# About Plastic Card Printing

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# About Plastic Card Printing

## *Contents*


## *Introduction*

Plastic cards are prevalent in our daily lives, from credit cards to driver's licenses, membership cards to employee identification badges. Their standard size, portability and durability make them the ideal choice for many applications.

Digital plastic card printers offer the ability to create customized cards on demand, right at the point of issuance. With a computer and an image capture system, such as a digital camera, plastic card printers provide the delivery point of a highly integrated system. At just a few seconds per card, the printing process is fast, so that cards are generated and personalized immediately, quickly connecting the customer or cardholder to the issuing organization or program.

Digitally printed plastic cards provide numerous technological features, but start with a blank card that can be printed with any combination of artwork, graphics, text, digital photograph, bar codes, logos, etc., limited only by the issuers' imagination. Additional machine-readable information, such as magnetic stripes and smart card chips, can also be encoded.
Digital plastic card printing represents the next generation of card production. With digital printing technology, it integrates the card delivery process into the electronic environment that helps you manage your business or agency.

## *Photo Identification Cards*

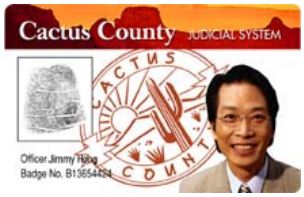
Photo ID cards are generally produced using either a traditional film based method or digital printing technology. The older, more traditional way to produce personal ID cards is a multi-step cut/paste/laminate process consisting of:

- Taking an instant photo of the person, then cutting and trimming the picture to fit the card
- Separately printing the person's ID information on a card-sized piece of paper or card stock

- Laminating the picture and card together

Student or employee ID badges, club membership cards and driver's licenses are a few examples produced by this method. However, such cards are easily counterfeited or altered, and the card-making process can be both labor intensive and time consuming.

In contrast, digital card printing is a one step process in which text, graphics and pictures are printed directly on a card from a computer system. These cards are usually the same size as a standard credit card and made of a plastic called Polyvinyl Chloride, or PVC. Plastic cards can be printed single or dual sided, and in monochrome or full color.




Digital access control card with photo image, hologram and fingerprint scan


Digital access control and stored value debit passenger card with photo ID and smart chip


Digital club membership card with photo ID, membership number and barcode

## *Digital Card Printing Advantages*

**Image Quality**

The image quality of digitally printed plastic cards produced with is far superior to those produced through the traditional method described above. Not only are digitized photo images sharper, but also they can be edited for color quality. Moreover, positioning of graphical elements on the card is more consistent, and text is both clearer and more readable.

**Flexibility**

Plastic card printers can print text, line art, and photographic images. They can also encode magnetic stripes and provide smart card chip programming contact stations, all in a single step process. Card design software provides users the flexibility to change designs, store and access multiple designs, create variable text fields, and implement database programs to store images and track information.

**Security**

Plastic card printers can also apply various protective materials, such as hologram overlays and laminates, to make cards resistant to tampering and alteration. This helps make cards more secure because they cannot be easily reproduced or counterfeited. These protective materials also help to increase card life.

**Durability**

Card protection materials such as overlay varnishes and laminates provide various levels of card durability by making the cards resistant to abrasion, UV light exposure, water damage, and exposure to liquid chemicals.

**Economy**

In-house printing of plastic cards using a Zebra card printer is far more cost and time-efficient than the traditional photographic cut/paste/laminate method. A plastic card printer is also more economical than using a lithographic printer or service bureau. Outside suppliers must mark up card production costs significantly in order to cover overhead and servicing costs, making them cost-effective only for large volume applications.

**Convenience**

Printing your own plastic cards gives you the convenience of being able to produce cards on demand, when and where you need them. Having your own card printer capability also makes it easy to make changes to card content or design quickly.

## *How It Works*

All Zebra plastic card printers feature the same basic printing operations; dye sublimation and/or thermal transfer printing. Both techniques involve heating a thermal print head while in contact with a ribbon. However, thermal transfer printing differs from dye sublimation in that thermal transfer uses ink rather than dye. In thermal transfer printing, heat melts the ink on the ribbon, causing it to transfer to the card surface. In dye sublimation, heat vaporizes the ribbon dye, which then permeates the plastic card.

The ribbon used in color dye sublimation printing is divided into three separate color panels Yellow, Magenta, and Cyan (see Figure 1). This configuration is referred to as YMC.


