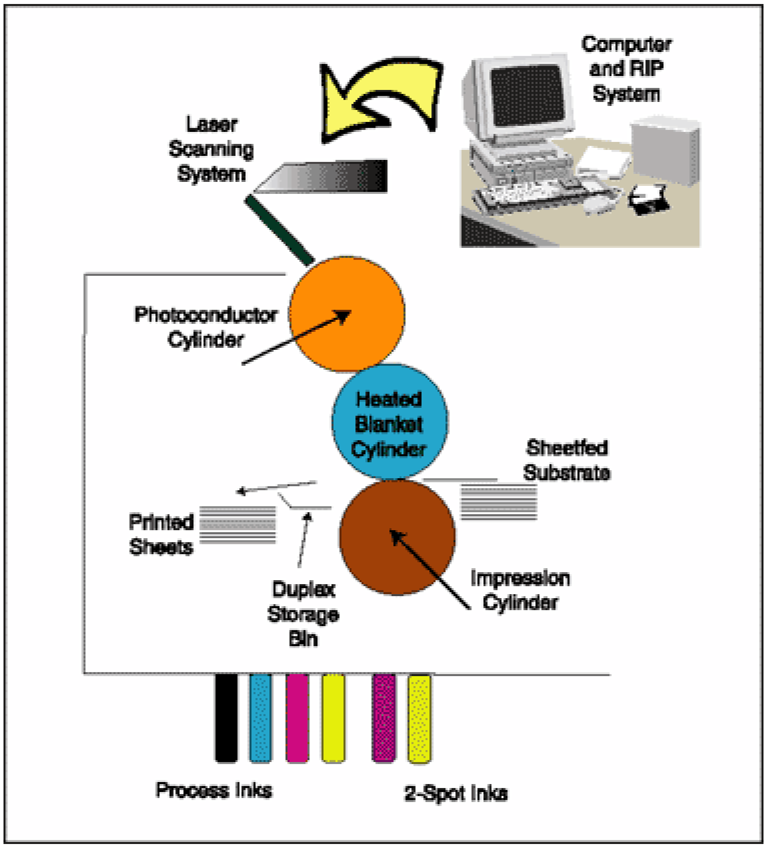
Unit IV

Digital Printing

4.1.1 Principles of Digital Printing:

Digital printing is generally defined as any type of print reproduction method that utilizes electronic files to produce a printed piece from spots and dots of ink, toner, or dye. Applying it to the print workflow has eliminated most of the manual steps involved with conventional print processes.



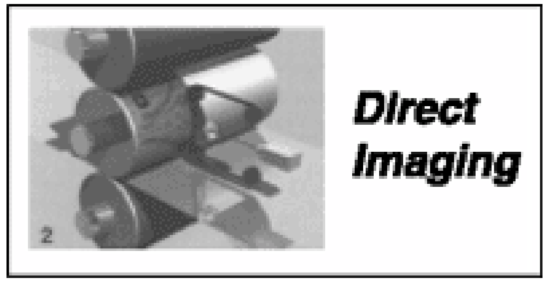
Digital printing technology can be divided into two main classifications: **Variable Imaging and Direct Imaging.**

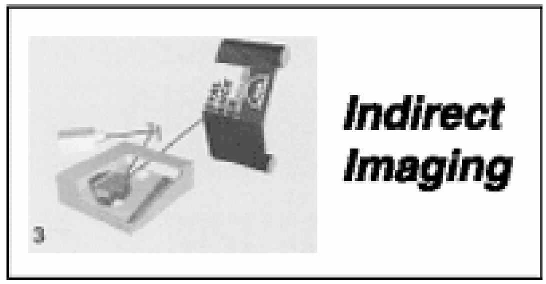
1) Variable Imaging

- **Computer-to-Print**

Variable imaging, also known as Computer-to-Print, is a totally digital workflow, including the design process, prepress functions, and print output. Computer-to-Print systems, such as digital presses, utilize a digital print engine that allows the image carrier to be reimaged for each printed impression. Common to all Computer-to-Print systems is the ability to produce print applications in which every page that is printed is different. This is known as *variable data publishing*. Some of the output processes that use this plateless technology are electrophotography, ink jet, ion or electron deposition, magnetography, thermal transfer, and thermal dye sublimation.

2) Direct Imaging





Direct imaging uses electronic files to create films or plates for printing. Direct imaging technology includes the following:

- **Computer-to-Imagesetter**

  Computer-to-imagesetter involves the electronic preparation of a print application including the design process and then outputting it to film from an imagesetting device. The film is then used to create an image on printing plates which are mounted on a conventional press to produce printed documents. The output of the films used for imaging plates is becoming less common as a majority of printers convert to a more complete digital workflow.

- **Computer-to-Plate(CTP)**

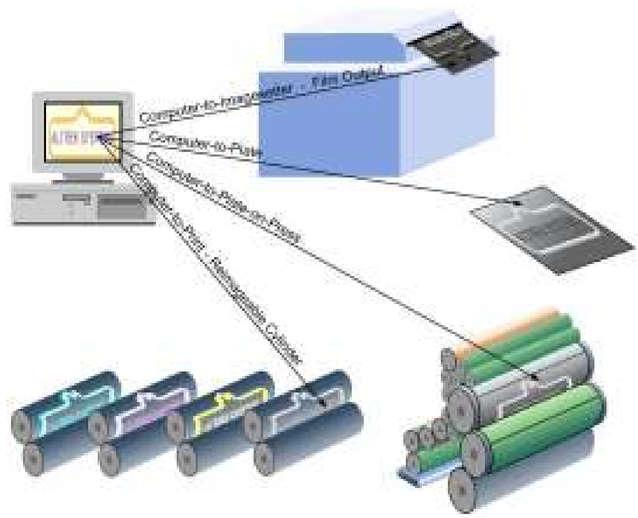
  Computer-to-Plate, or digital platemaking, can be divided into two groups: *Computer-to-Plate* and *Computer-to-Plate-on-Press*.

