

PRINTING FOR PACKAGING



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<https://www.brushyourideas.com/blog/types-printing-methods-web-to-print-industry/>

<https://www.glocaluniversity.edu.in/files/eContent/eBpharm/QUALITY%20CONTROL.pdf>

TYPES OF PRINTING FOR PACKAGING



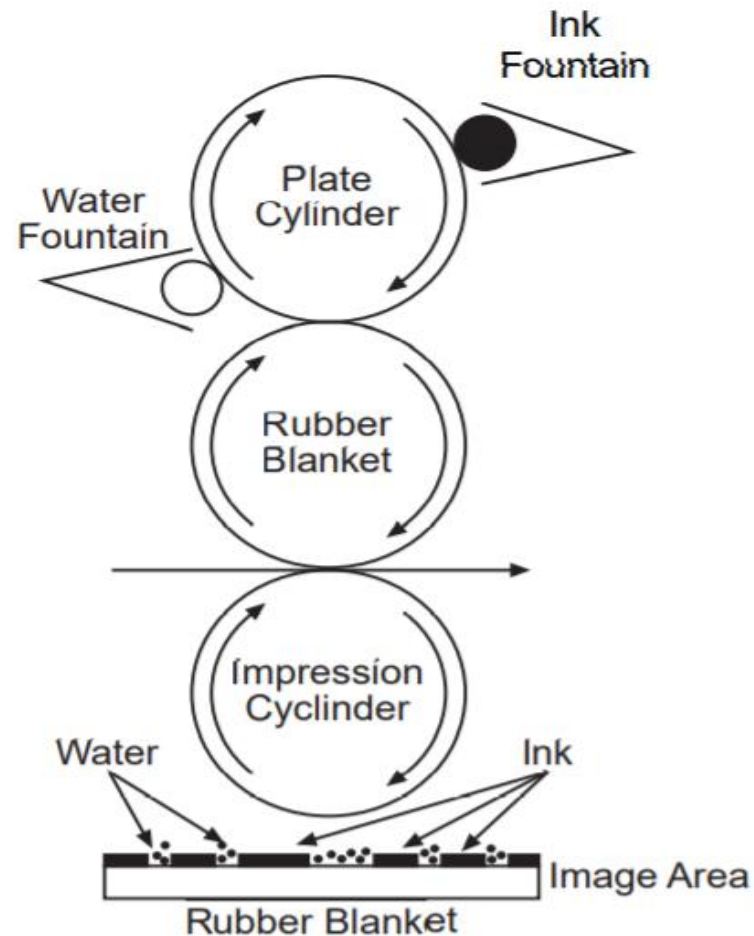
1. Lithography or “litho” or “offset” for short
2. Flexography or “flexo” for short
3. Rotogravure or “gravure” for short
4. Silkscreen or “screen” for short.
5. Digital

1. PLANOGRAPHIC PRINTING



- Lithography is the most dominant of the printing processes. When people refer to printing, especially color printing, they usually think of lithography.
- Lithography was invented by Alois Senefelder.
- Lithography is a chemical process.
- Lithography works on the principle that oil and water do not mix. A lithographic plate is treated in such a way that the image areas on the plate are sensitized and as such are oleophilic (oil-loving); and the non-image areas are treated to be ink repelling or oleophobic.
- During the press run, the plate is charged twice; first by a set of dampening rollers that apply a coat of dampening solution and second by a coat of the inking rollers. During this process the image areas have been charged to accept ink and repel water during the dampening.

PLANOGRAPHIC PRINTING



PLANOGRAPHIC PRINTING



❑ Plate, blanket and impression cylinders

- The lithographic process operates with three basic cylinders. They are the plate cylinder, the blanket cylinder, and the impression cylinder. All these are plain heavy metal cylinders.
- The plate cylinder has the printing plate wound around it. This plate is the carrier of the image that needs to be printed. In other words, it is the equivalent of the types and blocks of letterpress.
- The blanket cylinder has a rubber blanket wound around it. This facilitates the transfer of the image from the plate to the blanket, and thereupon to the paper (or other substrates), when the substrate is passed between the blanket and the impression cylinder.
- The impression cylinder is just a bare cylinder that acts to provide the necessary pressure to impress the image from blanket to the substrate. Pressure settings are varied between the impression cylinder and blanket cylinder when stocks of varying thickness are used.

PLANOGRAPHIC PRINTING



□ Image transfer

- The image areas accept ink and transfer them to the blanket.
- The orientation of the image in the plate is readable. When transferred to the blanket it becomes unreadable and in the next revolution, the image is transferred to the paper that travels between the blanket and the impression cylinder.
- The image is first set off from the plate to the blanket and then set off from the blanket to the paper. For this reason, lithography is also called offset printing. Since the image and the non-image areas on the plate are both in the same plane, lithography is also called a planographic process.

PLANOGRAPHIC PRINTING



❑ Types of offset presses

- There are two ways in which paper can be fed to an offset printing press; either in the sheet form or in the roll form.
- Presses that feed paper in the cut mode are called sheet fed presses and the presses that feed paper in the roll mode are called web fed presses. Some of the presses can print on both sides of paper and they are called perfecting presses.
- Many of today's presses have the capability to print many colors as they have been configured with the plate, blanket and impression cylinder configurations many times over. A press that has one of this set is called a single color press, and presses that have multiple sets of the above mentioned combinations are called multicolor presses. They are usually in the two-, four-, five-, six-, eight-, and now ten-color configurations.
- The plate used in lithography usually has a flat surface and is called planographic. There is no physical or mechanical separation between image and non-image areas. The plate material can be paper, plastic, or metal.

PLANOGRAPHIC PRINTING



□ Printing unit

The printing unit is the section of the press where the print is generated and applied to the substrate. On a single color lithographic offset press, this is usually done with three cylinders called the plate, blanket, and impression or back cylinders. The plate cylinder has four primary functions:

- hold the plate in register
- come into contact with dampening system
- come into contact with inking system
- transfer inked image to the blanket

PLANOGRAPHIC PRINTING



❑ Dampening system

The purpose of the dampening system is to apply a very thin layer of water or moisture to the plate. The water is actually a special mixture of chemicals called fountain solution. The fountain solution keeps the non-image areas of the plate desensitized and printing clean. The separation between printing image area and nonprinting area is accomplished chemically by having:

- Image areas repel water and accept ink (hydrophobic)
- Non-image areas accept water and repel ink (hydrophilic)

PLANOGRAPHIC PRINTING



□Perfecting

Printing on both sides of a sheet of paper in a single pass through the press is called perfecting. In office imaging, laser printing, or photocopying, this is called duplexing. Sheetfed presses usually perfect sequentially. Webfed presses perfect simultaneously.

PLANOGRAPHIC PRINTING



❑ Inking system

- The purpose of the inking system is to apply an accurately measured or metered amount of ink to the plate. Each process requires a special type of ink and method to apply it to the image carrier. Some inks are thick like a heavy paste and others are fluid.
- If the ink is a thick paste, then it can be distributed by a series of soft rubber rollers. If the ink is a fluid, it would drip off the rollers due to gravity. Fluid inks require miniature wells or cups to transfer the ink. These wells can be part of the image carrier itself or a special type of inking roller.

PLANOGRAPHIC PRINTING



❑ Offset

Offset is the method of transferring an image from the plate to the substrate through an intermediate rubber blanket. When lithography was first invented, it was not an offset process, but a direct process. The blanket cylinder has two primary functions:

- hold the rubber blanket
- transfer ink from the plate to the substrate

PLANOGRAPHIC PRINTING



❑ Waterless offset

- With this concept, the use of water is eliminated from the process.
- The problems that are associated with ink water balance, paper expansion due to moisture content caused by water in the dampening solution, etc. are overcome with waterless offset.
- This concept was developed in the late 1960s by 3M as a dryographic process, but they stopped marketing because of the poor scratch resistance and durability of the plates.
- Plates were developed by Toray Industries of Japan in 1973. Toray made positive working plates that were more durable, had better scratch resistance, allowed longer print runs, and produced better quality.
- By 1978 they marketed positive working waterless plates, and by 1985 they were able to offer negative working plates.
- Aluminum is the base material for the plate. A light-sensitive photopolymer coating is given to the aluminum base. Over this there is a very thin layer of silicon, approximately 2 microns. The plate is protected by a cover sheet, which is approximately 7 microns.

PLANOGRAPHIC PRINTING



❑ Exposure and development

- The waterless plates are made from either positives or negatives, depending on the plate type used.
- The plate is exposed to actinic UV light. During the exposure, the bond between silicon and the photopolymer is broken. The silicon loosens its hold on the photopolymer.
- The plate is developed by a chemical process that consists of tap water solution for lubrication and a glycol-based solution for treatment with a dye solution, which recirculates and is not discharged from the processor.

PLANOGRAPHIC PRINTING



❑ Waterless press

- Any offset press that has a dampening system on it can be used for waterless offset printing.
- Temperature and humidity control in the press room is critical in waterless offset between 80 to 88 degrees F. This is considered the optimum temperature range for inks and ink rollers in a waterless system.
- Each unit of the press has a different temperature, with black needing the hottest, yellow the coolest and cyan and magenta in between.

PLANOGRAPHIC PRINTING



❑ Offset lithography features

- Printing from right-reading planographic (flat) plate to blanket and substrate
- Basic principle: “ink and water don’t mix”
- Principal applications: publications, packaging, forms, general commercial printing, labels, books, etc.
- Recognition characteristics: sharp, clear images

PLANOGRAPHIC PRINTING



❑ Sheetfed offset trends

- ✓ Press automation increases competitive advantage. Most automated features deal with makeready, nonproductive costs, and turnaround time.
 - Programmable, automatic blanket and roller washing
 - Semiautomatic and fully automatic plate changing
 - Presetting systems for fast format changes
- ✓ Improvements in feeder, sheet transfer, and delivery systems increase running speed to 10,000 to 15,000 impressions per hour.
- ✓ Digital press controls allow virtually total press supervision and control from central workstation
- ✓ De facto standard for multiple printing units on new sheetfed presses in six color units with inline coating unit. Placement of presses with seven, eight, or more units is increasing.
- ✓ Higher number of printing units accommodates more complex design and color applications.
- ✓ Increased demand for short run lengths

PLANOGRAPHIC PRINTING



❑ Waterless offset

- Silicone surface of non-image area on a plate—recent advances in inks, plates, and presses make this a rapidly growing process
- Advantages: no fountain solution; yields cleaner, purer, more consistent color; improved color contrast; reduced dot gain; high gloss levels; reduced makeready, and running waste; faster job changeover times
- Requires special ink and plates, adapted presses

PLANOGRAPHIC PRINTING



❑ Web offset trends

- Continued development of automated control systems expected for all aspects of web offset production, from makeready through drying, folding, stacking, and delivery.
- Press speeds of 2500-3000 feet per minute now possible.
- Successfully entering into competition with sheetfed at lower run lengths.
- Waterless offset becoming more widely accepted.

