Imposition sheet for 8 pages with information on page orientation,

later printing and Finishing

The *imposition sheet* is the basis for preparing the print of a sheet. It is provided with information about the *imposition layout*, which establishes the division of the printed sides onto the front and back of the sheets and gives an overview of the number of printing plates. While the imposition sheet establishes the position of the pages on the printed sheets, the imposition layout shows how the total number of pages of a printed product should be divided up. It also indicates how often and in which way individual sheets have to be folded.

The imposition layout shows how a printed sheet in a format of 70 cm x 100 cm, for example, is folded into the required final format. In this respect the imposition layout adds to the imposition sheet and is the result of optimization by a number of factors, such as:

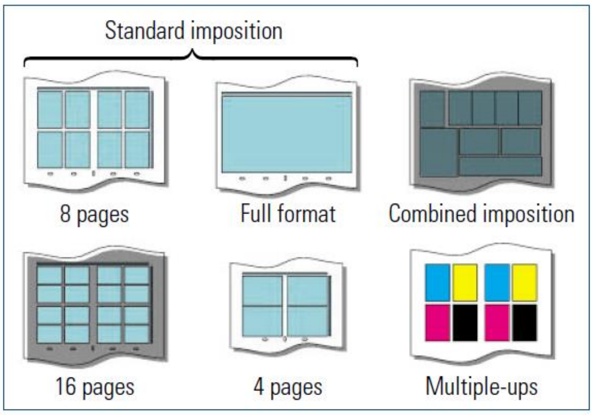
- The number of pages in the printed product,
- Format of the printed sheet,
- Paper composition and grain,
- Format of the printing press,
- Format of the finishing machines (cutting and folding machines),
- Final format,
- Type of binding (perfect binding, thread or wire stitching).

Demands on Imposition Programs:

Imposition programs have to fulfill requirements of the kind listed below. From the technical point of view they must, for example, be in a position to,

- make and store imposition sheets,
- process the number of pages per plate, their format and alignment, together with defined gutters, margins, and imposition patterns,
- produce several imposition patterns for each imposition sheet, including multi-page printing and partial sheets,
- take perfecting, work and tumble, and work and turn procedures into account,
- process bled pages and double-page spread,
- produce combined forms and multiple-ups,
- impose according to the type of binding (stapling, wire stitching, or perfect binding),
- take trim allowance, paper thickness etc., into account,
- automatically equalize the binder's creep,
- Take the creep and format increases, folding and register marks, and much more into account (in accordance with the installation defined above). Apart from their purely technical functions imposition programs must be in a position to
- fulfil the Adobe PostScript Document Structure Convention (DSC),
- interpret EPS, TIFF, PDF data, and Pict pages/ files,
- integrate different types of data from layout programs within a particular job,
- show the pages on the screen in certain modes in reader-view,
- call up the pages for editing, adding, or removing, as well as for changing the sequence,
- Show the sheet as a job in imposed sheets.

Programs that create a new PostScript data file after each step are disadvantageous because more storage space is needed. An example is the calculation for a 16-page brochure: Every A4 page needs about 40MB of memory (corresponding approximately to a full four-color page) which means 640 MB for a 16-page brochure. If this data file is stored permanently in the memory, the storage space of standard configurations can quickly run out.



Imposition of pages with standard, multiple-up, and combined forms

Imposition Workflows:

The manufacturers of prepress systems are constantly working on solutions that avoid slowing down the workflow with overly large memory requirements and that produce a continuous workflow including imposition. Most manufacturers of imagesetters (computer to film systems) and computer to plate systems have made it their job not to offer the output units as an isolated system, but rather to configure the image setter (Whether as film or plate setters) as a complete system. However, they often abandon the ready-prepared and targeted standard solutions in order to make their systems faster, more stable and, above all, more economical.

The workflow from the individual digital page to the imposed eight or sixteen-page sheet requires special data management. Considerably more is needed than just the output of digital text and image information. In comparison to standard programs it is often much more interesting to use complete workflows of the manufacturers that have compatibility, reliability, and speed as their goal. In addition to preflight-checks, RIPing, imposition, spreads and chokes, job-management, and the actual output belong to the system solutions. The manufacturers also often offer an interface to CIP 3, to be able to provide printing presses with prepress data for procedures such as ink key presetting.

Some *imposition workflows* are described in more detail in the following:

Apogee (Agfa):

Apogee-Workflow is a system that uses the *PDF format* (Portable Document Format) and consists of the Apogee Pilot Production Manager, a PDF-RIP, and the Apogee Print Drive Output Manager. In contrast to systems that convert the PDF format into their own formats during processing, the PDF format is maintained in the Apogee system. As a result, all PDF performance features can be used, editing can still be done and page independence can be maintained. Apogee optimizes the output because completed jobs are automatically stored, managed, and made available for output on different media. The system also has at its disposal functions for last minute corrections and an imposition tool before output to film or plate.

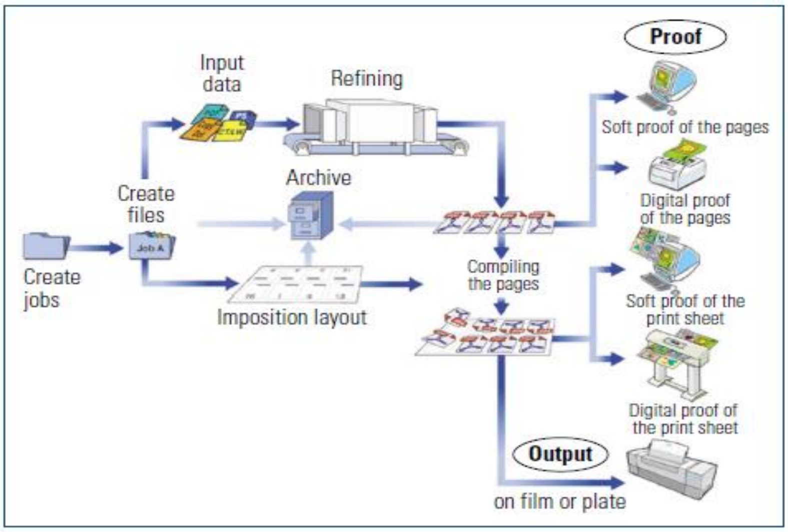
Impose (Barco):

The imposition programs Impose! and Auto-impose! are part of the fast-lane concept in which the imposition of pages also takes place. The imposition data files only contain the relevant data for imposition. The pages and pictures themselves are on a separate server. The creation of a ready-to-process imposition data file can consequently be postponed until the last minute before the exposure. This offers the advantage of incorporating correction of data files and inclusion of page sections that arrive late until just before exposure. The program also checks at regular intervals which pages of a job are available. If the pages of a particular imposition sheet are ready, the signature (full-sheet) data file is generated.

Signastation (Heidelberg):

After selecting a defined imposition layout for the print job from the library and the input of the corresponding printing parameters, the required number of sheets including all marks and symbols are automatically calculated. Creeping and bottling for the whole printing process is also taken into account. The user can also produce individual folding schemes with an editor. To optimize the workflow, Signastation supports OPI. The high-resolution image data which is stored on a server will only be used for exposure in the full sheet assembly. For a form proof or reduced-size print-out on an electrophotographic or ink jet printer, lower resolution versions are used. Signastation processes PostScript-data files from different applications and also takes the “Delta lists” into consideration in connection with *Delta-Technology* (Heidelberg).

These have already been through the RIP-process and are page-independent. Signastation is also used in the PDF workflow *Prinergy.*



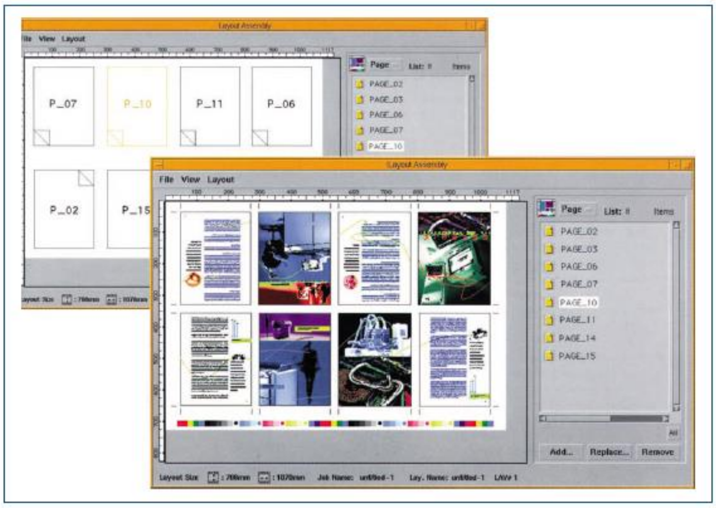
Imposition layout and sheet assembly in the Prinergy workflow (Heidelberg)

Bit-Impose (Scangraphic):

The Scangraphic imposition program is part of workflow- management system’s *Scantext Combo*, a combination consisting of file and printserver, software RIP, imposition software, and output control. PostScript data files of any application (Adobe Document Structure Convention required) are fed into Bit-Impose without using special drivers or filters. They are analyzed and checked for completeness by the program. The page displays that are produced are attached to the imposition scheme; the sheet is imposed and stored for exposure. The sheet assembly itself takes place with access to the low-resolution files produced by the RIP with Bit-Impose. Finally, Bitmap Control checks whether the high-resolution bitmaps needed for the exposure are present or still need to be produced by the RIP. If all bitmaps of the pages are present, Combo automatically starts the output process, which then always runs at the maximum imaging speed of the output device.

Brisque-Impose (Scitex):

Two different procedures are offered here for the production of digitally imposed signatures/sheets and to image them on Scitex imagesetters. There is the Scenic Soft *Preps* imposition program, which has already been mentioned, and in addition the qualities of Preps have been combined with Brisque technology to produce the imposition solution Brisque-Impose. It is a part of Brisque-Workflows. Individual pages or parts of a job run through a preflight check, the OPI, and the RIP process, as well as trapping, and are stored on hard disks. Finally they can be proofed on an ink jet proof system (Iris-Realist). If the pages are ready and the imposition is set, Preps is used for positioning the sheet layout. Since the pages available on Brisque-Impose are already ripped, the information where the relevant data files are is enough for the imposition program. Since the RIP'd data files are available as individual pages, only the changed sheet has to be RIP'd again when a page is amended. All other pages remain unaffected by this.



Positioning of pages: the pages are positioned and displayed in accordance with the imposition layout shown in the background (Brisque, Scitex)

3.2 Raster Image Processor (RIP):

A RIP is a component used in the printing system which produces a bitmap. This bitmap is then sent to a printing device for output. The input may be a page description in a high level page description language such as postscript, portable document format, XPS or another bitmap of higher or lower resolution than the output device.

RIP is the process and means of turning vector digital information such as postscript file into a high resolution raster image.

Stages:

Interpretation:

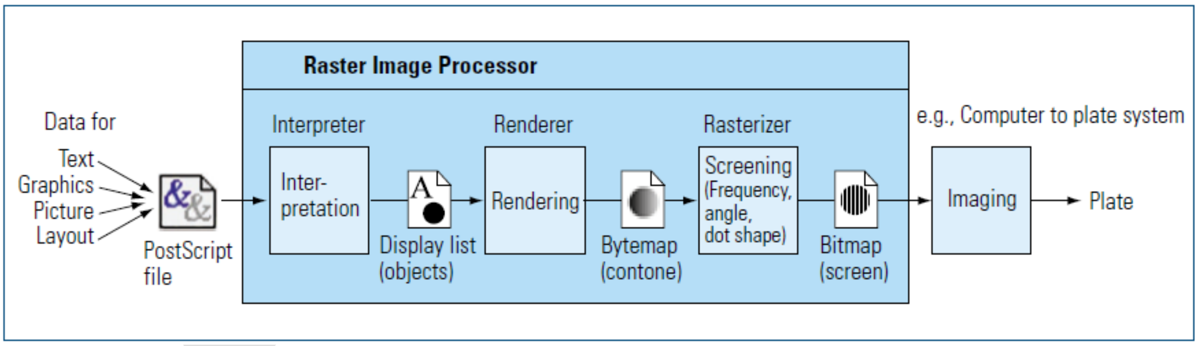
This first translates the commands of the page description language into the so-called "*display list.*" It is here that all the calculated objects of a page are buffered in a uniform format.

Rendering:

In a second step the objects of the "display list" are converted by the *renderer module* into the device-specific resolution of the output device – for instance, the smooth contours of a typeface font are emulated by stepped gradients.

Screening:

The resulting *continuous-tone* image (contone) is then divided up by the *rasterizer* into *halftone dots* and translated into the original data format (normally bitmap) of the output device. In most RIP environments of electronic printing systems a "controller" follows after the processing of the page data and this ensures that the *bitmap data* is transferred correctly to the actual printing unit.



PostScript-RIP in the prepress workflow

Raster Image Processors (RIPs) have been around for as long as there has been digital, electronic prepress. There has also always been (very diverse) page description languages in the digital world with which the information from the application program is brought via the interpretation to the page. Practically every manufacturer had his own page description language and therefore also had an RIP set up to handle this.

The term "Raster Image Processor" (RIP) has come to be very closely associated with the *PostScript* page description language. To run computer programs that have been written in a higher programming language such as C, Pascal, or PostScript, the language must be translated into the individual, binary program structure of a computer system.

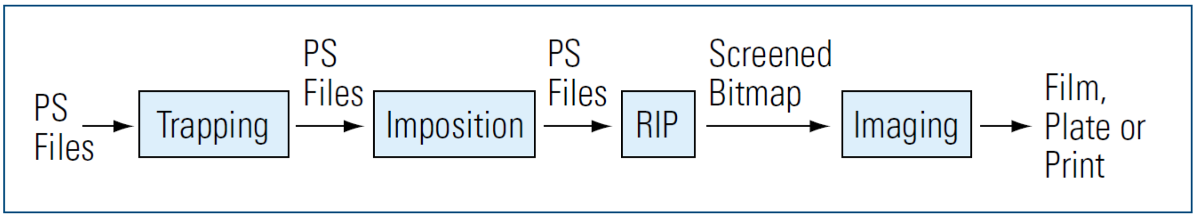
Modern computer technology uses two basic principles: in the first, the command written in the higher programming language can be translated into a machine- compatible binary structure by a "*compiler*" immediately after program generation. In the second, the program can remain in the higher language and is transferred into the machine-compatible code on the final computer system by an "*interpreter.*"

The advantage of the interpreter-based system is that the computer program remains coded regardless of which computer system is later used while remaining universally compatible. A few examples of interpreter based programming languages are BASIC, JAVA, and particularly PostScript. Since PostScript is not merely a programming language but also principally a page description language and a device-independent data exchange format for documents, a PostScript interpreter is of great importance in prepress.

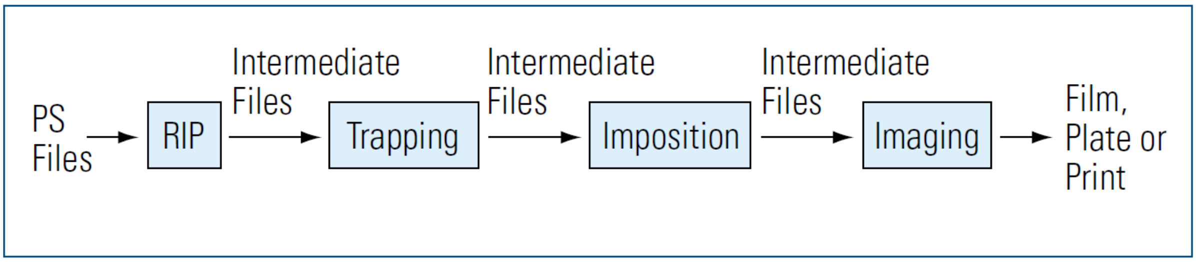
RIP in the Prepress Workflow:

Raster image processors are integrated in the *workflow concepts* of prepress systems in different ways. In modern *prepress workflows* the desire for media-independent, high-performance, and automated production is increasingly becoming the main focus of attention. This means that no adaptation to the final output system should be necessary after the individual pages have been generated in a layout program. This characteristic concerns the color mode of the file (not CMYK!), the screening, trapping, and the imposition to a complete page/sheet for plate exposure. The page data is generated at a preliminary stage, yet the data is not prepared for the output system "printing press" until it undergoes further, if possible, automated processes of color transformations, spreading, full-sheet layout, and screening.

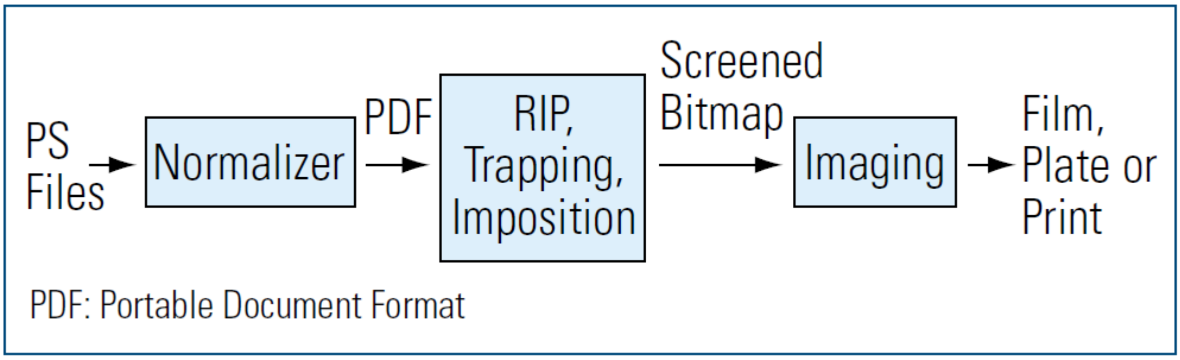
In the classic *PostScript-RIP concept* trapping already takes place in the CMYK color mode of the layout program. The data normally leaves the layout tool in the form of pre-separated PostScript files. For full-page/sheet assembly, special software products are used that impose the PostScript color separations separately. In this case the PostScript-RIP simply has the task of generating the data structure for the controller format of the output system and screening the continuous- tone data.



