The GATF Encyclopedia of Graphic Communications

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Graphics Scanner
See *Scanner*.

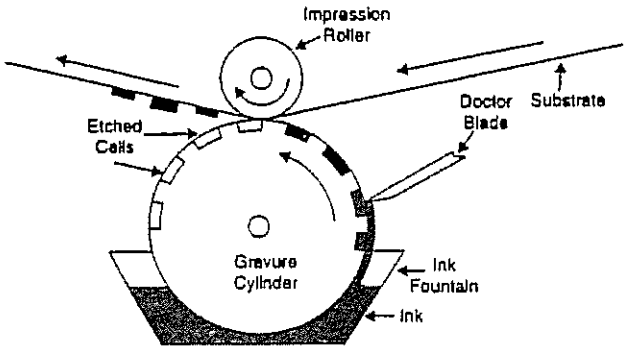
Graphics Terminal
In computing, a monitor or ***terminal*** capable of displaying pictures or other images, either in ***raster*** form or, less commonly, ***vector*** form. Some common graphics terminals of the recent past have included the ***CGA***, ***EGA***, ***VGA***, etc.

Graphic Visualization
A means of presenting data—such as in scientific and engineering research—in a graphic or visual way, such as by means of charts, graphs, etc. Often, data from ***spreadsheet*** or database programs can be imported into graphics programs that will facilitate its conversion to visual form.

Graphic Window
In computing, a ***pixel*** matrix or grid in which each pixel can be specified by the user as either black or white.

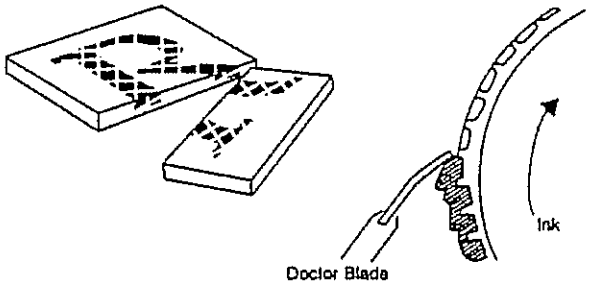
Grave Accent
In typography, a left-pointing ***accent*** (`) placed over a character such as "è." The accent pointing in the opposite direction is called an ***acute accent***. See ***Accent***.

Gravure
A printing method that utilizes engraved cylinders or, infrequently, cylinder-mounted plates as the image carriers. The image areas are etched into the surface of the cylinder as a collection of tiny cells. The cylinder rotates in an ink fountain and ink collects in the cells, the excess ink being scraped from the nonimage areas by a ***doctor blade***. The paper (or other ***substrate***) is passed between the



The gravure printing unit.

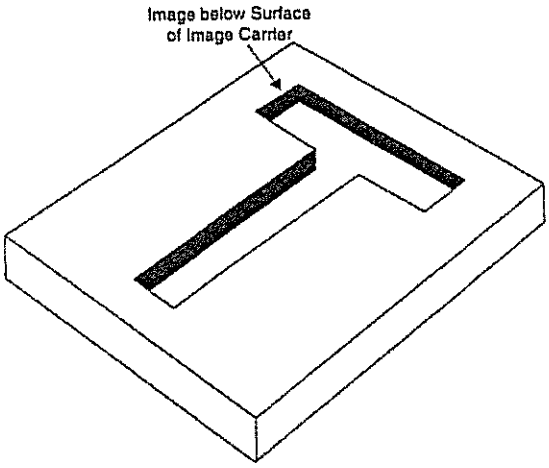
gravure cylinder and a rubber-coated ***impression roller***, and ink is transferred by a combination of capillary action and the pressing of the substrate into the engraved cells of the cylinder, helped by the rubber surface of the impression roller. Most gravure printing performed today is web-fed ***rotogravure*** printing, with occasional sheetfed use. Gravure is also well-suited to the printing of packaging on a variety of nonpaper substrates.