  - **Computer-to-Plate**

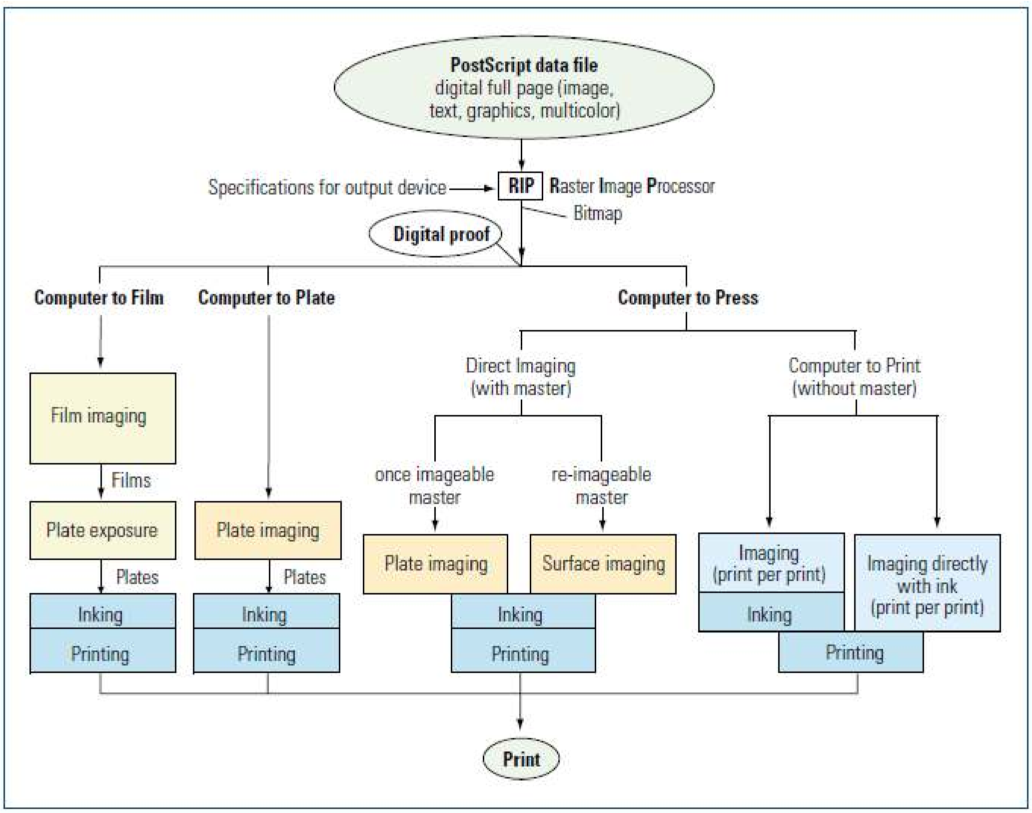
    Also known as digital platemaking, a Computer-to-Plate (CTP) workflow includes electronic design and direct imaging of printing plates from the computer files. After digital imaging, the plates are mounted on conventional presses for print output.

  - **Computer-to-Plate-on-Press**

    With this technology, the image is transferred directly from the digital files to the image carrier already mounted on a press. An offset press with this capability is known as a *direct imaging press*. A direct imaging press is much like a conventional offset press except that the image carrier (plate) can be reimaged for every press run, thereby eliminating the step in a conventional print workflow of manually mounting different plates onto the press for every job that is printed.



4.1.2 Flow chart of Digital printing:



4.1.3 ADVANTAGES OF DIGITAL PRINTING:

1. Digital printing requires minimal press setup and has multicolor registration built-in to its system.
2. This eliminates many of the frontend time consuming processes and permits quick response and just-in time print delivery.

3. Digital processes can vary every print “on-the-fly” i.e. while production printing, providing variable data, personalization, and customization.
4. Most digital printing technologies are non-contact printing which permits printing of substrates without touching or disturbing them. This eliminates image distortion encountered in some analog processes such as screen printing. It also does not require as aggressive substrate hold down methods which can distort or damage some substrates such as fabrics.
5. Digital technologies can print proofing, sample and short runs more cost effectively than analog methods. Digital color printing processes offer a range of color processes including 3 color process (CYM), 4 color process (CYMK), 5,6,7 & 8 extended gamut color options in addition to some spot colors. These match growing market demand for full color.
6. Most digital print processing requires less or no color overlap or trapping.
7. Digital printing does not use film masters, stencils, screens or plates. It requires much less space for archiving text and images than analog printing methods require.
8. Digital printing uses less hazardous chemicals, produces less waste and results in less negative environmental impact than analog technologies.
9. Digital printing is employing sophisticated color matching and calibration technology to produce accurate process color matching.
10. Digital web printers can print images limited only by the width of fabric and the length of the bolt or roll. They can print panoramas and are not restricted to repeat patterns.
11. Digital files are usually easier and quicker to edit and modify than analog photographic images.
12. Designers, artists, photographers, architects, and drafts people are increasingly creating and reproducing their work digitally.
13. Digital processing has replaced optical and manual methods for typesetting and page composition. Telecommunication has largely converted to digital processing.
14. One can use the same digital files for electronic media, such as Internet, CD-ROM, Video and TV, print media and multimedia.
15. One can readily convert analog images and text to digital with scanning and optical character reading (OCR) software.
16. Digital files are easy to transport and communicate. One can send a digital file to any digital printer on the planet within seconds. This permits distribution of design to many locations for quick response printing. Industries are adopting digitally generated and communicated art and print copy.

4.1.4 DISADVANTAGES OF DIGITAL PRINTING:

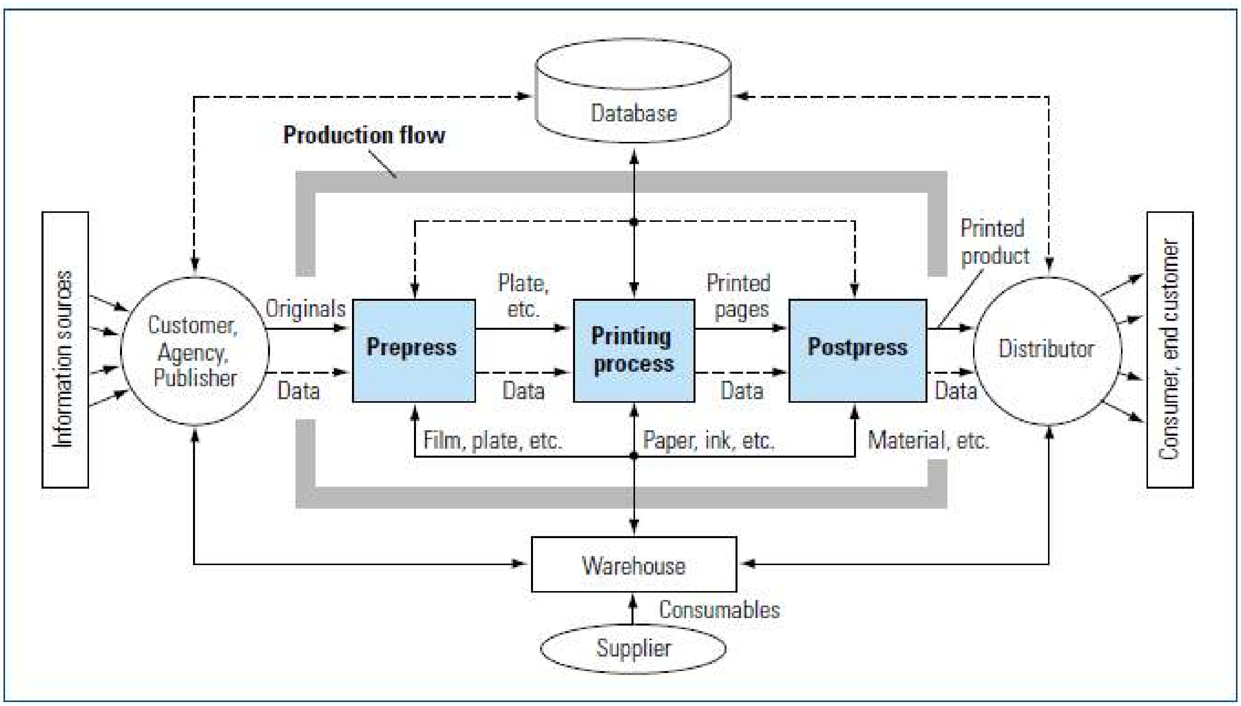
1. Most digital technologies have slower throughput as compared with comparable analog printing.
2. Digital printing will often cost more per copy than analog printing for longer print runs.

