Flexography

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a. Description

Flexography is a printing process which utilizes a flexible relief plate that can be adhered to a printing cylinder. It is basically an updated version of letterpress. It much more versatile than letterpress in that it can be used for printing on almost any type of substrate including plastic, metallic films, cellophane, and paper. 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 color.

b. Applications

Flexography continues to be one of the fastest growing print processes and is no longer reserved just for printing specialty items. The ability of flexography to print on a variety of substrates allows the process to be used for a wide range of printed products. Food packaging is an important market because of the ability of flexography to print on non-porous substrates. This ability makes it useful for printing on plastic bags as well. Other common applications printed with flexography include gift wrap, wallcovering, magazines, newspaper inserts, paperback books, telephone directories, and business forms.

c. Printing Process

The relief plate used for flexography is made of molded rubber or photopolymer materials with the image areas raised above the non-image areas of the plate. Flexographic plates can be created with **analog** and **digital** platemaking processes.

Flexography is a direct printing method in that the inked plate applies the image directly to the substrate. An inked roller known as the "anilox roller", applies ink to the raised portions of the plate which is then transferred to the substrate. The anilox roller has cells that carry a specific amount of ink to the plate. The number of cells per linear inch can vary according to the type of print job and the quality required.

The name "anilox" is derived from the ink that was used for the process until the 1950's. Anilox ink was manufactured with "aniline" dyes which, in the 1950's, were discovered to be health hazards, so pigment based inks were developed and have been used ever since. The ink carrying roller has continued to be called the "anilox roller" even though the aniline dye inks are no longer used for flexography. The current inks are very fluid and dry rapidly and are most often water based.
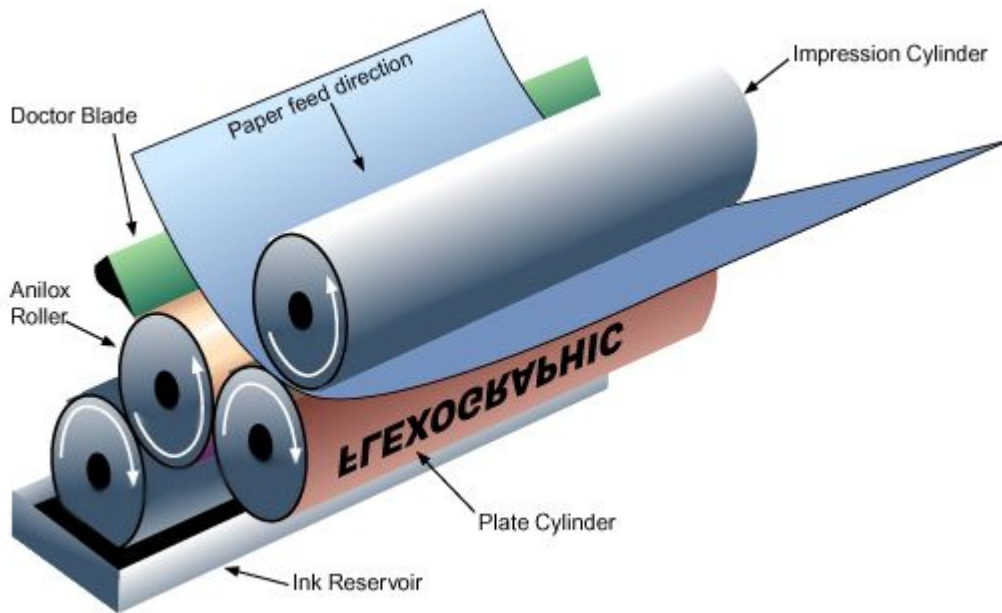
d. Press Types

Flexographic printing is accomplished on rotary web presses. The presses can be divided into three main categories: stack press, in-line press, and common impression cylinder press.

Stack Press: The stack press has separate printing units stacked vertically and each printing unit has its own impression cylinder. This was the first type of press developed for flexography. It is difficult to hold registration between multiple colors printed on stretchable substrates using the stack press, even with web tension controls. It is best suited for heavier gauge substances, such as thick paper products, that will not stretch or for applications that do not require good registration.
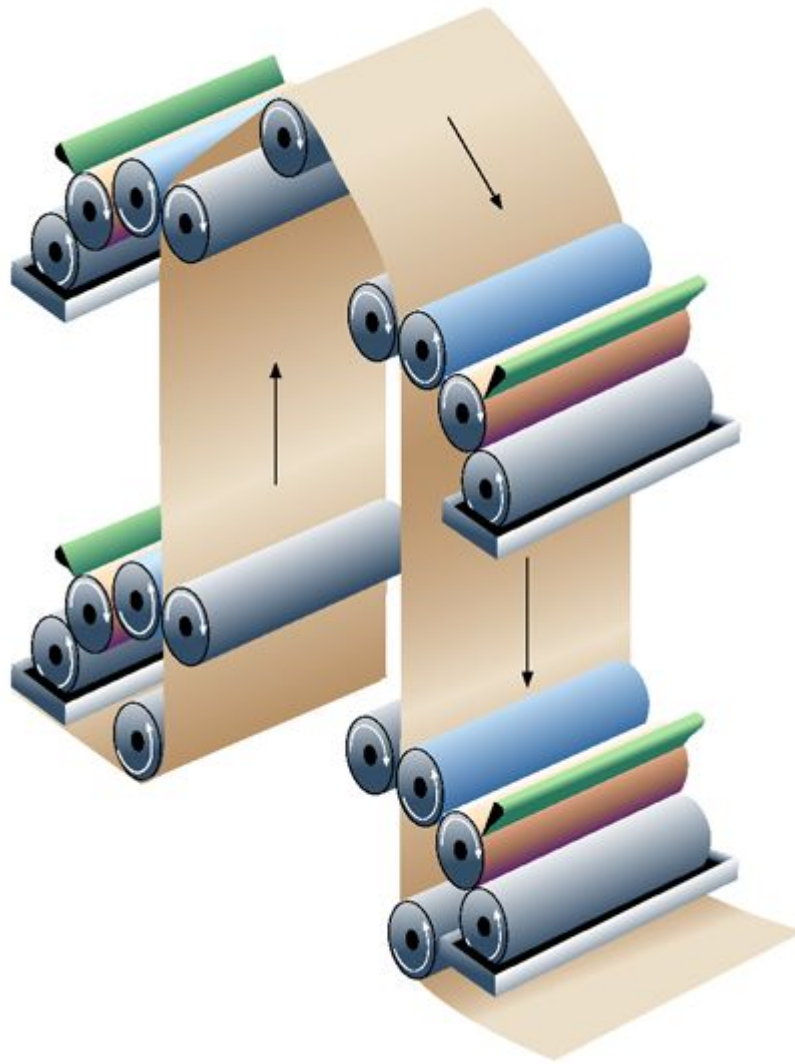
In-Line Press: Like the stack press, the in-line press has separate printing units for each color and each unit has its own impression cylinder, but they are arranged in a horizontal configuration just like a rotary offset press. Because of the distance between the printing units, problems with print registration can occur. Tension control equipment is used on the press to hold proper registration between multiple colors. The wider in-line presses are used for printing large items such as corrugated cartons and smaller width webs are used for printing pressure sensitive labels at high speeds.
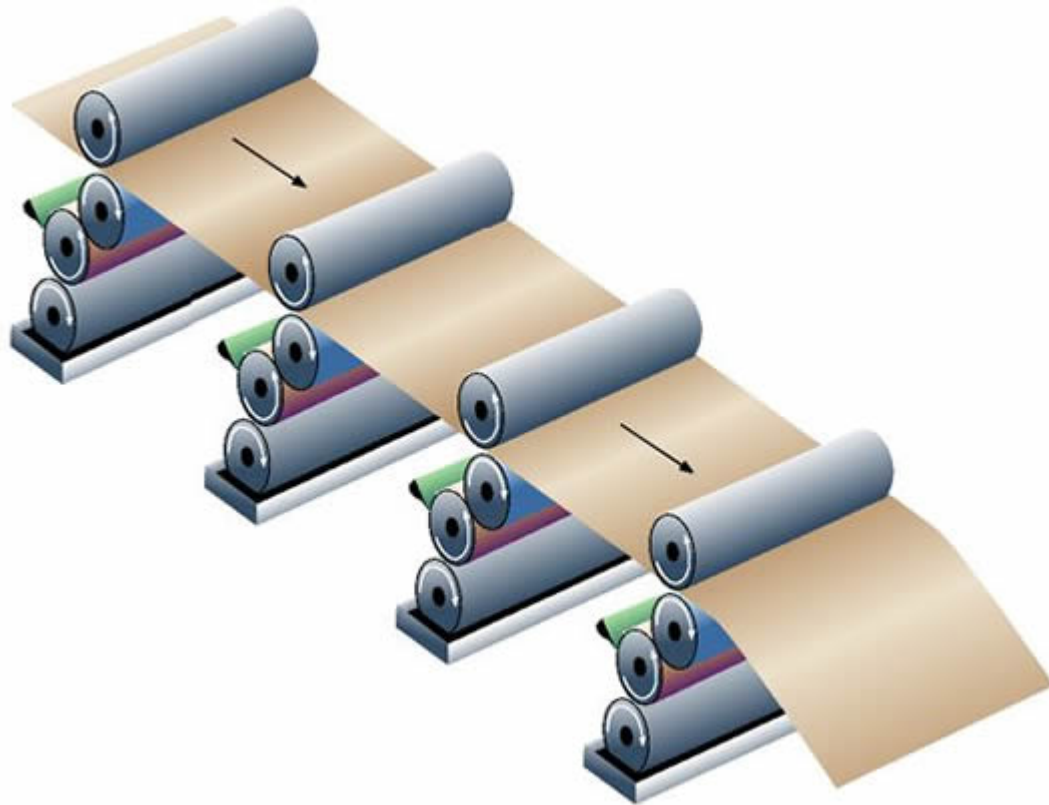
Common Impression Cylinder Press: Instead of the printing units being independent from the others, they are all grouped around a common impression cylinder. Substrates do not stretch as they move around the impression cylinder so the common impression cylinder press is a good choice for printing on substrates such as thin plastics that would normally stretch when used on other types of presses. This type of press provides for better registration of multiple colors. Some CIC presses have impression cylinders that are as much as 8 feet in diameter which allows for as many as 8 stations to be placed around the cylinder. The only drawback of the CIC press is that they can only print on one side of the substrate.
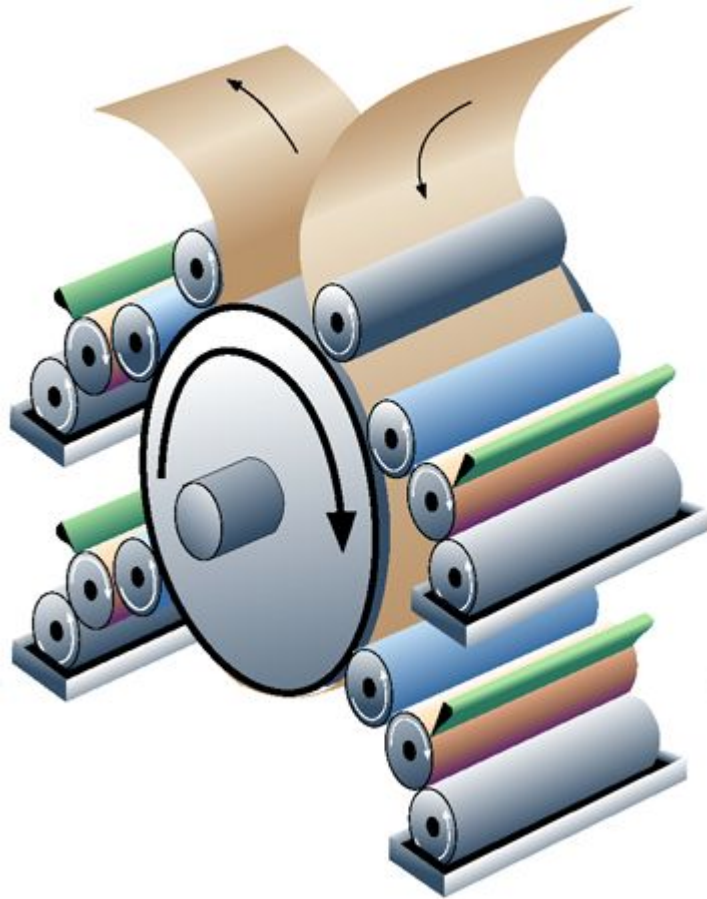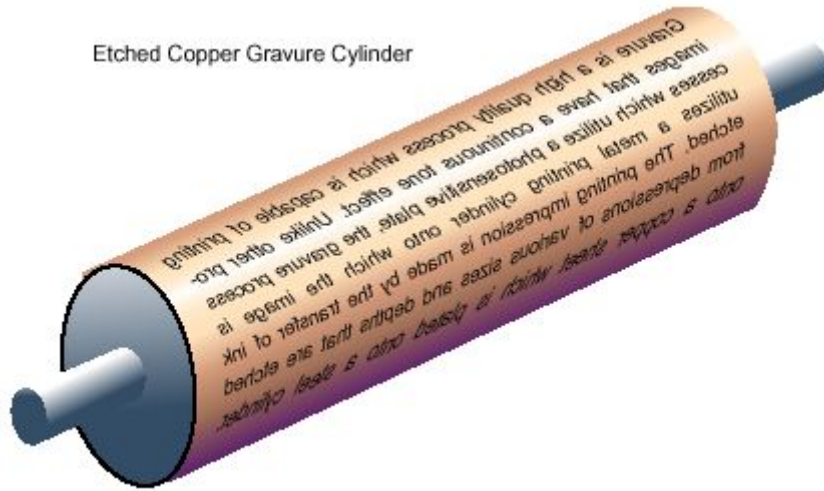
Gravure