FIG. 1


These three colors are the primary colors used in printing to produce all other colors including black.

The dye from the ribbon is applied to the plastic card via a multi-pass operation. This means the card will pass under the print head once for each of the three colored ribbon panels - applying each color separately.

'Dye Sublimation' is also referred to as Dye Diffusion. When the print head heats the dye on a ribbon, the dye is transformed from a solid to a gas and diffused onto the plastic card, which is specially coated to absorb the color dye. The temperature of the print head controls how much dye is converted to a gas – as the print head temperature rises, more dye can be absorbed into the plastic card. Consequently, the picture quality and continuous color tones produced by a dye sublimation printer – at 300 dpi – can outperform most laser or ink jet printers with higher resolutions. The advantage of dye sublimation is the millions of colors that can be created. Varying the heat intensity on the ribbon panels yields various shades of each color, making color selection virtually unlimited.

As mentioned above, thermal transfer differs from dye sublimation in that it uses ink instead of dye. However, both dye sublimation and thermal ink (sometimes referred to as Resin) can be combined in one ribbon (see Figure 2). This ribbon is known as a YMCK Ribbon. The letter "K" designates the color black in the printing industry.


FIG. 2

*Why do you need a separate black panel, when you can create black by mixing the three basic YMC colors together?*

The black created by mixing the YMC colors together is referred to as “Composite Black.” Composite Black is not recommended for printing bar codes since it does not produce the sharp edge many scanners require. Although this is invisible to the naked eye, it is easily observable under magnification). Composite Black is also invisible to IR scanners since there is no carbon in the dye. Since you may not know what type of scanner will be used, the rule is to always use TT (resin) black to print bar codes.

All Zebra printers are capable of printing in monochrome using a single color ribbon. These ribbons are less expensive than full color multi-panel ribbons and can be either dye or ink (thermal transfer). The most commonly used monochrome ribbon is "Black" but there are several other colors available including; Red, Green, and Blue.

## Monochrome Ribbon

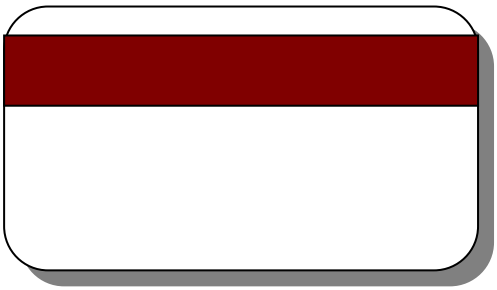
FIG.3

Dye Sublimation ribbons are preferred for printing pictures, since they can produce many shades of gray for a smoother look and a better picture quality. A resin black picture normally uses a dithered gray scale (gray made from a combination of pixels which limits the number of shades), producing a coarser, grainy look to the image.

Thermal Transfer (resin) or monochrome ribbons should be used to print text, bar codes or single color graphics such as simple logos. The letter “K” followed by a lower case “r” or “d” (Kr or Kd) denotes black monochrome ribbons. The “r” designates a Thermal Transfer ribbon with resin ink. The “d” designates a dye sublimation ribbon. Monochrome ribbon colors include black, red, green, blue, white, metallic silver, metallic gold, and scratch-off gray.

## *Magnetic Stripe Encoding*

Magnetic stripe cards have been in existence since the early 70's when they were used on paper and film-based ID cards as well as credit cards. Magnetic stripe technology is widely used throughout the world and remains the dominant technology in the United States for transaction processing and access control. Other technologies such as PDF bar codes and smart chip cards are now capturing part of the magnetic stripe market since they can hold more information.



Magnetic Stripe Plastic Card

Magnetic stripe encoding terms:

**Coercivity**

A technical term used to designate how strong a magnetic field must be to affect data encoded on a magnetic stripe. Coercivity is measured in Oersteds (Oe). Coercivity is the measure of how difficult it is to encode information in a magnetic stripe.

**HiCo**

Abbreviation for High Coercivity. HiCo magnetic stripes provide the highest level of immunity to damage by stray magnetic fields. They are more difficult to encode than LoCo magnetic stripes because the encoding requires more power. HiCo magnetic stripe cards are slightly more expensive for this reason.

**LoCo**

Abbreviation for Low Coercivity. Easier to encode and slightly less expensive than HiCo magnetic stripe cards.