Conventional PostScript workflow



Converting to intermediate formats



Combined PDF/PostScript-3 workflows

For several years, virtually all the traditional suppliers of prepress equipment have been offering an extended *PostScript workflow concept* that enables an earlier conversion of the PostScript data into a proprietary intermediate format.

The (ideally media-neutral) PostScript file is converted just once into a less complex intermediate format (normally contone or contone /contour format) by the PostScript-RIP. The resolution of the intermediate file is oriented towards the greatest real output resolution. All characteristics that are specific to the printing process are calculated following the Post-Script interpretation in downstream trapping, imposition, color transformation, and screening function modules by processing the proprietary intermediate format.

The advantages of this concept lie in the one-off interpretation of the PostScript data. This enables the computation-bound PostScript interpretation procedure to be reduced as far as possible and a “safe” intermediate format to be generated. In this context, “safe” means that the risks of abnormal termination when interpreting a complex PostScript file are relatively high but a reduction of the complexity through format conversion generates production stability. A disadvantage is the dependence on a single system manufacturer that comes about due to the proprietary data structure.

The workflow advantages of this RIP concept can only be achieved with those products that are compatible with the data structure. Similar advantages can also be attained by replacing the proprietary intermediate formats with a PDF based workflow concept in connection with PostScript Level 3 (PostScript 3)-RIPs. In this case PDF files are created instead of the proprietary intermediate formats after the interpretation of the PostScript data by a standard interpreter (CPSI). Since a PDF file has already been interpreted, a subsequent rendering process can take place much more quickly and safely than with the original PostScript file. At the same time the device-independence of the PostScript data structure is maintained. Since the *PostScript Level 3*, trapping and imposition functions can also take place in the RIP. PostScript based color transformations were already possible prior to this. PostScript 3 was, nevertheless, enhanced by useful color functions, in particular for addressing proof systems and supporting more than four output channels.

Handling File Formats:

File format is a standard way that information is encoded for storage in a computer file. A file format specifies how bits are used to encode information in a digital storage medium. File formats may be either proprietary or free and may be either unpublished or open.

TIFF: (Tagged Image File Format):

TIFF is a classical, pixel-based data format. It was originally developed by Aldus (now Adobe Systems) and Microsoft. The basic parameters of a picture (e.g., resolution) are saved in standard “tags”, which are documented in the TIFF Reference Manual. “Private” tags can also be defined. Their contents can only be read by specific applications. Due to its freely definable tags, TIFF is a strong, extendable data format, which has become a de-facto industry standard. It is based on the “Lempel-Ziv-Welch” compression method (LZW), making it a simple, and no-loss data compression option.

TIFF files are bitmapped files and are used for picture images, both gray scale and color. Gray scale TIFF can hold 256 grays and color TIFF can handle 16.7 million colors.

TIF is lossless (including LZW compression option), which is considered the highest quality format for commercial work. The TIF format is not necessarily any "higher quality" per se (the image pixels are what they are), and most formats other than JPG are lossless too. This simply means there are no additional losses or JPG artifacts to degrade and detract from the original. And TIF is the most versatile, except that web pages don't show TIF files. For other purposes however, TIF does most of anything you might want, from 1-bit to 48-bit color, RGB, CMYK, LAB, or Indexed color. Most any of the "special" file types (for example, camera RAW files, fax files, or multipage documents) are based on TIF format, but with unique proprietary data tags - making these incompatible unless expected by their special software.

JPEG:

The JPEG File Interchange Format (JFIF) is used particularly for large data sets, optimized prepress workflows (e.g., newspaper production), and for Internet solutions. The data compression mechanism developed by the Joint Photographic Expert Group (JPEG) includes several combined compression methods. The so-called “baseline” process offers a series of successive compression modules with defined parameters as a standard application.

The JPEG picture data compression is based on a discrete cosine transform. This method which is more prone to data loss can achieve very high compression rates (up to 1:100), depending on the parameters selected. However, the loss rate of this method depends on the content of the picture. It is not possible to predict the exact data loss. The JPEG format is specified both for RGB and CMYK data, but not for CIELAB data.

PDF:

The PostScript page description language is closely related to the Portable Document Format, PDF. This format is primarily used to describe documents. PDF is mostly based on the imaging primitives of the PostScript language and is also suitable for the description of a document page. PDF can also include additional information regarding the document page, for example to link its contents to other parts of the document. It can contain fonts, graphics, printing instructions, special keywords for search and index functions, “job tickets,” interactive links (hyperlinks), video clips, and much more.

Contrary to PostScript, a PDF document stores each page of a publication separately. This means that the file need not be completely interpreted in order to print or display the contents of a page.

GIF:

GIF was designed by CompuServe in the early days of computer 8-bit video, before JPG, for video display at dial up modem speeds. GIF always uses lossless LZW compression, but it is always an indexed color file (8-bits, 256 colors maximum), which is poor for 24-bit color photos. Don't use indexed color for color photos today, the color is too limited. PNG and TIF files can also optionally handle the same indexed color mode that GIF uses, but they are more versatile with other choices too.

But GIF is still very good for web graphics (i.e., with a limited number of colors). For graphics of only a few colors, GIF can be much smaller than JPG, with more clear pure colors than JPG). Indexed Color is described at Color Palettes.

EPS:

Graphics data files are mainly stored as outline-based data. The main graphics application programs already generate spline data structures internally; these can be directly converted into EPS data for further processing. Being directly derived from PostScript, EPS can be used to transport alternatively or combined outline and pixel- based data. For the coding of graphics, EPS mainly implements outline-based coding. EPS stands for “Encapsulated PostScript”. This means that an EPS file contains embedded information that cannot be changed.

EPS is a special file version of the PostScript page description language. Internally, it uses the same operators as PostScript, yet it can be imported as a file into other documents. To avoid the interpretation of the entire PostScript data set to simply visualize the contents of the file (which would require the interpretation of the complete file by a PostScript RIP), a low-resolution "preview" image is added in the file header during the creation of the file. When an EPS file is loaded, for example, in a page layout, the preview image is used for the screen display.

An EPS file can contain both outline and bitmap-based data. As a transport format for picture data, EPS is generally only used with its own bitmap-saving capacities. Moreover, cut-out paths can be used to complement outline-based data. Like Post- Script files, EPS files cannot be edited without first being fully interpreted by a RIP. They can be positioned, rotated, and scaled, but their content cannot be altered. This property is particularly useful when unwanted manipulation of an EPS file by applications later in the workflow is to be avoided.

PNG:

PNG can replace GIF today (web browsers show both), and PNG also offers many options of TIF too (indexed or RGB, 1 to 48-bits, etc). PNG was invented more recently than the others, designed to bypass possible LZW compression patent issues with GIF, and since it was more modern, it offers other options too (RGB color modes, 16 bits, etc). One additional feature of PNG is transparency for 24 bit RGB images.

Normally PNG files are a little smaller than LZW compression in TIF or GIF (all of these use lossless compression, of different types), but PNG is perhaps slightly slower to read or write. That patent situation has gone away now, but PNG remains excellent. Less used than TIF or JPG, but PNG is another good choice for lossless quality work.

UNIT - IV : COLOUR MANAGEMENT

4.1 Color:

Color is a sensation or as an object, which absorbs different wavelength of different degrees. We live in a colorful world. With the help of colors, we brighten up our surroundings to make us feel good. Interior design and color schemes directly influence our impressions and feelings. Colors that go well together create a harmonious and feelings putting us in a good mood. The printing industry also uses colors to make presentations more effective.

Color is a complex visual sensation that is influenced by the physical properties of the illuminant and sample, but it is determined largely by the physiological characteristics of the individual observer. Insights into the process of color perception may be gained through examinations of these distinct elements (illuminate, sample, human observer) and the manner in which they interact.

Color is an optical phenomenon, a sensory impression conveyed by the eye and the brain. Light reflected or transmitted by an object is received by our eyes and transformed into nervous impulses, which trigger the color sensation in our brain. Color is not a physical variable; accordingly it has no physical unit.

An object is not colored, but the sensation of colors produced because of irradiation by light. Sunlight, which appears to be white, radiates on to an object and is partially reflected. Consequently, an object that reflects the red area of the spectrum appears colored.

An object that reflects completely in the entire visible spectrum usually appears to be white and an absorbent body appears to be black.

When perceiving and describing colors, physical and physiological effects are always involved. The physical components are measurable, where as the physiological components are not measurable.

The mixing of certain basic produces all of the colors we can perceive. There are three categories of colors: primary colors, secondary colors, and tertiary colors. Primary colors are those that are not formed by mixing of any other colors and can be said to be “pure” colors. Secondary colors are those formed by the mixing of two or more primary colors.

Tertiary colors are those produced by mixing of two or more secondary colors. In the process of seeing, cones in the retinas of our eyes are stimulated. Different cones are sensitive to blue, green, and red. The stimuli are transformed into excited states, in turn, causing signals to be sent along the optic nerve to the brain, which interprets them as color.

This same process can be emulated in a measuring instrument. One such measuring instrument is the spectrophotometer.Of course, a measuring cannot actually perceive anything, but it is able to perform calculations on predefined and measured values.

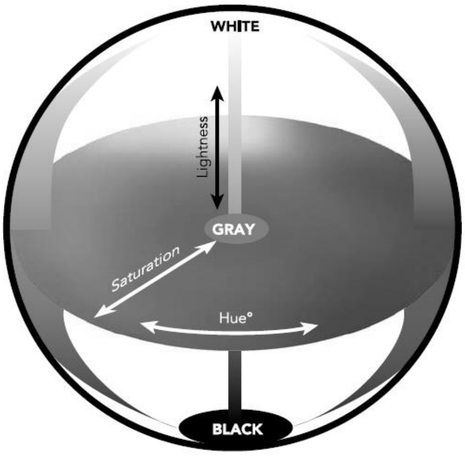
Properties of color:

Hue:

The first dimension of color is hue. It is the name of the color which places the color in its correct position is the spectrum. For example, If a color is described as blue is different from yellow, Red and green or other colors.

Hue is the name given to a specific color, to differentiate it from any other. The Hues, blue, green and red, yellow, magenta and cyan from the familiar color wheels. The hue identifies whether a color is red, blue, green, yellow, or some combination term as greenish yellow or bluish red. Such other terms as magenta or crimson are often used as hue names. Hue may have an infinite number of steps, or variations, within a color circle.

A circle displays all the hues that exist indeed, it can be said that any reproduction process is capable of matching any given hue. In most color models, the hue is plotted around the circumference of the color circle. By design the hues are positioned around the color circle from shortest to longest wavelengths.



Color circle

Saturation:

The second dimension of color is saturation. It refers to the degree of hue in color. It is the quality of color, which enables an observer to state how strong the color is a color sensation by which one can distinguish a hue as being pale or rich, weak or strong.

Saturation, similar to chrome, indicates the purity of a color. It refers to the strength of a color, i.e. - how far it is from neutral gray. In color circle it is found as a hue changing as it moves toward the center.

A gray – green, for example, has low saturation, whereas an emerald green has higher or saturation. A color gets purer or more saturated as it gets less gray. In practice, this means that there are fewer contaminants of the opposite hue present in a given color. To illustrate this concept, imagine mixing some magenta pigment with a green pigment (the opposite hue).

The green will become less and less saturated until eventually a neutral gray will be produced. A gray scale has zero saturation. Magenta becomes desiderated by the addition of green in the same way green becomes desiderated by the addition of magenta.

Brightness/lightness:

The third dimension of color defines a specific hue and saturation of color and provides a variable in the lightness or darkness that the color appears. Another name used for lightness is the value of color. The brick red crayon can vary in degree of lightness when reproduced. The vertical dimension of the color model provides an axis for lightness with white at the top and black at the bottom. The term brightness is sometimes used for lightness.

Color Management:

Color Management is defined as the use of software, hardware and methodology to control and adjust colour among different devices in an imaging system.

Color management is the calibration of all input and output devices within an image processing chain with the aim of always achieving the desired color reproduction independent of the devices used.

Why Color Management?

When a prepress expert produces files for offset printing in usual environment, that is, using familiar scanner and screen, generally achieves a quality of color reproduction that can scarcely be improved upon by employing color management. However, if this expert is asked to produce images once a year for newspaper printing, is no longer likely to achieve the desired color quality at the first attempt. Skill in controlling color quality also suffers if suddenly has to work with a different monitor. would also not find it possible to deliver optimum images immediately if was told that a poster is going to be produced on a large format ink jet printer. Color management comes into play at precisely that point where the accuracy of the expert in controlling color reproduction ceases. Color management ensures optimum color reproduction irrespective of the input device, monitor, and output device used, as long as the device is characterized by an *ICC profile* (International Color Consortium). Therefore, an important reason for using color management today is the certainty that the correct output result will be achieved at the first attempt.

Needs for Color Management:

Color management gets us very close, very quickly. It removes the need for endless iterations. There are of course many instances where a particular image will need further editing and “tweaking.” Color management provides a way to get to a good baseline from which to make further, aesthetic changes. At the end of the day color management saves time and money the bottom line with which few can argue. Color management provides flexibility, the ability to proof at remote locations, and the ability to use inkjet printers instead of high-end proofers. In the final analysis it facilitates a quicker, less expensive workflow, which is what counts.

Imaging device as its own personality or particular characteristics color image only produce accurate results if take into account the personal characteristics of each device. To do this need some global frame work for color control. Each scanner or digital camera captures the same scene slightly differently. Each printer print the same digital file in a different way: we need to quantify and compensate for device variability. Included in this variability is the issue of color gamut.

The gamut is the range of color a device can produce. No device can reproduce all colors. In general, a monitor may be able to display a large range of colors but a printer may not be able to generate all of these colors. In this situation some colors from an image on the screen cannot be matched by the print so there will be an inevitable difference between the screen and the print. We need to be aware of the limitations of each devices and the ramifications these limitations can have an image colors some sort of color control system is needed to deal with each devices unique characteristics, which include device variability and differences in gamut.

Targets of print color management:

Color Checker:

Color Rendition Chart (often referred to by its original name, the **Macbeth Color Checker** is a color calibration target consisting of a cardboard-framed arrangement of 24 squares of painted samples. The Color Checker was introduced in a 1976 paper by McCamy, Marcus, and Davidson in the *Journal of Applied Photographic Engineering*. The chart’s color patches have spectral reflectance’s intended to mimic those of natural objects such as human skin, foliage, and flowers, to have consistent color appearance under a variety of lighting conditions, especially as detected by typical color photographic film, and to be stable over time.

Designs:

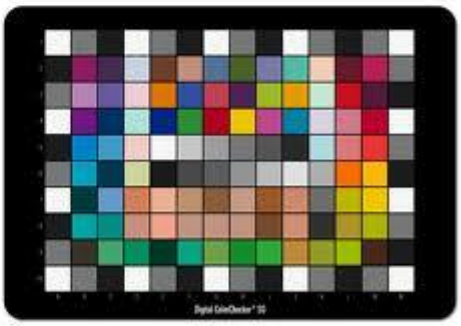
The Color Checker chart is a rectangular card measuring about 11 × 8.25 inches, or in its original incarnation about 13 × 9” and aspect ratio approximately the same as that of 35 mm film. It includes 24 patches in a 4 × 6 grid, each slightly less than 2 inches square, made of matte paint applied to smooth paper, and surrounded by a black border. Six of the patches form a uniform gray lightness scale.

Another six are primary colors typical of chemical photographic processes red, green, blue, cyan, magenta, and yellow. The remaining colors include approximations of medium light and medium dark human skin, blue sky, the front of a typical leaf, and a blue chicory flower. The rest were chosen arbitrarily to represent a gamut "of general interest and utility for test purposes", though the orange and yellow patches are similarly colored to typical oranges and lemons.

Use:

Color targets such as the Color Checker can be captured by cameras and other color input devices, and the resulting images' output can be compared to the original chart, or to reference measurements, to test the degree to which image acquisition reproduction systems and processes approximate the human visual systems.

Because of its wide availability and use, its careful design, and its consistency, and because comprehensive spectrophotometric measurements are available, the Color Checker has also been used in academic research into topics such as spectral imaging.



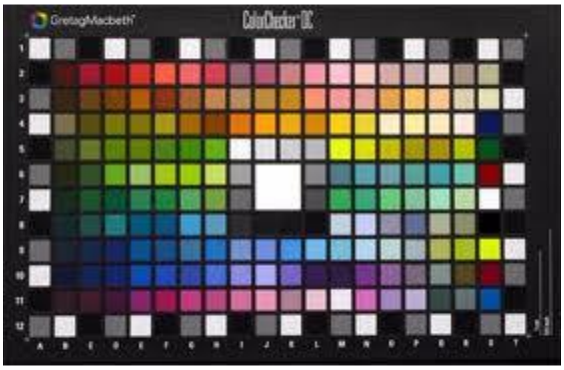
The Macbeth Color Checker is the traditional standard for visual

and measuring reference.