PLANOGRAPHIC PRINTING



❑ Direct imaging technology

- Heidelberg came out with “Direct Imaging” which they called the “system solution for Computer To Press” (a different kind of CTP, essentially Computer to Plate on press). This technology takes the data stream from the computer that acts as its front end and images the plate directly on the press.
- The spirit of offset printing is very much alive in presses that incorporate the direct imaging technology.
- The plate has two layers, a base layer that is an ink-loving layer and a top layer, made of silicon, that is an ink repelling layer.

PLANOGRAPHIC PRINTING



□ Digital Front End (DFE)

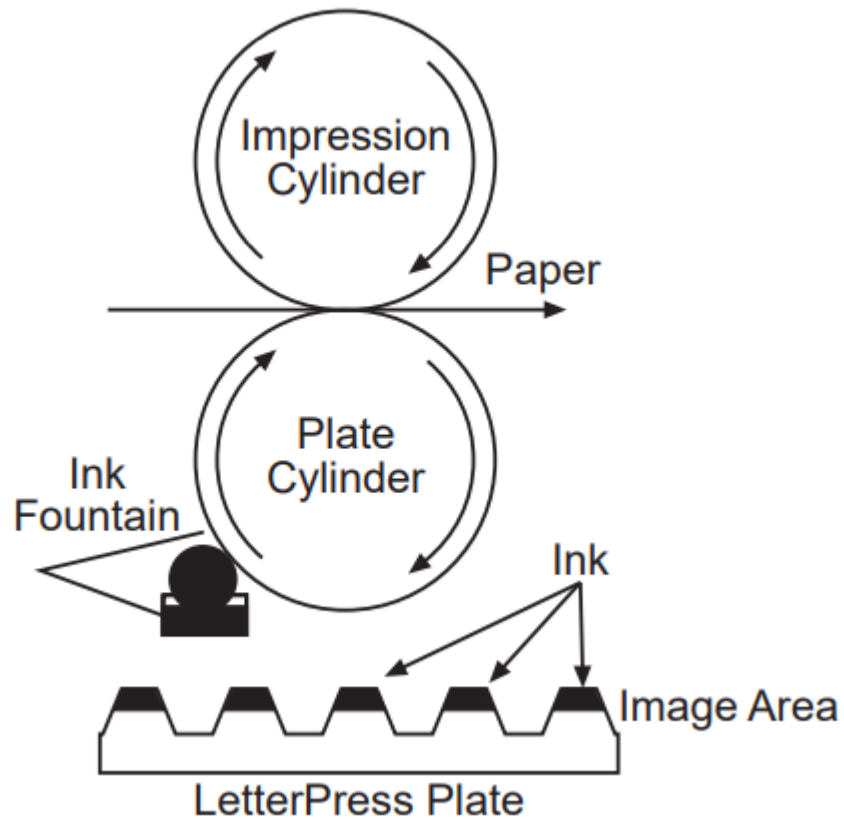
- The front end of the press is a computer that controls the digital data into the press.
- Direct imaging technology uses waterless printing.
- When the press is in operation, the plate is in contact with the ink rollers that apply ink onto the image areas. The image is transferred to a blanket and then onto the substrate as in offset.

2. RELIEF PRINTING - LETTERPRESS



- As the name of the process says, the image areas are in relief and the non-image areas are in recess.
- On application of ink, the relief areas are coated with a film of ink and the non-image areas are not. With pressure over the substrate to bring it in contact with the image area, the image is then transferred to the substrate.
- If you can picture how a rubber stamp transfers ink to paper, then you understand the principle of letterpress and flexography.
- Relief printing was the earliest form of printing and remained dominant for a very long time.
- It is essentially a modern version of letterpress which can be used for printing on almost any type of substrate, including plastic, metallic films, cellophane, and paper.

RELIEF PRINTING - LETTERPRESS



RELIEF PRINTING - LETTERPRESS



- It is widely used for printing on the non-porous substrates required for various types of food packaging (it is also well suited for printing large areas of solid colour).
- A letterpress printed product can be identified by the indentation that it creates in the paper. This is due to the mechanical pressure applied to the paper. In spite of this, letterpress produces images that are sharp and clean.
- It is a direct printing process, which means that ink is transferred directly from the printing surface to the substrate.
- Letterpress is still used to some extent for embossing, imprinting, and special-purpose reproduction.

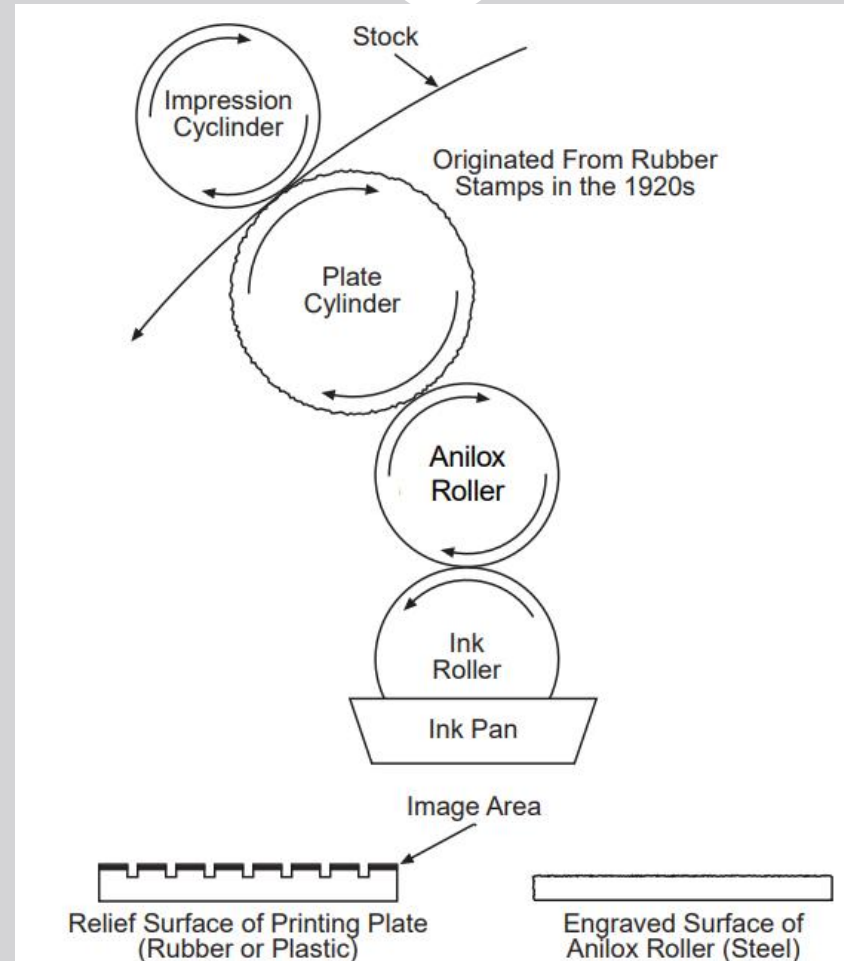
RELIEF PRINTING - LETTERPRESS



❑ FLEXOGRAPHY

- This process adopts the same principle of relief printing and is therefore similar to letterpress.
- The printing surface is made of rubber instead of metal. The plate (the printing surface) is imaged from film or laser. Rubber plates were replaced by photopolymer plates during the 1970s as was the case with letterpress printing.
- Flexography is largely used in the packaging industry, where the substrates used are plastic, aluminum, foil, etc., for which the rubber plates are more suitable, due to their being soft.
- Usually flexography prints rolls of paper or foil instead of cut sheets.

RELIEF PRINTING - LETTERPRESS



RELIEF PRINTING - LETTERPRESS



❑ Flexography features:

- Printing from wrong-reading raised image, flexible plate direct to substrate
- Principal applications: almost any substrate which can go through a web press – tissue, plastic film, corrugated board, metal foil, milk crates, gift wrap, folding cartons, labels, etc.
- Recognition characteristics: as a relief printing method, has recognizable, but slight, ink halo effect around letters and solid color areas
- Two categories: wide web (18 or more inches wide) and narrow web - Wide web flexo market: flexible packaging, newspapers, corrugated boxes - Narrow web market: primarily labels, high-quality process color - Some flexo corrugated box printing is sheetfed

3. RECESS PRINTING



- Gravure is another direct printing process, like letterpress with, however some major differences. The image is directly transferred from the image carrier, which is usually a cylinder, onto the substrate.
- Gravure is called intaglio because the image areas are in a sunken area and the non-image areas are in relief.
- In gravure printing, the image is engraved onto a cylinder because, like offset printing and flexography, it uses a rotary printing press.
- Once a staple of newspaper photo features, the rotogravure process is still used for commercial printing of magazines, postcards, and corrugated (cardboard) and other product packaging.
- Gravure is an industrial printing process capable of consistent high quality printing.

RECESS PRINTING



❑ Press construction

- A gravure press is constructed with two cylinders per unit, a printing cylinder, which carries the image and an impression cylinder like in the offset process, that applies the required pressure to transfer the ink.
- Gravure cylinders are usually made of steel.
- This cylinder has a number of tiny cells in it, around 50,000 to a square inch.
- The cells are protected by walls that are in relief.
- The surface of the cylinder is plated with copper to hold the image.
- The image is transferred photographically to the electroplated copper surface.
- The non-image areas on the copper are chemically etched or mechanically engraved to form the cells. Each cell varies in its depth, and this enables each cell to transfer varying densities of ink to produce tones.
- The ink used in gravure is in a liquid form.