3. It often requires specially prepared and coated substrates.
4. Most digital printing technologies deposit very thin ink or toner layers. These limits necessitate layering for applications requiring thicker deposits, resulting in slower operation.
5. Digital inks and toners are limited in capacity and carry high price tags.
6. Most digital devices are printing transparent chemistry which limits their use for white or light substrates.
7. Some processes currently have difficulty matching color consistently.
8. This is new technology which requires investment for training as well as equipment.

4.2.1 Digital Printing Workflow:

There are three main processes to occur to print to the customer:

1. **Pre-press** - From design to production of the image carrier
2. **Press** - The process for transferring image to substrate. electronic or conventional
3. **Post Press** - final manufacturing processes; folding, conversion, binding, die-cutting, etc



The Digital Prepress Process:

1. Gathering your information, i.e. image, text, or both through an analog means like scanning in your document or through a digital means like a digital camera or word processor document.

2. Converting your information; your file format needs to be converted to a useable file, such as TIFF, or EPS.
3. Setting your layout.
4. Printing can start almost immediately after your design and layout is set.

4.2.2 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.As shown in figure 3.2-1b, text, images, and layout can be prepared either by the customer, the author, or the agency. This division of work is also applicable to the jobs carried out within a printshop with a prepress stage included. The basic stages in the creation of a digital page and a complete digital print sheet are shown in figure 4.1.

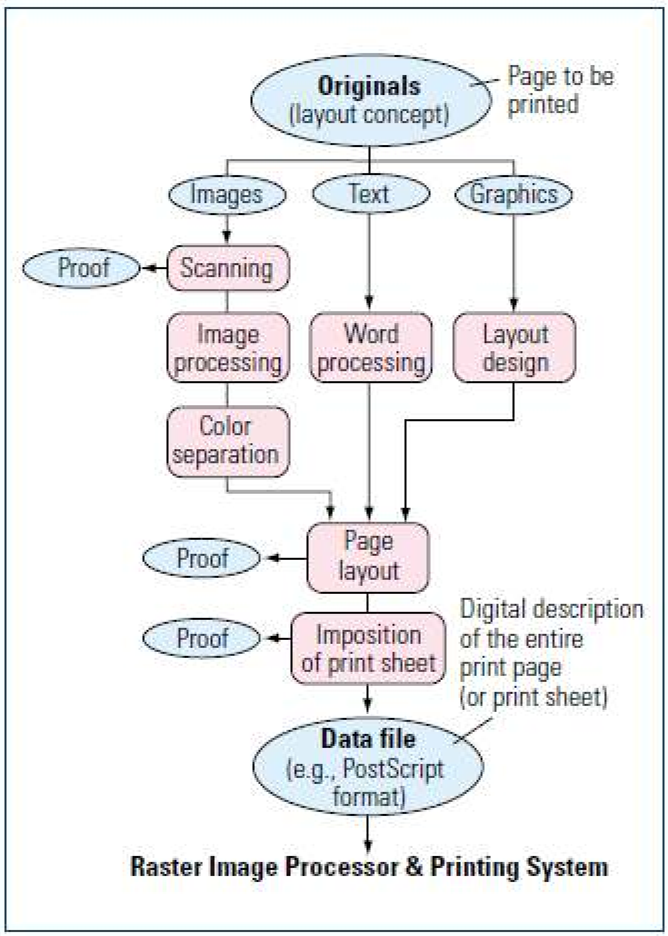


Fig 4.1 The purpose of the page layout is to create a digital page from individual elements such as text, graphics, and images, which contains all the information relevant for further processing.

Text

The method of working has not been changed by the introduction of digital production, only the place of execution has changed in most cases: that is from the departments of typesetting and reproduction to the corresponding departments at the customer's or at the agency.

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 canned 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. This procedure still includes the use of a camera and the development of the film. However, very often the result is not a slide, but 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 (PhotoDisc, Bavaria, ImageBank, 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.

In many cases, a proof of the set of image data is already prepared to check the reproduction quality before the generation of the full page.

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.

To clarify the concept: the data generated with the different layout programs are not PostScript files.

Rather, they contain all the information required, in line with PostScript conventions.

All these application programs offer the opportunity to create PostScript files or separated component files. This procedure has both the advantage and the disadvantage that the contents of the data can no longer be modified. On the one hand, unwanted changes can be prevented. On the other hand, faulty files can no longer be corrected and must be created anew.

In this context, a distinction is made between “separated” and “composite” files. Composite files offer the advantage that data can be corrected or complemented at any time; above all when used in PDF workflows, they guarantee a higher degree of flexibility.

Digitizing Originals:

Image Processing Using Scanners:

A color scanner converts photographs, transparencies, and artwork into an electronic bitmapped image that can be used by the computer. The bitmap images can be scaled and rotated during the scan. After the scan, they can be also be scaled (to a minimum) and rotated or color corrected in an image editing program such as Adobe Photoshop®.

Almost any type of original can be scanned, including photographs, negatives, transparencies, artwork, previously printed materials, and text. The text scanning requires an OCR (optical character recognition) program. Scanners are available in several different sizes ranging from a small hand-held model to the large drum scanners. If you need to scan images larger than the scanner will allow, scan it in pieces and then stitch it together in an image editing program.

Type of Original

- Reflection
- Transparent

- Color
- Continuous tone
- Black and white
- Line art
- Printed original
- Flexible original
- Rigid original
- 3-D original

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

Redigitizing or copy dot scanners are particularly suitable for 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.

Scanner Technology

Modern digital input processes such as scanners, digital cameras or photo CDs allow flexible editing and processing of images on a computer. In this respect digital data have the indisputable advantage of being able to be copied as often as required without loss of quality.

Digital images consist of an arrangement of small squares known as picture elements or pixels Fig 4.2.

When scanning in, the input devices reduce the visible color spectrum to the RGB color system, for which one color set is allotted to each pixel.

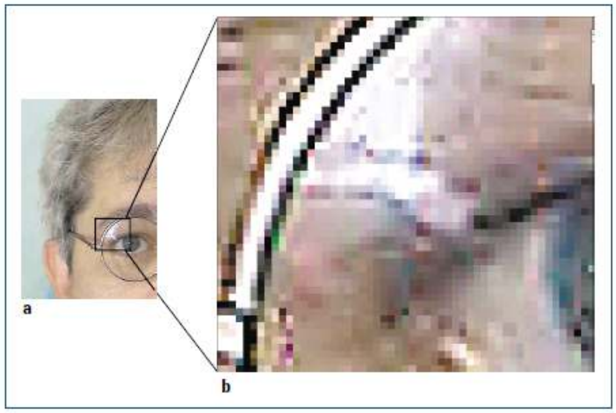


Fig. 4.2 Scanner resolution

The resolution of scanners is usually quoted in pixels per inch (ppi) or dots per inch (dpi). At a reproduction scale of 100%, scanning in a continuous-tone image is normally done at a scanning resolution of 300dpi (see also sec. 3.2.2), while a line art original ought to be scanned in with at least 600 dpi. (As a comparison: the maximum resolution of output devices is quoted as the number of printable or exposable dots per inch (dpi).)

Scanners offering higher resolution need this degree of resolution for enlargements. The true optical resolution of a CCD scanner is determined by the optical system and the number of dots per inch that can actually be registered by the CCD cells. It is advisable when comparing scanners to determine whether the optical resolution is improved by means of the software (interpolation). It is true that this process avoids visible pixels in enlarged images but it is unable to record any extra detail.