The two basics of gravure printing—the recessed image and the doctor blade.

Gravure printing is a direct descendent of older ***intaglio*** printing (gravure and intaglio, commonly used synonymously, are different processes; all gravure printing is intaglio, yet all intaglio printing is not gravure—for example, ***copperplate printing***, which is an intaglio process without being considered a gravure process), developed around the same time as Gutenberg was developing relief-based printing (the mid-15th century). Intaglio, primarily an artist's medium, was essentially a wooden (and soon metal) block on which the image to be printed was etched. A thin ink was poured into these etched lines or dots, and the paper on which the design was to be printed was brought into contact with the inked image carrier in such a way as to force the paper into the cells where it could pick up the ink. A porous substrate allows capillary action to enhance this process. Around 1440, the first metal plates began to be used, commonly made from copper (hence the term *copperplate engraving*). Intaglio was used primarily for illustration matter and playing cards. Around the same time, Gutenberg's letterpress-based printing press was increasing in popularity, and the use of intaglio for text was not actively pursued, as the intaglio plates were incompatible with the relief method of printing. Still, intaglio represented a more artistic rather than commercial medium, perhaps best exemplified by the woodcuts and other engravings of German artist Albrecht Dürer in the late 15th and early 16th centuries, as well as engravings by other noted artists such as Rembrandt van Rijn and Peter-Paul Rubens.

In the first half of the 16th century, the invention of chemical etching of intaglio plates was a great leap forward for the process. Rather than laboriously scrape away the metal itself, artists could now simply scrape away a soft coating (known as a ***resist***), which would allow the penetration of an acid only in certain areas, which would then etch the copper beneath the coating chemically. Chemical etching made the intaglio process even more favored by artists, and intaglio printing proved to provide better-quality illustrations than did letterpress, so it was not uncommon for the text of a book to be printed using letterpress, and illustrated pages to be printed using intaglio, the separate pages being collated together after printing. Denis Diderot's great and controversial *Encyclopédie*, published



Intaglio printing, in which the image is below the surface of the image carrier.

in seventeen volumes of text from 1751 to 1755, was supplemented by several additional volumes of intaglio illustrations, which served to primarily illustrate various manufacturing processes as part of Diderot's extolling of the virtues of artisans. (This would be a contributing factor in the French Revolution of 1789.) Intaglio-based printing was also widely used for the reproduction of sheet music, as well as maps, needed more than ever once the New World was found and colonized. The invention of the ***mezzotint*** (an early means of representing shades of gray in copperplate engraving; "mezzotint" itself literally means, in Italian, "halftone") in the 1600s further refined the use of intaglio for high-quality pictorial reproduction.