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a. Description

Gravure is a high quality printing process capable of producing printed images which have a continuous tone effect similar to a photograph. The gravure process utilizes a metal printing cylinder onto which the image is etched. The gravure cylinder can be created with **analog** or **digital** plating processes.

Etched Copper Gravure Cylinder

b. Applications

Gravure is used for many packaging applications, magazines, and pressure sensitive labels. Gravure is the preferred method of producing magazines and catalogs that have large circulations. An example of a high volume, high quality publication that utilizes rotogravure is the "National Geographic" magazine.

There are also many specialty items that are created with rotogravure including gift wrap, wallpaper, plastic laminates, printed upholstery, imitation wood grain finishes, and vinyl flooring. Many of the specialty items are printed on very wide presses. Some of them, such as those that print patterns on floor coverings, are up to 150 inches wide.
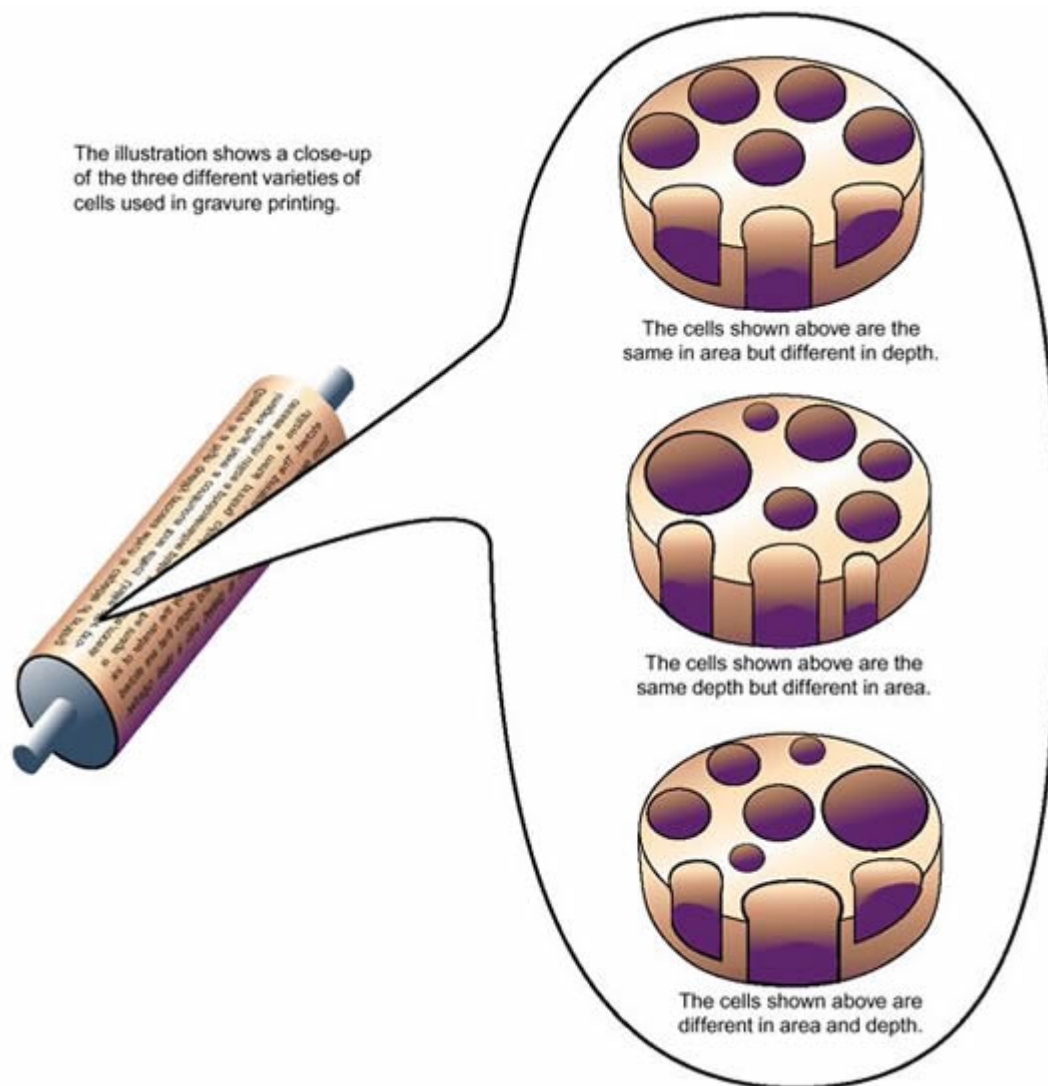
A gravure sheet-fed process is used for smaller runs for such items as limited edition prints and other artwork, photographic books, high denomination postage stamps, stock certificates, and some advertising pieces.

c. Cells

The printing impression produced by the gravure process is accomplished by the transfer of ink from cells of various sizes and depths that are etched into a copper covered steel cylinder. The cells are different sizes and depths and the cylinder may contain as many as 22,500 cells per square inch. The various sizes and depths of the depressions create the different densities of the image. A larger or deeper depression, transfers more ink to the printing surface creating a larger and/or darker area. The areas of the cylinder that are not etched become the non-image areas.