Selecting which type of magnetic stripe to adopt depends on how the card is to be used. Will the magnetic stripe be used daily, once a month, or just a couple of times a year? The chart below shows some of the applications where magnetic stripes are used and which stripe is common for that application.

*Typical Magnetic Stripe Card Applications, Types and Usage*

| APPLICATIONS | LOCO | HICO | USAGE |
|---|---|---|---|
| Access Control | | λ | Daily |
| Retail Customer Loyalty Cards | λ | | Weekly |
| Membership Cards | λ | | Weekly / Monthly |
| Time and Attendance | | λ | Daily |
| Debit/Credit | International | United States | Weekly / Monthly |
| Drivers License | | λ | Occasional* |

* HiCo required by most states

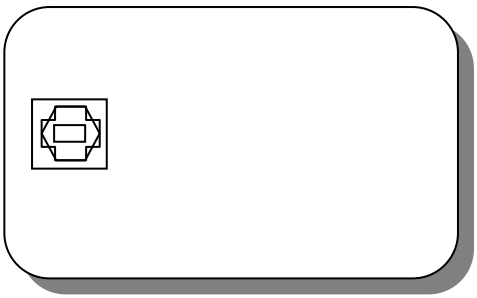
The easiest way to determine visually if a stripe on a card is HiCo or LoCo is by the color. HiCo stripes are black and LoCo stripes are a lighter brown. Magnetic stripe readers are "blind" as to whether a stripe is HiCo or LoCo and are designed to read both.

Another term often used is Stripe-up and Stripe-down. Stripe-up means the magnetic stripe is on the front of the card and Stripe-down means the magnetic stripe is on the back of the card. This information is important when ordering a printer since the magnetic encoder must be installed differently for Stripe-up and Stripe-down models at the factory. The most common is Stripe-down.

All Zebra Encoders follow the ISO standard for encoding, but can be changed via the Windows driver to enable proprietary encoding. Proprietary encoding offers greater security and most readers can also be easily reprogrammed to read custom encoding.

## *Smart Cards*

There are a wide variety of contact and contactless smart cards currently in use. The terms "Smart Chip Card, IC Card, and Smart Card" all refer to the same type of card. Smart cards feature an embedded, programmable chip and can store over 100 times more information than a magnetic stripe. They can also be reprogrammed to add, delete or rearrange data.



Microprocessor Smart Card

Invented in Europe in the 1970s, smart cards were in wide use by the early 1980s. Smart cards are an easy, inexpensive way for European businesses to do off-line transaction verification. Off-line verification is preferred throughout Europe due to the high cost of telecommunications. In contrast, the cost of having

the current magnetic stripe readers "on-line" via telecommunications is relatively inexpensive in the U.S. compared to the rest of the world. Thus, the United States has been slow to implement smart cards because it would require replacing the widely installed magnetic stripe card reading equipment with smart card readers.

The second type of smart card contains both a microprocessor as well as memory. Not only can cards can store massive amounts of information, but the micro-processor enables the card to make independent decisions regarding the information stored.

Zebra card printers can accommodate both types of chips, since they all offer an optional smart card contact station or embedded encoder. The printer brings the card into the contact station and then passes programming signals from a programmer to encode the smart chip.

Contactless smart cards utilize various RFID technologies to write and read. Many card printers print on these kinds of smart cards. Encoding or programming the electronic devices on these cards is typically accomplished by an external encoding or programming device, but contactless smart card encoders integrated into the card printer are increasingly available.

### *Proximity Cards*

Proximity cards are primarily used for access control applications. They are similar to contactless smart cards, but are passive, read only devices. Proximity cards contain embedded RFID antenna and can nominally be read from distances up to 10".

### *RFID Technology*

Radio Frequency Identification Technology is a method of identifying objects using radio waves. RFID works by employing an RFID transponder (or tag) and a reader. The RFID transponder is comprised of a microchip that holds information to identify an object, product, or person and an antenna for transmitting this data to the reader. The antenna transmits the data to a reader that converts the radio waves to usable information.

Unlike bar code and magnetic stripe technology, RFID transponders can be read anywhere within the magnetic field sent out by the reader. Radio waves can travel and be read through many non-metallic objects. Because RFID antennas can be embedded into many objects, including plastic cards, and still be detected, data is protected from the wear and tear of everyday use and environmental elements. Depending on the power of the reader, an RFID antenna can be read from direct contact up to 20 feet.