This target is available in the "standard" size only. Also, the gray patches on the Color Checker are considered some of the most neutral available - more neutral than most Kodak targets. For gray balance on digital cameras, this target is a must-have.

The White Balance card is a full-size version of the white reference square on the standard Color Checker. This white is scientifically engineered to provide a precise, uniform surface that is spectrally neutral in all types of light conditions.

The Custom Grayscale card is an 8/5 x 11", spectrally neutral three-step grayscale card engineered to provide quick studio lighting balancing. This card is used to quickly determine the maximum lighting ratio for the fill and main lights in the studio.



The Gretag Macbeth Color Checker is an array of 24 printed color squares, which include spectral simulations of light and dark skin, foliage, etc. The Color Checker is used for precise color balance when shooting color film. 9:13 proportions will fill a 35mm frame. Scientifically engineered to ensure true-to-life images, the Color Checker cards are designed to help recognize, evaluate and adjust colors quickly and efficiently. Uses include photography, graphic arts, electronic publishing and television.

One of the most photographed images in the world, the Color Checker is a unique test pattern scientifically designed to help determine the true color balance of any color rendition system. It allows to avoid costly mistakes by checking for potential problems.

Color Checker DC is specifically designed to meet the needs of digital photography. Users can check and compare the digital reproduction of a real scene or a test pattern, make a white balance with a digital camera, or use the chart with camera profiling software to create an ICC profile of camera.

Gretag Macbeth is an international leader in color management tools. A related company, Gretag Imaging, is in the high-end of color digital printing equipment.

4.2 CIE:

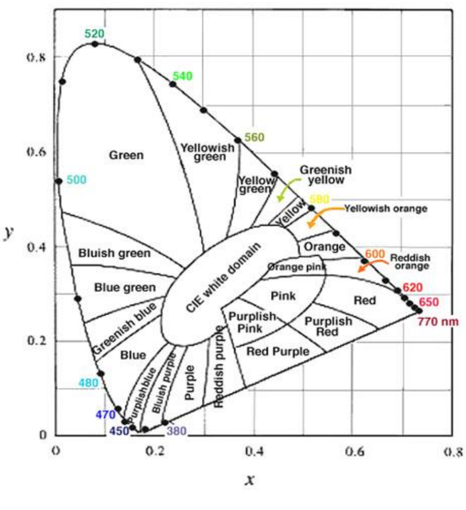
Perhaps the most universally accepted system of color measurement is the CIE system, which was developed by the commission Internationally de l 'Eclairage (CIE) of France during 1931. This system was one of the early attempts to develop a device - independent, uniform color model. Starting with a standard observer and viewing condition, the CIE system as evolved in to different color spaces to meet the needs of different market sectors.

In 1931, an effort to establish an international system or standard to measure color was conducted in England. The group assembled created the CIE chromaticity diagram based on the previous Maxwell Triangle. The Maxwell Triangle, developed by James Maxwell, is an equilateral triangle that includes red, green, and blue as the three primary corners of the triangle. The CIE chromaticity Diagram used the same primaries of light while indicating the different wavelengths of light. The CIE chromaticity diagram uses chromaticity co -ordinates or Tristimulus data.

The measurements used by the CIE were based on a standard observer. The CIE sampled 1,700 individuals to establish a standard red, green, and blue wave length of light that represented the average observer. Tristimulus data (XYZ) could be calculated for a color by using RGB filters that match the way a human eye sees color. Colorimeters see color using Tristimulus filter readings. The XYZ values of the Tristimulus data are used to create the XY chromaticity co-ordinates required to plot color on a CIE chromaticity diagram. The third value used to plot color on a CIE chromaticity diagram is the Y value (0 to 100) for luminance, and is plotted on a right angle to the chromaticity plane. The CIE chromaticity diagram was also used the lighting industry for the measurement of light. It should be noted that there is no defined white value in the CIE chromaticity diagram.

In an effort to better refine color measurement, CIE LAB / CIE LUV were developed in1976 and are still widely used today. The CIE LAB model is used primarily for reflective color, including printed sheets. The CIE LUV model is used primarily for color monitors or displays. The L*a* b*(or L* u* v*) colors are stimulus values used in a Mathematical model. L * represents lightness. The a* (or u*) value shows the position on a red -green axis and the b* (or v*) values is the position on a yellow - blue axis.

CIE LCH is a color model that is derived mathematically from the CIE LAB or CIE LUV color models. This model converts the rectangular co-ordinate system in to a cylindrical polar co-ordinate system. The L* value is the same as Lab lightness. The C* value indicates the chroma or saturation, and is the vector distance from the centre of the color space. The H* value describes the hue angle.



1931 X, Y Chromaticity Diagram

1931 X, Y Chromaticity Diagram:

XYZ Tristimulus values are fundamental measures of color. However, they do not give an immediately obvious representation of color. XYZ values can be transformed in to other representations described in this and the following sections. The first system we look at is the CIE 1931 Yxy system. In this system, a color is represented by its x, y co-ordinates and plotted on a horseshoe –shaped diagram an example. This diagram is called the x y chromaticity diagram and, XY are as chromaticity co- ordinates.

ILLUMINANT	X	Y	Z
A	109.850	100.000	35.585
B	99.072	100.000	85.223
C	98,074	100.000	118.232
D50	96.422	100.000	82.521
D65	95.047	100.000	108.883
F2	99.19	100.000	67.39

Table shows the customary for CIE illuminants to be shown with Y= 100, there is no similar restriction on the values of X and Z

It is possible to make a small calculation based on the X Y Z values of a sample to obtain X Y which can then be plotted on this diagram to show the position of a color in this color space, from XYZ values , we can calculate X Y chromaticity co-ordinates using the following simple equations.

$$x = \frac{X}{X+Y+Z} \qquad y = \frac{Y}{X+Y+Z}$$

Here X Y are the chromaticity co ordinates, and XYZ are Tristimulus values by convention the lower case X Y is reserved for the chromaticity co-ordinates and upper case (capital) X Y Z for the predecessor tristimulus values.

The X Y system can be explained in terms of three attributes of color. Around the edge of the chromaticity diagram are fully saturated colors and the locus is labeled with the wavelength of the domain hue. The saturation of color is depicted by considering the distance of sample from the locus edge .thus neutral samples occupy the centre of the diagram. While saturated samples are found near edge of the diagram. The diagram cannot show the attribute of lightness and the lightness value must be quoted as a separate value (Y)

The chromaticity diagram is widely used in color management and many programs display color using this type of plot. However the diagram does have some serious limitations. We now look at the advantages and disadvantages of using the chromaticity diagram.

Advantages of the X Y chromaticity diagram:

The chromaticity diagram can be used for a number of useful calculations and visualizations.

To use this diagram first need to calculate or measure the X Y chromaticity co ordinates of sample then plot the X Y position of the color and of the illuminant the color was measured. Next a line is drawn starting from the illuminant (white point) through the color to the locus edge. Here it is possible to read of the dominant wavelength of the sample. It is possible to calculate the saturation of a color by considering the distances of the illuminant to the sample (a) and the sample to the locus (b). The saturation or purity of a color is given by a (a+b) and can be expressed as a percentage.

(A) Straight line is drawn at the base of the horseshoe to connect the ends of the spectrum locus. This is called the purple boundary line.

(B) If a line from the illuminant through the sample falls on this boundary the line is reversed and a complementary dominant is quoted.

(C) It is possible to change the illuminant and predict the effect this has on the appearance of a sample. When we select the co ordinates of a new illuminant a line is drawn starting from the new illuminant through the sample to the locus edge .here it is possible to read off a new dominant wavelength which represents the color of the sample under the new illuminant.

(D) It is also possible to add two colors and predict the color of the result. If two emissive colors are represented by two points on the diagram the result of their addition will be on the line joining the two samples

Disadvantages of the X Y chromaticity diagram:

The chromaticity diagram is widely used in color management. However a significant problem with this diagram is that it is perceptually non uniform. Colors with an equal perceptual difference should be equally separated in the diagram. If examine the top part of the diagram you will see that two colors can be very far apart in the green part of the diagram before they appear to change color. In the red and especially blue part of the diagram the same perceptual difference occurs over a much a smaller distance.

If we were to use this diagram to described color difference, we would have problems. Suppose we described a “1 cm” color difference between two samples. In the green, this would mean colors are quite similar, were as in red this would mean the colors are markedly different. If this diagram were to be used in conveying color difference information, we would always have to provide a clarification. That is, the 1cm color difference in the greens or in the reds. If it is in the greens, it is nothing to worry about however, if chat same difference is in the reds, it is very significant. In an ideal color space a 1 cm distance in the diagram would represent this same perceptual color difference for all colors this concept is referred to as perceptual uniformity.

Another way to appreciate the perceptual non uniformity of this diagram. Is to look at the spacing of the wavelength tick mark around the locus of the diagram. Notice that a 10-

nm difference from 490-500 nm is shown as a huge distance, while 620-630 nm is much smaller.

Although no diagram can achieve perfect perceptual uniformity, some are better than others, and in this respect LAB is much better than Y xy.

CIE LAB:

Color scientists continue to develop new color spaces and variations of the of the X Y Z color space with the goal of providing better perceptual uniformity and thus better correlation with the human perception of color. In the last section we saw how X Y Z can be used as the basis for xy in this section we see how X Y Z can be used the basis for an improved system known as LAB and LCH.

Color Management relies on LAB for a number of significant operations. In fact it is used to specify the central interchange space the profile connection space through which all image data passes as described in chapter 1

The LAB diagram is a 3D color diagram. The color of a sample is specified by its position in this 3D volume expressed in LAB co-ordinates. The LAB system separates the color information in to lightness (L) and color information (a*, b*) on a red/green (a*) and yellow /blue (b*) axis. The lightness of a color changes as we move vertically through this solid with L* of 0 representing black and L* of 100 representing white. As the position of a color moves from the central region toward and the edge of the sphere the hue angle (or dominant wavelength) changes. Thus we see that the main attributes of color are clearly defined in the LAB system.

An important difference the X Y chromaticity diagram and LAB diagram is that the LAB system has better perceptual uniformity. This means that the geometrical distance between colors is more representative of the perceptual difference notice for example how the green region is much smaller in the LAB diagram than the same region in the chromaticity diagram .The LAB color space is not perfectly perceptually uniform but it is a lot better than Y xy.

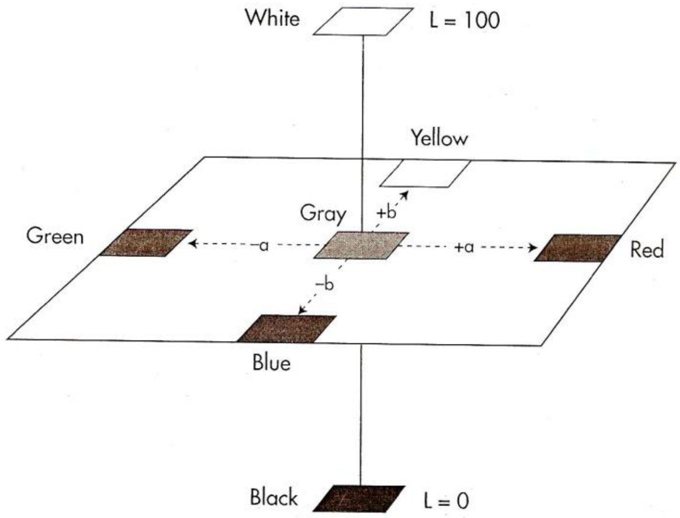
XYZ is used to drive LAB as follows.

$$L^* = 116\left(\frac{Y}{Y_n}\right)^{1/3} - 16$$

$$a^* = 500\left[\left(\frac{X}{X_n}\right)^{1/3} - \left(\frac{Y}{Y_n}\right)^{1/3}\right]$$

$$b^* = 200\left[\left(\frac{Y}{Y_n}\right)^{1/3} - \left(\frac{Z}{Z_n}\right)\right]$$

Here X, Y, Z is the tristimulus values of the sample and Xn, Yn Zn are the tristimulus values of the reference illuminant (light source). There is a further correction to this equation for very dark colors.



CIE LAB

Although it is not necessary to understand these equations in detail there are a few points that can be made even from a cursory glance. Both x,y and LAB are derived from XYZ . However note how much more complicated the LAB equation is compared to the xy equation. The additional computation helps make the LAB equation involves functions raised to the power of 1*3 (a cube root function) The cube root function is a nonlinear function, which means that it compresses some values more than others – exactly the sort of correction we wanted to see happen to the colors in the x,y chromaticity diagram. This equation is responsible for the better spacing of colors in the LAB diagram such as in the green region.

The other aspect of the XYZ to LAB conversion worth noting is that the equation explicitly considers the viewing illuminant shown in the equation as X_n, Y_n and Z_n. The interpretation of this that LAB expresses the color of a sample as viewed under a different, so that if we wanted to predict the color of sample under a different illuminant. The LAB system is the most widely used color space in color Management.

The Image Reproduction Process using Color Management:

We will begin by considering the process without color management: The original image is scanned; giving RGB values that are converted into CMYK values using an image processing program or the RIP of the output device. When using color management, there are now several intermediate steps inserted between the output of the RGB values and calculation of the CMYK values. This appears at first sight to be lengthening (and hence slowing down) the process. However, these intermediate steps ensure that the weaknesses of the conventional system mentioned earlier are eliminated.

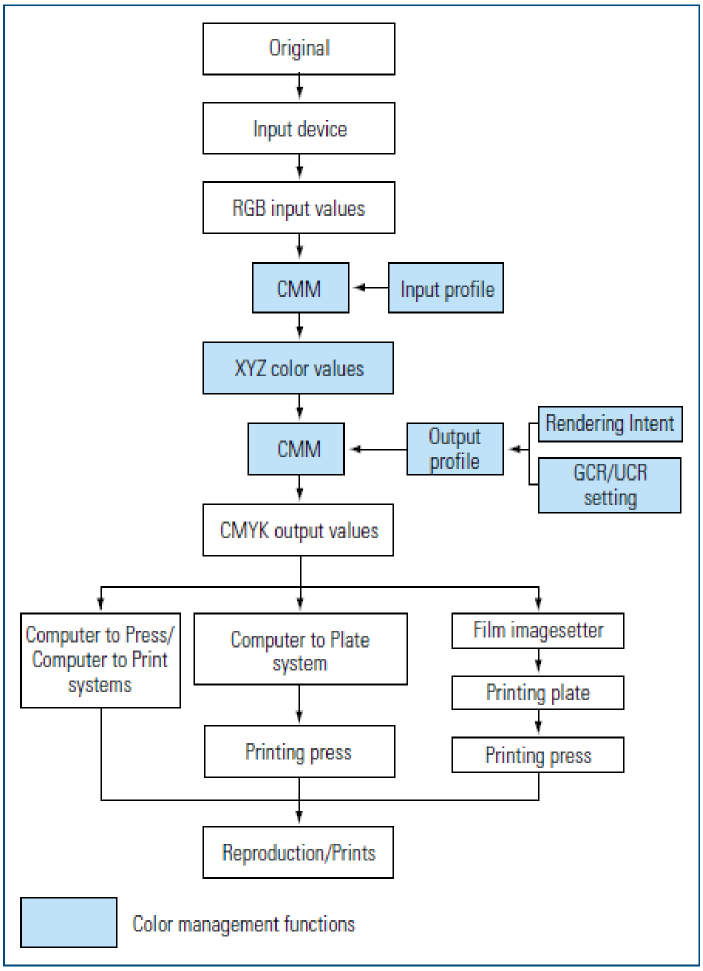


Image reproduction process using color management

(CMM = Color ManagementModule, i.e., software; GCR = Gray Component Replacement;UCR = Undercolor Removal)

Details of the additional steps involved in the color management process are as follows:

1. 1. The RGB values of the input device are converted into *device-independent color values* (e. g., CIE XYZ) with the aid of the color profile for the input device and conversion software (often described as *color management module* or CMM for short. Input devices that supply CMYK values directly are not suitable for color management). In this form the image values may be used for any output processes or devices. This becomes important when the process to be used to output the image has not been firmly established at the

image recording stage, or when the image is to be output using different processes in parallel (e. g., by offset printing and on a CD-ROM or on the Internet).

2. When the *process for outputting the image* has been established, the color values of the image are converted into the process-specific output values (CYMK for printing) with the aid of the *color profile* of the output process and the same conversion software (CMM). The *output profile* from this process acquires universal significance since the color profile also contains the specifications for image make-up (under color removal, black definition) and the desired rendering intent in addition to the color gamut and the gradation characteristic of the output process. Before applying the process the profiles for the input and output devices involved must be produced.

Rendering Intent:

The term *rendering intent* is a new term introduced by the ICC and means that the reproduction of colors may be chosen specifically depending on the intended purpose of the reproduction.

When the gamut of source color space exceeds that of the destination, saturated colors are liable to become clipped (inaccurately represented), or more formally burned. These define how the colour reproduction process should cope with colours and tones which are outside of, or near the edge of the device's colour gamut, in order to achieve the desired colour 'rendering'.

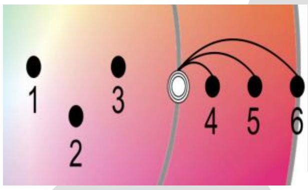
When reproducing colour using a medium (paper and ink) with a smaller or different shaped colour gamut than the original photograph or scene, it is inevitable that some colours or tones may be lost or degraded. These are said to be 'out-of-gamut'. The subtle tones, particularly saturated colours and dark shadows, may be squashed, flattened together or 'clipped'. This applies to the tonal range, or density, as well as to colour hue and saturation. An extreme case would be a colour transparency, which is designed to be viewed by transmitted light, which could have (Fuji Velvia, etc.) a maximum density range of nearly D4.0, being reproduced in a newspaper with it's dull 'grey' paper, where the density range may be lower than D1.2.