Originally, the cells in a gravure cylinder were all equal in area but they were different in depth. Today, the cells that are engraved in the cylinders are different in area and depth or they can be the same depth but different in area. This allows for greater flexibility in producing high quality work for different types of applications.

Cells that vary in area but are of equal depth are often used on gravure cylinders for printing packaging applications. The gravure cylinders with cells that vary in area and depth are reserved for the highest quality printing.

The illustration shows a close-up of the three different varieties of cells used in gravure printing.

The cells shown above are the same in area but different in depth.

The cells shown above are the same depth but different in area.

The cells shown above are different in area and depth.

Printed images produced with gravure are of the highest quality because the thousands of ink cells appear to merge into a continuous tone image. One drawback with the cells is that the quality of small typefaces, although good, may not be as sharp as type printed with a process such as offset lithography. This is because the type is created with individual cells just like the rest of the image, instead of being printed as a continuous solid shape.
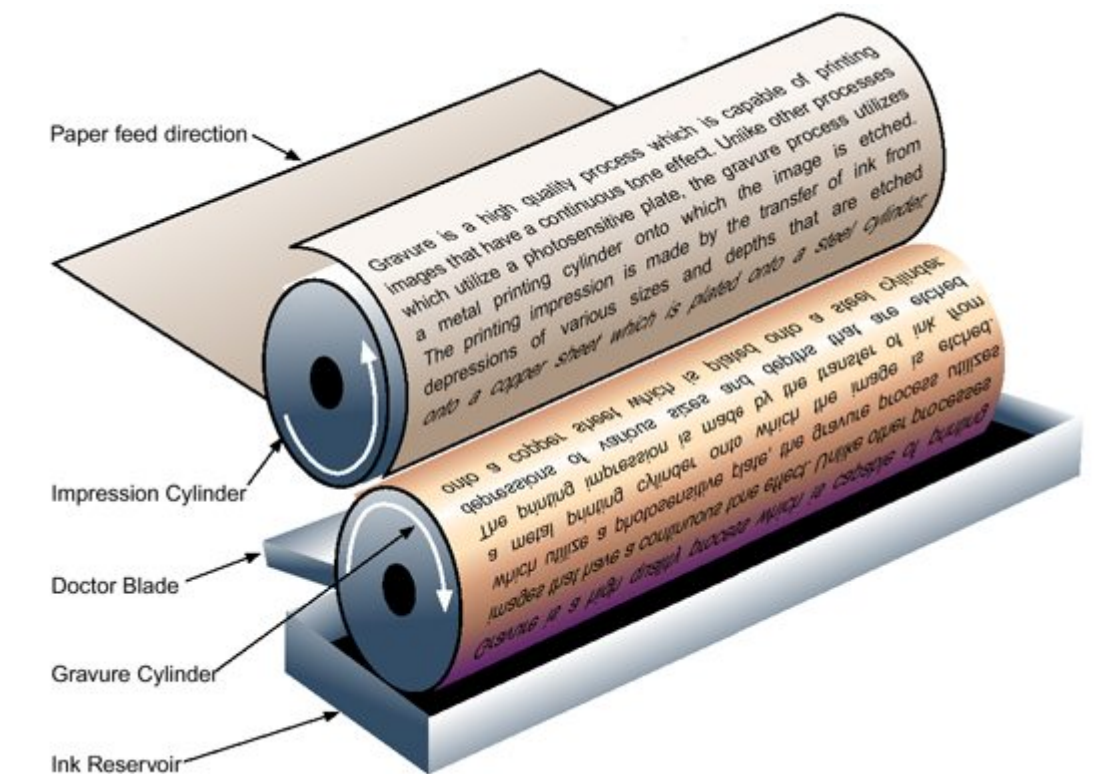

d. Printing Process

Because of the expense of the cylinders, gravure is largely performed as a rotary web process (rotogravure). It is most often used for very long runs of up to a million and many times the press runs are greater than that. For runs of a million or more, the cylinders are plated with chromium to provide extra durability. If the chromium begins to wear, it is removed from the cylinder and a new coating is applied.

During the printing process, the gravure cylinder revolves in an ink fountain where it is coated with a very fluid ink. A stainless steel blade (doctor blade) clears the ink from the unwanted areas, leaving the ink in the depressions of the cylinder. The substrate passes between the gravure cylinder and an impression cylinder covered in rubber. The substrate passes between the two cylinders and the ink from the cells is deposited onto the substrate.

Besides being very thin and fluid, the ink colors used with process color applications differ in hue than the inks used with other processes. Instead of the usual cyan, magenta, yellow, and black used with offset lithography, blue, red, yellow, and black are used. Standards have been established by the Gravure Association of America for the correct ink types and colors that should be used for different types of substrates and printing applications.

Gravure is a direct printing method so there is no need to utilize fountain solution to keep the non-image areas clean. Eliminating this variable allows for better print quality control and jobs can be run at higher speeds. Some applications can be run as high as 3,000 feet per minute. The microscopic depressions on the gravure cylinder create an almost continuous tone image on the printed surface, which is why it is often used for high quality image reproduction.

Letterpress

a. Description

The letterpress process is referred to as a "relief" process because the printed image is produced from a plate in which the image area is slightly raised above the non-image surface of the plate. It is a direct printing method in that the inked plate applies the image directly to the substrate. Letterpress is one of the oldest printing processes and was the most widely used process until the middle of the 20th century when advances in other printing processes made it obsolete. **Flexography**, which is an updated version of letterpress, is now the dominate relief printing process.

The letterpress process utilizes an ink that is thick in consistency and is well suited for relief printing. A set of rollers deposits the ink on the raised image area of the type or plate, but ink is not deposited on the non-image areas. For this reason, **letterpress plates** do not require any dampening in order to keep the non-image areas free of ink. This makes the process a simple one and allows for consistent results, but the process still cannot match the quality of more sophisticated print processes.

b. Applications

Because of the popularity of other printing processes, letterpress is a fast diminishing printing method. It is still used for publishing a few small town newspapers, several types of labels, packaging materials, and some narrow web printing.

An area where letterpress has greater usage than it does with actual printing is with some finishing operations. Old letterpress equipment is used for procedures such as embossing, die-cutting, numbering, perforating, and foil stamping. The types of products that can be finished using letterpress equipment include embossed business cards and government documents, die-cut labels and folders, numbered tickets and membership cards, perforated mailers, and foil stamped letterheads and invitations.

c. Press Types

There are four types of relief presses which are described below:

- **Platen Press:** With platen press, movable metal type is locked into a frame called a chase. The chase is then placed in the press bed and it is also locked into position. During the printing process, grippers move a sheet of paper from the feedboard, which contains a stack of paper, to the platen, which is the surface where the print impression is made. A set of rollers applies ink to the type on the press bed and then the press bed and the platen are pressed together like a clamshell which produces the image on the paper. When the impression is complete, the platen and the press bed spread apart and the grippers remove the paper, placing it on a delivery tray.

Platen Press
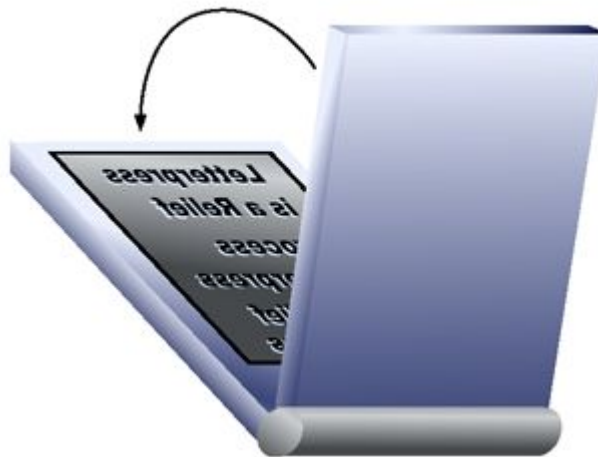
- **Flatbed Cylinder Press:** The type or plate is locked in a chase which is then mounted on the flatbed of the press. Grippers on a rotating impression cylinder pick up a sheet of paper and as the cylinder revolves, the paper is pulled around it. The inked flatbed containing the letterpress plate then moves under the impression cylinder. The squeeze between the impression cylinder and the flatbed creates the printed impression on the paper. When the impression is complete, the flatbed returns to its original position and is inked for the next impression.