RECESS PRINTING



❑ Doctor blade

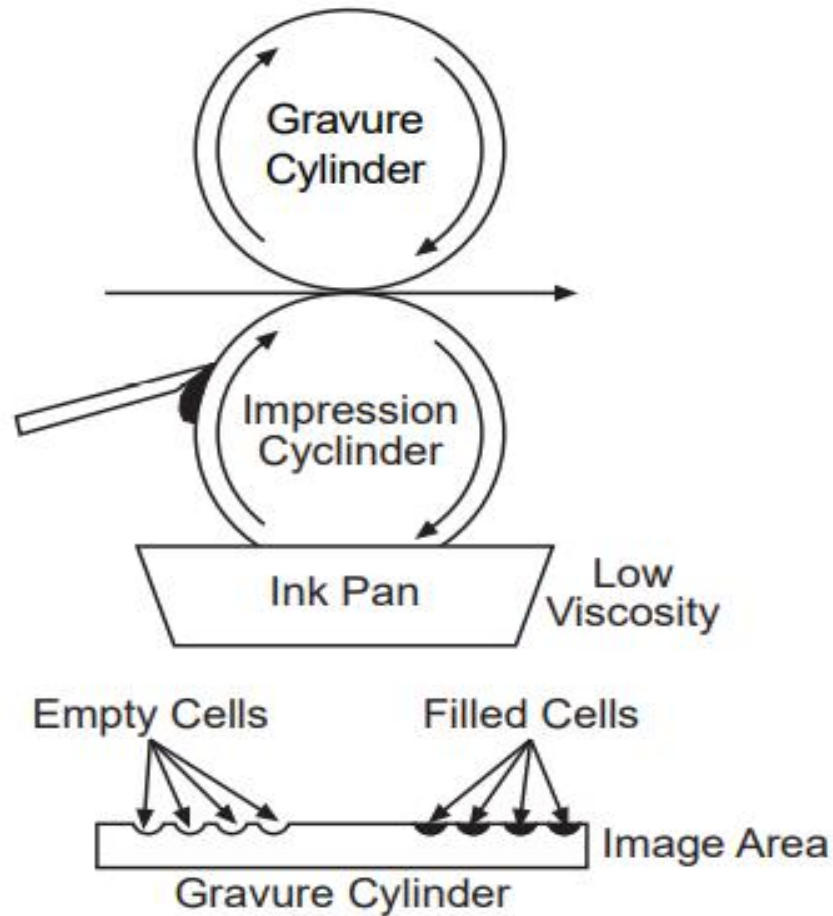
- The printing cylinder rotates in a trough of liquid ink. During this motion, the inks fill the cells of the cylinder and inks the image areas. However, the non-image areas also get inked as they are in relief. This excess ink is wiped clean by a blade called a doctor blade.
- The doctor blade is positioned at an angle over the cylinder so that when the cylinder rotates, the excess ink that was picked up by the non-image areas are wiped clean.
- In the continuing motion of the cylinder, the paper (or the substrate) is fed in between the printing cylinder and the impression cylinder. By pressure, the ink in the cells is forced out onto the substrate.
- Since the printing image is made of copper, which is quite expensive, gravure is usually used for very long-run jobs which it handles well because the image is placed on the cylinder directly, and on copper, which is a strong metal.

RECESS PRINTING



- Traditionally gravure has been used by markets that have a need to produce long run and consistently good quality printing.
- Most gravure presses are web-fed. Some are as large as 16 feet wide.
- The gravure process is used for specialty products like wall paper and vinyls.
- Gravure presses can print at incredible speeds like 2500 feet per minute. So one can imagine that unless the job calls for huge numbers to be reproduced, in high quality, gravure as a process cannot be chosen.

RECESS PRINTING



RECESS PRINTING



❑ Gravure features

- Printing from wrong-reading recessed image cylinder direct to substrate
- Three major segments: publications, packaging, and specialty product printing
- Principal applications: packaging, long-run magazines and newspaper inserts, catalogs, wallpaper, postage stamps, plastic laminates, vinyl flooring
- Recognition characteristics: serrated edge to text letters, solid color areas
- Relatively short makeready times on press; high color consistency; continuous, repeated image
- Cylinders last forever, making repeat runs very economical
- Cost of making cylinders remains high, making gravure expensive for jobs that are not repeated or not extremely long
- Trend is toward removing chemistry from cylinder-making procedure, increased use of water-based inks

4. STENCIL PRINTING – SCREEN PRINTING



- This is a process that is used by many artisans for short-run jobs.
- It is such a less expensive process that many screen printing units are operated out of garages. But that does not mean that screen printing cannot offer good quality printing. It is a pretty simple process to understand and operate.
- Basically if you have seen how printing is done from a stencil, then you have probably seen the process of screen printing.
- The process is pretty much photographic in the image creation stage and it is mostly manual at the printing stage.
- The image that needs to be printed is first captured on a photographic material, a positive usually.
- A silk screen is stretched tightly by hinging around a wooden frame.

STENCIL PRINTING – SCREEN PRINTING



- The process derives its name from this silk screen, which was used as the image carrier.
- The positive image is then transferred to the screen and developed.
- The image that has been transferred to the silk screen is on the porous area of the screen.
- The non-image areas are blocked out during the stage of image creation itself.
- The screen is laid over the substrate that is to be printed and ink is poured on the frame over the screen.
- The ink is then wiped across the surface of the screen using a device called a squeegee.
- A squeegee is a wooden device that has a rubber blade. It facilitates the smooth flow of ink over the screen. Since the screen is porous in nature, the ink flows through it. Because the image areas are porous, they allow ink to flow through them. This ink is thus printed onto the substrate beneath.

STENCIL PRINTING – SCREEN PRINTING



❑ Printing capability

- Since the printing surface in the screen printing process is very flexible, it allows printing on three-dimensional objects too.
- A substrate that is two-dimensional and flat is all that can be fed into those machines; in the case of screen printing, the printing surface itself can be wound around the substrate. So objects like cups, mugs, watches or other irregular-shaped products can be done using the screen printing process.
- Although this description of screen printing may sound quite simple, in actuality there are screen printing presses that are as automated as any other printing presses.
- Multi-color printing presses employing screen printing process with capability to print on different substrates like polyester, metal, and pressure-sensitive materials are today a common scenario. These presses are equipped with online corona (electrostatic) treatment, and can even combine ultraviolet drying in some color units.

STENCIL PRINTING – SCREEN PRINTING



❑ Screen printing features

- Printing by forcing ink through a stenciled screen mesh image directly onto substrate
- Principal applications: can print on any substrate; point-of purchase displays, billboards, decals, fabric, electronic circuit boards, glasses, etc.
- Ink formulation, screen mesh count, and image type are major quality factors
- Recognition characteristics: heavy, durable, brilliant layer of ink

5. DIGITAL PRINTING



- Digital printing refers to methods of printing from a digital-based image directly to a variety of media.
- It usually refers to professional printing where small-run jobs from desktop publishing and other digital sources are printed using large-format and/or high-volume laser or inkjet printers.
- Digital printing has a higher cost per page than more traditional offset printing methods, but this price is usually offset by avoiding the cost of all the technical steps required to make printing plates.
- Application-Desktop publishing, Variable data printing, Fine art, Print on Demand, Advertising, Photos, Architectural Design, Screen printing etc.

DIGITAL PRINTING



❑ Dot matrix

- These were the early forms of outputting a document from a personal computer. Used largely in the office environment, they did (and do) a pretty good job.
- The printers have a series of hammers in the print head. A color ribbon, usually black, is placed in front of the head. On instruction from the computer to print, the hammer whacks the ribbon against the paper placed behind it. The ink from the ribbon is thus transferred to the paper. The character or images are constructed by a formation of small dots.
- The quality of the output is quite poor, and the noise that is generated by the printer is quite disturbing.
- Types do not look sharp and the problems are worse when printing one color over another.
- The quality of image transfer deteriorates with aging of the ribbon and/or the hammer.

DIGITAL PRINTING



❑ **Electrostatic**

- A laser beam creates a selective charge on a selenium drum when exposed to laser light. The charge takes place in the image areas. The equivalent of ink is a toner particle. This toner particle gets attracted to the charge in the drum. When the substrate is fed into the machine, the toner particles transfer from the drum onto the substrate.
- A lot of document copying and printing work is done this way, and is also called photocopying, because multiple copies of a document are created by the use of light.
- Color electrostatic printers adopt the same principle to reproduce color and, depending on the equipment, the paper may pass through the machine four times, in a single writing station, or once in a multiple-pass station.
- These printers can print good line work, as they have a high addressability. Some of these printers print 600 dpi.

DIGITAL PRINTING



❑ Laser printing

- This is electrophotographic imaging as in copying machines, with the printing machines driven by computers. When the document is sent for output, a laser beam charges the printing drum by applying a static charge to the photoreceptive drum.
- The areas that received the charge tend to attract toner particles, and the image is transferred to substrate. For permanency, the toner-based image is heated and fused with the substrate.
- The early models of laser printers which produced good quality copies had one drawback. The speeds were not very attractive for high volume requirements.
- Now high-speed printers are available like the Xerox Docutech 135 and 180, as well as Docucolor 40 and 70/100 which can be used for production work. They all use the laser process principle. Though claimed to be high-speed printers, they do not compare with traditional printing process speeds. Nonetheless, they are quite popular in the short-run, and on-demand printing markets.

DIGITAL PRINTING



❑ Thermal printing

- If you have seen the way something gets printed from a fax machine, then you have pretty much understood this process.
- A specially made paper that is coated with a dye is used in this process. When the paper is heated it turns black. So, during the imaging process, the image areas are heated and the spots on the paper turn black, giving us the reading matter printed.
- This is also a popular method employed for generating labels and barcodes. Because the process involves an induced change in the state of the substrate (paper), the process is limited to printing only in single color.

