

What is pad printing?

Pad printing is a printing process that can transfer a 2-D image onto a 3-D object. This is accomplished using an indirect offset (gravure) printing process that involves an image being transferred from the printing plate (cliché) via a silicone pad onto a substrate (surface to be printed). Pad printing is used for printing on otherwise impossible products in many industries including medical, automotive, promotional, apparel, electronics, appliances, sports equipment and toys. It can also be used to deposit functional materials such as conductive inks, adhesives, dyes and lubricants.

Physical changes within the ink film both on the cliché and on the pad allow it leave the etched image area in favor of adhering to the pad, and to subsequently release from the pad in favor of adhering to the substrate (material being printed).

The unique properties of the silicone pad enable it to pick the image up from a flat plane and transfer it to a variety of surface (i.e. flat, cylindrical, spherical, compound angles, textures, concave surfaces, convex surfaces).

Pad printing cycle

1. From the home position, the sealed ink cup (an inverted cup containing ink) sits over the etched artwork area of the printing plate, covering the image and filling it with ink.
2. The sealed ink cup moves away from the etched artwork area, taking all excess ink and exposing the etched image, which is filled with ink. The top layer of ink becomes tacky as soon as it is exposed to the air; that is how the ink adheres to the transfer pad and later to the substrate.
3. The transfer pad presses down onto the printing plate momentarily. As the pad is compressed, it pushes air outward and causes the ink to lift (transfer) from the etched artwork area onto the pad.
4. As the transfer pad lifts away, the tacky ink film inside the etched artwork area is picked up on the pad. A small amount of ink remains in the printing plate.
5. As the transfer pad moves forward, the ink cup also moves to cover the etched artwork area on the printing plate. The ink cup again fills the etched artwork image on the plate with ink in preparation for the next cycle.
6. The transfer pad compresses down onto the substrate, transferring the ink layer picked up from the printing plate to the substrate surface. Then, it lifts off the substrate and returns to the home position, thus completing one print cycle.

Open inkwell system (older technology)

Open ink well systems use a trough (ink well) for the ink supply, located behind the printing plate. A flood bar pushes a pool of ink over the plate, and a doctor blade removes the ink from the plate surface, leaving ink on the etched artwork area ready for the pad to pick up.

Sealed ink cup system (latest technology)

Sealed ink cup systems employ a sealed container (ink cup), which acts as the ink supply, flood bar and doctor blade all in one. A ceramic ring with a highly polished working edge provides the seal against the printing plate.

Printing pad

Pads are three dimensional objects typically molded of silicone rubber. They function as a transfer vehicle, picking up ink from the printing plate, and transferring it to the part (substrate). They vary in shape and durometer depending on the application.

There are three main shape groups: "round pads", long narrow pads called "bar pads", and miscellaneous shapes (square, rectangular, etc.) called "loaf pads". Within each group there are three size categories: small, medium, and large size pads. It is also possible to engineer custom-shaped pads to meet special application requirements.

Image plate

Image plates are used to contain the desired artwork "image" etched in its surface. Their function is to hold ink in this etched cavity, allowing the pad to pick up this ink as a film in the shape of the artwork, which is then transferred to the substrate.

There are two main types of printing plate materials: photopolymer and steel. Photopolymer plates are the most popular, providing a good do-it-yourself option. These are typically used in short to medium production runs. Steel plates come in two choices: thin steel for medium to long runs, and thick steel for very long runs. Both steel plate types are generally processed by the plate supplier as it involves the use of specialized equipment.

Printing ink

Ink is used to mark or decorate parts. It comes in different chemical families to match the type of material to be printed.

Pad printing inks are "solvent-based" and require mixing with additives at the time of use. They typically dry to the touch in seconds although complete drying (cure) might take a substantially longer period of time. Inks of today(2010) have come a long way.

Climatic conditions will significantly affect the performance of any pad printing ink, especially the open ink well style printers. Too dry conditions can lead to faster evaporation of solvents causing the ink to thicken prematurely and too much moisture can lead to ink issues of "clumping" or something alike. Also the climate can affect other aspects of the printing process such as ink pick up and release from the plate to the pad to the substrate, as well as polymer plate to blade chattering or binding due to humidity. Keep this in mind when planning the location of your pad printer. Use any necessary heater, air conditioner, humidifier or dehumidifier as needed.

Substrate

Substrate is the technical name used to address any parts or materials to be printed, and it is critical to match substrates and ink series as to their chemical compatibility. Please consult the substrate compatibility chart for proper ink selection. Typically you will need a "fixture" to hold and support your substrate in order to ensure good quality printing. Fixtures vary in materials and complexity depending on the application. One of the most interesting examples of fixture making creativity is the use of Lego for short run printing. This began in a eureka moment of inspiration when Cliff Rowell, a small print shop owner and grandfather in Calgary, Canada, was playing with his grandson. This innovation has begun making its way through the industry in recent years and saves the time and expense of building job specific custom fixtures. Note that substrates need to be clean and free from surface contamination to allow proper ink adhesion.

Printing plate making

There are two main techniques used to create a printing plate. The traditional technique requires a UV exposure unit and involves photo exposure with film positives and chemical etching of a photopolymer plate. A second technique known as "computer to plate" requires a laser engraver and involves laser etching of a specialized polymer plate. Although the latter technique is convenient for short run printing it does have several disadvantages over the former.

Laser plate making is a process that requires the use of a very soft, low quality polymer coated plate. Thus, the standard cycle life that can be expected out of a laser etched plate is quite low (10,000 impressions on the high end). By comparison, a hardened steel plate can easily last for over 1 million impressions.

Printing application examples

- Medical devices (surgical instruments, etc)
- Implantable & in body medical items (catheter tubes, contact lenses, etc.)
- Golf ball logos/graphics
- Decorative designs/graphics appearing on Hot Wheels or matchbox toy cars
- Automotive parts (turn signal indicators, panel controls, etc.)
- Letters on computer keyboards and calculator keys
- TV and computer monitors
- Identification labels and serial numbers for many applications