Flatbed Cylinder Press
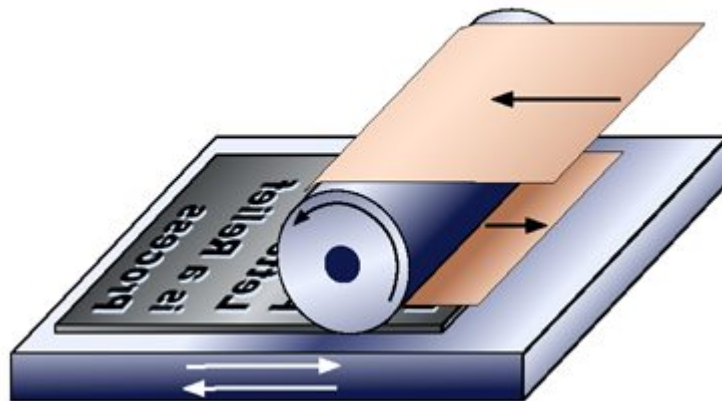
- **Rotary Sheet-Fed Press:** The plate is mounted on a cylinder where a roller system applies ink to the raised area of the plate. The paper passes between the plate cylinder and an impression cylinder where the resulting squeeze between the two cylinders produces the printed impression on the paper.
- **Rotary Web-Fed Press:** The web-fed system also utilizes a plate cylinder and impression cylinder, but instead of individual sheets passing between the two cylinders, the paper is a continuous web unwound from a large roll. After printing, the web is cut into individual sheets. Web-fed presses are used for larger print runs. Like other printing processes, the letterpress web-fed press usually contains several printing units

so that multiple colors can be printed from a single pass.

Rotary Press
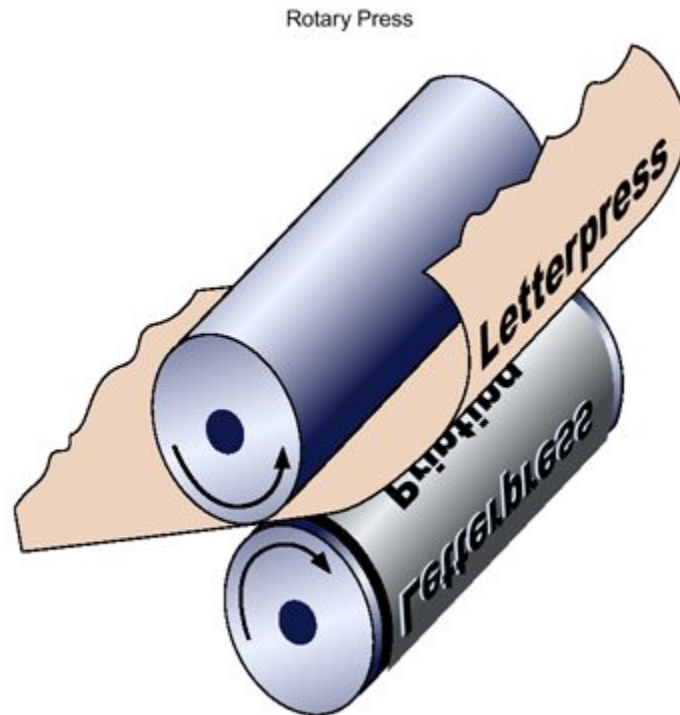
Offset

a. Description

Offset lithography is the most widely used print process. About 40% of all print jobs are produced with offset printing. It is an indirect printing process which means that an image is transferred, or offset, from one surface to another. A printing plate mounted on a cylinder transfers the image to a rubber blanket mounted on another cylinder. The image is then transferred from the blanket cylinder to the substrate as the substrate passes between the blanket cylinder and an impression cylinder. The image on the plate is "right reading" and when the image is transferred to the blanket it becomes "wrong reading". When the image is transferred to the printing surface it becomes right reading again.
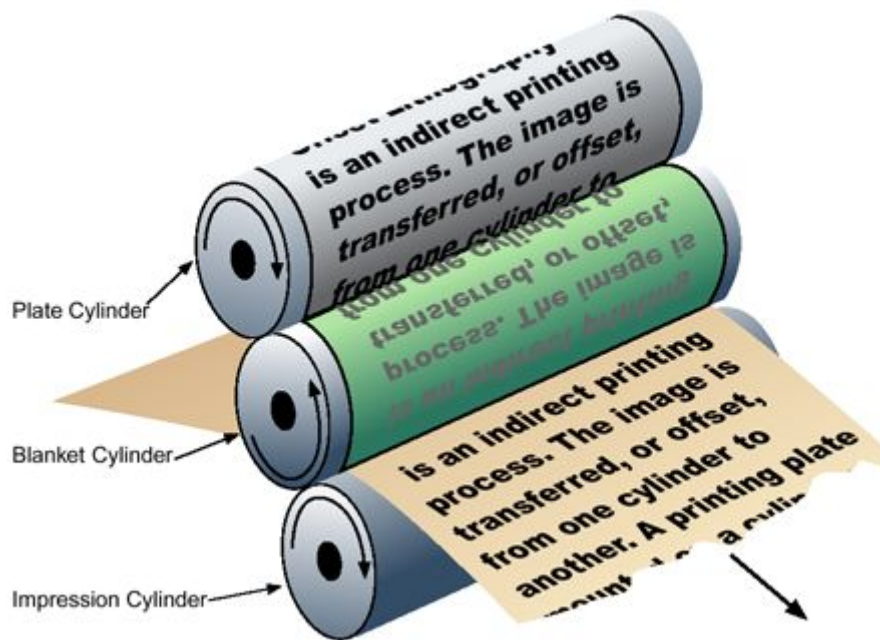
The image area and non-image area of the **offset plate** are on the same plane and work on the principle that oil and water do not mix. The non-image areas of the plate attract a wetting agent (fountain solution) and repel ink made from an oil base. The image areas attract the ink and repel the fountain solution.

b. Applications

The types of printed materials that can be produced with offset lithography are numerous and varied. Some of the items include: newspapers, magazines, books, continuous business forms, unit sets, advertising pieces, brochures, posters, greeting cards, business cards, folders, mailers, laser sheets, integrated products, coupons, and art reproductions.

c. Press Types

Offset presses can be put into two categories: sheet-fed and web-fed.

Sheet-fed: A sheet-fed press prints an image on single sheets of paper as they are fed individually into the press. The print quality and sheet to sheet registration is often better than web-fed printing, but it is often more economical to produce very large runs on web presses because of their higher running speeds.

Sheet-fed presses can be divided into three categories: small, medium, and large sheet presses.

1. **Small Sheet-fed:** The small sheet-fed press can print sheets up to 14" x 17". They are used primarily for short runs of one or two colors for such items as business forms, letterheads, and business cards and are popular for instant print companies.

2. **Medium Sheet-fed:** Sheet sizes of up to 25" x 38" can be printed on a medium sheet-fed press. The presses are used for runs up to 20,000 and are common equipment for many medium and large printers. Products such as brochures, business forms, medium press runs of color work are produced with the mid-size press.
3. **Large Sheet-fed:** The largest runs (usually 100,000 or more) and the most complex jobs are reserved for the large format sheet-fed presses. They can accommodate a paper size of up to 49" x 74" and they may have several printing towers so that multiple colors can be printed with one pass.
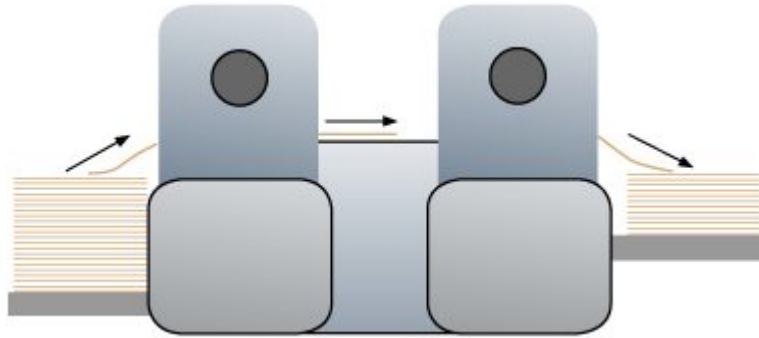
Web-fed: A web-fed press prints images on a continuous web of paper fed into the press from a large roll of paper. The web of paper is then cut into individual sheets after printing or as with continuous business form applications, it is left in web form and is perforated for later separation into individual sheets.