The increasing proliferation of flat-bed scanners may be attributed primarily to technical improvements that allow up to 8000 or even more CCD elements in a single chip. Up until just a few years ago CCD arrays contained only 2000 elements per chip. Flat-bed scanners allow various originals to be scanned in, some-thing that cannot be achieved with drum scanners because the original is affixed to the curved surface of the drum.

Drum Scanners

Drum scanners of the old design were stand-alone systems or input devices that were part of an EIP system (electronic image processing). The photomultipliers used to register RGB color values in drum scanners result in high quality reproductions. Drum scanners remain the image recording devices that satisfy the highest demands of resolution and quality (figs 4.3)

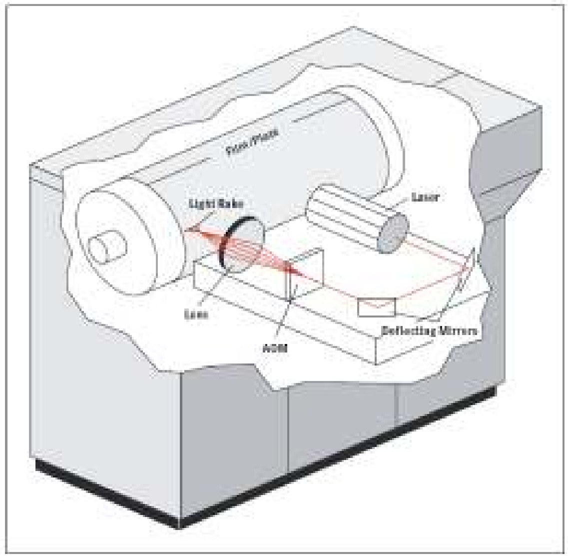


Fig. 4.3 External Drum scanner

Drum scanners are based on highly sensitive photomultiplier technology, which scans the light reflected or transmitted by the original and separates it into red, green, and blue (RGB) component colors. Drum scanners have a xenon or tungsten halide light source that is focused on to a small area of the original by means of glass fiber optics and condenser lenses.

Only flexible originals may be mounted on transparent drums. Processing can normally be carried out on negative or positive transparent or opaque originals. Transparent originals are illuminated from within the drum, while opaque originals are illuminated from the outside. The light transmitted or reflected from a tiny point of the image enters the sensor unit, which passes along the external surface of the fast rotating drum. The light is directed on to mirrors arranged at an angle of 45° to the light beam. Part of the light is reflected by each mirror/beam splitter while the rest is transmitted to the next mirror. The reflected light passes through a red, green, or blue filter and then reaches one of the three light amplifiers, the so-called photomultipliers. Analog/digital converters digitize the analog voltage signals of the photomultiplier.

A fourth photomultiplier unit can supply information to immediately produce a high-definition image.

Photomultipliers (just as charge-coupled devices, CCDs) convert different brightness values into continuously changing, analog voltages. These are split up by an analog-digital converter (A/D converter) into a distinct number of steps using a process described as “sampling.” The purity of the signal concerned may be affected by electrical interference leading to the possibility of noise.

Flat-bed Scanners

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 (fig.4.4).

Fig. 4.4 Flat-bed scanner as table-top unit

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. 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.

Word Processing and Typesetting

Desktop Publishing (DTP) systems are used for editing the input text. This is the technology of electronic publishing where full-page documents are designed on a stand-alone work station, which may be a

Personal Computer (PC) or other work station. Texts, graphics, and images are designed according to a pre-determined layout and integrated into the page.

Cost effective DTP technology has now replaced the earlier photosetting technology. Typographically sophisticated

DTP-typesetting/composition programs and a large choice of fonts enable photosetting quality to be achieved. Leading layout programs in the field of DTP are InDesign (Adobe Systems) and QuarkXPress.

Text input is followed by word processing, which creates the design parameters planned in the layout such as the choice of font, font size, line length and spaces for images to be added. The layout data are set by the author and publisher or agreed upon between the author, publisher, and printing house.

Word processing is followed by text output. The designed blocks of text are output onto film or paper. In this form they are ready for manual page make-up, that is, for completion with images and graphics required by the page of the book. If page layout including the integration of text and image is carried out electronically in the computer, the completed page is output on film or paper.

The file forms a useful starting point either for electronic/digital processing, such as computer to plate or computer to film, for digital printing by direct imaging, and so on, or for further use in electronic media. Corrections to the output text are time-consuming and expensive and should therefore be avoided as much as possible. For this reason a number of correction stages are incorporated into the procedure. “House corrections” are made in the printing house with the help of paper printouts of the digitally stored text. Corrections by the author follow the completion of the designed columns of text. These are output as galley proofs on paper and sent to the author for proofreading.

When corrections have been made the page is made up. The main function of the correction process which forms page make-up is the placing of the pictures in the correct position on the page, the correct and complete assigning of the picture captions, footnotes, cross references to other pages, and the arranging of headers and footers including page numbering.

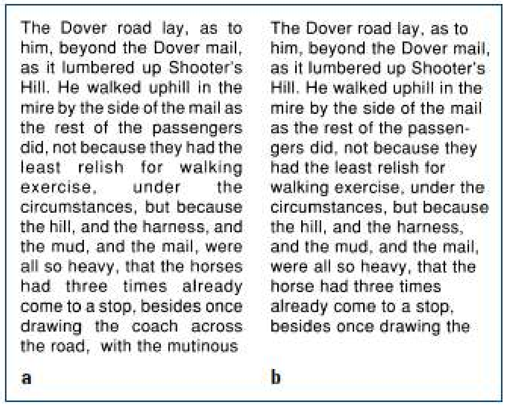
Since corrections from this point on can be very expensive, it is important to ensure that the previous correction stages are carried out with utmost care and attention so that work can be guaranteed to be as free of errors as possible. After further proofreading and checking the author signs to confirm that the pages are correct and ready for printing, that is, he passes them for press.

Page Layout

The text is set justified on the base line grid in two columns; highlights are italicized; paragraphs start with a 3 mm indent in the first line.

A bullet is used as the first-level numbering symbol; a dash (en rule) is used as the second-level numbering symbol. There is an empty line spacing before and after a list. The following paragraph is not indented. Besides pure typeface decisions all other aspects of the book were also determined:

- the page format (193 mm ¥ 242 mm),
- the type area with two columns (156mm¥ 200 mm),
- the column width (76 mm).


The Dover road lay, as to him, beyond the Dover mail, as it lumbered up Shooter's Hill. He walked uphill in the mire by the side of the mail as the rest of the passengers did, not because they had the least relish for walking exercise, under the circumstances, but because the hill, and the harness, and the mud, and the mail, were all so heavy, that the horses had three times already come to a stop, besides once drawing the coach across the road, with the mutinous

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The Dover road lay, as to him, beyond the Dover mail, as it lumbered up Shooter's Hill. He walked uphill in the mire by the side of the mail as the rest of the passen-gers did, not because they had the least relish for walking exercise, under the circumstances, but because the hill, and the harness, and the mud, and the mail, were all so heavy, that the horse had three times already come to a stop, besides once drawing the

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Fig. 4.5 Layout.