DIGITAL PRINTING



❑ Dye diffusion printers

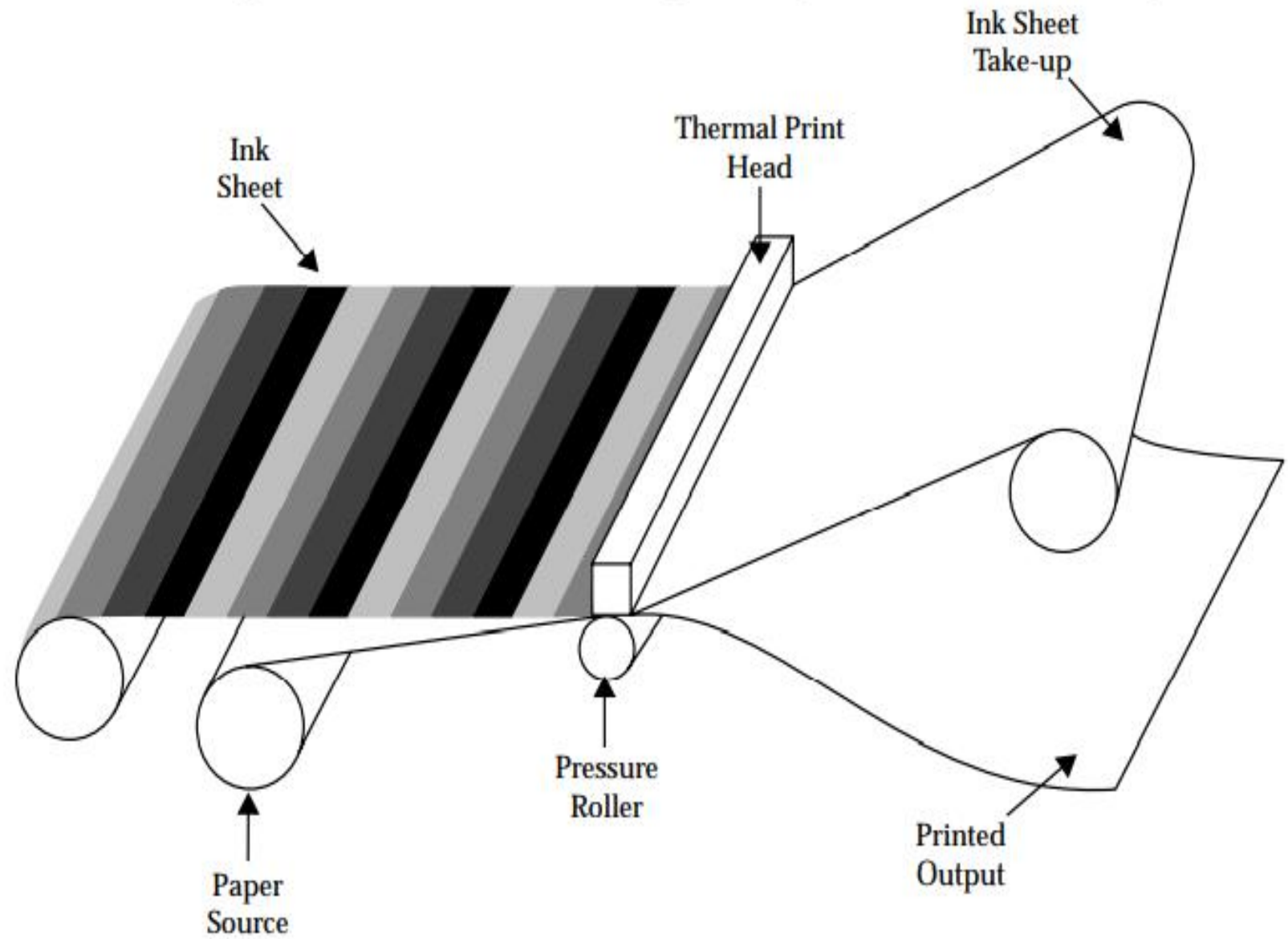
- Originally this process was created for printing on fabrics. It uses a color donor ribbon that transfers the dye to the substrate by the use of heat.
- The temperature is usually very high, in the region of 400 degrees C. By varying the temperature on the print heads, varying intensities of color can be printed. This can produce a feel of continuous tone printing.
- This process has a good potential, as the inks used in dye diffusion printing have a color gamut greater than that of photography. However the flip side to this technology is that it is expensive, slower, and requires special substrates to print on.

DIGITAL PRINTING



❑ Thermal wax printing

- This process is somewhat similar to that of a dye diffusion printer, using wax as the medium of “ink transfer.”
- A metal drum is divided into a grid that addresses a pixel to a spot on the grid. Every spot on the grid is assigned a color value.
- The pixels in the grid heat up and melt the wax in the ribbon, which is transferred to paper. These waxes are transparent, which makes it advantageous for these prints to be used as overhead slides for projection.
- Some of these types of printers have a three- or four-color ribbon to print from. They both produce color prints, but the one with four-color ribbons has more visual appeal than the tri-color ribbon printer.



Thermal and dye diffusion printers have special ribbons with alternating color areas

DIGITAL PRINTING



❑ Inkjet printing

This process works by spitting small droplets of ink on the surface of the paper. The amount of ink that is to be spewed on the substrate is controlled by a computer. There are three kinds of ink jet printing:

- ❖ continuous inkjet printing
- ❖ drop-on-demand inkjet printing
- ❖ phase-change inkjet printing

DIGITAL PRINTING



❖ **Continuous inkjet “spits” the ink at the substrate**

- Continuous inkjet printing “spits” liquid ink in a continuous fashion, and the pressure of the spurting of the ink is controlled by a vibrating device and the ink is spurted from an orifice which also determines the size of the droplet that will ultimately land on paper.
- All of the ink is fired from a single nozzle. This produces print which makes good line work and solid colors, which is acceptable for some low-end applications of the market.
- When it comes to printing fine images and multi-color printing, the drawback in the process stems from the single nozzle rather than an array or group of them. And that is what happens in continuous array ink jet. Every droplet’s size is controlled by a single nozzle. Because of multiple arrays, speeds can be increased, and this gives better productivity.
- An array of continuous ink jet printing nozzles can also be attached to highspeed printing presses for specialized printing like barcoding or personalization.

DIGITAL PRINTING



❖ **Drop-on-demand inkjet printing**

- The ink is forced out of the orifices onto the substrate only where it is required. This is done by one of several methods. The inks used in this process are water-based. When heated, the water in the ink vaporizes and forms a gas bubble. This causes a droplet of ink to be pushed out of the orifice in the chamber, which will have to be replenished. The replenished ink then goes through the same process till it is pushed out. Because of this alternating method of throwing out the ink and then replenishing the chamber, the process slows.
- Another drop-on-demand ink jet printing method uses a piezoelectric plate. This plate carries the ink, and on an electrical current being passed, the size of the plate is deformed. The deformation of the plate reduces the volume of the ink in the plate and causes it to spill a drop. The drop of ink lands and dries on the substrate. This kind of inkjet printing is commonly used for large billboards and posters. The quality is acceptable.

DIGITAL PRINTING



❖ **Phase-change inkjet printing**

- The process derives its name because the ink changes its state from solid to liquid to solid before it actually lands on paper.
- These printers use a waxy kind of an ink in the ink chamber. This wax is heated and the ink changes to a molten state in a reservoir. When the print head receives an electrical signal, the volume of the reservoir reduces, causing the molten ink to be ejected. The reservoir is filled when there is no charge. Based on the signal received from the computer, the print head either turns on or turns off the electrical signal. Thus, the ink ejection from the reservoir is controlled. Since the ink is wax-based, it gels well with the substrate and does not penetrate the substrate.
- Up to 600 dpi can be addressed by this process, and it produces sharp and saturated images. As the ink settles on the surface of the substrate, its thickness can be felt; this also adds to the feel of the image printed on it. However, if handled, the print is subject to abrasion and can get damaged.

DIGITAL PRINTING



❑ Digital printing features

- Digital printing is a rapidly growing segment of printing.
- Principal applications: short-run, on-demand printing.
- A digital printer can be defined as one that inputs a digital data stream and outputs printed pages. The broad categories of digital printers include electrostatic, inkjet, and thermal. But we can also say that any printing process that takes digital files and outputs spots is also digital.
- Interdependency with digital presses will likely create major changes in the operation of the printing industry and increase the volume of digital printing.
- Xerox DocuTech, Xerox Docucolor, Indigo E-Print, Xeikon DCP, Scitex, Agfa, Chromapress, and Canon CLC-1000 are among current major electronic systems.

HOW TO IDENTIFY PRINTS



- Before digital and photographic technology, images were transferred to paper from stone, metal, and wood. Part of a good education in art history involves studying and identifying these different printing processes.
- There are three methods to identify prints:-
 1. Identifying relief prints,
 2. Identifying intaglio prints and
 3. Identifying planographic lithographs.

HOW TO IDENTIFY PRINTS



- **IDENTIFYING RELIEF PRINTS**

Relief printing is the oldest and most traditional printing technology, and involves reproducing images at its most basic. In relief printing, a wood or metal relief block is carved by cutting away the areas of the picture that will not be printed, then ink is applied to the raised areas either by dabbing the areas to be printed, or rolling the ink on. The final stage of the process involves transferring the ink to the page by laying a sheet of paper and applying pressure.

- It involves 4 steps

1. Understand the process of relief printing.
2. Examine the rim of the print.
3. Look for signs of embossing.
4. Look for signs of cutting in the cross-hatching or shaded areas.

HOW TO IDENTIFY PRINTS



- **IDENTIFYING INTAGLIO PRINTS**

Intaglio is Italian for “incising,” and correspondingly revolves around a process of applying ink into the grooves or etches or engravings, then using a lot of pressure to transfer that ink from the indents onto the page. This usually results in slightly crisper, more substantial lines that you can learn to identify.

- The process was developed in the 1500s. Engraving and etching are both styles of intaglio printing, with slightly different techniques and signifiers.
- It involves 6 steps
 1. Understand the process of intaglio printing.
 2. Look for plate marks.
 3. Look for raised ink.
 4. Look for varying intensity of color in single lines.
 5. Look at the shape of the line.
 6. Study more intaglio techniques.

HOW TO IDENTIFY PRINTS



- **IDENTIFYING PLANOGRAPHIC LITHOGRAPHS**

Lithography is a big term often used to refer to many different styles of printing, contemporary and classical. But, in pre-photographic terms, planographic lithography is that which is printed from a flat surface.

- In planographic printing, plates are prepared by laying down an image in a greasy or oily substance, typically called tusche, that will hold ink.
- The blank areas of the plate will then be washed off with water, removing the ink from those areas.
- Types of planographic lithography include: Chalk-manner prints, Chromolithography, Tinted lithography, Transfer lithography.

HOW TO IDENTIFY PRINTS



- It involves 6 steps
 1. Understand the different varieties of lithography.
 2. Magnify the image.
 3. Look for the absence of plate marks.
 4. Look for the flatness of the ink.
 5. Look for the illusion of shade, created by multiple layers.
 6. Look for blurriness.