Like sheet-fed presses, web-fed presses come in many types and sizes. Some smaller web presses are capable of printing only on narrow width paper rolls and can only print one or two colors on the front side of the paper. Other web presses can handle large width webs and can print on the front and the back side of the paper in one pass through the press. There may be 8 or more printing units so that applications requiring full color on the front and back can be printed.
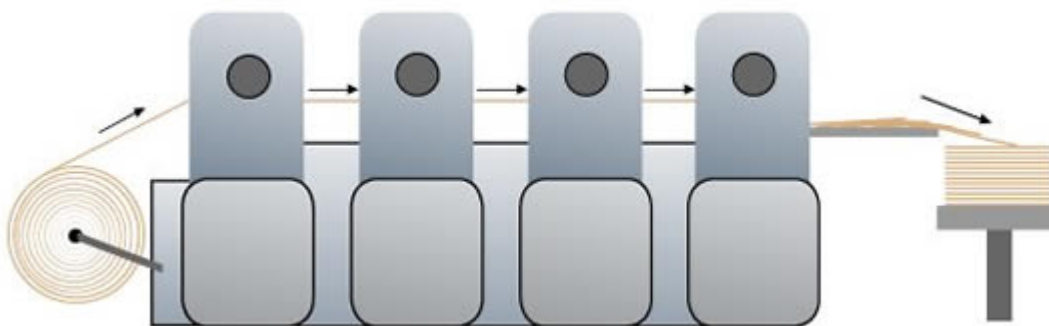
d. Press Components

Offset presses (sheet-fed and web-fed) are made up of some common components that work together to carry out the offset printing function. Some of the common components include a device for feeding paper into the press, a set of cylinders that create the printed impression on the paper, a roller train for distributing ink and for

dampening non-image areas of the plate, and a system for removing the printed paper from the printing system.

Feeding System: The feeding system is the device that feeds the paper into the press. There are different types of feeding systems for sheet-fed and web-fed presses.

- **Sheet-fed:** The paper is usually stacked in a tray at the front end of the press where it is pulled into the press one sheet at a time. Vacuum devices called "sucker feet" pick up each sheet of paper from the stack. As paper is fed into the press, the tray of paper automatically raises up so that there is no interruption in the paper feed until the tray is empty.
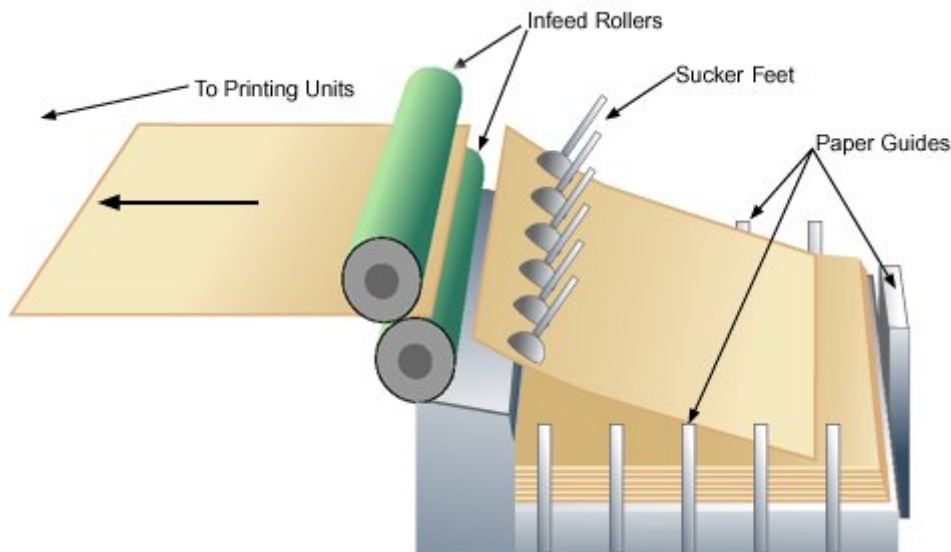
- **Web-fed:** A mechanism called a "rollstand", which accommodates a large continuous roll of paper, is used with the web-fed system. As the paper is fed through the press, another system maintains proper tension on the paper web as the roll of paper gets smaller in the rollstand. Some presses have automatic roll changers which splice in a second roll of paper as soon as the first roll is nearly out of paper.
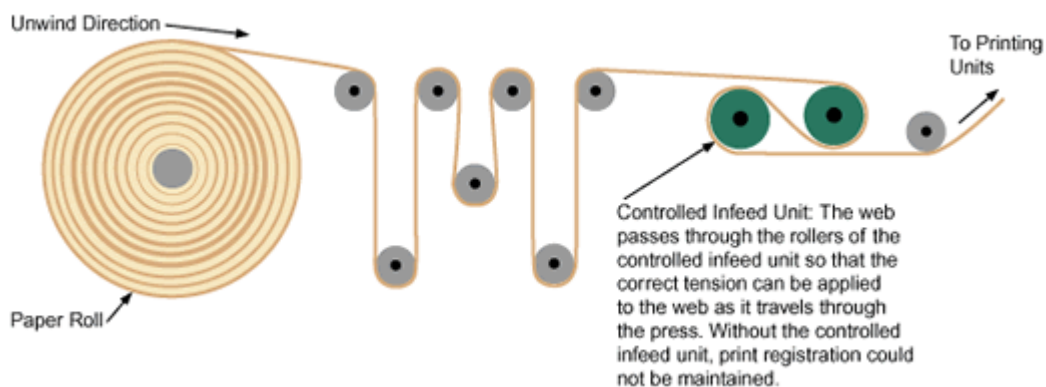

Printing System: The printing system for offset presses contain 3 major components: the plate cylinder, blanket cylinder, and the impression cylinder. The circumference of the cylinders determine the size of the applications that can be printed on the press. For example, a press with printing cylinders of 17" in circumference is able to print applications with a depth of 17",

8 1/2", 4 1/4", and so on. For an 8 1/2" application, there would be two separate 8 1/2 inch pieces printed per revolution of the cylinders. Presses are often named for the circumference of their cylinders, such as a "17 inch press", or a "22 inch press".

- **Plate Cylinder:** The plate cylinder contains a slot or "plate gap" into which the lead edge of the plate is inserted. The plate is wrapped around the cylinder and then the tail end of the plate is inserted into the slot. The plate ends are then locked into the slot. Some sheet-fed presses utilize plates the are punched at both ends. The plate cylinder gap contains two sets of pins that the punched ends of the plate fit over. The pins are tightened do that that the plate remains stationary on the cylinder.
- **Blanket Cylinder:** The blanket cylinder is much the same as the plate cylinder except instead of holding a plate, a compressible rubber blanket is mounted on it. The blankets vary in type and thickness depending on the type of press on which it is used.
- **Impression Cylinder:** The impression cylinder is usually a seamless, hardened steel cylinder that provides a surface for the print impression to take place. The paper passes between the blanket cylinder and impression cylinder where just the right amount of squeeze between the two cylinders allows for the transfer of the image onto the paper.

> **Note:** The gaps in the plate and blanket cylinders are "non-printable" areas. Allowances must be made with the overall image size so that the image on the plate does not extend into the plate gap when the plate is installed. The slot in the blanket cylinder, known as the "blanket gap" is usually wider than the plate gap, so even though the image may look correct on the plate, a sliver of the image may not be offset to the blanket because of its wider gap. For this reason, the image allowance is usually based on the non-printable area of the blanket cylinder. The non-printable gap is also known as the "lock-up" dimension and it varies between different types of presses.
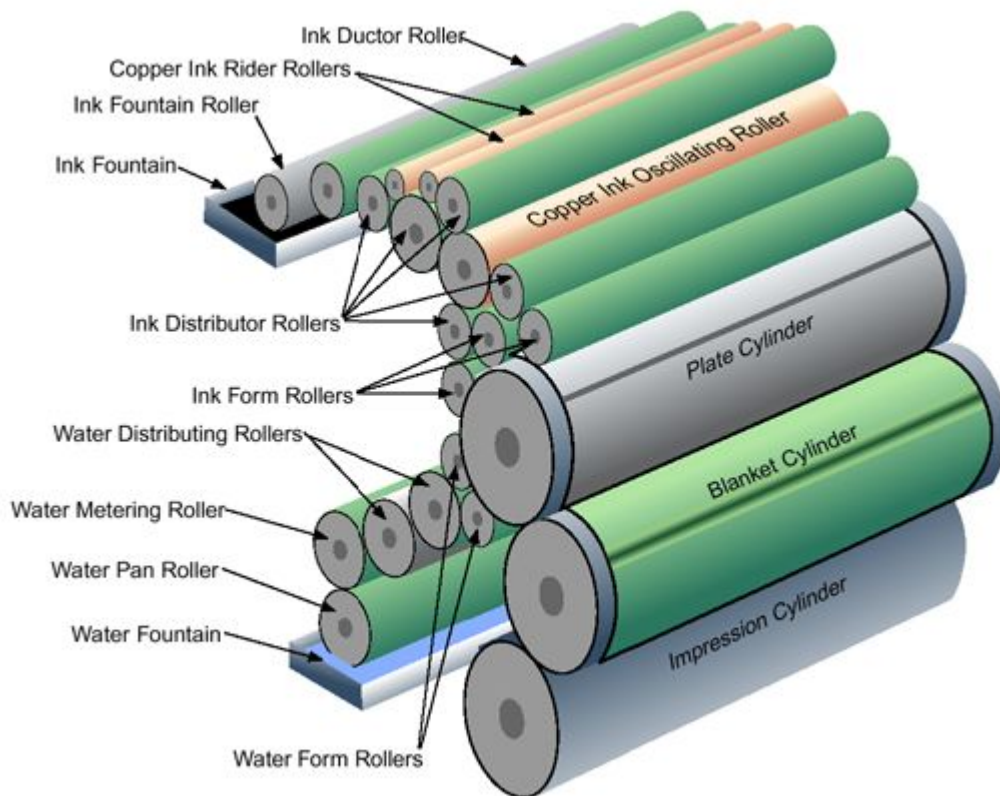