The color management module can deal with this problem in several ways. The ICC specification includes four different **rendering intents**: *absolute colorimetric*, *relative colorimetric*, *perceptual*, and *saturation.*

Colorimetric:

Colorimetric moves out of gamut colors proportionally to the nearest in-gamut color. Unlike saturation and perceptual, colorimetric does *not* move the in-gamut colors and maintains both the tonality *and* saturation of the image—essentially giving you the best balance of smooth tones and bright memory color that we are all sensitive to (e.g. red apples, green grass, blue skies).

To reproduce an image colorimetrically means having colours 'mapped' as accurately as possible. The downside is that distinct colours which are out of gamut may be 'mapped' to be the same, thereby losing detail by being 'clipped'. Dark shadow detail may well be lost, or 'fill in'. These Intents are designed for use when the original has a smaller gamut than the reproduction; e.g. when 'proofing'. When proofing we typically have a larger colour gamut in the (usually inkjet) proofer than with the (usually offset litho) printing press we are simulating. So out of gamut colours are seldom a problem. Additionally, the colorimetric rendering intent selection can be *absolute* or *relative*.



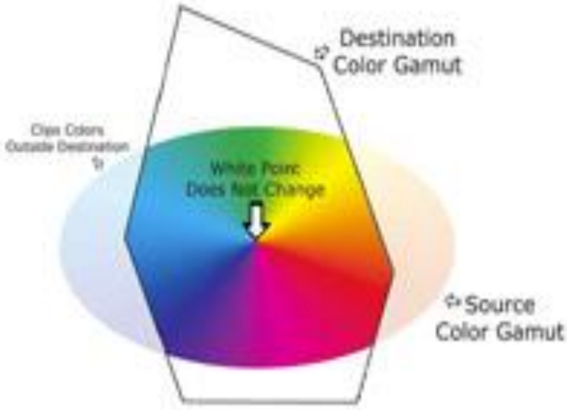
Colorimetric rendering intent (image concept courtesy John Nate, EFI).

Absolute colorimetric

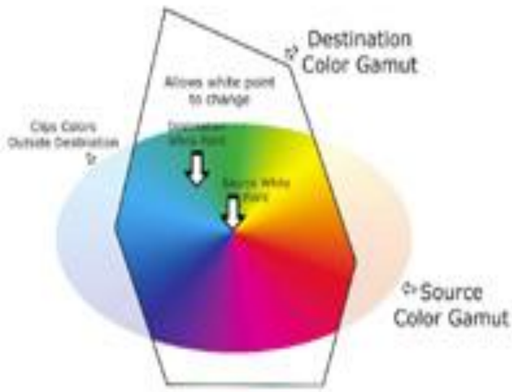
If the output device has a much larger gamut than the source profile, i.e., all the colors in the source can be represented in the output, using the absolute colorimetry rendering intent would "ideally" (ignoring noise, precision, etc.) give an exact output of the specified CIELAB values. Perceptually, the colors may appear incorrect, but instrument measurements of the resulting output would match the source. Colors outside of the proof print system's possible color are mapped to the boundary of the color gamut. Absolute colorimetry is useful to get an exact specified color (e.g., IBM blue), or to quantify the accuracy of mapping methods.

Choosing *absolute colorimetric* will simulate the color of the paper when output (the color of the paper which is included in every ICC profile is sprayed in the background of the proof), and is most useful in inkjet proofing where substrate choices are limited and you want to show the paper color on which the job will be printed

This will simulate the paper colour, if necessary by adding a 'tint' of that colour. If the printed paper you are trying to simulate is a 'dull yellow' and the proofing stock is a 'very bright bluish white', it will print a very light tint of yellow (and probably magenta) in the 'white paper' background, and also throughout the image's tonal-range. Although being very accurate 'colorimetrically', some customers may question the appearance of the 'paper tint'. It is normally only used in digital proofing. It will also do absolutely no compression in the dark tones/colours. We would not advise using this Intent for reproducing scanned or camera images as they will probably reproduce too 'flat' with heavy highlights. So proofing only.



Absolute Colorimetric



Relative Colorimetric

Relative colorimetric

The goal in relative colorimetry is to be truthful to the specified color, with only a correction for the media. Relative colorimetry is useful in proofing applications, since you are using it to get an idea of how a print on one device will appear on a different device. Media differences are the only thing you really would like to adjust for. Obviously there has to be some gamut mapping going on also. Usually this is done in a way where hue and lightness are maintained at the cost of reduced saturation. Relative colorimetric is the default rendering intent on most systems.

This will map the white point of the image reproduction 'relative' to that of the original. The white point of the original colour space (often the Photoshop 'Working Space') will be matched to that of the output (typically a printer profile) and other colours scaled in relation. It can be used in proofing situations where accurate reproduction of the printing press 'paper white' isn't required. It is often used with reflection copy scanned images, and digital camera images. In which case always use Black Point Compensation, in Photoshop, etc., if available.

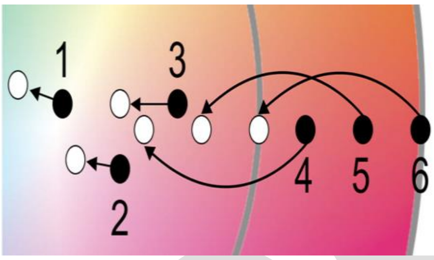
Choosing *relative colorimetric* will not include the paper in the conversion. Most software applications, RIPs, and digital front-ends default to relative colorimetric.

Perceptual:

Also sometimes known as 'Photographic'. Renders colours in a way which is natural to the human vision. The gamut of the source image colour space (typically a 'Working Space' or scanner profile) is scaled to the output colour space (usually a printer profile). This will pull out of gamut colours into gamut. Colours at or near the edge of the gamut will also be pulled in to give a distinction between them. This will generally give a pleasing result.

Different ICC-profiling software vendors may achieve different results with the Perceptual intent. In particular, profiles generated with older software versions may exhibit a lack of saturation. Perceptual should usually be used for colour transparencies, and often also gives the best results for scans from reflection colour prints. For digital camera images you should try Perceptual and Relative. Not recommended for use in proofing.

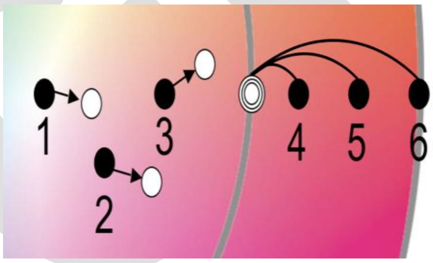
Perceptual proportionally moves the out of gamut colors inward to the color space that the device is capable of producing (figure below). In-gamut colors are also moved inward proportionally to make room for the out-of-gamut colors. Perceptual rendering is a good choice for photographic images as it maintains the tonality of the image at the expense of color saturation.



Perceptual rendering intent (image concept courtesy John Nate, EFI).

Saturation:

This will pull saturated colours out to the edge of the gamut, thereby increasing saturation, or colour 'strength'. It is intended to be used for vector graphics; i.e. logos, line-art, etc. Never use it for photographs (except special effects) or proofing!



Sauration rendering intent

Saturation intent is most useful in charts and diagrams, where there is a discrete palette of colors that the designer wants saturated to make them intense, but where specific hue is less important.

Before the actual rendering intent is carried out, you can temporarily simulate the rendering by soft proofing. It is a useful tool as it predicts the outcome of the colors and is available as an application in many Color Management Systems.

Saturation moves colors that are out-of-gamut to the closest in-gamut color that the device is capable of producing (figure below). In addition, the in-gamut colors are also changed and are moved outward to the edge of the reproducible CMYK color space, increasing the saturation of the image. The saturation rendering intent would not be a good choice for photographic images and is best for business graphics such as those created in Microsoft Office applications.

Implementing color management:

Color management module

Color matching module (also *-method* or *-system*) is a software algorithm that adjusts the numerical values that get sent to or received from different devices so that the perceived color they produce remains consistent. The key issue here is how to deal with a color that cannot be reproduced on a certain device in order to show it through a different device as if it were visually the same color, just as when the reproducible color range between color transparencies and printed matters are different. There is no common method for this process, and the performance depends on the capability of each color matching method.

Some well known CMMs are ColorSync, Adobe CMM, LittleCMS, and ArgyllCMS.

Operating system level

Apple's Mac operating systems have provided OS-level color management since 1993, through ColorSync.

Since 1997 color management in Windows is handled at the OS level through an ICC color management system. Beginning with Windows Vista, Microsoft introduced a new color architecture known as Windows Color System. WCS supplements the *Image Color Management* (ICM) system in Windows 2000 and Windows XP, originally written by Heidelberg.

Operating systems that use the X Window System for graphics use ICC profiles, and support for color management on Linux, still less mature than on other platforms, is coordinated through Open ICC at freedesktop.org and makes use of LittleCMS.

File level

Certain image file types (TIFF and Photoshop) include the notion of color channels for specifying the *color mode* of the file. The most commonly used channels are RGB (for display and printing) and CMYK (for commercial printing). An additional *alpha* channel may specify a transparency mask value. Some image software (such as Photoshop) perform automatic color separation to maintain color information in CMYK mode using a specified ICC profile such as US Web Coated (SWOP) v2.

Application level

As of 2005, most web browsers ignored color profiles. Notable exceptions were Safari, starting with version 2.0, and Firefox starting with version 3. Although disabled by default in Firefox 3.0, ICC v2 and ICC v4 color management could be enable by using an add-on or setting a configuration option.

As of 2012, notable browser support for color management is:

- Firefox: from version 3.5 enabled by default for ICC v2 tagged images, version 8.0 has ICC v4 profiles support, but it needs to be activated manually.

- Internet Explorer: version 9 is the first Microsoft browser to partly support ICC profiles, but it does not render images correctly according to the Windows ICC settings (it only converts non-sRGB images to the sRGB profile) and therefore provides no real color management at all
- Google Chrome: uses the system provided ICC v2 and v4 support on OS X, and from version 22 supports ICC v2 profiles by default on other platforms.
- Safari: has support starting with version 2.0
- Opera: has support since 12.10 for ICC v4.

3 Cs of Color Management:

The whole process of color management can be neatly defined in terms of three Cs- Calibration, Characterization, and Conversion. Calibration involves establishing a fixed, repeatable condition for a device. Anything that alters the color of the image must be identified and “locked-down.” Calibration involves establishing some known starting condition and some means of returning the device to that state.

After a device has been calibrated, its characteristic response is studied in a process known as characterization. In color management, characterization refers to the process of making a profile. During the profile generation process, the behavior of the device is studied by sending a reasonable sampling of color patches (a test chart) to the device and recording the device’s response. Thus, the typical behavior, gamut and characteristics of the device are ascertained, and this information is stored in the device profile. Creating a profile is the characterization part of the process.

The third C of color management is conversion, a process in which images are converted from one color space to another. The conversion process relies on application software (e.g., Photoshop), system-level software (e.g., ColorSync), and a CMM (e.g., Adobe CMM) the three Cs are hierarchical each process is dependent on the preceding step. Thus characterization is only valid for a given calibration condition.

UNIT - V : COMPUTER TO PLATE SYSTEMS

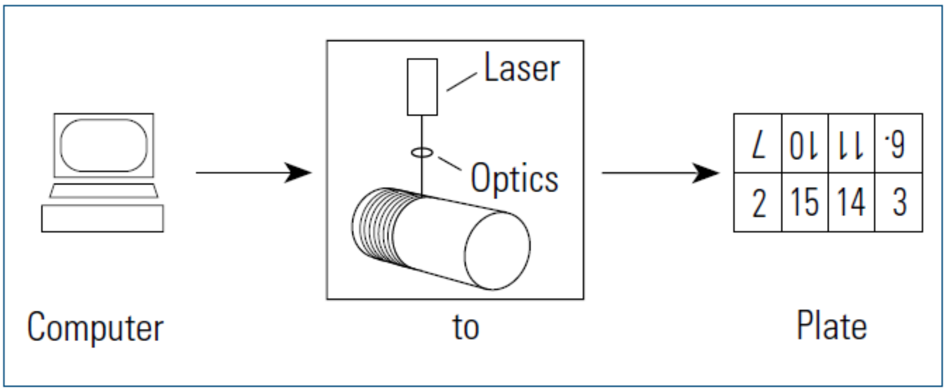
5.1 CTP Technology:

Introduction:

"Computer to plate" is the term used to describe the computer-controlled direct imaging of printing plates from digital data. It refers to the production of printing plates for offset printing as well as to the production of plates for flexographic printing.

A wide range of computer to plate technologies and systems was introduced on the market at the end of 1993 (IPEX 93, trade fair for the graphic arts industry); and since then, it has been one of the great themes at all of the subsequent trade fairs and events for the graphic arts industry (e.g., DRUPA 95 and IPEX 98). There was more hesitancy in putting this type of printing plate production into practice than manufacturers had expected, however. The essential prerequisite for computer to plate, that the complete printing plate images be available as digital data files, had still not been adequately met. The digitization of prepress has moved forward slowly, since the entire organization of work and sequences (workflow) has to be converted to the digital process. This is a big challenge for a company and its employees as regards education and training and a change of tasks. Another hurdle in the path of its introduction is the volume of investment required. However, it is to be expected that this technology will be used more and more and that there will be more than five thousand systems in operation in the year 2000 (there were approximately six hundred in early 1997).

Computer to plate (CtP) comprises three basic components: Computer, imaging system, and printing plate/plate support. All components have now reached a suitably advanced technological state for practical application.



The three elements of computer to plate

Computer:

The computer rightly has first place, because it influences the entire workflow. Electronic imposition on computer, in particular, results in fundamental savings in the time and cost of platemaking compared to manual assembly on light tables. The overall system usually comprises several computers dedicated to various functions such as imposition, a raster image processor (RIP), intermediate data storage, and a control computer for the equipment.

Imaging System:

The transfer of digital data from the computer to image the plate surface is performed by the central element of the computer to plate system, the *plate imagesetter*. In most systems lasers are used for this purpose. The power and wavelength of the laser beams have to be matched to the sensitivity of the plate surface.

Printing Plate:

A large number of plate types are available for computer to plate applications. *Offset plates* vary with respect both to the base, namely aluminum, polyester, or paper, and to the coating. In the current state of the art most plates still have to be developed by means of a solvent or water-based process after imaging.

Computer to Plate Workflow

The digitization of the workflow entailed by the introduction of computer to plate necessitates adaptation and possibly a complete conversion of previous workflows. These changes present both a technical and an organizational challenge. The required employee qualification profile changes considerably: The computer to plate system operator must have understanding and experience of computer processing.

This assumes that there is a print shop that receives digitally printing data from outside and first of all checks it for completeness, correctness, and printability in the so-called "*preflight check*."

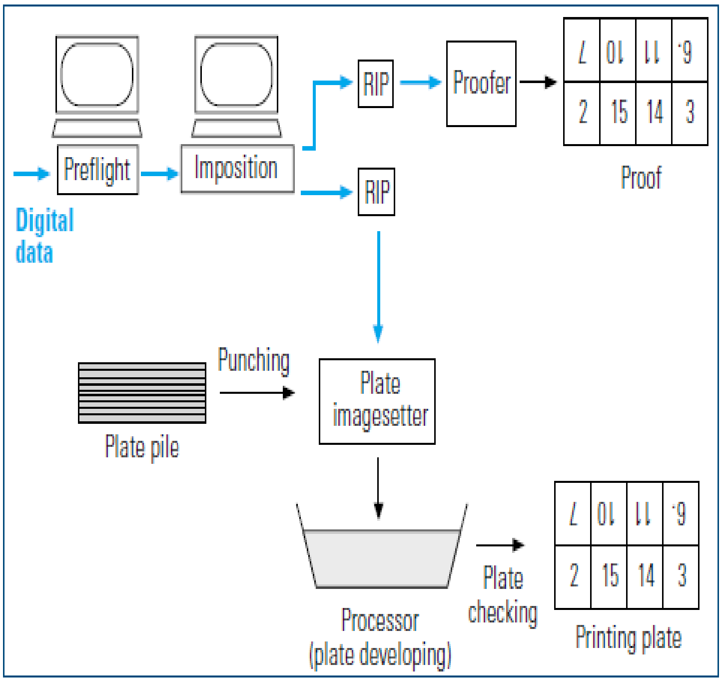
After imposition, the entire sheet, now available as a PostScript data file for example, is usually sent to the raster image processor (RIP) for transforming into the bitmaps to be used.

For example, in some configurations, imposition is not done until after the raster image processor (RIP), and hence on the basis of bitmap pages. There are also various solutions for transferring bitmap data from the RIP to the plate imagesetter. In many CtP systems the imaging unit is directly connected to the RIP. There is no intermediate storage for the bitmaps, but the data is transferred directly "on the fly" from the raster image processor (RIP) to the imaging head.

In other configurations the imaging data (bitmaps) generated in the RIP is first stored on hard disk in a buffer memory. In the digital data flow is indicated by blue arrows, while black arrows are used to indicate the route that the plate takes. Not to be ignored is the *quality control* of the finished plate, irrespective of whether this is done automatically or visually by an employee. For example, the Krause company supplies a so-called "Plate-checker," a camera system that simulates the expected print image of the four plates on the monitor and makes possible inspection by the operator.