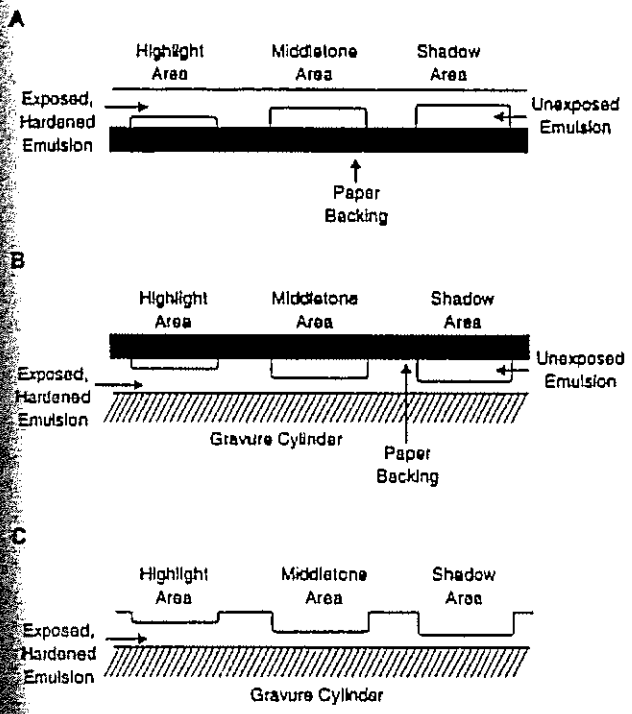
Following the invention of ***lithography*** at the tail-end of the 18th century, and its further development in the 19th century, the search was on for a means of printing utilizing cylinders, rather than flat plates, stones, or locked-up bits of type. The one desperate need of any printing press is, as its name indicates, *pressure*. It is easier and less laborious to produce suitable and uniform printing pressure in the nip of two cylinders than over the surface of a flat plate, but the question was how to accomplish it; a litho stone could not be bent into a cylinder, the individual letters, or even lines, of type were impractical for rotary printing, and intaglio techniques were not able to keep the ink from spilling out of the cells. The development of ***stereotype*** platemaking eventually solved the problem for letterpress printing, and the later use of zinc and aluminum plates eventually solved it for lithography. Interestingly, the first cylinder-based printing press was a gravure press, originally developed for printing on textiles in 1680. The quality was most likely not very high, but its primary usage was in the printing of calico patterns on cheap clothing. In 1783, British textile printer Thomas Bell patented a rotary intaglio press for use in higher-quality textile printing. His patent drawings show a system very much like that still in use in gravure printing today, but for non-textile printing, the idea of a rotary press languished.

The invention of photography in the 1820s and 1830s resulted in the search for a means of transferring a photographic image to an intaglio plate. William Henry Fox Talbot devoted himself to the search for photoengraving materials and techniques. Using gelatin-based coatings for metal plates, he was able to achieve photographic etching initially for only line art, but eventually he devised formulations that would enable the selective variation of image density, which would print at varying shades. Fox Talbot soon hit upon the halftone screen, which broke up continuous images into very small, discrete dots that could be varied in size and shade of gray. This was the breakthrough photoengravers (and printers everywhere) needed. Letterpress and lithographic platemaking were the direct beneficiaries of this process, however. The intaglio process was desired by most people for little more than fine art reproductions and illustration material.

The problem for gravure still remained: how to produce a photographic coating for a cylinder that could be used for etching. The English engraver J.W. Swan solved the problem in the early 1860s with a ***carbon tissue***, which was a gelatin resist coating on a light-sensitive material applied to the surface of paper. After exposure, the paper could be removed, and the exposed coating applied to another surface, such as a metal plate—or a cylinder.

Thus, all the disparate elements needed for modern gravure printing existed, and it remained for someone to put them all together. That someone was Karel Klic (in German spelled Karl Klietsch), from Bohemia (now the Czech Republic). Combining Bell's rotary intaglio textile press, Fox Talbot's halftone screen process, and Swan's carbon tissue coating, Klic developed the first gravure printing press. Still used exclusively in the printing of textiles, however, Klic made his way to England and teamed up with Samuel Fawcett, an engraver at Story Brothers and Company, a textile printing company. In the early 1890s, they developed new techniques for photoengraving, and began commercial printing of intaglio art prints, conducted with such secrecy that company employees were not allowed to venture into rooms other than those they were assigned to, lest they become exposed to all of the various parts of the process. A bit paranoid, perhaps, but the company—under the name of Rembrandt Intaglio Printing Company—held a monopoly on the process for over a decade. In 1903, an employee of Klic's came to the United States and revealed Klic's process. The jig was up.

Meanwhile, in 1860, a French publisher named Auguste Godchaux developed a rotogravure press that printed on rolls (or ***webs***) of paper, a design very similar to modern rotogravure press designs. In the early 1900s, gravure presses began turning up in the United States, and the *New York Times* in 1913 was the first to print rotogravure newspaper supplements. Other newspapers began to take notice of the high-quality reproduction of photographs the new system afforded. (Today, most Sunday newspaper sup-



The principle of the carbon tissue resist. After exposure to a continuous-tone positive (A) highlight areas are more highly exposed and thus produce a thicker and harder emulsion than do shadow areas. After the exposed resist is attached to a gravure cylinder (B), an etchant is applied, which eats through varying thicknesses of emulsion (C).