The figures are preferably single column, double column, or 1.5 column width; the frames are 100% colored and 0.4 pt thick (for figures without a background), all figures with a background (e.g., photographs) remain frameless; pictures are centered within the frame. Figure captions appear below the figure and are set justified; for 1.5 column width figures they are next to the figure and unjustified; the distance between the caption lines and the edge of the picture is 3 mm.

The figure number stands on its own if the caption text is longer than one line, otherwise it is at the beginning of the line without a following period. The part-figure designations (a, b, c, etc.) are printed black and in bold. They are always placed on their own line.

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:

Quickmaster 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. In the example given, a thermal sublimation printer is used for the proof . The entire format (A3+, + means: a little larger than the DIN/ISO standard size A3) is reproduced in true colors with a powerful color management system.

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, a 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.

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. 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.

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).

Fig. 4.6 Imposition color proof with large-format ink jet printer

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.

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.

4.3 Computer to Press (Direct Imaging and Computer to Print):

There are two different computer to press technologies. With computer to press/direct imaging technology, a printing plate as is required, for example, in conventional offset printing, is produced directly in the printing press. For instance, four printing plates for multicolor printing can be imaged inside the printing press. The register alignment that can be achieved in this manner depends only on the quality of the press and of the imaging process and is no longer subject to operator-related influences Another computer to press technology is computer to print (also referred to as computer to paper).

This technology does not require production of printing plates for each print job. The technology of the printing method used (non-impact printing) makes it possible to introduce job data directly into the replication process without a printing plate, as, for example, in electrophotography. In this non-impact printing process, a laser creates a charged image corresponding to the printing image on a unit comparable to a plate cylinder. The charge image attracts an appropriate medium, for example, powder toner, and is subsequently transferred to the paper

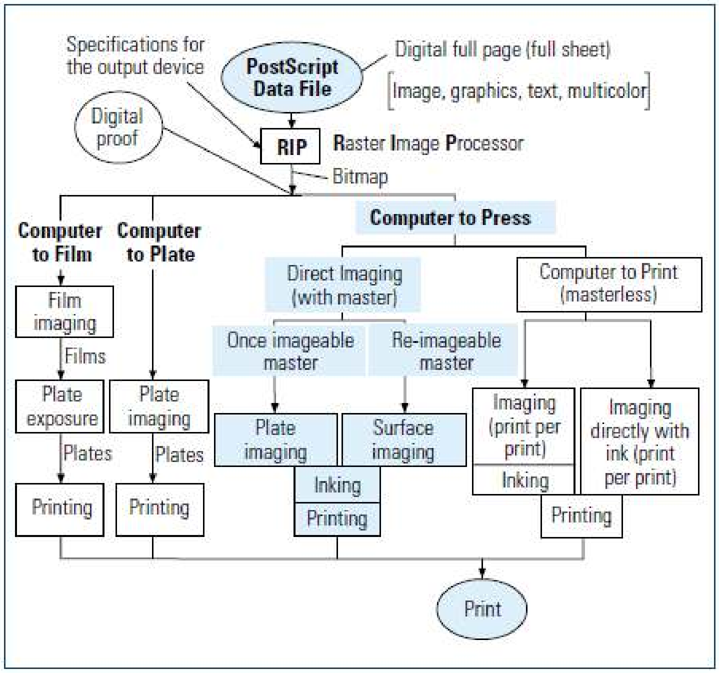


Fig 4.3.1 Computer to Press

Figure 4.3.1 includes another computer to print process in which imaging takes place without any intermediate image carrier, as is the case in ink jet systems. In these processes, the ink is applied directly to the printing sheet via electronically controlled nozzle systems.

4.3.1 Computer to Press/Direct Imaging Printing Systems:

Figure 4.3.2 is the technological comparison of these computer to press/direct imaging technologies with conventional platemaking outside the press as well as with computer to press/computer to print technologies where no plate is required.

It is evident from the illustration that with the increasing degree of automation some special additional equipment is necessary inside the printing unit. In the case of direct imaging with the once usable plate, the imaging unit must be installed inside the press; if a technology comes into play where a plate can be used several times, then additional erasing and preparation systems are needed in addition to the imaging unit. The printing process itself is not different, that is, direct imaging technologies and systems can be realized in various printing processes.

So far direct imaging technology has been used in offset printing; however, there are also attempts to employ direct imaging in gravure printing. For screen printing simple single-color printing systems using direct imaging technology exist.

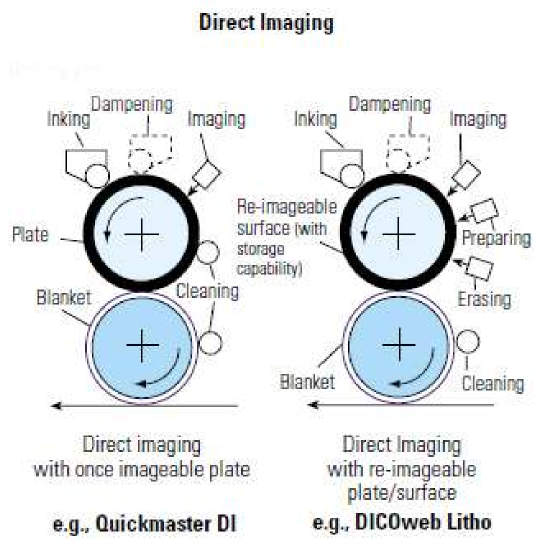


Fig. 4.3.2 Printing unit equipment in computer to press/direct imaging systems

4.3.4Configuration of Direct Imaging Machine: 74 Karat

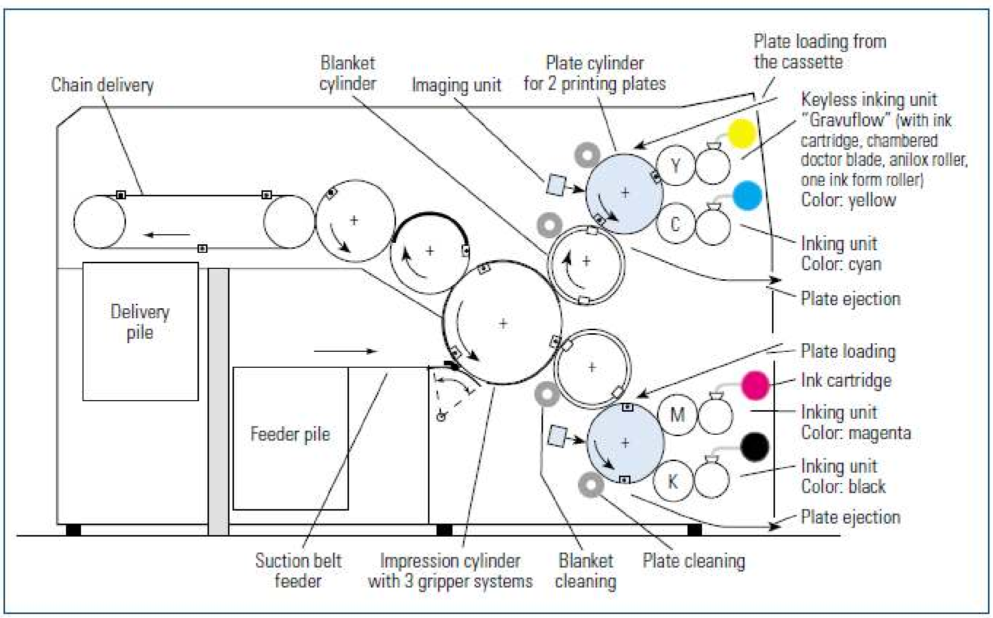


Fig. 4.3.3 Computer to press/direct imaging printing system with two printing plates per plate cylinder