There are devices for *plate handling* with varying degrees of automation, such as those in which the plates have to be inserted in the safelight and removed from the plate imagesetter individually, and at the other extreme those that grip the individual printing plate from the light-proof magazine automatically, remove the separating paper, and, after exposure, pass the plate *inline* to plate developing. Many devices with "*autoloading*" operate from several cassettes, in which various plate formats, models or films can be loaded. The "Platesetter 3244" system, for example, , can be loaded with aluminum plates in one cassette and with polyester printing plates in the other. After leaving the platesetter, a diverter routes the plates into the corresponding plate processor (plate development).

Fig. 4.3-17
Workflow with computer to plate



CTP Machine:

Components of a computer-to-plate system include a raster image processor, or RIP; aplate-holding area; systems for slip sheet removal, punching, and loading and unloading plates; a platesetter; and a post-processing system.

DIGITAL FRONT END OR RASTER IMAGE PROCESSOR

The DFE, or RIP, prepares a screened believe bitmap for each color separation, which drives the imaging system to image each plate.

UNIMAGED PLATE-HOLDING AREA

Plates are stored in a light-tight loading area, usually in special cassettes; although, some plate suppliers will offer packaging that does not require re-handling of plates. If the automatic plate-handling option is not selected, the plate setter must be installed in a darkroom if light-sensitive plates are used. New thermal plates require yellow light conditions or may operate in daylight.

SLIP SHEET REMOVAL

Automatic systems must deal with slip sheets. All of them have developed approaches that sense the difference between the slip sheet and the aluminum plate and thus can deal with the sheet and then select the plate. Automatic plate handling contributes to overall productivity. Plates supplied come with intend between each plate.

PLATE-LOADING MECHANISM

A mechanical system must sense the interleaf sheet and remove it, then “grab” the plate and transport it to the plate-imaging area. Usually some sort of suction system is used.

PUNCHING MECHANISM

There is still debate over whether to punch the plate before or after exposure. It usually cannot be done in the imaging area because of the delicacy of the optics.

PLATE-IMAGING AREA

Your selection of a platesetter will depend upon the size of plates you want to expose using CTP, but generally speaking, the larger the format and the higher the resolution required, the more money it is going to cost. We can categorize systems as:

- 66X82 inches very large format
- 55X67 inches large format
- 41X52 inches format.
- 32X42 inches format.
- 22X28 inches format

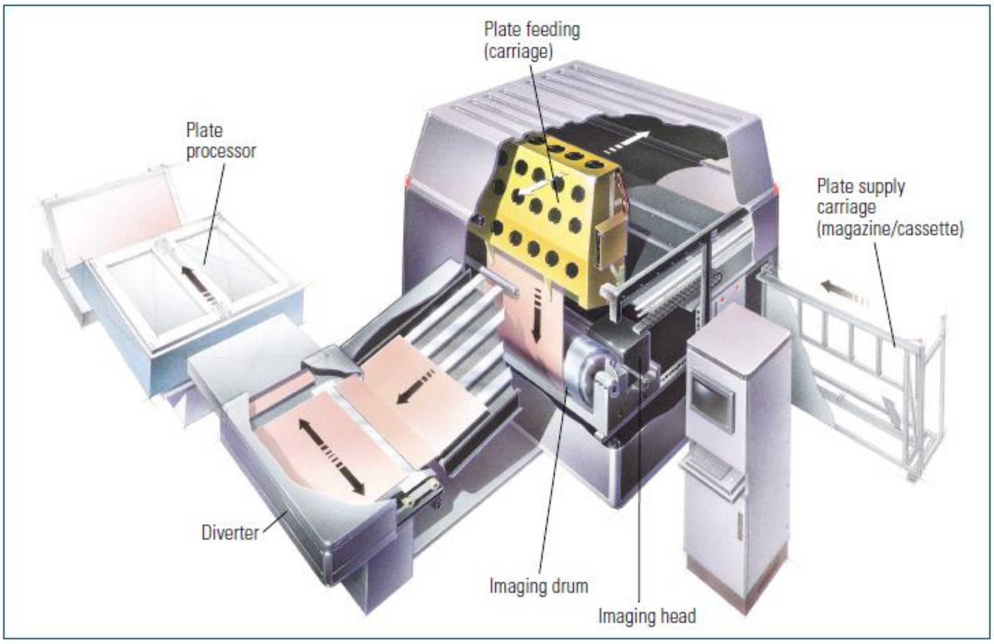


Fig. 4.3-18 Diagram of a fully automated computer to plate system (Platesetter 3244, Heidelberg/Creo)

Advantages:

- *work time* can be reduced considerably, depending on the complexity of the elements.
- *Productivity* in the prepress area is thereby increased;
- There is a *saving in materials* (base material, copy and print control strips, adhesive strips, intermediate film).
- Preparation of film is not necessary.
- With repeating imposition patterns, in particular with *repeat jobs*, the imposition data is available and can be called up at the touch of one button.
- *Operators learn* to handle digital data and digital methods of production in general, and gather experience for use later
- If needed, *proofs* can be produced using analog equipment
- The *plate copy* requires less time.
- There are even advantages in time and quality at the *printing press*.

<u>Types of Computer to Plate Systems:</u>

There are three types of computer-to-plate systems currently in use:

- Plates or image carriers for gravure and flexography on which the images can be produced by etching with high-powered lasers or electromechanical engraving devices.

- High-speed light-sensitive plates for offset with coatings that have light sensitivities on the order of film and that can be exposed with low-power visible lasers.
- Non-light-sensitive plates for offset with coatings on which images can be produced by heat (infrared) radiation rather than light.

Different Configuration of CTPs:

Design Principles:

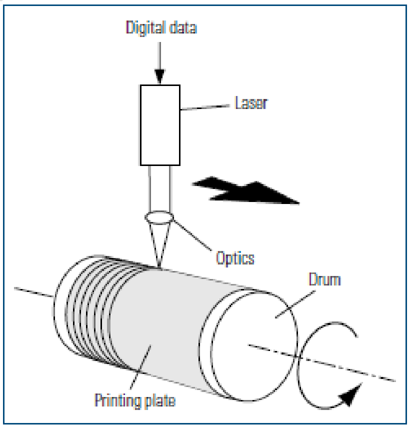
There are three major design principles for the design of plate imagesetters: internal drum, external drum, and flat-bed imagesetters.

External Drum Design:

The plate is mounted on a drum, on the same basic principle as with the plate cylinder of a printing press. The imaging head focuses one or more laser beams on the plate surface. The imaging head moves along the axis of the drum while the drum rotates. Feed may be continuous, so that one individual laser beam writes one sweep, or in stages if the gap (the area of the drum in which the clamping device is located, not the plate) rotates past the imaging head.

The crucial advantage of the external drum method over the internal drum imaging method is that both structurally and optically it is relatively easy to focus several laser beams on the plate surface simultaneously. This leads to a corresponding reduction in imaging time for the entire plate. The imaging heads of the Canadian company Creo, for example, operate with about 240 parallel, independently controlled beams the imaging head moves along the entire axial length of the drum.

This is quite different from the carrier bar design with separate laser diodes arranged at intervals (e.g., Presstek about 20 mm apart). The carrier bar is nearly as long as the drum and only needs to be moved within the distance of the laser diodes. This principle is also applied in the computer to press/direct imaging system “Quickmaster DI”.



Design principle of an external drum plate imagesetter:

The printing plate is mounted on the drum

Internal drum	External drum
Stationary printing plate	Rotating printing plate (risk of unbalance, centrifugal forces)
Punch can be integrated in the drum	Easy plate handling (as with plate cylinder in the printing unit)
One laser beam (several laser beams with more recent developments) for the complete plate: – uniform beam intensity throughout – longer imaging time – very short radiation time per pixel → greater accuracy, with thermal plates less loss of energy	A large number of parallel laser beams (e.g., 200) possible: – risk of uneven beam intensity – shorter imaging time
Large optical depths of focus	Optics very close to the plate, short optical path

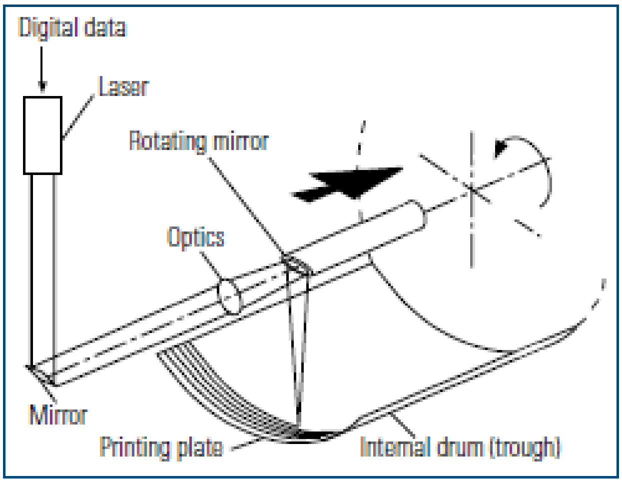
Characteristics of internal and external drum plate imagesetters

Internal Drum Design:

The internal drum concept derives from the design of film imagesetters. The printing plate is placed in a cylindrical trough. Most devices use angles greater than 180°. There is a rotating mirror on the geometrical axis of the internal drum/trough. The laser beam is reflected into the axis of the drum and deflected by the rotating mirror onto the plate surface, which it scans in a circumferential direction. The optics with the rotating mirror move slowly in an axial direction.

The rotating mirror rotates very fast: the number of rotations may be more than 40000 rpm (revolutions per minute). Some manufacturers who have decided in favor of the internal drum principle construct the trough with a granite base, so that it is as solid, geometrically stable, and vibration-proof as possible. The plate support is usually fixed in position.

In one of the first computer to plate systems from Krause-Biagosch (former Hope) the entire trough with the printing plate was moved in a direction parallel to the axis, while the imaging optics was fixed in an axial direction. The Gerber Company, now Barco, should be mentioned as a pioneer of internal drum technology. It is more difficult to work with several beams in parallel using the internal drum method. But there are even solutions to this. In 1997 the CtP system "XPose!" was introduced by Lüscher. In this system there are sixtyfour laser diodes in the rotating module. This array ofdiodes is close to the plate surface. Deflecting mirrors are not necessary. There is fast contactless image data transfer, the data being transferred to the rotating imaging head. (Other multibeam concepts are demonstrated by Fuji Film, ECRM, and Cymbolic Sciences).



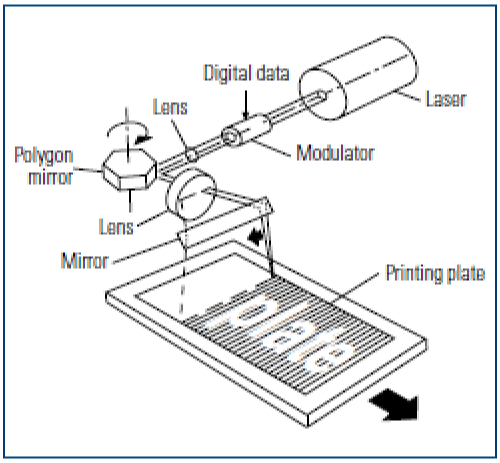
Design principle of an internal drum plate imagesetter:

The printing plate is held in a concave cylindrical support

Flat-Bed Design:

In the flat-bed concept, the printing plate is held flat on a level base during the imaging process. In the simplest and most commonly used example of imaging technology, the laser beam is deflected line by line across the plate by a rotating polygon mirror with imaging and correction optics. Here, the problem arises that in spite of the complicated optics, the laser dot at the edges of the plate is of a different geometry than that in the center area of the plate (the projection is less sharp and round). Because of this optical distortion, which increases with the format, flat-bed imagers are more suitable for smaller formats and less stringent quality requirements (e.g., in newspaper printing). However, developments in this direction are in progress.

A great advantage of the flat-bed method is the very easy handling of the plate. High-quality devices that use the flat-bed method are therefore fitted with several special imaging heads working in parallel (e.g., “LithoSetter” from Barco) or they have an imaging head that moves across the plate in several consecutive strips (“Titan 582 Combination Platesetter” from ICG). There is a relatively high number of flat-bed systems in the 50 cm x 70 cm format range and in newspaper printing. The ease of plate handling makes this method particularly favorable for newspapers, because a high throughput, and consequently a short production time, is particularly important here.



Design principle of a flat-bed plate imagesetter: The printing plate is held on a flat table

5.2 PDF Workflow:

The PostScript page description language is closely related to the Portable Document Format, PDF. This format is primarily used to describe documents. While PostScript constitutes a complete programming language like BASIC or FORTRAN with which the programmer can write application programs, the so-called "Portable Document Format" (PDF) is a data format, comparable with EPS or any other outline-based data format.

PDF is mostly based on the imaging primitives of the PostScript language and is also suitable for the description of a document page. PDF can also include additional information regarding the document page, for example to link its contents to other parts of the document. A PDF file is superior to an EPS file in many respects. It can contain fonts, graphics, printing instructions, special keywords for search and index functions, "job tickets," interactive links (hyperlinks), video clips, and much more. Contrary to PostScript, a PDF document stores each page of a publication separately. This means that the file need not be completely interpreted in order to print or display the contents of a page.

A PDF file is actually a PostScript file that has been interpreted in an RIP and divided into clearly separated objects. These objects can be represented on the screen, and not simply in their ASCII code, as in a Post- Script file. Since PDF files have already been RIPPING, they can ensure a far more reliable result when printing or imaging. Additionally, the user can display and check the file after the interpretation, as well as before the output of the file onto the printer or the Imagesetter. To speed up the interpretative process for fast printing systems, Adobe's "Extreme" converts each PostScript file into PDF for later output in parallel interpretation processes.

PDF Workflow:

In a PDF workflow, the PDF file is used to create the film or plates needed by the print production facility. The PDF file contains all of the necessary information, such as the fonts, graphics, images, text, and document layout. No further prepress steps remain to be completed by the production department. Portable document software typically saves a document bitmap, the ASCII text, and the font data. Even with compression, most PDF files may be many times larger than the native file. The PDF file format allows incorporation of an extended job ticket. An extended job ticket is an electronic document that contains all the instructions required for processing a job. It includes customer information, proofing directives, trapping, imposition and ripping parameters, and even finishing and shipping instructions. The job ticket specifications can be easily viewed and modified by everyone who has access to the file. The PDF file is practically an ideal preflighting tool. If all the necessary elements are not present at the time of file creation, the user is warned. PDF files also provide a single file for viewing, distributing, archiving, editing, and printing small file sizes, and a built-in preview. PDF files can access many types of files including EPS, TIFF, PICT, QuarkXPressR, PageMakerR, and PostScriptR from applications on both MacintoshR and PC platforms.

Job Definition Format:

Job Definition Format (JDF) is a technical standard being developed by the graphic arts industry to facilitate cross-vendor workflow implementations of the application domain. It is an XML format about job ticket, message description, and message interchange. JDF is presently managed by CIP4, the International Cooperation for the Integration of Processes in Prepress, Press and Postpress Organization. JDF was initiated by Adobe Systems, Agfa, Heidelberg and MAN Roland in 1999 but handed over to CIP3 at Drupa 2000. CIP3 then renamed itself to CIP4.

The initial focus was on sheetfed offset and digital print workflow, but has been expanded to web (roll)-fed systems, newspaper workflows and packaging and label workflows.

The goal of CIP4 and the JDF format is to encompass the whole life cycle of a print and cross-media job, including device automation, management data collection and job-floor mechanical production process, including even such things as bindery, assembly of finished products on pallets.

The JDF is an industry standard designed to simplify information exchange between different applications and systems in and around the graphic arts industry. To that end, JDF builds on and extends beyond pre-existing partial solutions, such as CIP3's Print Production Format (PPF) and Adobe Systems' Portable Job Ticket Format (PJTF). It also enables the integration of commercial and planning applications into the technical workflow. JDF joins the growing number of standards based on XML, ensuring maximum possible portability between different platforms and ready interaction with Internet-based systems.

JDF is a comprehensive XML-based file format and proposed industry standard for end-to-end job ticket specifications combined with a message description standard and message interchange protocol.

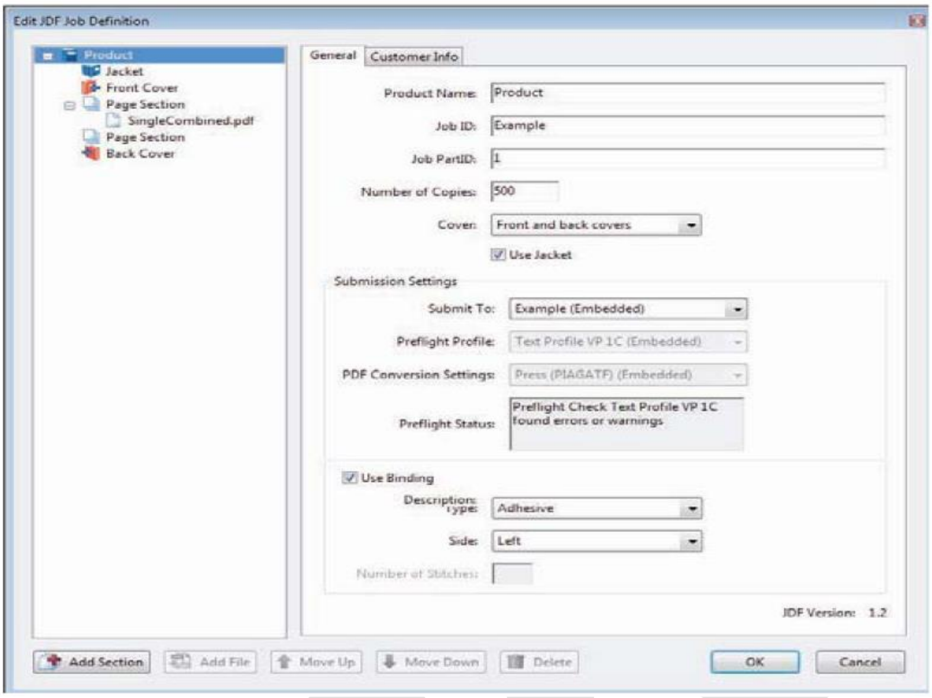
- JDF is designed to streamline information exchange between different applications and systems.
- JDF is intended to enable the entire industry, including media, design, graphic arts, and on-demand and e-commerce companies, to implement and work with individual workflow solutions.
- JDF will allow integration of heterogeneous products from diverse vendors to create seamless workflow solutions.