Plate Cylinder Gap

Blanket Cylinder Gap
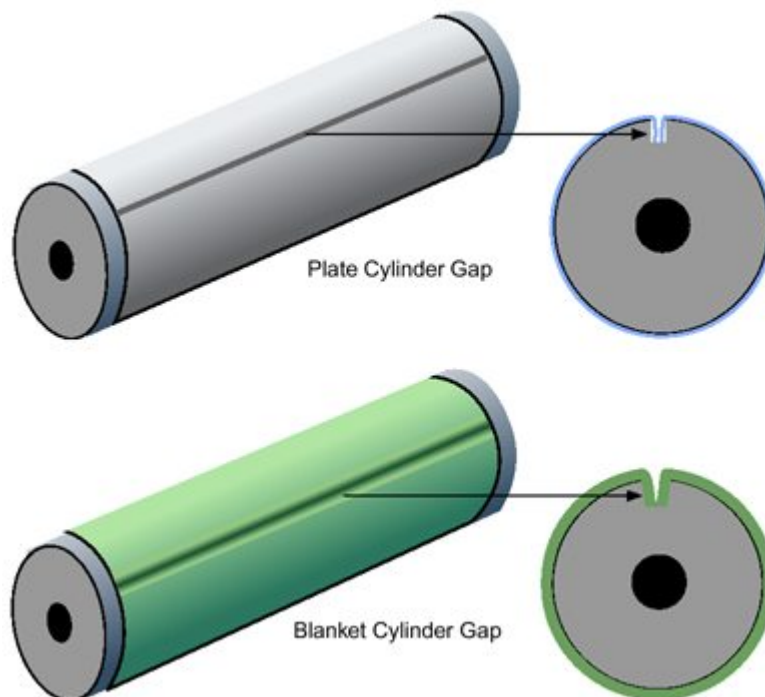
Note: Some applications may require that the printed image be slightly larger than what can be actually printed by the press. To accommodate the larger print size, the copy may have to be split and printed on two separate printing units. This is known as an "over image" job or a "split image" and should be taken into consideration when planning a print job.

Inking System: The inking system on offset presses consists of a fountain which holds the ink and a set of rollers, known as the roller train, which distribute the ink and carry it to the printing plate. A roller within the fountain draws the ink from the fountain into the roller train where it is milled into the proper thickness. It is then brought to the final rollers in the system called the "form rollers" which apply the ink to the plate.

The number and type of rollers in an inking system varies widely between different types of offset presses. A small duplicator press may have only a minimum number of rollers to supply the flow of ink to the plate as most of the applications printed on a duplicator press are very basic. A large web press used for printing complex applications in full color requires a larger number of rollers to mill the ink and several form rollers to apply the ink to the plate. The more rollers there are in an inking system, the better the ink will be distributed and the better the print quality will be.

Dampening System: The dampening system consists of a set of rollers that distribute the fountain solution to the plate. The fountain solution is necessary to keep the non-image areas of the plate free of ink. As with the inking system, the dampening system consists of a fountain which holds the dampening solution, a roller within the fountain that carries the solution into the dampening rollers, and form rollers that apply the dampening solution to the plate. Like inking systems, the type of dampening system can vary greatly between different types of presses.

Ink Ductor Roller
Copper Ink Rider Rollers
Ink Fountain Roller
Ink Fountain
Copper Ink Oscillating Roller
Ink Distributor Rollers
Ink Form Rollers
Water Distributing Rollers
Plate Cylinder
Water Metering Roller
Blanket Cylinder
Water Pan Roller
Water Fountain
Impression Cylinder
Water Form Rollers

Delivery System: Sheet-fed and web-fed presses each have different types of delivery systems, which are described below:

- **Sheet-fed:** Printed sheets are carried from the printing units of a sheet-fed press to a delivery tray. The tray has guides which assist in delivering the sheets to the proper place on the tray. A jogging system helps to keep the printed sheets in a neat stack. The tray of the delivery system automatically lowers as it is filled with printed sheets.

Sheet-fed Delivery

Paper Infeed
To Printing Units
Paper Delivery
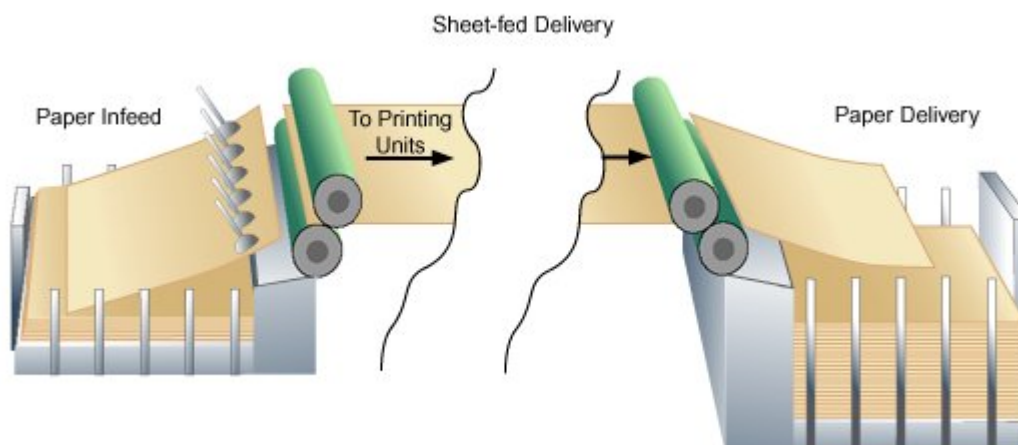
- **Web-fed:** The printed web is carried from the printing units to one of two types of delivery systems. A "roll-to-sheet" press has a mechanism for cutting the web into individual sheets. The sheets are then carried a short distance on belts to a delivery tray where they are automatically jogged and can be removed in predetermined increments by the press operator.

Another type of web-fed delivery system is found on a "roll-to-roll" press. The printed web is carried from the printing units to a "rewind" unit where it is wound onto a spool. There are several reasons why rewinding is necessary:

1. A multiple part business form may require off-line collating, so each part of the form would be printed separately and wound on rolls at the press. The rolls would then be mounted on a collating machine where the individual parts would be attached together.
2. The application may require additional features that cannot be applied at the press, so they are handled off-line on other web-fed equipment.
3. Some types of continuous business forms are supplied to customers on rolls so that the forms will work properly through certain types of statement rendering equipment.

Web-fed Delivery: Roll to Sheet

Cut-off Cylinder: Cutting blades inserted into the cylinder, cut the web into the proper lengths.

Unwind Direction

Paper Roll

Impression Cylinder: The cutting blades strike the impression cylinder resulting in the paper web being cut as it passes between the two cylinders.

Web-fed Delivery: Roll to Roll

Unwind Direction

Paper Roll

Rewind Unit: The paper web is wound onto a spool after printing.

Note: Besides the common components described above, many offset presses have other components for applying additional finishing functions that would otherwise have to be accomplished off-line. The addition of perforations,

scoring, punching, and consecutive numbering are only a few of the additional functions that can be performed. Many presses are modular in that additional printing units and finishing units can be added to the basic press in order to provide added functionality.

Thermography

Thermography is the process of spreading thermal powders on the wet ink of a print application and heating it in order to melt the powder into a single solid mass which is raised above the printed surface. It is also known as "imitation engraving", however an engraving die is not needed with thermography. The process is faster than engraving and it is less expensive.

a. Applications

Thermography can add value to many ordinary print applications. Among the many applications that can benefit from thermography are letterheads, greeting cards, invitations, business cards, marketing applications, announcements, and envelopes. Thermography can make the appearance of many print applications more distinctive, providing a customized appearance that cannot be achieved with any other method.

b. Thermographic Process

Thermography is successful when the powdered resins are applied to a printed surface on which the printing ink is still wet. This enables the powder to stick to the printed areas. Any powder on non-image areas and any excess powder on the image areas is suctioned off the substrate before the heating takes place.

The heat is produced with electric heating elements that are placed inside an oven or tunnel. The powdered substrate passes into the heat tunnel where the powder melts onto the heated substrate and is fused with the wet ink. The substrate must be raised to the temperature of the melting point of the powder in order for the process to work correctly. When the heating process is complete, the sheet is cooled and the melted powder hardens into the raised thermographic image.