What is Reprographics?



- There are many different types of documents which need to be copied within Caledonian Health & Fitness. Examples are:
 - Legal documents eg employee contracts
 - Educational documents eg training manuals
 - Memorandums; Letters; Notices etc.
- The process of copying documents is known as reprography.

Reprographics Equipment



- Reprographics involves carrying out a range of tasks some of which are more complex than others.
- As a result, a variety of equipment is required for the Reprographics department to act as an efficient support function to the organisation.
- Mr Millar has asked Heather to carry out an inventory (an audit) of the reprographics equipment currently used within Caledonian Health & Fitness.
- Heather noted the following pieces of equipment:
 - Photocopier
 - Printer: Ink Jet and Laser
 - Scanner
 - Binder: Comb and Thermal
 - Laminator
 - Desk Top Publishing Software

The Photocopier



- This is the most common piece of reprographics equipment used in modern offices.
- Photocopiers come in many shapes and sizes
- They range from desktop models to larger models – some are very technical and can be operated from a VDU screen
- Caledonian Health & Fitness has a number of photocopiers to cater to the needs of each department. For security purposes each department has a SECURITY PIN NUMBER for accessing the photocopier to ensure that only authorised personnel have access to such an expensive resource.

Features of The Photocopier



The photocopier can perform the following tasks:

- Produce an exact copy of the original document (the original document can then be filed away, kept safe and referred to in the future)
- The document can be copied onto paper, card or overhead transparencies (OHPs)
- Single or multiple copies can be produced
- Back-to-back copies can be made
- The size of the document can be altered eg A4 to A3
- Booklets can be made

The Printer



- This is a very clever piece of equipment
- It enables the document which has been created on the PC (this is known as the soft copy) to be copied onto paper (this is known as the hard copy)
- There are 2 main types of printers:
 - The INK-JET Printer
 - The LASER Printer

The Ink-Jet Printer



ADVANTAGES

1. Good standard of print quality
2. Can print in colour as well as black
3. Less costly than a laser printer

DISADVANTAGES

1. Operates slower than a laser printer
2. Not suitable for longprint runs (some higher-priced models may cope with this)
3. Smudging or fading may appear on the printouts
4. Running costs are high.

The Laser Printer



ADVANTAGES

1. Very high standard print quality
2. Printing speed is far greater than inkjet printer
3. Ideal for long print runs
4. Smudging and fading does not occur whilst printing
5. Running costs are relatively low

DISADVANTAGES

1. More expensive to buy than an inkjet printer
2. Colour laser printers are very expensive

The Scanner



- The scanner SCANS (copies) what is known as the SOURCE MATERIAL
- Examples of source material are: magazines; photos; chart; printed text etc
- Once the source material has been copied it is then saved as a computer file
- The file can then be used for a specific purpose eg Mr Smart could scan photos of new pieces of gym equipment and place them into the company's monthly newsletter for customers to see

Types of Scanner



There are 2 main types of scanner:

- Flat Bed
 - The source material is placed onto the glass plate
 - The scanner then moves across the document (exactly as a photocopier) copying the image
 - The image is then saved as a file to be used on the PC
- Hand Held
 - This is a portable scanner
 - The scanner is simply passed over the information and copied
 - Many supermarkets are using these today to enable the customer to have more control over their shopping

Binder



- The binder is used to hold pages together to ensure that they are all kept in order
- Documents which often require a binder are: reports; plans; instruction booklets etc
- Mr Ray Cruik often binds his training manuals together as he believes that it makes the documents look more professional and enables the users to look at the pages in the correct order. It also keeps the pages free from wear and tear

Binder



There are 2 main types of binders:

- COMB
 - holes are punched lengthways and a plastic comb is used to fasten the pages together
 - the binder can be removed at any time if certain pages were required to be replaced or copied
- THERMAL
 - heat is used to fasten an adhesive spine to the pages in order to produce a booklet.

Laminator



- A laminator is a machine which is used to seal documents inside a plastic coating
- Ensures that the paper/card is protected from 'wear and tear'
- Laminating is a great idea if the piece of paper/card is likely to be used regularly eg:
 - Notices
 - library card
 - instruction sheets
- Mr Wallace issues staff with Identity Badges and laminates them to protect them for a long period of time

Desk Top Publishing



- This is a software package used to create high quality documents
- Microsoft Publisher is an example of DTP
- There is a variety of fonts, sizes and styles which can be used to create documents
- Also a range of graphics and designs can be used to enhance the presentation of the document
- Mrs Ambleon uses DTP to produce the following documents for the Sales/Marketing Department
 - Magazines
 - Catalogues
 - Posters



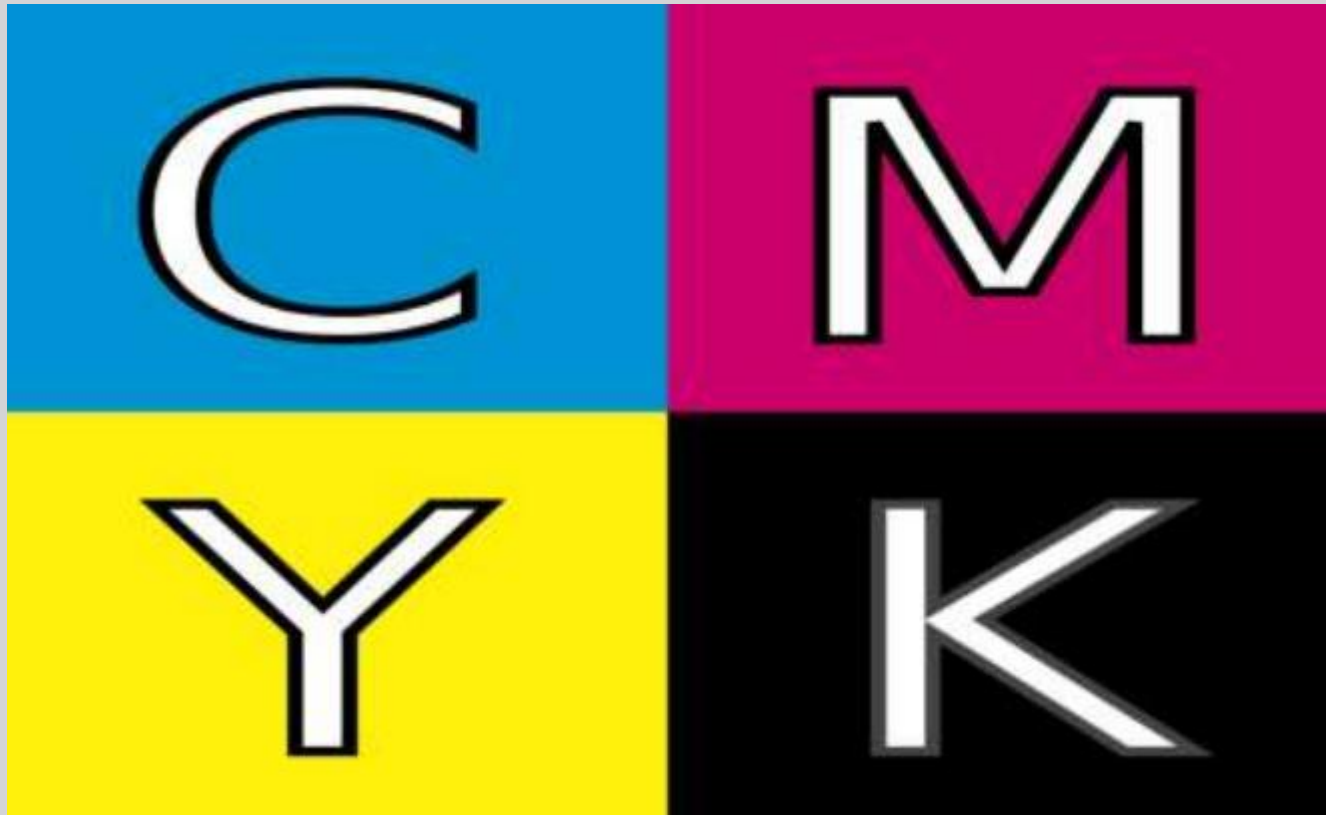
LIGHT AND COLOUR

CMYK



- To reproduce full-color photographic images, typical printing press (and some inkjet printers) use 4 colors of ink.
- The four inks are placed on the paper in layers of dots that combine to create the illusion of many more colors.
- CMYK refers to the 4 ink colors used by the printing press — the subtractive primaries plus black.
 - C is cyan (a blue-green color)
 - M is magenta (a reddish pink color)
 - Y is yellow
 - K is a pure black ink, the key plate or keyline color
- CMYK is not the only full color printing process but is the most common. Other full color methods include 6C Hexachrome and 8C Dark/Light (6 colors and 8 colors instead of just 4).

CMYK



FOUR COLOR PROCESS PRINTING



- Four color process printing is a system where a color image is separated into 4 different color values (called a color separation) by the use of filters and screens.
- This used to be done with photographic film on a graphic arts camera, but is usually done digitally with software now.
- The result is a color separation of 4 images that when transferred to printing plates and sequentially printed on a printing press with the colored inks cyan (blue), magenta (red), yellow and black (the k in cmyk), reproduces the original color image.
- Most of the entire spectrum or gamut of colors are reproduced with just the four process ink colors.

The four color printing process is universally used in the graphic arts and

CMYK PROCESS PRINTING FEATURES



- Uses same 4 standardized base colors all the time (Cyan, Magenta, Yellow and Black)
- Small dots of these colors are printed at different angles to create the printed image
- Most widely used and cost effective color system in commercial printing
- Significantly cheaper than toner based printing for larger quantity runs



ADDITIVE & SUBTRACTIVE DIGITAL COLOR

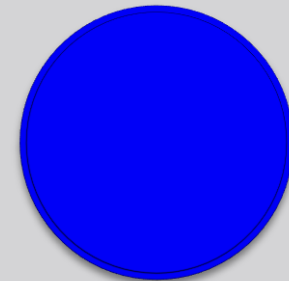
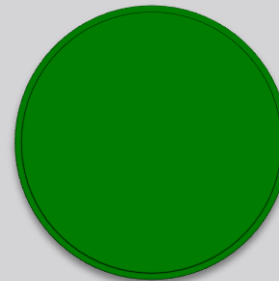
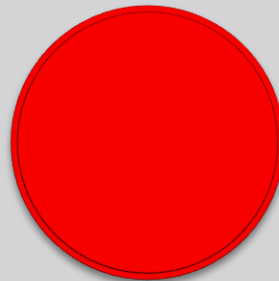
ADDITIVE & SUBTRACTIVE COLOR THEORY

- We have two basic systems for dealing with color - **additive and subtractive**.
- As designers, we work with these every day.
- **Primary colors** are the colors that all other colors are created from.