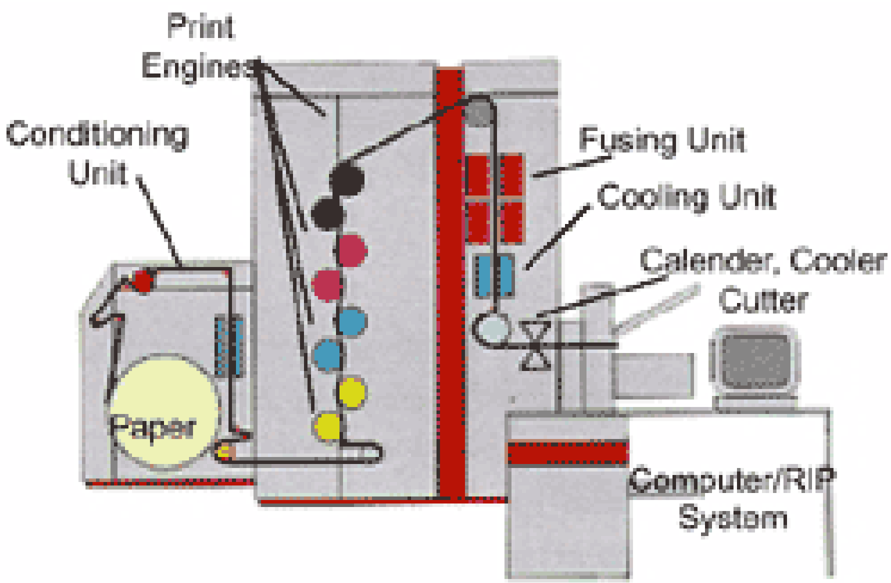
Figure 4.3.3 shows the operating console near the delivery of the direct imaging press 74 Karat. Each plate cylinder of the press can take up two plates, and inking is performed by a keyless short inking unit in waterless offset.

The technical details are described in the following.

It can be seen from the press diagram in figure 4.3.3 that only two plate cylinders are used for four-color printing. Two plates are mounted on each of the double- sized plate cylinders. The two plates are imaged with the desired image using only one laser system in a laser ablation process. Printing is effected in waterless offset. The keyless inking unit consists of an anilox roller and chambered doctor blade system; adjustment of the ink zones is not possible, which places greater demands on the quality of the original and color matching.

Through adequate temperature control of the ink form rollers, it is possible to influence the entire ink film thickness slightly. As is shown in figure 4.3.3 the color separations for yellow, cyan, magenta, and black are transferred to the two double diameter blanket cylinders. The plates on each plate cylinder are inked by alternately engaging the two ink form rollers. For example, the cyan form roller is engaged for the first plate when the second plate comes in, the cyan inking unit is disengaged and the ink form roller for yellow is engaged.

The short inking unit shown (short ink train, only two rollers) has the advantage that it can react quickly, which means in principle that there is a better control of the start-up (makeready) waste. The ink supply takes place via ink cartridges similar to the ones used in conventional sheet offset presses.



The imaging system of the direct imaging press74 Karat presented in 1997 is a laser system moving axially and having thirty-two beams; imaging can range from 1524 to 3556 dpi (600 dpcm and 1400 dpcm; dpcm: dots per cm). A resolution of 1524 dpi (600 dpcm) is typical. In the case of very high resolutions for reproducing very fine details, a resolution of 2540 dpi (1000 dpcm) is used. The press is designed for A2+ (four-page) format. The sheets pass through the press in “landscape form”, that is, the long side of the sheet lies in the axial direction of the cylinder groups, the short side of the sheet moves in the direction of print, which is generally the normal constellation with larger format presses.

The direct imaging press for A3+ format, the Quickmaster DI, prints format A3+ with the sheet passing through in “portrait”, that is, the short side of the sheet is in the axial direction to the cylinder and the sheet pass occurs in the longitudinal direction of print; this results in more favorable, larger diameters of cylinders for small formats, and permits a more efficient laser imaging system that stretches over the entire page width. In the diagram shown in figure 4.3.3 it is illustrated that plate loading and ejection are carried out automatically by means of cassette systems. The plates are imaged through thermal laser ablation; similar plate material is used to that used in the direct imaging presses described above.

The direct imaging press 74 Karat has an output of 10000 sheets (max. A2+) per hour. The time from the beginning of plate imaging with 1524 dpi to printing/paper run takes about 15 minutes. A print run of 1000 sheets is thus completed in about 30 minutes on the basis of ripped data.

Concepts for Re-imageable Masters with Material Application/Ablation

Offset Platemaking by Means of Thermal Transfer

DICOweb Litho.

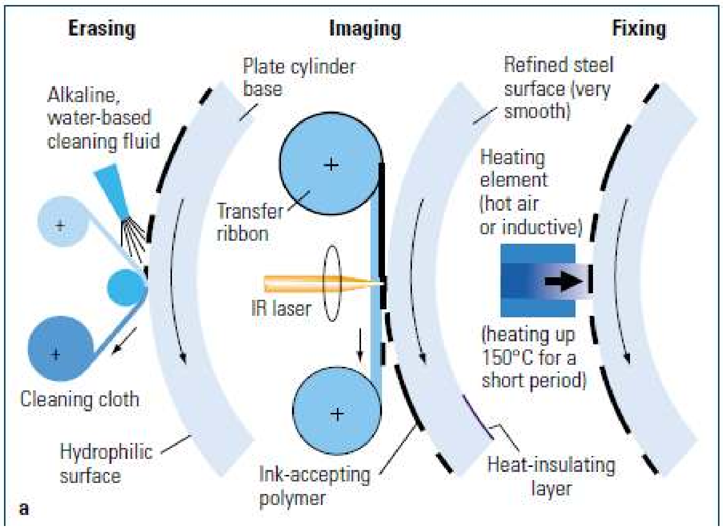


Fig 4.4.24 Direct imaging offset with re-imageable plate.

a Stages in the process: erasing, imaging, fixing;

Figure 4.4.24 shows how a plate suitable for offset printing is fused on the metallic surface of a plate cylinder by thermally transferring a suitable polymer. The polymer material, stored on a roll, is fused on the metallic cylinder surface by a thermal laser to create the image via laser ablation (fig. 4.4-24a).

Depending on the laser imaging head, the image can beburned in, e.g., by 64 beams simultaneously, at a resolution of up to 2400 dpi.While the cylinder rotates, the plate is imaged across the entire press width through axial shifting of the imaging system and the storage unit for the polymer material (width of the ribbon material about 15 mm).

After the imaging process the material is fixed on the cylinder by supplying heat (e.g., hot air, 150°C).