Even though RFID technology has been in use since World War II, its implementation has become widespread with the increasing use of proximity cards in security and access control type applications. As security has gained a heightened awareness, corporations, hospitals and even schools have begun to employ access control systems to monitor and secure entrances, labs, departments, and other areas that need to limit admittance to authorized individuals. Proximity cards can also be programmed uniquely, and utilized in many applications other than access control such as time and attendance, employee certification, emergency medical data storage, and biometric verification.

## *Card Durability and Security*

Various types of materials are used to protect plastic cards from abrasion, wear, fading, alternation, and duplications. Overlay varnishes and laminates are the most common materials used to enhance card durability and provide additional security.

Card durability has to do with how well the card withstands various forms of environmental stress. They include resistance to abrasion, such as passing the card through a magnetic stripe or bar code reader, protection from image fading when exposed to sunlight, and resistance to damage when immersed in water or exposed to chemicals.

Another important factor in applications such as drivers licensing is resistance to tampering, alteration, and/or replication. With the use of protective materials such as laminates with holograms, cards can be constructed to eliminate the potential of tampering and alteration.

Card security means that the card can be verified for authenticity. Techniques include the application of overlay varnish or laminate materials with hologram images. Use of these materials in constructing cards makes replication by anyone without access to the custom hologram image materials virtually impossible.

*Card Protection Materials*

| MATERIAL | CARD LIFE | DURABILITY | SECURITY |
|---|---|---|---|
| Overlay Varnish | Up to 2 years | Minimal | |
| Overlay Varnish with Hologram | Up to 2 years | Minimal | Visual |
| Clear Laminate | 5 to 7 years | High | |
| Laminate with Hologram | 5 to 7 years | High | Visual |

Overlay varnishes provide card protection, but have a much shorter life span that laminate material - and offer very little security (with the exception of some hologram varnishes). Varnishes are not a solid covering and have multiple tiny holes in the surface, which allows the dyes to be drawn away from the card. This will cause the image on the card to blur and fade due to UV light, shift in color, or just wear away. The life expectancy of a plain plastic card is up to 2 years.

Laminate material offer better protection than plain varnish, for both security and life expectancy. Laminate material is a polyester protective material that is applied to the surface of the card after printing. Laminates are available either 0.6 or 1.0 mil thick and are applied via a hot roll laminating station. The life expectancy of a plastic card with a laminate material is up to seven years.

## *Selecting the Right Zebra Card Printer*

Questions to consider:

***What kind of cards can be printed on dye-sublimation digital card printers?***
Blank or pre-printed PVC or PVC composite plastic cards are compatible with all Zebra-brand dye-sublimation and monochrome digital card printers. All Zebra models also feature magnetic stripe encoding options. Smart cards can be printed and encoded on Zebra's P310i, P330i, P420i, P520i and P640i.

All Zebra card printers support standard ISO CR80 size cards. Models P310i and P330i print on cards with thickness from 10mil to 60mil. Model P420i prints on cards with thickness from 30mil to 60mil. Models P120i, P205, P210i, P520i, and P640i prints on cards with thickness of 30mil. The P520i and P640i also apply lamination material. Cards should always be a PVC Composite material and 30mil thick.

***Do you want to print Color or Monochrome cards?***
All Zebra-brand color card printers – models P120i, P210i, P310i, P330i, P420i, and P520i – can be used for both color and monochrome printing. Model P640i can only be used for color printing and laminating. Models P310F and P205 are single-sided monochrome card printers and are optimized for fast, easy, economical monochrome card printing.

***Do you need to print on both sides of the card?***
Zebra models P120i, P420i, P520i and P640i all come with integrated card flip over features that support dual sided card printing.

***Do you need to encode magnetic stripes or smart card chips?***

Zebra card printer models P310i, P330i, P420i, P520i and P640i feature optional magnetic stripe encoders and/or smart card contact stations or built-in encoders. P120i, P205 and P210*i* also have magnetic stripe encoder options only.