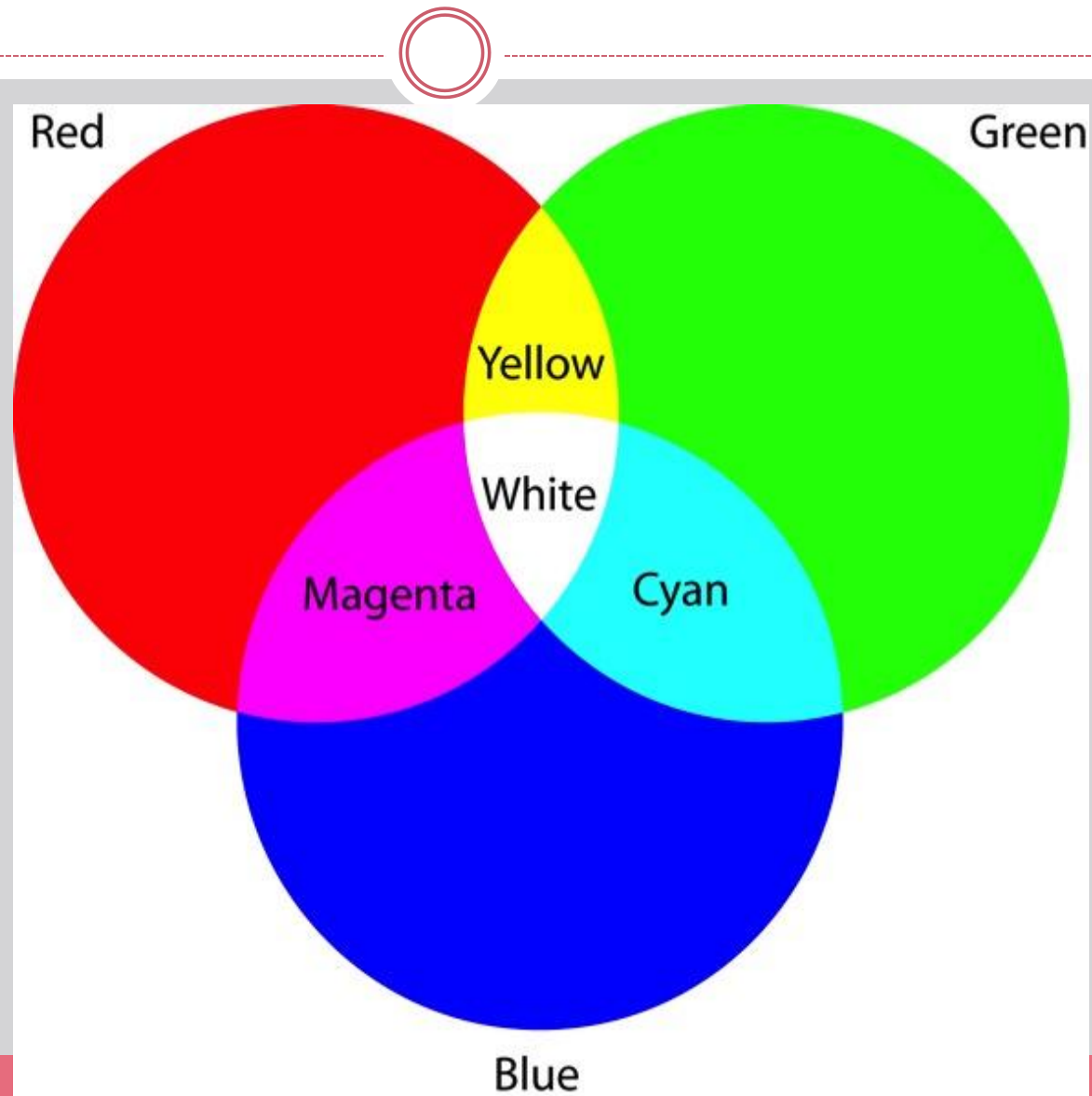
ADDITIVE COLOR THEORY



- **Additive color** theory deals with the **emission of light**.
- The **Primary colors** for an additive system are **Red, Green & Blue (RGB)**.



ADDITIVE COLOR THEORY



ADDITIVE SUMMARY



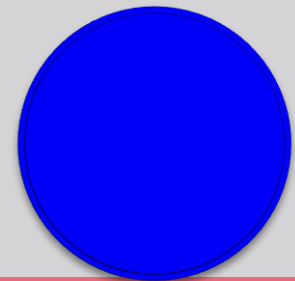
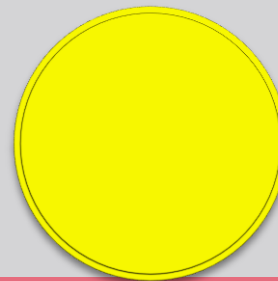
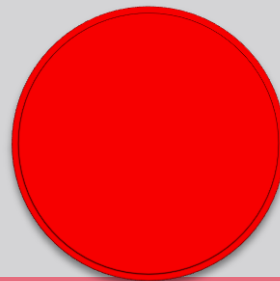
- The computer screen is an **additive color** device. It uses colored light (**Red, Green & Blue**) to display colors.
- Light is projected to our eye in various amounts and mixtures of color.
- Adding light makes things lighter, brighter, whiter.



SUBTRACTIVE COLOR THEORY



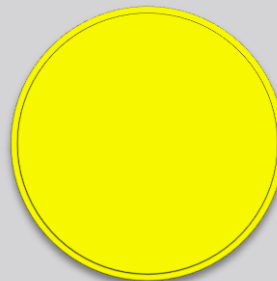
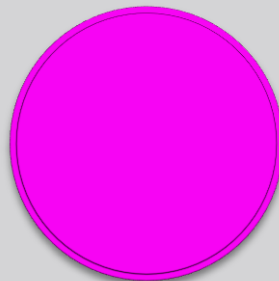
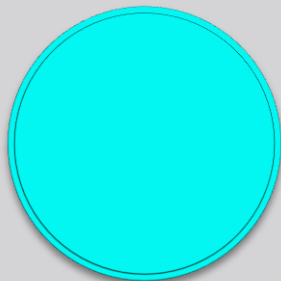
- **Subtractive color theory** deals with **absorption of light**.
- The **Primary colors** for a subtractive system are **Red, Yellow & Blue (RYB)** when working with pigments in paint.



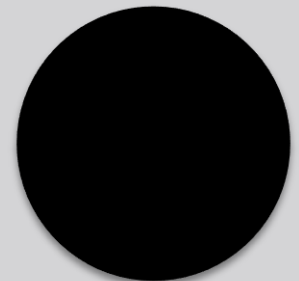
SUBTRACTIVE COLOR THEORY



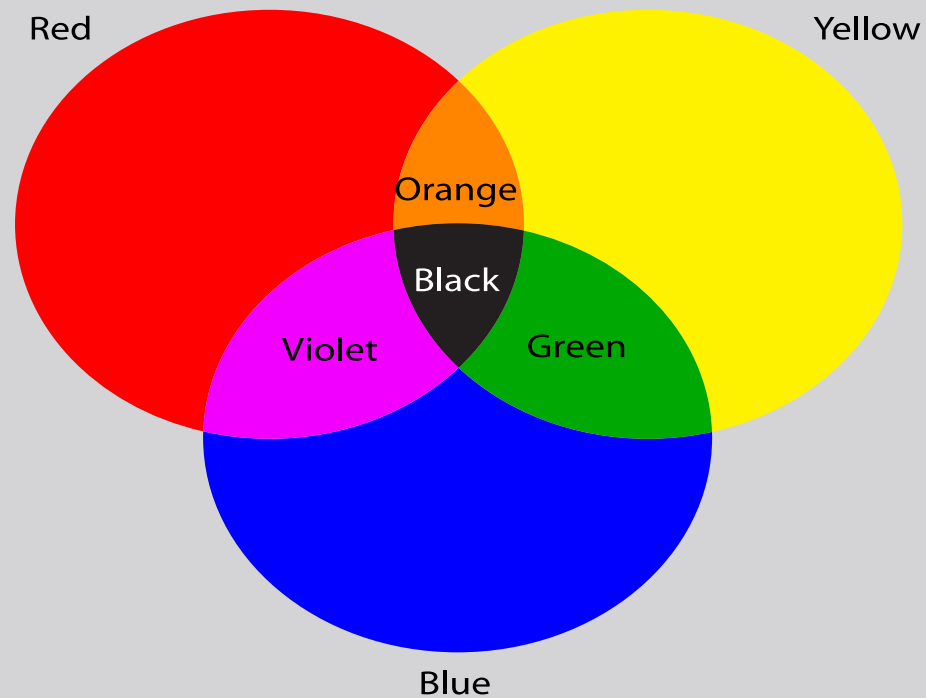
- The **Primary colors** for a subtractive system used in the printing industry are **Cyan, Magenta & Yellow (CMY)**.
- The dot screens are divided in to 3 films that have variable dots depending on image tones that blend to create other colors in the visible spectrum on the printing press.
- The addition of a 4th dot screen - **Black (K)** punches up the darker tones in the final print image.



+



SUBTRACTIVE COLOR THEORY



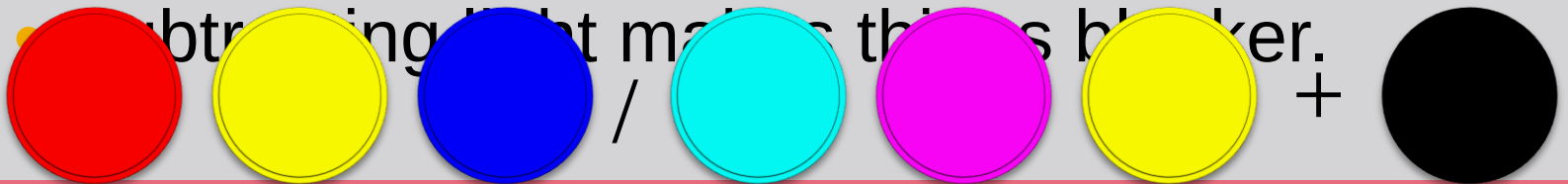
SUBTRACTIVE SUMMARY



- The **pigment** in the paint on our walls, in the wallpaper, dyes in our clothes, printed images etc. are **subtractive color**.
- Part of the light is absorbed and only a portion of it is reflected. We perceive the reflected portion as a color.