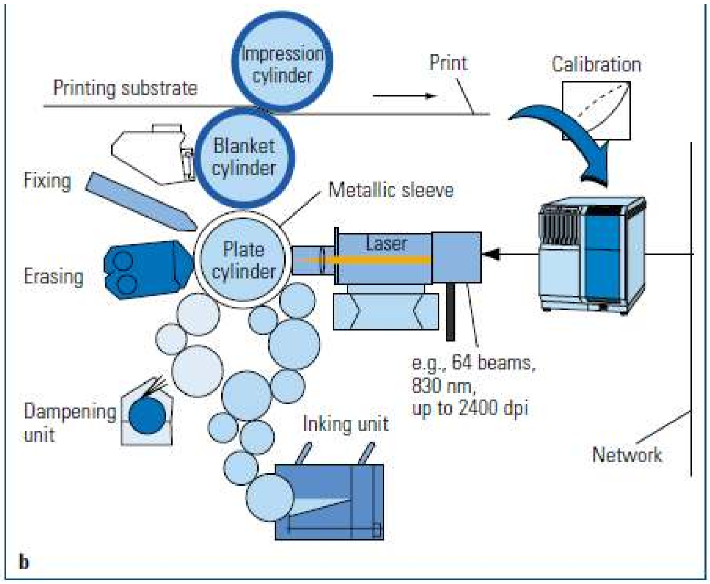


Fig 4.4.24 b Web offset printing unit with components for imaging and erasing the plate

One such master (imaged plate cylinder surface) is used in the printing unit illustrated in figure 4.4-24b where the image is printed in a web offset process (dampening and inking via the blanket cylinder) on the paper web.

After the print job is completed the ink-accepting polymer material is removed from the cylinder surface in a chemical and mechanical cleaning process. After this cleaning process the water-accepting/hydrophilic base cylinder is neutralized and ready for imaging the next job.

The difficulties here are the basic material properties of the base cylinder required for offset printing, the stability and quality of the ink-accepting surface areas that are thermally transferred to the base cylinder, and the additional equipment needed within the offset printing unit.

Figure 4.4-25b shows a two-stage thermal transfer process for comparison with the process (direct thermal transfer) described above where the imaging process takes place inside the press (fig. 4.4-25a). In this case the transfer material is imaged in a special imaging system and several jobs can be prepared one after the other on the roll material (similar to computer to film equipment using internal drum or capstan imagesetter design). The material roll with the prepared image (s) can now be stored in the press on a cassette and thermally transferred onto the metal surface of the neutral plate cylinder. This means that the press only needs a cylinder-wide heat source for material transfer as opposed to the laser system required for the direct thermal transfer. The corresponding fusing/fixing and cleaning units are illustrated in figure 4.4-24a. (In principle the transfer material can be imaged inside the press using a special module, yet off-line imaging would probably be more advantageous.)

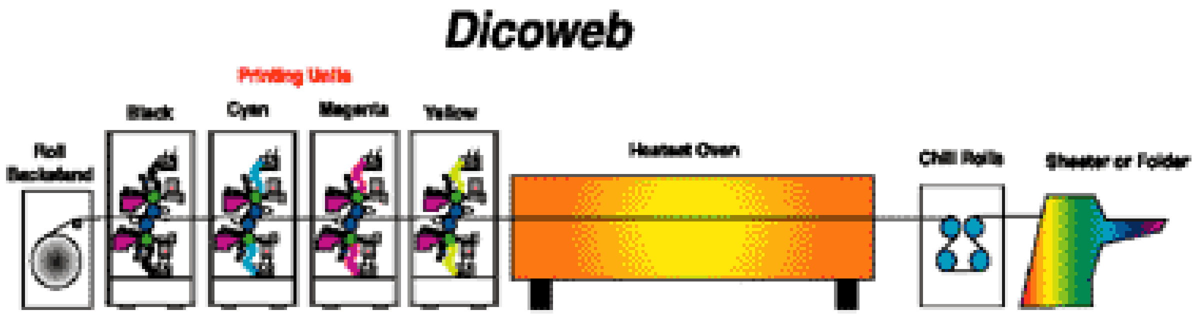
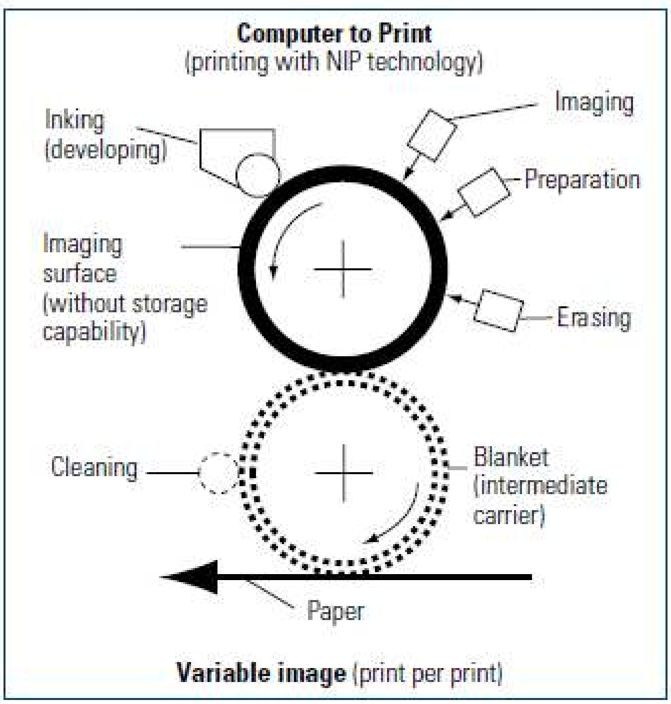


Figure 4.4-25c shows the diagrammatic view of a test installation in which both thermal transfer processes are tested and further developed. This diagram corresponds to the printing system shown in figure 4.1-6 for the technology presentation in 1995 of the DICOweb Litho system (Digital Change-Over for lithographic, offset printing technology) from MAN Roland.

4.4 Computer to Print



Another computer to press technology is computer to print (also referred to as computer to paper). This technology does not require production of printing plates for each print job. The technology of the printing method used (non-impact printing) makes it possible to introduce job data directly into the replication process without a printing plate, as, for example, in electrophotography. In this non-impact printing process, a laser creates a charged image corresponding to the printing image on a unit comparable to a plate cylinder. The charge image attracts an appropriate medium, for example, powder toner, and is subsequently transferred to the paper.

Another computer to print process in which imaging takes place without any intermediate image carrier, as is the case in ink jet systems. In these processes, the ink is applied directly to the printing sheet via electronically controlled nozzle systems.

This technology does not require a printing plate. The technologies used in this field are called non-impact printing technologies and are based on certain physical effects.