Important points to consider when designing a project for the thermographic process include:

- Thermography will not improve or mask the flaws of a poor design or a poorly printed application.
- Type sizes less than 6 point should not be avoided because they can fill in. Type faces that are very fine can also fill in.
- Large solid areas and very small type should be avoided on the same page because each of the elements requires a different type of resin.
- Many print applications using thermography may require special techniques for trimming because the raised print makes it difficult to cut stacks of thermographed sheets using a standard guillotine cutter. The cost of trimming thermographic applications may be more expensive than print projects without thermography. Some applications such as business cards (which are printed with many per sheet) are sent through special slitting machines in order to be separated.
- Large wholesale thermography companies handle large volumes of standard items and are the most cost effective source for standard products, but they may not offer specialized or customized thermography.

c. Thermographic Powders

Thermographic powders are made from plastic resins which were introduced in the 1970's. They have taken the place of resin materials that were traditionally manufactured with a base made from ground tree sap. There are a wide range of thermographic powders available that produce an endless variety of effects. The powders come in many particle sizes to suit any application. A choice of finishes, such as gloss, semi-gloss, semi-dull, and matte are also available.

d. Types of Powder

In addition to standard powders, the following types of thermographic powders are available:

- **Metallic Resin:** Metallic resin powders produce a metallic sheen after being melted and they are less expensive than foil stamping. Metallic resins are unaffected by the color of the paper stock and they are well suited for dark colored paper stocks. Applications include presentation folders, advertising, and announcements. Metallic resins come in silver, gold, bronze, and copper.
- **Glitter:** Glitter can be added to thermal resins to produce a sparkling effect after processing. Depending on the application, the glitter can be varied for different effects.
- **Varnish:** Varnish can be applied as an all over coat on applications such as four color process jobs to give the four color images a thermographic appearance.
- **Pearlescent Resin:** Special ingredients are contained in pearlescent resin along with pigments to produce a pearlescent sheen after the application is processed.
- **Static Resistant:** The build up of static electricity on the application is reduced with the use of static resistant powders.
- **High Viscosity:** A high viscosity powder is used to maintain the detail on images that are made up of fine lines.
- **Laser Safe Powders:** One drawback with standard resins is that the raised coatings on applications such as letterheads can remelt if they come in contact with other heat producing equipment such as laser printers and photocopiers. Laser safe resins are treated with ultraviolet light after they are applied and melted on the substrate. This gives the resins the ability to be unaffected by additional heat sources.

All of the above powders can be used alone or they can be combined in various ways to produce multiple effects. For example, adding glitter to metallic resin produces a sparkling effect on the metallic finish. Most resins can be mixed with a variety of substances such as tinsel, sequins, and diamond dust to create even more effects.

A thermographic sample using metallic powder.
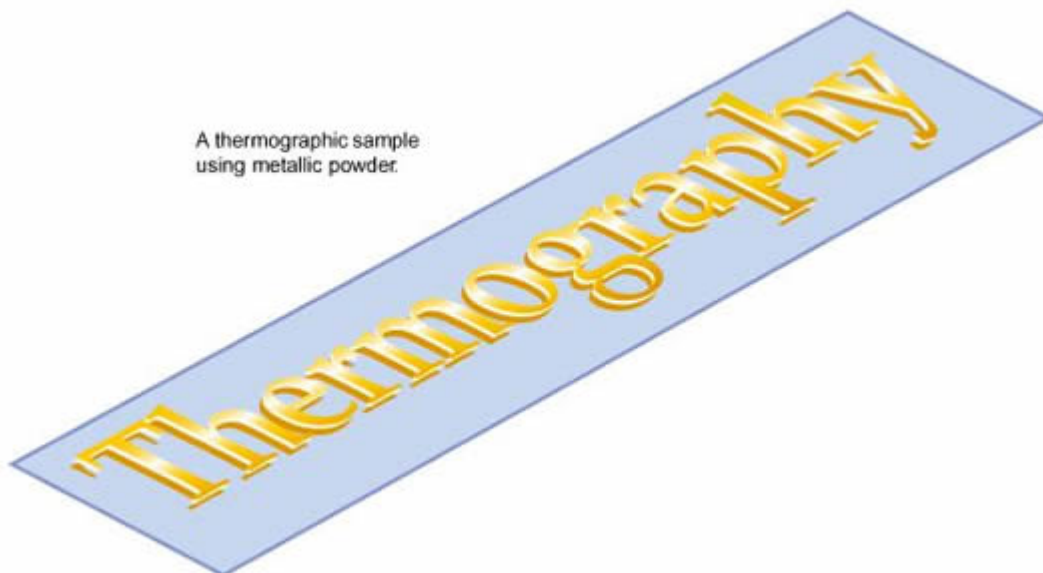
e. Particle Sizes

Different particle sizes are available ranging from fine to course. Fine powder is used on images with fine detail and thin lines. Heavier images can be processed with course powder.

- **Extra Fine:** Used for fine details and type sizes 14 point and smaller.
- **Fine:** A fine particle can be used for most purposes except the finest details and it works well with type sizes from 12 to 30 points.
- **Medium:** Used for solids and types sizes from 24 to 42 point.
- **Course:** Large solids and type sizes over 36 point are well suited for course powder.

f. Equipment

Table Top Models

Table top machines were developed in the 1970's which made it easier for more print manufacturers to offer thermography as an option for their customers. Some table top models involve mostly manual operations to produce the thermographic images. The powdered resins are applied to the printed sheet by hand and the excess is shaken off the sheet. The sheet is placed in the thermographic unit which is basically a heat tunnel. The sheet is removed and another sheet is placed in the machine. This can be a very time consuming process and may not be economical to use on runs over a few hundred unless a job is printed with many images per sheet such as a business card application.

Floor Models

Larger floor models are fully automated and are attached to and synchronized with press equipment in order to eliminate manual procedures. The printing press may need to be equipped with slow down pulleys in order to be properly synchronized with the thermographic unit. The desired speed of the equipment depends upon the design of the application, the materials used, and the type of equipment used for printing the application and for producing the thermographic image.
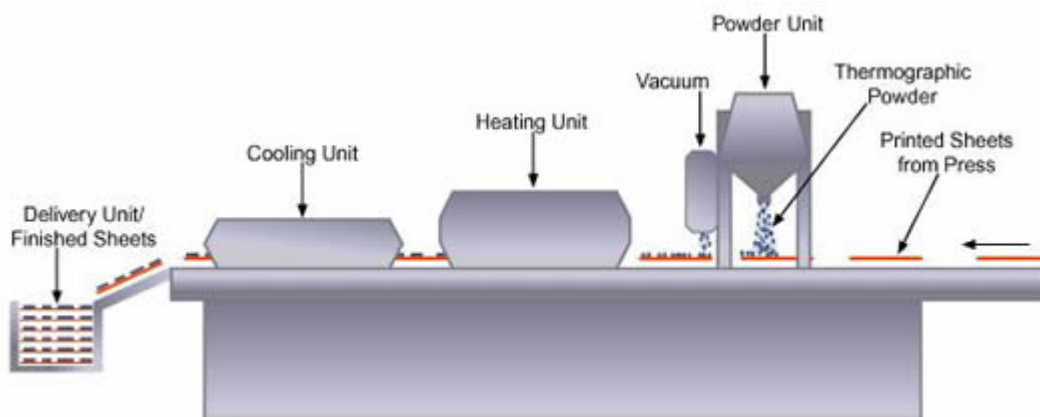
Paper Stock

Some points to consider when selecting a paper stock suitable for thermography are weight, moisture content, color, and texture. Don't assume that any paper stock can be used. Some paper stocks are not suitable for thermography mainly because of the high temperature required for the process. Paper stocks must be able to be heated to at least

250 degrees Fahrenheit in order for the process to work properly because the heat on the paper is what melts the resin. Paper stocks such as 20 lb. bond cannot handle the high temperature without adverse effects. The amount of thermographic raise that is achieved also changes depending on which paper stock is used.

Paper stocks should have a hard surface and a low moisture content. Excessive moisture in the paper can cause the paper to curl when it is subjected to high temperatures. Curling can also occur when uneven heating is applied to the paper. Curling often happens when one side of the paper is heated more intensely than the other side. Excessive moisture content in the paper can also leave the thermographic image with a cloudy appearance as a result of moisture being released from the paper during the heating process and being trapped in the thermal coating. Paper that has a moisture content which is too low may absorb the ink so fast that the thermographic powder may not stick to the ink.

The heavier and thicker the paper, the more heat is required to raise the temperature of the paper to the melting point of the thermal powder. Some heavily textured stocks may require special resins in order to produce a smooth thermographic finish over the printed areas.

g. Ink

The quality of the ink and the quality of the printed image are directly related to the degree of quality that can be expected when applying thermography to the application. The ink should be tacky (sticky) when entering the thermographic device. The tackiness of the ink is what causes the thermographic powder to adhere to the printed surface before it is melted. If the ink is not tacky enough, the vacuum used to remove excess powder from the non-image area can also remove some of the powder from the image area resulting in substandard thermography. The press operator may have to run more ink and/or less water than normal to achieve the proper ink coverage and ink tackiness required for thermography and yet the coverage must not be so great as to produce **set-off** on the back side of the printed sheet. Thermography works best when as much ink as possible is laid down on the paper with a minimum amount of impression. Inks with little or no drier additives are well suited to thermography because the ink stays wet longer and the ink acts as the adhesive for the thermal powder.