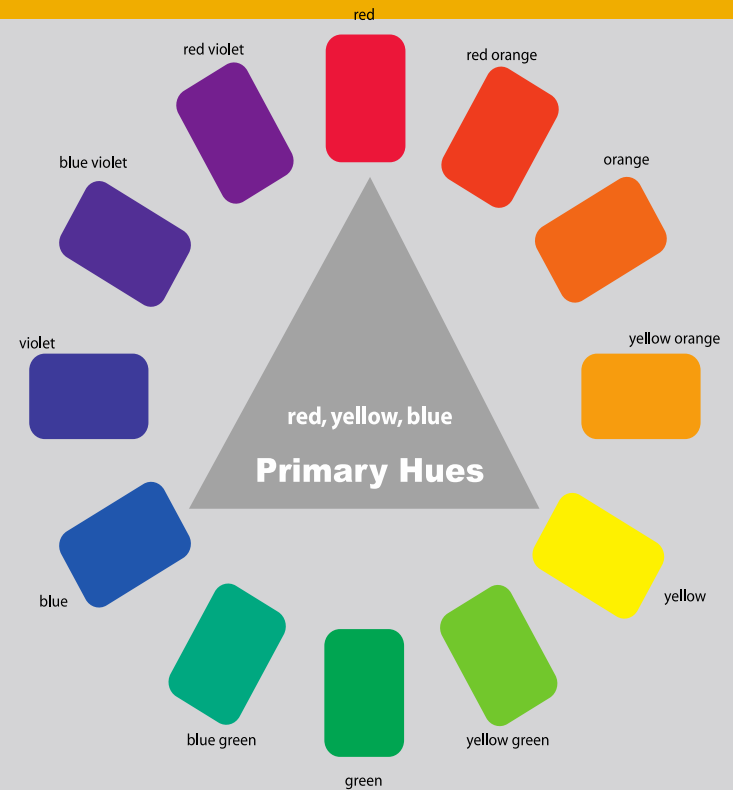
Primary Paint Pigments

Primary Print Pigments



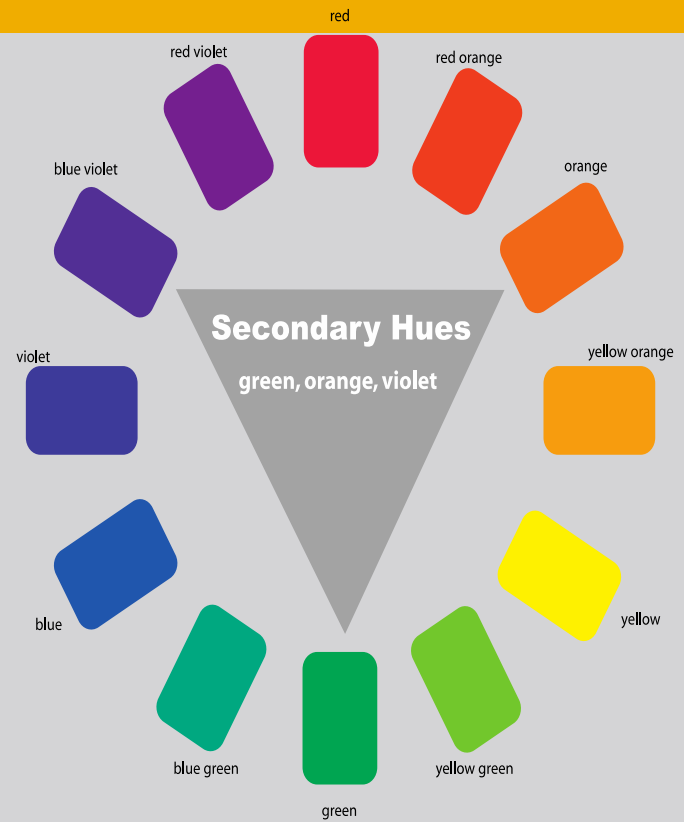
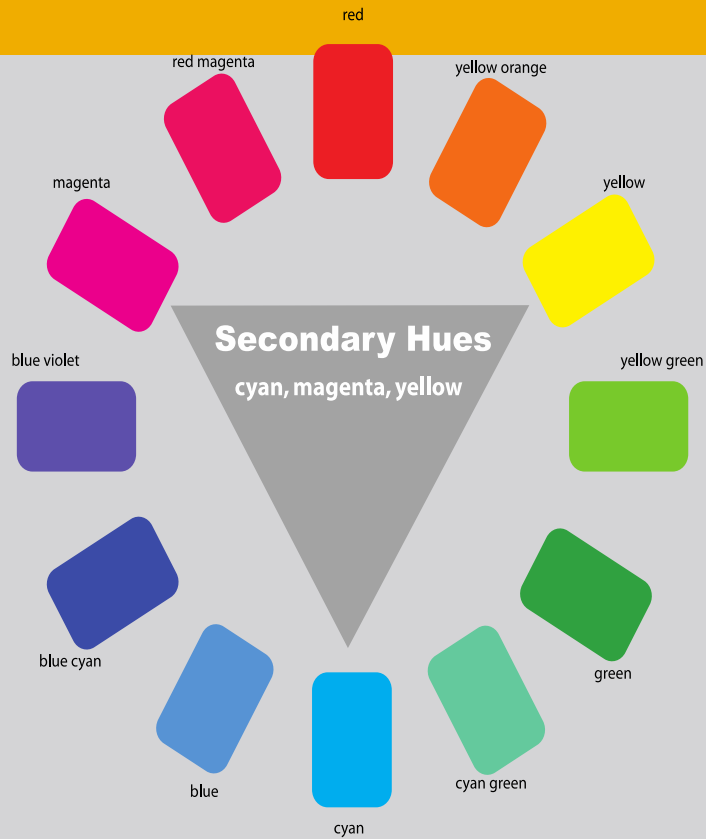
ADDITIVE COLOR WHEEL

SUBTRACTIVE COLOR WHEEL



ADDITIVE COLOR WHEEL

SUBTRACTIVE COLOR WHEEL





QUALITY CONTROL TESTING OF PACKAGING MATERIALS

INTRODUCTION



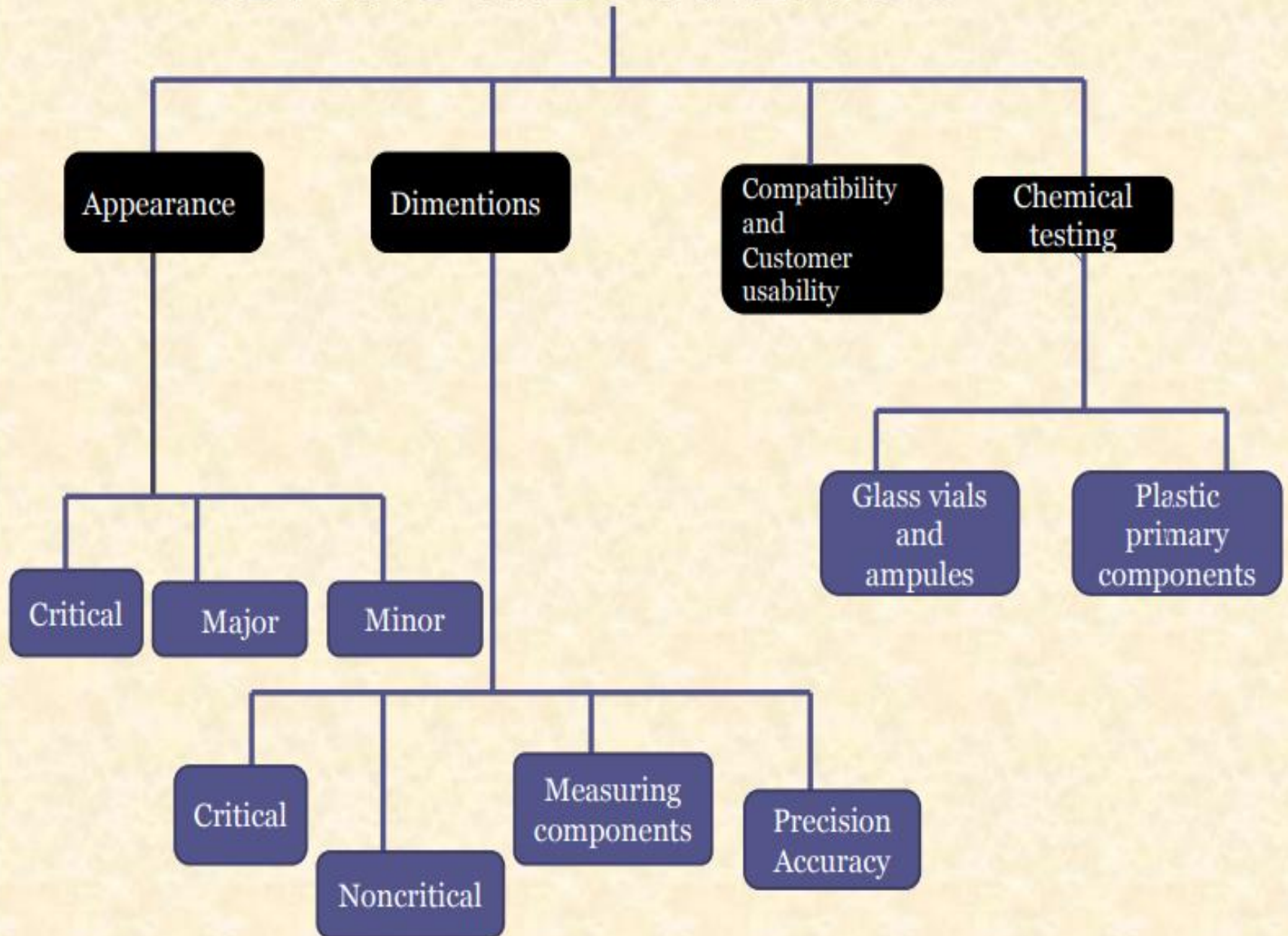
- QC - backbone of pharmaceutical industry.
- Defects in packaging – harmful for dosage form
- Quality control of a packaging component starts at the design stage.
- All aspects of a pack development that may give rise to quality problems must be identified and minimized by good design.
- Physical protection: eg ; shock, vibration
- Barrier protection: eg; oxygen, light
- Portion control: eg; single dose pack.