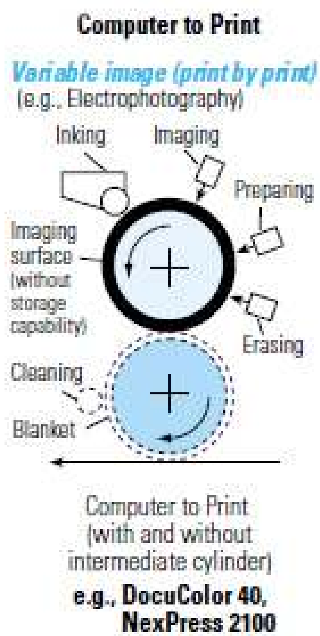
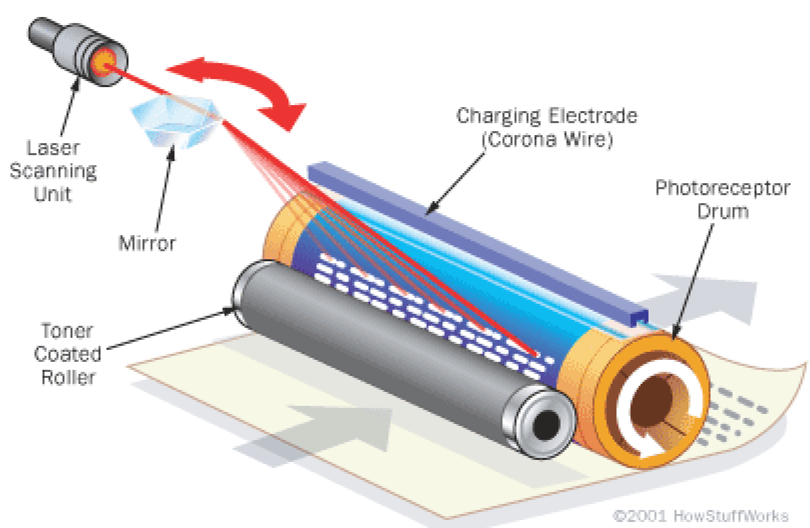


Fig 4.4.1 Printing Unit of Computer to Print System

Figure 4.4.1 shows a printing system for electrophotographic multicolor printing using liquid toners. The main feature of this system is that a single printing unit is sufficient to produce a four-color print. Multicolor printed products are produced in that the paper sheet is held on the impression cylinder during four rotations. During these four rotations, the color separations cyan, magenta, yellow, and black are subsequently applied to the sheet by means of a cylinder that, as in offset printing, is covered by a blanket.



This intermediate cylinder receives the individual color separations from a photoconductor drum that has been imaged by means of a laser to carry the particular color separation. The liquid toner is applied to the photoconductor drum by means of a special type of inking unit. From the intermediate cylinder, the individual color separations are transferred directly to the paper sheet. The different process colors of liquid toner are transferred to the sheet subsequently, by means of the same ink applicator system and imaging system. In the process described above, four or six different color separations can thus be subsequently printed onto the paper. (Such systems are also referred to as multipass systems, since the printing sheet passes the printing nip several times.)

4.4.2 Configuration of Computer to Print Machine: E-Print 1000

Fig 4.4.2 This computer to print system forms the basis of a series of models for 4-color printing on sheet material (E-Print Pro) and six-color printing including a powerful front-end system (TurboStream). A model with increased productivity (UltraStream) has been presented in the year 2000 with a modified printing unit design as well as a model for printing on web material (Publisher).

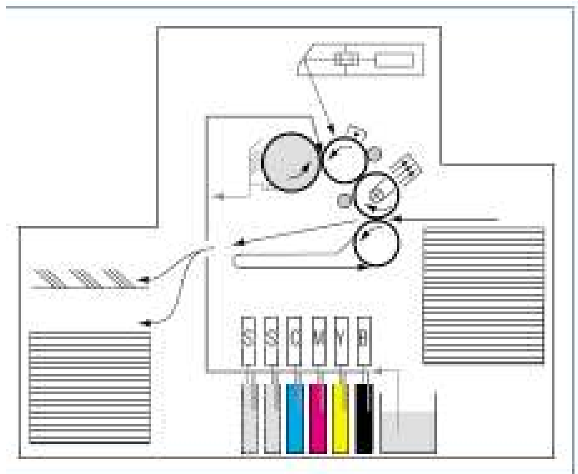


Fig. 4.4.2 Computer to print system for multicolor printing using electrophotography

The TurboStream model is illustrated in, together with an outline view of the E-Print 1000 and a more detailed explanation of the components.

The system works with liquid toner. The printing unit is designed as a “multipass system” and an intermediate cylinder that is fitted with a blanket is used for the ink transfer onto the substrate (sheet material).

Imaging takes place via a scanning, multi-beam laser system. The printing system can also be used for duplex printing. A finishing unit can be connected.

For four-color printing the productivity is 33 A4 pages per minute (equivalent to approximately 0.15 m/s; the speed for a color separation is approximately 0.6 m/s).

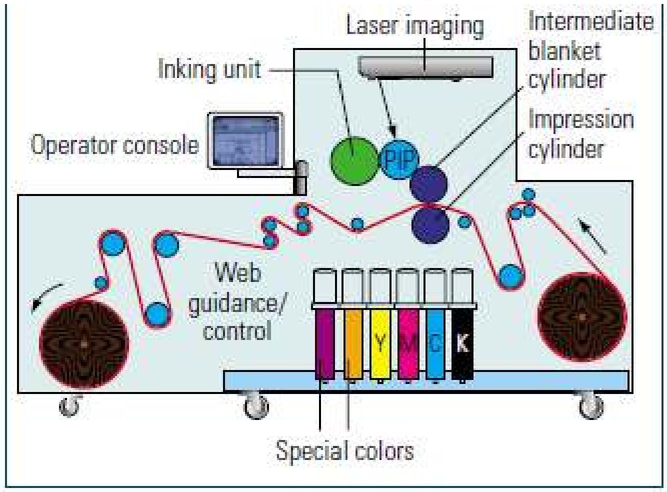


Fig. 4.4.3 Computer to print system for multicolor printing in one printing contact ("one shot" technology)

Figure 4.4.3 shows a variant derived from this printing system, the Omnius model, for printing on web material.

The printing method corresponds to that of sheet-fed multicolor printing and is similar to the system.. The basic difference is that the color separations are not collected on the printed sheet by quadruple rotation (or six-fold rotation for printing with six colors) of the impression cylinder on which the sheet is held by grippers, as was previously the case. Here, all the color separations are collected on an intermediate carrier, a cylinder covered with a flexible blanket, before the entire multicolor print image is transferred to the web material in a single printing contact. This enables flexible materials to be used since register accuracy is determined solely by the quality of the transfer to the intermediate carrier.

In this system the imaging also takes place by electrophotography and laser systems with a resolution of 800 dpi. The printing speed for four-color printing is 33 A4 pages per minute. The web transport must be intermittently controlled because of the special ink transfer system (which the manufacturer calls "one shot technology").

Advantages of E-Print:

- Economic Advantages:

  E-Print 1000 eliminate the expensive materials, the time-consuming processes, and the skilled labor requirements associated with conventional offset.

- No films or plates:

  Electronic data is received directly from the publishing system, so no films or plates are required.

- No proofing:

  On-demand single prints replace proofs, instantly-on the final paper, using the final inks.

- No press make ready:

Perfect registration is assured and color balance is automatic. The first print itself is usable copy and no wastages in this process.

- No expert operators required:

  Quality is assured electronically, without dependence on press operator skills. Because E-Print 1000 are so easy to set up and easy to use quality color printing is more economical than ever-even for very short runs.

- Additional options:

  Beyond saving time, materials and money, E-Print 1000 offers new printing capabilities, it was not possible before with conventional printing.

- Electronic collation:

  With no plateless required, images can be modified electronically-at full printing speed, even from page to page. This option enables even complex publications to be printed in their entirely, with each page in its correct sequence.

- Automatic duplex printing:

  Each page can be automatically printed on both sides. This option, together with electronic collation, means that an entire multi-page document can be printed and ready for finishing-fully automatic.

- Booklet Maker (Automatic Booklet Making):

  This automatic finishing option enables the production of fully-finished booklets folded and stapled with no manual intervention.