Digital Printing vs. Offset Printing Costs

A digital printing workflow has several advantages over offset printing in terms of cost. For example, digital prepress costs are usually lower than conventional prepress because the digital workflow eliminates many of the manual operations of conventional prepress. With digital printing, there is no need for steps such as process photography, manual stripping, and platemaking, although preparing print applications on the computer and processing them through the RIP may still be time consuming.

In terms of print output for the shortest runs, digital printing has a definite advantage over offset printing because there is no extensive setup required in preparing the press for the print run. Conventional offset presses require a lengthy makeready time, which adds a considerable cost to the total price of a short run application, therefore the cost per piece is much higher for the smallest print runs. When using offset printing, as the quantity increases, the price per piece decreases. When the quantity is large enough, the price per piece is lower than a digitally printed job of the same quantity.

The point at which it becomes more cost effective to use the traditional offset printing process may vary substantially, depending upon the application. In fact, when determining a cutoff level in which digital printing is a better choice than offset, you must consider the type of application that is being printed. Except for the smallest press runs, it is difficult to compete with offset printing costs when, for example, the job is a static, single sided document, in a quantity of 1,000 or more. However, if the application is a multiple page, full-color report or brochure, in a quantity of 500 or less, then digital printing is often the best choice. A similar job would be very expensive when using conventional offset printing because of the initial makeready time and the large number of plate changes that would be required. If a print project is a variable data application, digital printing is really the only printing process to consider.

A premium is usually charged for digitally printed variable data applications. The simplest applications are often priced 25% higher than conventionally printed jobs. Complex digitally printed variable data jobs are often 50% more expensive than conventionally printed (static) jobs.

Finishing charges for variable data jobs are often higher as well. Because all of the documents in a variable data application are unique and in order, any errors in finishing that occur on even one document, will necessitate the need for a reprint of the single document. If a finishing mistake occurs on a small quantity of pieces contained in a static application, there is usually enough of an overrun so that a reprint is not necessary.

Applications that are printed in regional centers, which allow easier distribution throughout the country (distributed digital printing), are often less expensive when using digital printing. With a digital workflow, document files can be sent anywhere in the world to be printed near the location where the application is

needed. Transferring files saves time and reduces the cost of shipping because the application is printed near the point of distribution.

Cost Overview of Digital Print Projects

As with conventional printing processes, the cost of producing a digital print application depends upon many factors. All of the factors are related to either time or materials. One application may require more time in prepress than with any other step while another application may require a lengthy output time due to a very large quantity or perhaps off-line finishing processes may be time consuming. A large expense may be incurred with an upgrade in the substrate that is used for the application.

The cost of producing digitally printed applications has been steadily declining as the technology improves and the market share increases. The average cost for color digital printing has declined to about 5 cents per sheet for press runs of 500 or more, while black and white costs are now about 0.5 cents per sheet for quantities over 500.

Most digital print vendors use a grid system for their pricing, which recognizes that there are certain flat charges common to all jobs and the price per sheet is usually greater on small runs than on large print runs. There are major industry sources that publish standardized costs which can be used as a gauge for all printers. Even though there are some differences in pricing between printer providers or by regions, the cost standards can be very helpful. Described below is a breakdown of some of the costs encountered with digital printing.

a. Prepress

The smallest quantity jobs do not require any prepress work if they are to be produced on a copier. Eliminating prepress from the workflow removes a substantial cost that is common to applications that are built from scratch. It is possible that the original document may need some touching up before it is suitable for producing copies, but the cost for this would be minimal.

Most other applications are designed on a computer and set in a page layout program. Various software programs are used to create original illustrations, digital cameras are used to record original images, or a scanner is used to convert photographs and artwork into digital information, which can be stored on the computer. Images that are digitally photographed or scanned may require color correction and manipulation, which adds further cost. If proofing is required, the file can be sent through a digital proofer or to the digital press where a copy can

be output on the actual substrate selected for the job. The more time required for prepress work, the greater the final cost of the job.

b. Variable Data Publishing

Costly Errors When Converting to VDP

Before investing excessive time and money, it is always wise for print manufacturers and vendors to do their homework to avoid costly mistakes when adapting their business to variable data publishing. In their zeal to begin variable data printing as soon as possible and to get jobs out the door immediately, some print manufacturers may be tempted to hastily purchase printers or presses before becoming knowledgeable on the correct software to use with the equipment. This can result in equipment that may print slowly and may actually be quite troublesome to operate. Most reputable firms offering digital printing equipment or print software will allow the print manufacturer to test the equipment with the software, before requiring payment, to ensure that the equipment operates at its optimum level.

The print manufacturer may also assume that they need complicated software packages in order to accomplish their variable data printing goals, but they may discover that some of these software programs require additional programming to perform certain functions in which case, they would need specialized personnel to handle the requirements for proper use. Simple, user friendly programs are often the best software for most variable data applications and contribute to increased efficiency and increased profits.

Database Preparation

For any type of variable data job, one of the greatest expenses is the time

involved in preparing and maintaining the database. A large block of time must be set aside in order to update and edit the information in the database to ensure that variable data projects are 100% accurate. Additional time is spent extracting the records that are important for the current project and in making sure that the records will fit properly on the current design.

Cost Effectiveness of Personalized Variable Data Applications

For organizations using direct mail campaigns as a sales tool, applications with totally personalized information can often be more cost effective than applications that are more generic. For example, since each piece of a digitally produced, personalized variable data application is unique for each client, information that is of no interest to a specific client can be excluded, thereby decreasing the number of pages that are necessary in a booklet or catalog. This saves on paper costs, postal costs, and the requirement of printing large numbers of generic pieces that are warehoused and used as needed. Applications that are not uniquely personalized often include extraneous data to ensure that a client is receiving everything that may be of interest. A better understanding of the client's interests and a thorough knowledge of proper database management helps to eliminate the requirement of making sure that all options are covered. Although unique, personalized documents are usually more expensive to produce than less personalized pieces, they generate a greater response and a volume of sales that may not occur with a more generic approach to direct marketing.

c. Processing and Output

The time that a digital print application is processed through the RIP is another of the major expenses incurred when producing the job. This is especially true with personalized print applications. The more photographs and files that are included in the design, the more time will be required for processing. The processing time is included with the price of the job.

The cost of outputting a digital print application varies according to the type of printing equipment that is used and the time that is required for the output. For outputting the smallest quantities, the most economical method is with the use of digital copiers. The cost per piece is the same regardless of the quantity. There is usually no preparation involved before the copies can be produced, however there may be a small additional charge if the original document requires
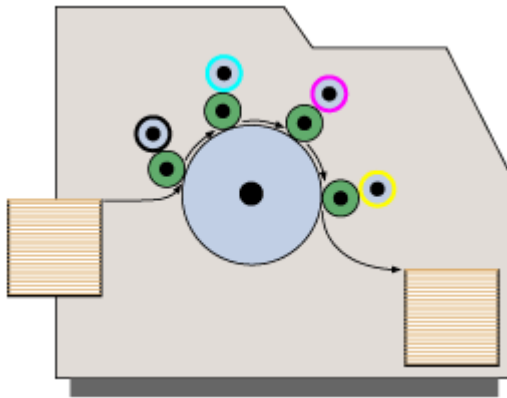
some repair or touching-up before it can be copied.

The use of a quick printer may be the easiest way to obtain the copies that are required. They usually charge a flat rate per piece which includes the time, the equipment charge, and the choice of several comparably priced papers. Copies made on paper types that are not included with the basic charge would require an upcharge. The cost per piece charged by a quick printer may also be higher because of the premium charged to the consumer for the convenience in producing a completed print job in a very short time.

Print applications that require design and prepress work are output on digital desktop printers or digital presses because the documents are output directly from electronic files. The use of digital desktop printers and digital presses for printing small quantities is an economical choice, especially if the application contains continuous tone images and the quality must be better than what can be achieved with color copiers.

Some of the largest print runs may be produced on direct imaging presses. The workflow is completely digital (including the imaging of the plates directly on the press, hence the name, direct imaging presses) except for the actual print output, which is based on conventional offset lithography. Direct imaging presses are not as economical for producing the smallest print runs as digital copiers, digital desktop printers, and digital presses, but they are economical for producing larger quantities of static documents due to their higher printing speed and a per document cost that becomes lower as the quantity increases. They also provide the same high quality as conventional offset presses.

d. Finishing

Many types of digital output equipment feature on-line finishing capabilities such as sorting, stapling, hole punching, and folding. The printing and finishing of products such manuals, booklets, and brochures in one operation can significantly reduce the cost of the job compared to the same job that must have the finishing functions completed off-line.

Some applications printed digitally may require special folds, die-cuts, or bindings that cannot be accomplished on-line. The need to use off-line equipment for finishing operations can add a significant cost to the job. In order to reduce the cost, your printer may be able to suggest alternatives for some of your finishing requests. Even a slight change in the design of the application may

help decrease the expense of finishing the job.