The most prominent features of JDF are:

1. Ability to carry a print job from genesis through completion. This includes a detailed description of the creative, prepress, press, postpress and delivery processes.
2. Ability to bridge the communication gap between production and Management Information Services (MIS). This ability enables instantaneous job and device tracking as well as detailed pre- and post-calculation of jobs in the graphic arts.
3. Ability to bridge the gap between the customer's view of product and the manufacturing process by defining a process-independent product view as well as a process-dependent production view of a print job.
4. Ability to define and track any user-defined workflow without constraints on the supported workflow models. This includes serial, parallel, overlapping, and iterative processing in arbitrary combinations and over distributed locations.
5. Ability to do so (1, 2, 3, and 4) under nearly any precondition.

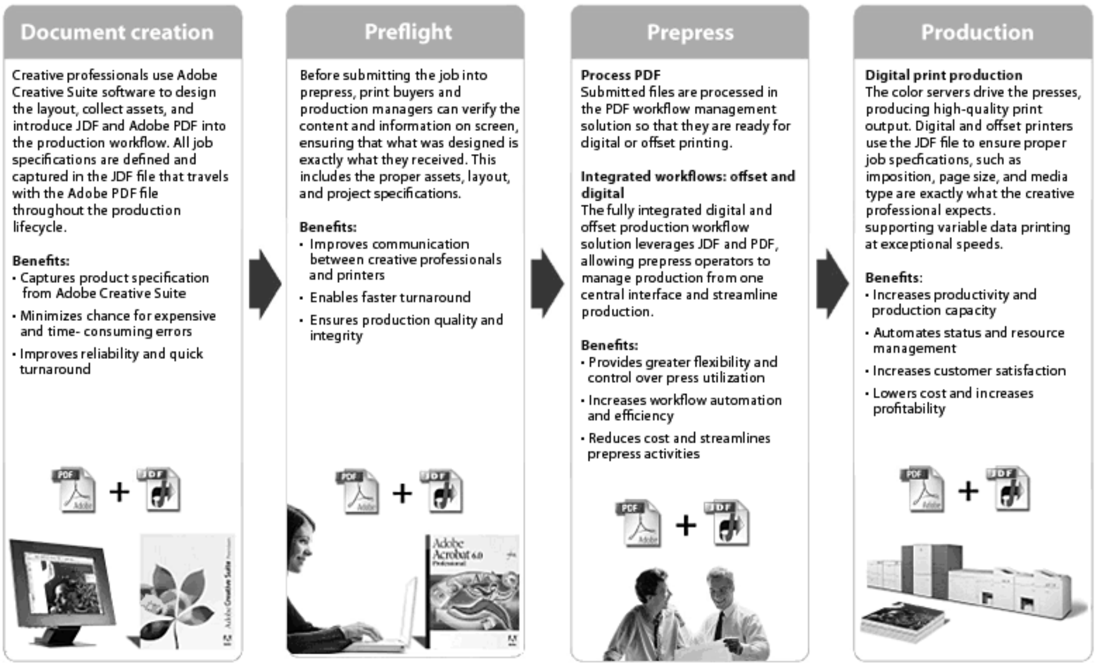
JDF files are similar to an embedded electronic job ticket, in that they can contain information on the document designer, fonts used, images contained, stock type and size, ink colors, bindery instructions, and other static data. In addition, the file may contain instructions for JDF-enabled devices used in the production process, including ink fountain settings on a press and the configuration of bindery equipment.

Throughout the production process, the information and instructions contained in a JDF file may be manually amended to allow for adjustments or additions, such as completion dates, delivery schedules, and client contact information. This technology expedites production, reduces errors that occur in the processes, and automates the workflow of print production. Other workflow solutions that are designed to optimize print manufacturing processes include Kodak Prinergy™, Agfa: Apogee Suite, HeidelbergR PrinectR, and EFI OneFlowR.



A job ticket contains several files, which allow the operator to access customer information, specific page data, processing details, and finishing specifications

Job Definition Format workflow:



Pre-flight (printing):

Pre-flighting is a term used in the printing industry to describe the process of confirming that the digital files required for the printing process are all present, valid, correctly formatted, and of the desired type.

Background:

In a common digital prepress workflow, a collection of computer files provided by clients will be translated from an application-specific format such as Adobe InDesign or QuarkXPress to a format that the raster image processor (RIP) can interpret. But before this rasterization occurs, workers in the prepress department confirm the incoming materials to make sure they are ready to be sent to the RIP. This is an important step because it prevents production delays caused by missing materials or improperly prepared materials. Once the incoming materials have passed the pre-flight check, they are ready to be put into production and sent to the RIP.

These intermediate formats are commonly called page description languages (two common PDLs are Adobe PostScript and Hewlett-Packard PCL). The RIP prepares the final raster image that will be printed directly (as in desktop inkjet or laser printing), set to photographic film or paper (using an imagesetter), or transferred direct-to-plate.

Depending on the hardware and software components and configurations, RIPs have unique problems rasterizing the image data contained in a PDL file. If there is a failure in rasterizing the image, it can be costly, as imagesetters, direct-to-plate systems, and high-end inkjet printers can consume expensive supplies, can require extensive amounts of time to process complex image data, and require skilled labor to operate.

The pre-flight process:

The process of pre-flighting a print job helps reduce the likelihood of rasterization problems that cause production delays. Page layout software applications, (which allow users to combine images, graphics, and text from a variety of formats,) automate portions of the pre-flight process. Typically, client provided materials are verified by a pre-flight operator for completeness and to confirm the incoming materials meet the production requirements. The pre-flight process checks for:

- images and graphics embedded by the client have been provided and are available to the application
- fonts are accessible to the system
- fonts are not corrupt
- fonts are in a compatible format
- image files are of formats that the application can process

- image files are of the correct color format (some RIPs have problems processing RGB images, for example)
- image files are of the correct resolution
- required color profiles are included
- image files are not corrupt
- confirm that the page layout document size, margins, bleeds, marks and page information all fit within the constraints of the output device and match the client specifications
- confirm that the correct colour separations or ink plates are being output

Other, more advanced pre-flight steps might also include:

- removing non-printing data, such as non-printing objects, hidden objects, objects outside the printable area and objects on layers below
- flattening transparent objects into a single opaque object
- converting fonts to paths
- gathering embedded image and graphic files to one location accessible to the system
- compressing files into an archive format

The specifics of what checks are made is governed by the features of the pre-flight application, the formats of the client provided files, and the targeted output device as well as the printing specifications.

A purpose-built software application is not required to pre-flight a file, although several commercial applications are available. Small shops may use an inexpensive laser printer to test whether or not their file will print. The conversion to Portable Document Format (PDF) can reveal problems, and can in some circumstances be considered a pre-flight process.

Preflight Check:

So-called "*preflight checkers"* represent a special version of proofing. To avoid the risk of incorrect imaging, above all of PostScript files, preflight checkers carry out a consistency inspection of the files prior to forwarding them to production. Missing type and defective files, which could lead to incorrect imaging or a system crash, are recognized early in this way. The importance of preflight checkers is likely to increase with the growing complexity of the modern data formats. Some software products falling under this category have the function of interpreting PostScript files with a complex structure and converting them into simple "Postscript data, which, in the majority of cases, can be processed quickly and reliably in any RIP software. Preflight checking has become a special service function for contractors of numerous operations in the graphic arts industry and has also become successful in business models as an additional business for the benefit of all parties (checking the data of the contractor and, if necessary, correcting instead of sending back).

Pre-flight checking:

Pre-flighting can either be done manually, ticking off the various stages from a printed form or it can be done by the computer, using commercially available software. There are benefits in both methods.

Manual pre-flighting:

One of the benefits of preparing your own pre-flight routines is that they can be customized to your own product, workflow and suppliers. All prepress houses will supply a list of instructions as to how they would like files delivered. Some of these lists are very comprehensive and are virtually complete pre-flight instructions. Others are less exhaustive but nevertheless are a useful foundation on which to build your own. The important thing to remember when you are setting up your own routines is that you are not working in a vacuum. The whole reason for needing pre-flight checking is that your work is going to be passed to someone else who needs to understand your requirements efficiently and unambiguously. The development of your routines should be a cooperative process drawing on the input of all people in the workflow.

Software pre-flighting:

The use of dedicated software as a pre-flighting tool has the advantage over manual pre-flighting in that it can be left to work on its own. It will open the files and check that it has been put together properly, that the colours are correctly defined and that all the elements which the page/design demands are available to it. Pre-flighting software can be quite expensive, but in comparison with the time (and money) wasted by sending out incomplete files or, say, not recognizing that a font was substituted until checking the press running sheets, its purchase should not be difficult to justify. However, software checking is not usually sufficient on its own.

Because, there are elements outside the data file which are important too. Pre-flighting is so important to the smooth running of a digital workflow that routines combining both manual and software checking should be installed and *all* work should pass through them before being passed on to the next stage of production.

Lasers:

Laser light is the concentrated light beam of only one wavelength, while regular light is emitted at many different wavelengths. The word "LASER" is actually an acronym for "Light Amplification by Stimulated Emission of Radiation".

Laser light is coherent, monochromatic, and directional, meaning that the photons emitted by the laser are traveling in coordination, the light is of one color, and the light is concentrated and travels in a tight beam (whereas normal light sources release light that travels in many directions). Laser light is concentrated with the use of concave mirrors that bounce the light between them to create a single beam, which is focused onto an object.

Laser Light Wavelengths

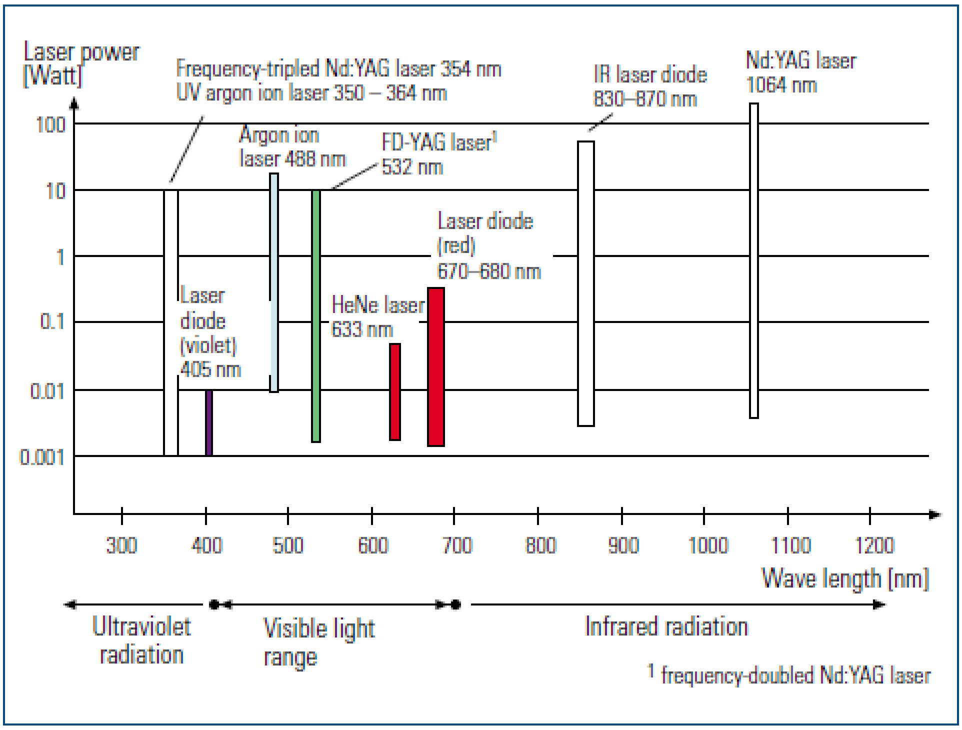


***Fig. 4.3-8** Laser sources for use in computer to plate systems with their wavelengths and power ranges (approximate values)*

Laser Components

All lasers have three basic components: A *pumping source*, a *lasing medium*, and a *resonator*.

- Pumping Source: a device that feeds the energy to the laser.
- Lasing Medium: an active medium that is able to absorb the energy from the pumping source and re-emit the energy as laser light.
- Resonator: a device, such as a set of mirrors, that amplifies the light to produce the laser beam.

Laser Imaging

Laser technology is used for imaging in most computer to plate systems. Outputs in excess of 1 watt per beam may be necessary, depending on the type of plate used and the design method applied. This relatively high power is needed, because the laser beam only has an affect on an individual dot on the plate for a few microseconds at a high imaging speed, and therefore has only a short time in which to produce the desired effects.

Laser Types

A laser is usually described by the type of lasing medium that is used. Described below, are the mediums that are most often used for lasers.

Gas Lasers

Gas lasers use gases, such as helium or helium and neon, as the lasing material. Some common gas lasers include helium-neon lasers, argon-ion lasers, and carbon dioxide lasers. *Gas lasers* (argon-ion or helium-neon) are found in all design types (external and internal drum, flat-bed)

Liquid Lasers

Fluorescent organic dyes in a liquid suspension are used as the lasing material for liquid lasers. This type of laser is also known as a dye laser.

Solid State Lasers

Solid State lasers have lasing material distributed in a solid substance and are often pumped by diodes, which produce either flashes of light (pulsed energy) or continuous light.

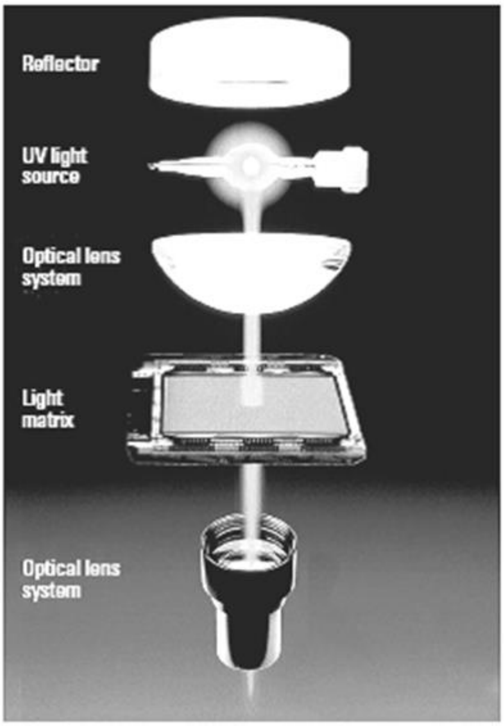
Solid-state lasers of a smaller structure are being used increasingly instead of large gas lasers, especially those made from Neodymium (Nd): YAG (YAG yttrium aluminum garnet). The YAG crystal is doped with optically effective Nd atoms. Nd:YAG lasers emit radiation with a wavelength of 1064 nm. By doubling the frequency, this radiation can be transformed from the infrared range to the visible green range (532 nm), and by trebling the frequency it can even be transformed into the UV range. Because of this frequency doubling, the abbreviation FD-YAG is often used for the frequency doubled Nd:YAG lasers. Nd:YAG lasers are currently the most commonly used solid-state lasers (not only in the printing industry). They offer good optical quality and can cover a power range from a few milliwatts to some 100 watts at an acceptable price/performance ratio

Semiconductor Lasers

Also known as diode lasers, semiconductor lasers use low power and generate light from the interaction between a positive and negative junction of various semiconductor materials.

Laser diodes are more economically efficient than gas and solid-state lasers, and they also have a longer life cycle. Red light laser diodes are particularly economical and common (630 and 670 nm). They have a life cycle of two to four years. Thermal laser diodes (e.g., wavelength of 830 nm) can operate at considerably higher power, such as is needed for thermal-sensitive plates.

Laser Imaging with UV Light



Design of the "Digital Screen Imaging (DSI)" system for computer to plate systems for the exposure of conventional UV-sensitive printing plates (basysPrint)

Digital imaging of conventional UV-sensitive plates is also possible. BasysPrint, for example, has developed the so-called "Digital Screen Imaging (DSI) process" for this purpose. The light originating from a strong UV lamp is, for example, directed onto a digitally controllable, two-dimensional light matrix, which consists of about 500 x 500 separate LCD elements (LCD Liquid Crystal Display–light valve matrix). They can be controlled individually, thus letting light pass through or blocking it out. As a result of this, a pixel-form image is produced from the light matrix, which is projected in the same way as with a projector, through the optics and onto the printing plate. An exposure operation always images only part of an entire plate, a square with side lengths of about 0.3 to 2.5 cm, depending on the resolution selected. An accurate drive system and a positioning mechanism make provision for the exact assembly of the partial images. They move the imaging head over the printing plate in stages. The plate imagesetter is designed on the basis of the flat-bed concept. In 1997, the company Purup-Eskofot also introduced a plate imagesetter for UV-sensitive plates. The "Mografo" plate imagesetter can expose plates with a format of up to 1850 mm x 1300 mm and uses a UV argon- ion laser with a wavelength of 351 nm.