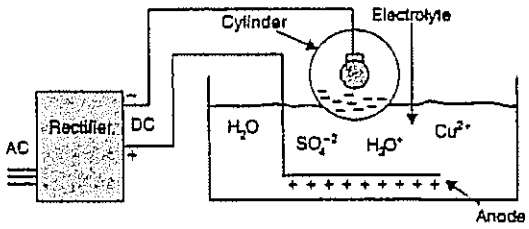
elements—such as the *New York Times Magazine*, *Parade*, *USA Weekend*, and other color supplements across the country—are printed on rotogravure presses.) In the 1930s, gravure presses began to be used in the printing of packaging; a single-color gravure press in 1933 was set up to print Tootsie Roll wrappers. In 1938, multicolor gravure presses were used for the printing of Jell-O boxes. These so-called "Jell-O presses" were the largest and fastest yet designed; together, they were capable of printing up to 36,000 cartons an hour and were in use until 1987.

Modern advances in engraving technology have made gravure printing a high-quality printing operation. The expense of producing and imaging the gravure cylinders, however, still continues to make gravure printing an expensive process, and gravure is rarely used economically for print-runs of under 200,000 or so. An advantage of gravure printing, though, is the relative simplicity of the press, which does not require the intricate series of ink and dampening rollers that a lithographic press requires.

Gravure Presses

The gravure printing press has several basic elements: gravure cylinder, ink fountain, impression roller, and substrate control.

Gravure Cylinder. A gravure press most often prints from a gravure cylinder, which comprises a steel base, that can either be a ***sleeve cylinder*** or a ***shaft cylinder***. A sleeve cylinder requires a shaft to be attached when it is mounted on the press, or when it is mounted in the engraving mechanism. The inaccuracies inherent in the fitting of a separate shaft have brought about the development of a shaft cylinder, which comes with shafts already mounted, and they are the dominant gravure cylinder bases currently utilized. Aluminum bases have be devised to hopefully replace steel, especially in presses used in the printing of packaging, but although they are lighter they are also harder to electroplate. Newer plastic cylinder bases are being developed that are much lighter than metal bases, and contain special surface coatings (most of which are proprietary) that facilitate ***electroplating***.



The principle of electroplating. The gravure cylinder base is given a negative charge and thus acts as a cathode. A copper anode is given a positive charge. Copper ions are thus forced into the solution, where—being positively charged—they bond with the negatively charged cylinder.

To the cylinder base is electroplated a layer of copper, which has historically been—and continues to be—the dominant surface material for gravure cylinders—and is commonly electroplated to the base utilizing a sulfuric-acid electrolyte. On top of the copper, after engraving, is plated a thin layer of chrome, which is applied to protect the etched copper surface from the abrasion of the doctor blade during printing. After print runs, the cylinder needs to be resurfaced. (See ***Electroplating***.)

The copper surface of the cylinder, prior to printing, is etched or engraved. A particular image printed in gravure is essentially a collection of many tiny cells that are etched with varying depths (darker regions of a print utilize deeper cells that can hold more ink, while lighter regions utilize shallower cells that hold less ink). This is why gravure-printed type can look fuzzy when examined under magnification. But due to this printing mechanism, gravure can print halftones extremely well. Before the development of ***electromechanical engraving*** in the 1960s, most gravure cylinder etching was performed photochemically, using carbon tissue resist coatings and ferric chloride etchants to chemically etch the image areas. Now, the artwork to be engraved is often placed before an optical scanning device, which uses photodiodes to receive the image, and the image is transformed into digital data, which is

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