***Do you need a card with additional security features?***

All printed plastic cards containing any useful information are subject to counterfeiting, alteration, duplication, and forgery. Card applications subject to these types of card threats should use custom security features either embedded in their plastic cards or applied to the card through lamination or overlay varnish to reduce these risks. As an overt security feature and a card life extender a protective film referred to as a laminate or overlay varnish roll can be applied to most printed cards during the printing process and/or lamination process. The protective film can include unique security elements, such as: visual holograms, optically variable inks (OVI), microtext, UV fluorescent images, guilloche patterns and metallic inks. Security images can be viewed as two or three dimensional picture that consists of a unique pattern that can change color and/or shape when viewed at different angles. This technique used in the card printing industry is referred to as a Diffractive Optically Variable Image Device (OVD). The images can be customized to include a company logo, a unique emblem, seal, and image or company name as unique security elements. Plastic cards can be customized to include security elements as well. Zebra offers cards with embedded holograms, color shifting ink, opacity marks, pre-printed microtext and or UV images. These options make cards more tamper resistant and secure.

Zebra card printer models P310i, P330i, P420i are capable of applying overlay varnish materials, with added security features, to printed cards. Models P520i and P640i are capable of applying laminates for added card security and protection.

***How rugged and durable must the cards be?***

Zebra models P310i, P330i, P420i, and P520i all have the capability to apply protective overlay varnishes with or without holograms. For higher levels of durability, the Zebra P520i and P640i feature fully integrated hot roll laminating stations for the application of 0.6 or 1.0 mil laminate patch materials, with or without holograms.

***How long do you need your cards to last?***

For cards that need to last less than two years, Zebra's P120i, P205, P210i, P310i, P330i, P420i are recommended. P520i and P640i produce cards lasting up to seven years. The P520i and P640i are recommended for abrasion intensive applications such as frequent bar code or magnetic stripe card reading. Both models support dual sided lamination, but the P640i actually has upper and lower laminating stations that laminate both sides of the card at the same time for optimum throughput.

## *Glossary of Card Printing Terms*

**Access Control Cards**

Plastic cards used to gain access to premises, usually associated with magnetic stripe and proximity cards.

**Bar Code**

An array of machine-readable rectangular bars and spaces arranged in a specific way defined in international standards to represent letters, numbers, and other human-readable symbols.

**Digital Imaging**

Scanning or otherwise capturing images which may be subsequently edited, filed, displayed or printed on a plastic card.

**Dye Sublimation**

An imaging method for transferring controlled quantities of printer ribbon dye onto a plastic card. Because of the print head resolution (300 dpi), photographic quality results.

**Encoding**

The process of electronically “writing” information on magnetic stripes or smart card chips.

**Font**

A character set (alphabet and numerals) of a specified design and size.

**Hologram**

A unique photographic printing that provides a three-dimensional effect on a flat surface. Holograms cannot be easily copied and are used for security and aesthetic purposes on cards.

**Image Capture System**

A hardware and software system used to obtain and save personal data and cardholder photographic images.

**Lamination**

The process of combining lamination material and core material using time, heat and pressure. Laminate patches used in card printers come on rolls, with and without carriers/liners.

**Machine-Readable**

A code or characters that can be read by machines.

**Magnetic Stripe**

Magnetic material, applied as a strip in the surface of a card, used to encode cardholder information.

**Memory Card**

A type of smart card. Also known as a synchronous card, it features memory and is suitable for use as a token card or identification card.

**Microprocessor Card**

A type of smart card, also known as an asynchronous card. Features memory, a microprocessor and is suitable for portable or confidential files, identification, tokens, electronic purse or any combination of uses.

**Overlay Varnish**

A thin transparent layer applied (using the print head) to cards to resist scratching and fading from exposure to UV radiation.

**Resolution**

Dimension of the smallest element of an image that can be printed. Usually stated as dots-per-inch (dpi).

**Prox Card**

Short for Proximity card; a form of contactless smart card used for access control applications. Embedded in the card is a metallic antenna coil, which allows it to communicate with an external antenna. Because the cards require only close “proximity” to a RF antenna to be read, they are also referred to as contactless cards.

**PVC**

Polyvinyl Chloride. The primary material used for typical plastic cards.

**Smart Card/Contact Smart Card**

Also called a “chip” card or IC card. A plastic card with an embedded microchip, which may be used to store information about the cardholder or record card transactions as they occur.

**Thermal Printing**

The process of creating an image on a plastic card using a heated print head.

**Thermal Print Head**

An electronic device which uses heat to transfer a digitized image from a special ribbon to the flat surface of a plastic card.

**YMC**

Yellow, Magenta, and Cyan are the primary print colors for cards. The three colors are combined in varying degrees to make a full spectrum of colors. **YMCKO** is the same as YMC plus Black (K) and clear protective overcoat (O).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