CTP Violet & Thermal:

Characteristics	CTP Violet	CTP Thermal
Quality	Not capable of producing ultra-high quality with line screens exceeding 300 lpi	capable of producing ultra-high quality with line screens exceeding 300 lpi

Plate base	Silver/photopolymer-based plate	Recent advances in photopolymer-based plate
Throughput	Generally faster, lower the resolution that is required, the faster the machine will image.	However, new technologies such as laser power, expanded quantity of diodes, are providing considerable improvement in the throughput of thermal platesetters.
Maintenance Requirements	maintenance cost will be considerably lower	Cost will be higher
	Lasers are less expensive to replace, they are longer lived	multiple diodes that may at some point require replacement, or in some cases, multiple diodes that cannot be replaced individually as they are contained in a single very expensive head
	maintenance of the plate clamps and registration punch are lower	maintenance of the plate clamps and registration punch are higher
Applications	The violet laser diode is used on account of durability and characteristics in the DVD technology. That's the reason why they are enormously inexpensive. Since 2000 it also be used in CTP systems. From the low power output of 120 mW (enough for exposing violet plates) of the violet laser diode there results a long operation period of approximately 5,000 to 10,000 working hours. An exchange of the laser diode costs about 5,000 to 10,000 EUR. The laser diode in most systems working longer than the whole operation time. All systems work with a single laser diode	The infrared laser diode is used for over ten years in CTP thermal systems. It was already at that time a very inexpensive alternative to other laser diodes, solid state- and gas lasers. It has on account of its high power output a relatively short lived operation period with approximately 3,000 working hours. An exchange of an infrared laser diode costs about 20,000 to 35,000 EUR. According to plate output an exchange of the laser diode is necessary after two to four years. It's more complicated if the CTP system is working with many (for example 16) laser diode units.
CTP working Principle	**chemistry** Systems with chemistry proc. in processor	**chemistry** Systems with chemistry proc. in processor

	unit **chem free** Systems with cleaning in cleanout-units	unit **chem free** Systems with cleaning in cleanout-units **chem free** Systems with cleaning in printing press **process free** Ablation systems (cleaning with air or water)
Costs & Investment costs	Investment costs (according to format size, automation and software applicatons of CTP system): **40,000 to 110,000 EUR**	Investment costs (according to format size, automation and software applicatons of CTP system): **65,000 to 150,000 EUR**
Maintenance/service	Accord. to system, construction and type, **low to moderate**	According to system, construction and type, **moderate to high**
Metal printing plates **Chemistry/Cleaner**	**7 to 12 EUR/m²**, free choice of printing plate and supplier about **15 to 60 Cents/plate** (incl. waste disposal)	**10 to 16 EUR/m²**, partly dependent on one plate/supplier about **0 to 60 Cents/plate** (incl. waste disposal) or **none**
Handling	**under yellow safe-light** (plates are light sensitive)	**in day-light** (plates are not light sensitive)
Processing stability	The violet printing plates are advancements of the conventional types of printing plates. The processing and tone values are stable und reproducible if all parameters are in tolerances.	Thermal plates, processing in a processor unit, are based on »digital« copy layers. That allows very stable tone values and processing. However, in chem free techn., especially by washing out in printing press, it could lead to fluctuating results.
Characteristics **in printing**	Very good printing characteristics in the printing machine like conventional plates, chemistry-resistant, abrasion-resistant, suituable for UV inks.	Sensitive plate over layer, partly other printing chemicals are necessary, partly suituable for UV inks (only chemistry plates)
Printing quality	Fine screening possible (according to plate and system) **2 to 98 % at 80 lines/cm**, until 100 l/cm	Very fine screening possible (according to plate and system) **1 to 99 % at 80 lines/cm**, until 160 l/cm

	FM screening of about 20 µm	FM screening of about 10 µm
Running length	**chemistry** Systems about **250,000** (1,000,000 baked) **chem free** Systems about **100,000**	**chemistry** Systems about **200,000** (1,000,000 baked) **chem free** Systems about **100,000** **process free** Ablation systems about **20,000 to 50,000**
Ecological aspects	Used developing chemicals are decontaminated, clean out solutions are also decontaminated partly. The chemistry of the outdated silver technology is extremely environment unfriendly and, hence, is not offered any more.	Used developing chemicals are decontaminated, clean out solutions are also decontaminated partly. Process free Ablation systems are very ecologically friendly, nevertheless, they also can be very unhealthy.

5.4 Printing plates for digital imaging:

Special plates have had to be developed to use computer to plate for *offset* and *flexographic* printing. For *gravure* cylinders, on the other hand, there have been no changes to the printing plate, as long as engraving is done mechanically with digitally controlled styluses. However, laser engraving requires a material that can absorb the laser beams energy well.

For this application, zinc is used instead of copper. The usual polyester mesh can in most cases be used for stencils for *screen-printing*, and only the coating material had to be adapted to the requirements of an image application using ink jet or laser imaging. New inks and waxes have been specially developed for this.

Types of CtP plates:

Introduction:

CTP (computer to plate) imaging technology has a fundamental relation ship to digital plate technology. To characteristics of the different kinds of digital plate media affect the cost, performance and economic justification of imaging solutions.

Aluminium – Backed Digital Printing Plates:

There are at least four different kinds of aluminium- backed digital printing plate s available. The plates are separated according to the type of emulsion used. Each plate has specific advantages and disadvantages related to printing applications imaging requirements, Processing requirements and manufacturer.

- Silver Diffusion

- Photopolymer
- Hybrid
- Thermally sensitive

Plates Sensitive to Visible Light:

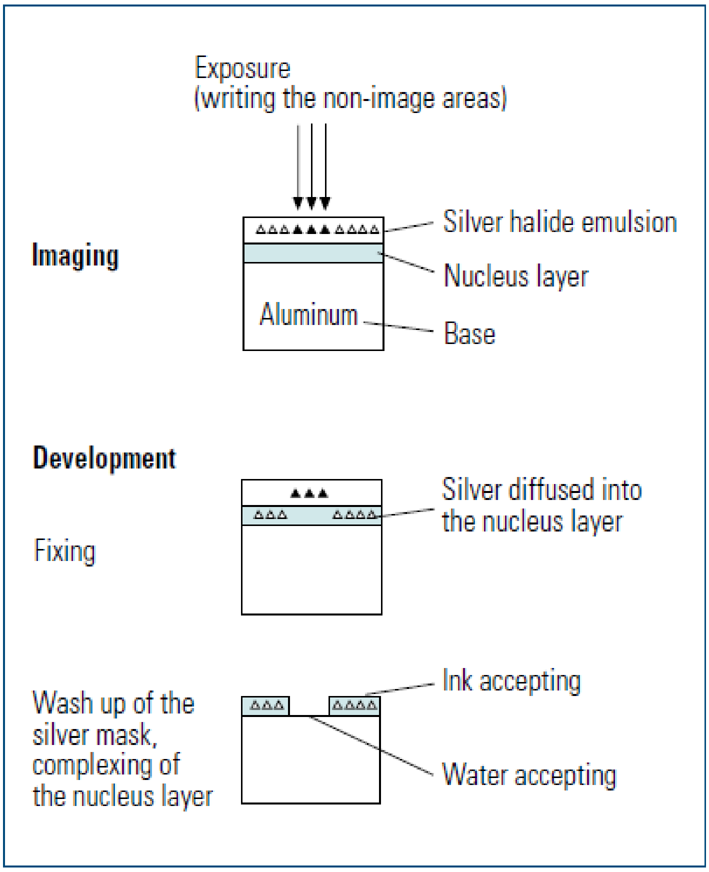
The most commonly used aluminium- backed digital printing plates are sensitive to exposure by light in the visible portion of the spectrum. Visible light sensitive plates were available long before those sensitive to thermal energy and they continue to dominate the digital plate market. The highest throughput CTP systems available are flat- field devices that support visible-light sensitive plates.

Plates with silver diffusion, photopolymer and hybrid emulsions are all sensitive to exposure by visible light. Specific plates with in these categories are sensitive to 488 nm (blue) light from argon-ion lasers, 532 nm(green) light from frequency-doubled YAG lasers, or 670 nm (visible red) light from laser diodes.

Silver halide plates:

Digital metal plates with silver diffusion emulsions are the most mature variety of digital plates available. Since their introduction in the early 1990s, they have built up the largest user base of all the digital printing plates.

The silver halide emulsion used on silver diffusion plates is very similar to the emulsion used in image setting film both rely on the photosensitivity of silver –based compounds and both react quickly too many field-proven laser light sources. The emulsion on a silver diffusion plate also features ink receptive characteristics that are necessary for lithographic printing during exposure the laser activates the silver halide particles in the emulsion. Following exposure a chemical processing step washes away the exposed silver particles and dissolves the unexposed particles which diffuse through a barrier layer and leave a silver-based image on the plate. This image which appears black attracts ink during the printing process. The portions of the plate exposed by the laser retain none of the emulsion and appear silver in color because of the exposed aluminum substrate. The grained aluminum surface attracts water during the printing process. Plants such as these; that carry ink on the unexposed portion of the plate, are known as positive working plates. This terminology comes from the analog plate making process in which a positive film is necessary to expose a plate with this characteristic.

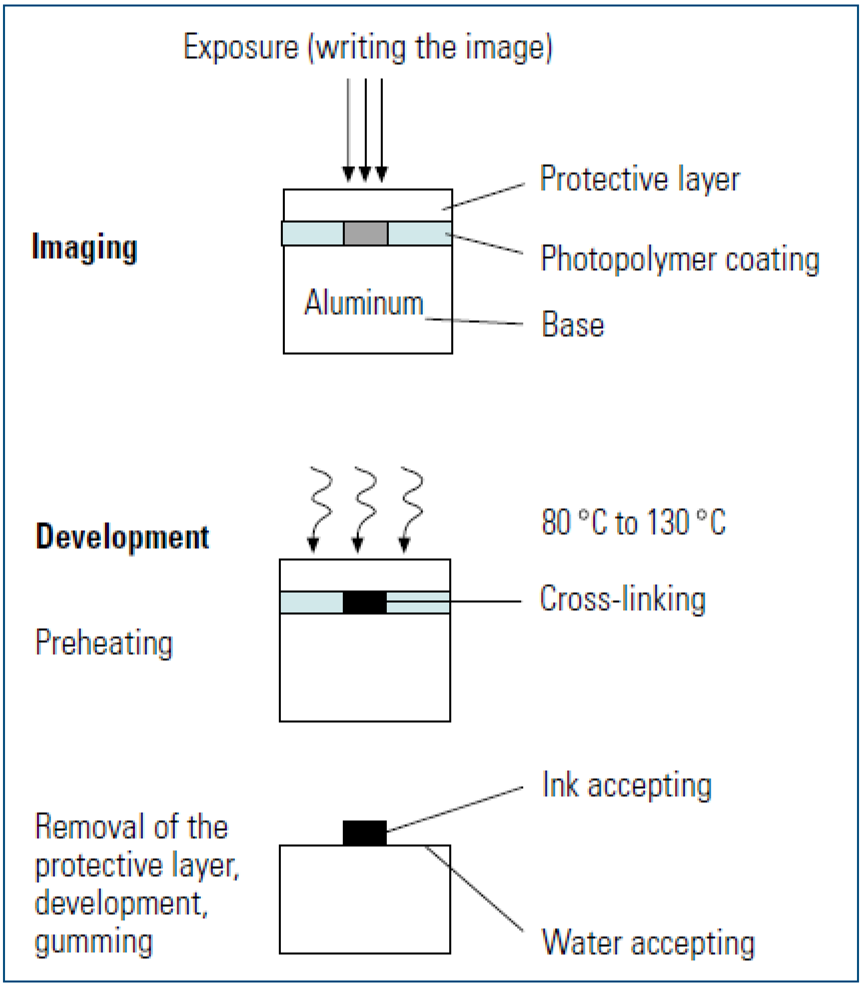


The imaging and developing of printing plates (aluminum-based) by diffusion transfer (imaging results in ink-repelling areas; positive working plate)

Silver diffusion plates have an extremely high resolution that allows them to hold screen rulings as high as 300 lpi , more than enough for virtually any application manufacturers of these plates specify run length of up to 1,000,000 impression and users report even longer runs. Since silver diffusion emulsions are more sensitive than the other emulsions used on digital metal printing plates, they usually require less laser power for exposure. Plates are available for CTP devices that use 488 nm blue lasers 533 nm FD-YAG lasers and 670 nm visible – red lasers. Silver diffusion plates require a chemical processing step as noted above silver recovery and chemical neutralizing are commonly necessary to make the processing more environmentally friendly.

Photopolymer:

The first commercially available digital metal printing plates had photopolymer emulsions. Continuing advancements in technology are allowing them to handle longer run-lengths and higher screen frequencies making them more competitive with silver diffusion plates. Photopolymer plates still don’t provide the resolution of some silver diffusion plates, but most can handle 200 lpi screens, which covers the majority of the printing market.



The imaging and developing of printing plates by photo polymerization

(Imaging results in ink-accepting areas; negative-working plate)

Unlike silver plates, photopolymer plates contain no silver instead their emulsions contain a light-sensitive plastic like substance called a photopolymer .when exposed with a laser individual photopolymer molecules with in the emulsion start bonding with one another. This causes the exposed portions of the emulsion to harden. Unexposed areas remain some what soft and soluble and wash away during processing. The hardened (expose) image on the plate attracts ink during the printing process. The unexposed areas attract water. Plates that carry ink on the exposed portions of the plate are called negative working plates since a negative film is necessary to expose such a plate in an analog work flow.

Because of the aqueous processor chemistry and the absence of silver in the waste stream use of photopolymer plates tends to reduce waste disposal issues. Silver recovery and liquid neutralizing stations are not a requirement and waste disposal regulation may be less restrictive. Run lengths for photopolymer plates vary between 200,000 and 2,000,000 impressions depending on the manufacturer and the technology some require a pre –

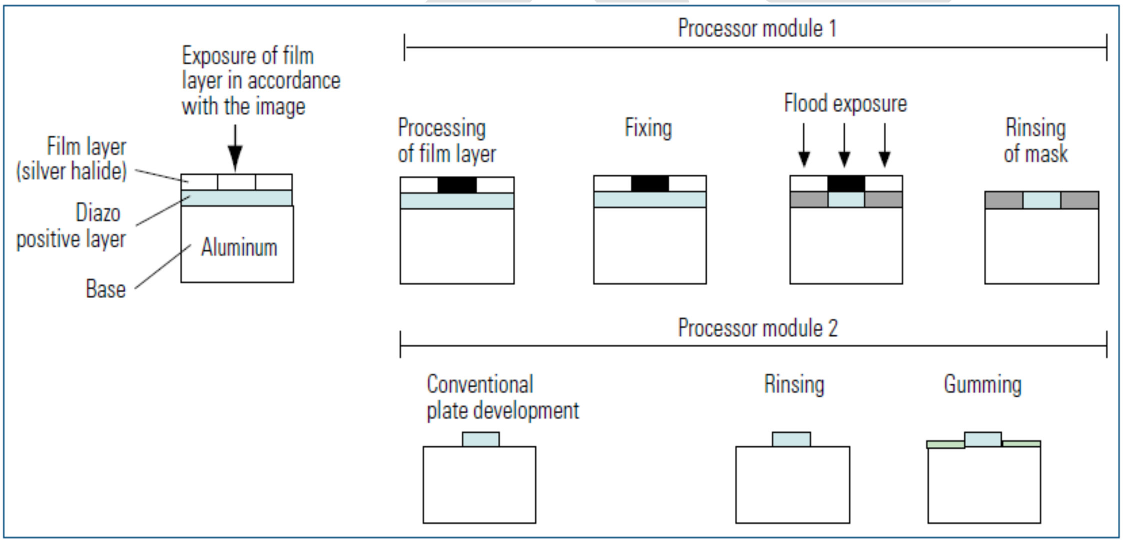
heating or baking step between the imaging and processing steps, to help harden the latent image on the plate. Other does not require pre-baking.

Photopolymer plates are available for 488 nm argon- ion lasers and 532 nm frequency – doubled YAG lasers. Although the spectral sensitivity of photopolymer plates is similar to that of some silver diffusion plates, the photo polymer plates require a higher laser intensity for proper exposure .

Hybrid:

Because one weak spot of the first generation of digital plates was their extreme exposure requirements some plates manufactures developed hybrid plates. Hybrid plates actually have two different emulsions. The bottom emulsions. The bottom emulsion is a conventional UV- sensitive photopolymer emulsion like those found on some analog plates. The top emulsion is very similar to a conventional film emulsion.

This emulsion reacts to the appropriate wavelength, or color of light, including light from Argon – Ion. Visible red, and infrared lasers diodes.



The imaging and developing of multi-layer printing plates (sandwich plates), For example, Polychrome CTX plates

To image a hybrid digital plate, the laser inside the plate setter exposes the top emulsion. The plate the passes into a relatively complex, multi – step processor necessary to process the multi – layer emulsion. The unexposed portion acts as a mask on top of the plate emulsion. This is similar to placing a piece of film on top of a conventional plate emulsion. The processor then scrubs off the mask layer and finishes the plate by processing the bottom (plate) emulsion. After completing the processing cycle, an optional baking step can help increase the run length of the plate.