QUALITY CONTROL AND TESTING STANDARDS



- It is to first determine which batch is for testing purposes.
- The basic testing system is the same for both the components, primary and secondary.
- Although component compatibility and chemical testing are required , in addition , for primary components.

SETTING THE STANDARDS



1. APPEARANCE



- Critical :Unacceptable at any level , eg; rogue printed items in a delivery, incorrect printing of data such as the product name or concentration , insects in the bottles, etc.
- Major: Acceptable at low level; standard is decided by the pharmaceutical company. Very easy to ask for perfection if not possible so a reasonable compromise has to be reached .

Two type standard will result in a supplier not supplying because the standard cannot be met or a 100% inspection of each consignment received by the pharmaceutical company. Too low standard – excessive complaint from market loss of company image and orders.

- Minor: acceptable at higher level then the major appearance defect this will detract from perfection and include marked components, slight color variation, etc.

2. DIMENSIONS



- Critical : requiring close control to insure that the components functions correctly and can be used satisfactorily by the packaging equipment.
- Non critical : necessary to maintain the component shape but not requiring close control . Eg a vial containing injectable product. Components are brought together by filling machine to give sterility to seal , rubber plug and aluminium overseal .

MEASURING COMPONENT



It is possible to accurately measure component without trained staff and variety of measuring equipment such as callipers, micrometer etc. the variety and types of equipment used are determined by materials to be measured.

- 1) Measuring techniques: Even when measuring something simple with a micrometer, such as thickness of a sheet of metal, it is possible to measure it incorrectly due either to not using the ratchet or using the ratchet incorrectly.
- 2) Precision and accuracy: Firstly a set of recently calibrated gauging blocks are required, together with a certificate of calibration. The gauging blocks must cover the full measuring range of the equipment and must be periodically recalibrated at a frequency to be determined by the frequency of use.

3. COMPATIBILITY AND CUSTOMER USABILITY



- This involves checking that each component forming a pack fits together and functions correctly.
- Consider an eye dropper pack as an example.
- The nozzle ,must have a interference fit in the bottle and allow 1 drop at a time delivery through the hole in the nozzle when inverted, but not leak from the fitted position.
- The cap must screw into position and leakage must not occur when the bottle is squeezed in the inveted position.

4. CHEMICAL TESTING



- The majority of chemical testing is required on primary component.
- The type of testing required depends on the type of component used.
 - 1) glass vials and ampules: The USPXXII requirements for glass containers are chemical resistance and light transmission. The requirements vary from country to country.
 - 2) plastic primary components: The testing is more extensive with plastic components, requiring both biological and physicochemical test. This is because the plastic components contain other substance such as plasticizers , stabilizers, antioxidants, pigment, lubricants ,etc.

WATER ATTACK TEST



- This test is used only with containers that have been exposed to sulphur dioxide fumes under controlled humidity conditions. Such a treatment neutralizes the surface alkali. Now the glass becomes chemically more resistant.
- The principle involved in the water attack test is to determine whether the alkali leached from the surface of a container is within the specified limits or not. Since the inner surface is under test entire container (ampoule) has to be used.
- The amount of acid that is necessary to neutralize the released alkali from the surface is estimated, the leaching of alkali is accelerated using elevated temperature for a specified time. Methyl red indicator is used to determine the end point. The basic is acid-base titration.

QUALITY CONTROL TESTS FOR GLASS CONTAINERS: CHEMICAL RESISTANT OF GLASS CONTAINERS



A. POWDERED GLASS TEST :

It is done to estimate the amount of alkali leached from the powdered glass which usually happens at the elevated temperatures. When the glass is powdered, leaching of alkali is enhanced, which can be titrated with 0.02N sulphuric acid using methyl red as an indicator .

QUALITY CONTROL TESTS FOR GLASS CONTAINERS: CHEMICAL RESISTANT OF GLASS CONTAINERS



B. HYDROLYTIC RESISTANCE OF GLASS CONTAINERS:

- Rinse each container at least 3 times with CO₂ free water and fill with the same to their filling volume. Also fill & Cover the vials and bottles and keep in autoclave. Heat to 100°C for 10min and allow the steam to issue from the vent cork. Rise the temp from 100°C to 121°C over 20min. Maintain the temp at 121°C to 122°C for 60min. Lower the temp from 121°C to 100 ° C over 40min venting to prevent vacuum.
- Remove the container from autoclave, cool and combine the liquids being examined. Measure the volume of test solution into a conical flask and titrate with 0.01M HCl using methyl red as an indicator. Perform blank with water and the difference between the titration represents the volume of HCl consumed by the test solution.

QUALITY CONTROL TESTS FOR GLASS CONTAINERS:

CHEMICAL RESISTANT OF GLASS CONTAINERS



C. ARSENIC TEST:

- This test is for glass containers intended for aqueous parenterals. Wash the inner and outer surface of container with fresh distilled water for 5min. Prep test as described in the test for hydrolytic resistance for an adequate no. of samples to produce 50ml. pipette out 10ml solution from combined contents of all ampoules to the flask.
- Add 10ml of HNO_3 to dryness on the water bath, dry the residue in an oven at 130°C for 30min cool and add 10ml hydrogen molybdate reagent. Swirl to dissolve and heat under water bath and reflux for 25min. Cool to room temp and determine the absorbance at 840nm.
- Do the blank with 10ml hydrogen molybdate. The absorbance of the test solution should not exceed the absorbance obtained by repeating the determination using 0.1ml of arsenic standard solution (10ppm) in place of test soln.

QUALITY CONTROL TESTS FOR GLASS CONTAINERS:

CHEMICAL RESISTANT OF GLASS CONTAINERS



D. THERMAL SHOCK TEST

- Place the samples in upright position in a tray. Immerse the tray into a hot water for a given time and transfers to cold water bath, temp of both are closely controlled. Examine cracks or breaks before and after the test. The amount of thermal shock a bottle can withstand depends on its size, design and glass distribution. Small bottles withstand a temp differential of 60 to 80⁰C and 1 pint bottle 30 to 40⁰C. A typical test uses 45C temp difference between hot and cold water.

QUALITY CONTROL TESTS FOR GLASS CONTAINERS:

CHEMICAL RESISTANT OF GLASS CONTAINERS



E. INTERNAL BURSTING PRESSURE TEST

- The most common instrument used is American glass research increment pressure tester .
 - The test bottle is filled with water and placed inside the test chamber
 - A scaling head is applied and the internal pressure automatically raised by a series of increments each of which is held for a set of time
 - The bottle can be checked for predetermined pressure level and the test continues until the container finally bursts.

QUALITY CONTROL TESTS FOR GLASS CONTAINERS: CHEMICAL RESISTANT OF GLASS CONTAINERS

F. LEAKAGE TEST

- Drug filled container is placed in a container filled with coloured solution (due to the addition of dye) which is at high pressure compared to the pressure inside the glass container so that the coloured solution enters the container if any cracks or any breakage is present.

QUALITY CONTROL TESTS FOR RUBBERS



- Fragmentation test for rubber closures
 - Place a 4ml of water in each of 12 clean vials. Close a vial with closure and secure caps for 16 hrs.
 - Pierce the closure with 21 SWG hypodermic needle. Repeat the operation 4 times for each closures.
 - Count the number of fragment visible on the rubber . Total number of fragment should not be more than 10 except butyl rubber

QUALITY CONTROL OF CLOSURES



1. **STERILITY TEST**

When treated closures are subjected to sterilization test at 64-66°C and a pressure of about 0.7 KPa for 24hr.

2. **Fragmentation test**

- For closures for aqueous place a vol of water corresponding to the nominal vol minus 4 ml in each of 12 clean vials.
- close the vials with the 'prepared' closures & allow to stand for 16 hours
- For closures for dry preparations close 12 clean vials with the 'prepared' closures.
- Using a hypodermic needle with an external diameter of 0.8 mm inject 1 ml of water into the vial and remove 1 ml of air.
- Carry out this operation 4 times with new needle each time Pass the liquid in the vials through a filter with a pores size of 0.5 µm.
- No. of fragments is NMT 10 except in the case of butyl rubber closures where the total no. of fragments is NMT 15

QUALITY CONTROL OF CLOSURES



3. Self – sealability test:

- This test is applicable to closures intended to be used with water close the vials with the ‘Prepared’ closures
- For each closure, use a new hypodermic needle with an external diameter of 0.8 mm & pierce the closure 10 times, each time at a different site.
- Immerse the vials upright in a 0.1% w/v solution of methylene blue & reduce the external pressure by 27KPa for 10 min.
- Restore the atmospheric pressure and leave the vials immersed for 30 minutes. Rinse the outside of the vials. None of the vials contains any trace of coloured solution.

QUALITY CONTROL OF CLOSURES



4. PH OF AQUEOUS EXTRACT

- 20ml of solution A is added with 0.1ml bromothymol blue when it is added with a small amount of 0.01M NaOH which changes the colour from blue to yellow. The volume of NaOH required is NMT 0.3ml and if it is done with HCl, the volume of HCl needed should NMT 0.8ml.

5. LIGHT ABSORPTION TEST

- It must be done within 4hrs of preparing solution A. It is filtered through 0.5 μ filter and its absorbance is measured at 220 to 360nm. Blank is done without closures and absorbance is NMT 2.0

QUALITY CONTROL OF CLOSURES



6. REDUCING SUBSTANCES

- 20ml of solution A is added with 1ml of 1M H₂SO₄ and 20ml of 0.002M KMnO₄ and boil for 3min then cool and add 1gm of potassium iodide which is titrated with sodium thiosulphate using starch as an indicator. Blank is done and the difference between titration volumes is NMT 0.7ml.

7. RESIDUE ON EVAPORATION

- 50ml of solution A is evaporated to dryness at 105⁰C. Then weigh the residue NMT 4mg.



THANK YOU