Hybrid plates will hold screen rulings up to 200 lpi. Without a post – bake step, the plates have a run length of approximately 150,000 impressions. Baking will increase the run length to approximately 1,000,000 impressions.

Digital metal plates with hybrid emulsions are as well as a broad selection of spectral sensitivity. However, they also have the drawbacks of requiring complicated processing the produces two waste streams due to their dual emulsion. Developments in plate emulsions and imaging technologies have overcome most of the issues surrounding extreme exposure requirements. Together with the complex processing and waste disposal issues, this has limited the use of hybrid plates. Few, if any, new CTP installations are being set up for hybrid plates, and future plate availability may be questionable.

Thermal sensitive plates:

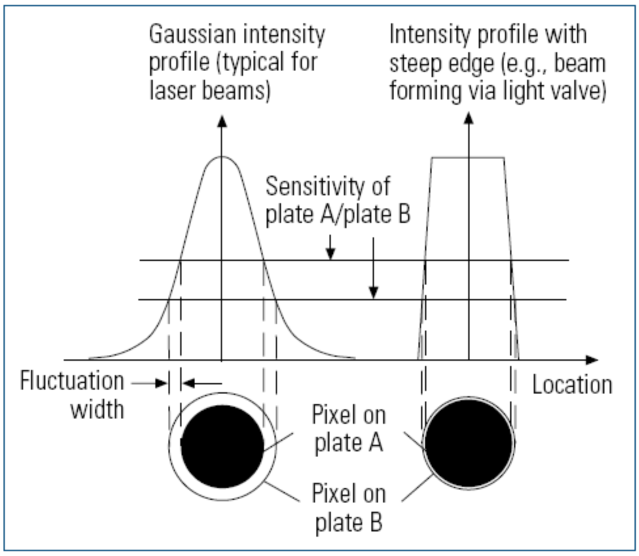
Digital metal plates with thermally sensitive emulsions continue to receive much attention in the trade press. Unlike most other imaging media, thermal plates are not sensitive to visible light. Instead, their emulsions react to thermal energy or heat. The specific reaction can vary from ablation (removal) to molecular bonding. As a result, the emulsions on these plates tend to be relatively insensitive to light, and to varying degrees lend themselves to UV - shielded light or daylight handling. Most thermal plates require fairly significant post imaging processing although one company offers plates that do not require processing. Some of these plates feature good resolution characteristics and are usable for long press runs, but some are subject to extremely short run lengths. Thermal plates typically have very slow emulsions that severely limit productivity.

The thermally sensitive plates include emulsions that are sensitive to 830 nm infrared laser diodes as well as 1064 nm YAG lasers. Some plate manufacturers like Agfa and Western Lithotech make separate plates for each frequency. Others, like Presstek and PDI make a single plate with a broad spectral sensitivity, allowing for exposure from either 830 nm infrared laser diodes or 1064 nm YAG lasers.

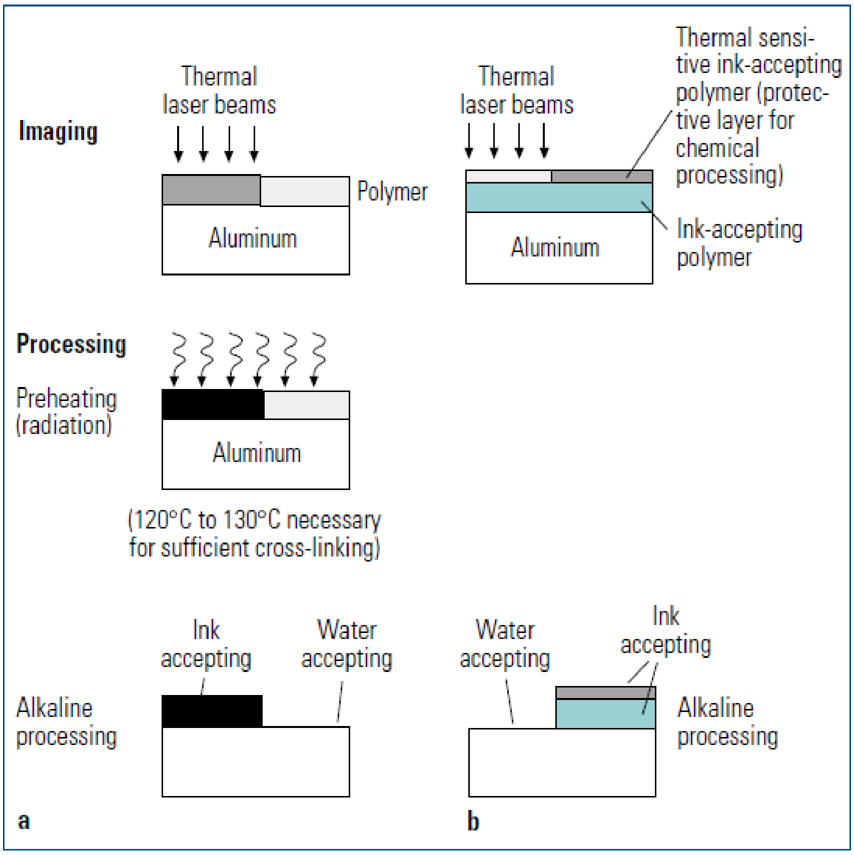
Thermal-sensitive plates were first introduced at DRUPA 95.They reacts not to visible light but to thermal radiation. They have a distinctive threshold characteristic during imaging: as soon as the thermal energy goes over a certain threshold during imaging, the surface changes completely, and any further increase in energy remains of insignificant effect with regard to dot quality. The danger of under or overexposure does not exist.

The beam profile of the light source (laser) is also important in connection with thermal plates. In addition to “Gaussian intensity profiles,” as being typical for many lasers there are also intensity profiles with steeper edges (e.g., imaging via light valves as, for example, implemented in the Heidelberg/Creo “Trendsetter” and elsewhere). Steeper edges produce a dot size with less fluctuation, which can occur as a function of the plate material (sensitivity, i.e., the threshold level) and light source (fluctuation in intensity).

Thermal-sensitive plates do not need a safelight because they are essentially insensitive to visible light. Among the first CtP plates of this type is Kodak's "Digital Plate/IR," which has a thermal-sensitive polymer coating. This coating is heated locally during imaging, in the course of which cross-linking is initiated. Complete cross-linking is accomplished by heating the entire plate to temperatures of about 125°C immediately after imaging. This so-called "preheating" process is followed by aqueous/alkaline developing.



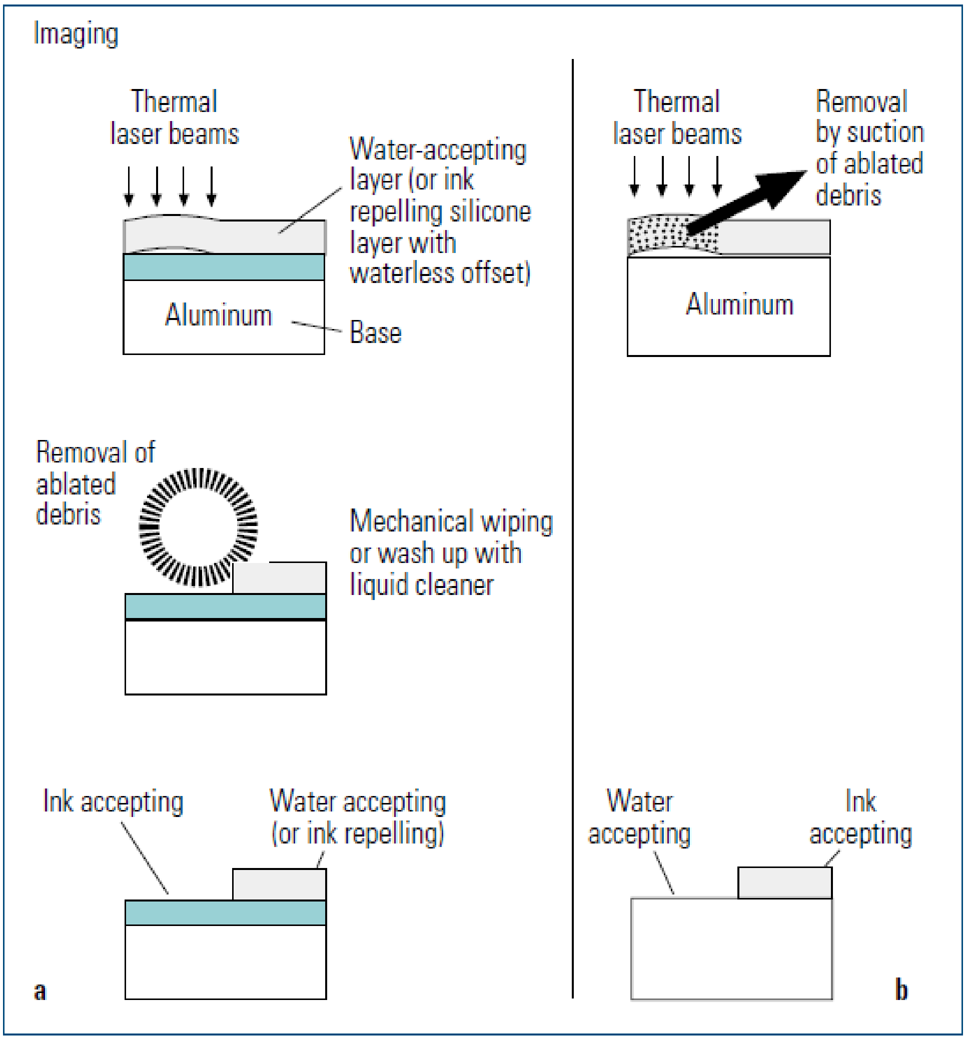
The edge steepness in the intensity characteristic of the light beam affects pixel sizes on the printing plate: steeper edges (on the right), for example, using light valves, produce less fluctuation in the pixel diameter In the event of different sensitivities of plates A and B



Technologies for thermal-sensitive plates with polymer coating for offset printing.

a Polymerization (cross-linking); b Thermal decomposition

Ablation means that the top layer of the plate being developed is removed under the effect of heat energy. Relatively high energy densities (approximately 500–1000 mJ/cm^2) are necessary for thermal plates working on the principle of ablation. Presstek first introduced plates using this method in 1993, initially for waterless offset. The “Pearldry” plate has an oleo phobic (ink-repellent) silicone coating on the surface, which is removed in the image areas by the thermal energy of the laser beam, so that the underlying surface of the ink-accepting plate coating is exposed. This plate is obtainable both with an aluminum and a polyester base.

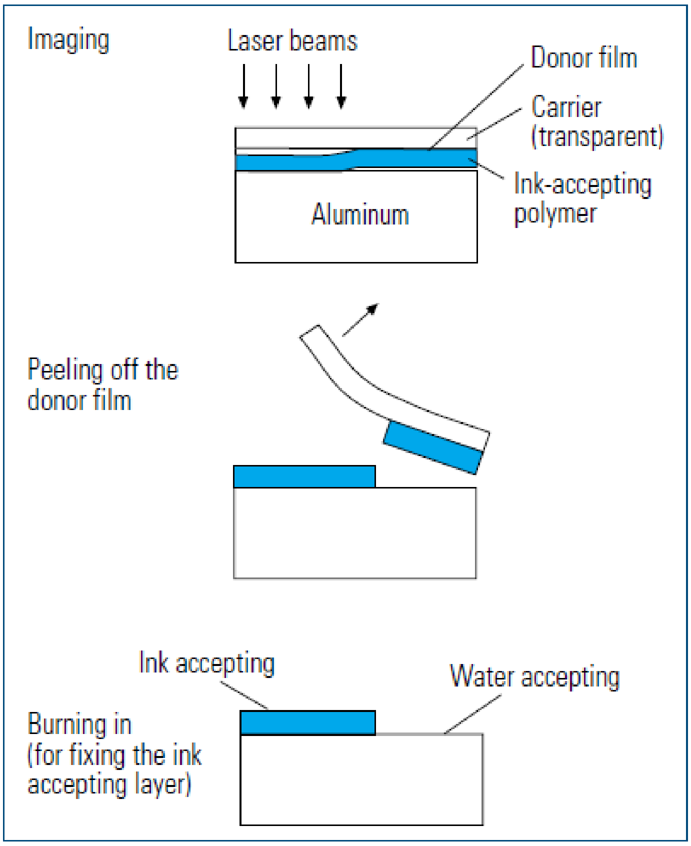


Ablative imaging technologies for offset printing plates (the absorbers for the thermal laser radiation are embedded in the top layer or in a layer beneath it, not shown here, depending on the plate technology used).

a. Cleaning after imaging b. Cleaning by suction during the imaging process

Presstek has also developed digital plates for conventional wet offset ("Pearlwet"). Already on the market is the second generation, the "Pearlgold," in which only a very thin layer is removed in accordance with the image.

It has an ink-accepting coating containing silver. With adequate removal by suction of the ablated (silver- containing) particles during imaging, no other separate cleaning operation is necessary. Unlike Presstek's "Pearl"plates, in this case those areas of the plate that are water-accepting during printing are irradiated by laser, so that the hydrophilic aluminum substrate is disclosed. For thermal-sensitive plates there is a trend towards *processless plates*, which no longer need chemical or "wet" developing. However, as long as ablation is the applied method (which means that particles are removed from the surface) cleaning the plates is necessary. Cleaning may possibly even be done in the printing press, if the plate has been mounted and imaged on the plate cylinder. Wiping off can be done by dampening rollers. This process is called *On Press Development* (*OPD*) and is familiar from analog plates, such as the Polaroid “DryTech Express”.



The principle of ablation transfer (LAT Laser Ablation Transfer) for the imaging of offset printing plates (Polaroid)

A donor film is mounted firmly on the aluminum plate. Ink-accepting polymers are transferred in accordance with the image from this donor film onto the plate. Incidentally, digital color screen proofs (true proofs) can also be produced using this technology, where colorants are transferred from the donor film (one color per film) to the production (job) paper. It must be expected that in the years ahead, some plate manufacturers will offer *completely process less plates*, in which material will not be removed by ablation, but rather, surface wet ability characteristics will be changed in accordance with the image. Process less plate is incorporated into with “Change of the surface property” and “Ablation transfer,” and technological differentiation is made.

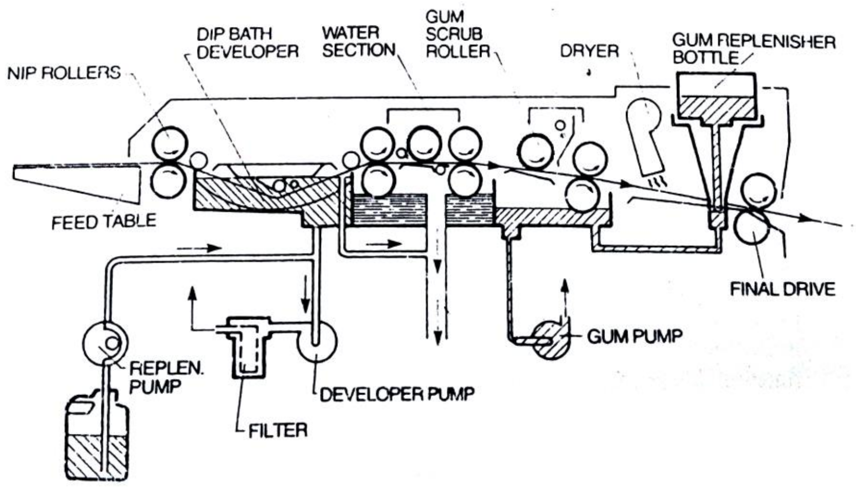
Inkjet plates:

Computer to plate systems using an ink jet technology for imaging were also introduced for the first time at DRUPA 95. In the ink jet process, a mask (the equivalent to a film) is applied to a pre-coated conventional plate. This is followed by exposure with flood introduce for the first time in 1997 by Iris/Scitex, as a device used to being ready for series production. In this process, a special aqueous ink is used to spray an image onto an uncoated, electrolytically grained, and anodized aluminium plate in an external drum device. After drying and thermal after treatment the image applied carries the printing ink has an oleophilic coating.

Automatic plate processors:

Equipment for automatically processing plates has come into almost universal use. Essential in high volume situations, automatic processors increase productivity, improves consistency and reduces consumption. Automatic processors reduce downtime and the number of makeovers from plate failures on press.

Some plate processors are designed for plates of specific manufactures. Other processors are capable of processing plates from various manufacturers. Some processors are not adjustable and maintain standard condition for a specialized situation most plate processors are automated to the extent that they develop desensitize gum and dry the plate. Chemistry is applied automatically and automatic replenishment is common it may have continuous filtration and recirculation. Plate processors must be operated and maintained according to its manufacturer's instruction.



Automatic Plate Processor

An **automatic plate processing** unit provides an alternative to shallow tray processing. Most machines are designed for dry to dry delivery in 4 to 5 minutes.

The plate is feed to the automatic plate processor using continuous belt or roller system that passes through a developer, stop bath, fixer, a washing tank and dryer.

An automatic processor automatically develops, fixes, washes and dries large volume of exposed plate with very little operator time required. Automatic processor reduces the man power. Improves reproduction quality and standardize processing procedures. The machine contains the processing and washing solution. Exposed plates are transported through the development, fixing, and washing solution and delivered after being dried by warm air. Total processing time varies depending on the plate, processing solution and processor used. The developing time and temperature and the amount of developer agitation are controlled.