APPLICATION NOTE 19
DYE SUBLIMATION PRINTING ON HID PVC
ACCESS CONTROL CARDS

1.1 Purpose

This document provides guidelines for dye sublimation printing on HID Proximity, Contact and Contactless Smart cards made with Polyvinyl Chloride (PVC). HID PVC cards include:

- ISOProx II
- DuoProx II
- Smart ISOProx II
- Smart DuoProx II
- HID Mifare
- HID Proximity & MIFARE

This document also deals with add-on technologies, such as magnetic stripe, contact smart chip module, Wiegand, bar code, and signature panels.

1.2 Overview

- HID PVC cards are designed for dye sublimation printing of text, graphics and images (card artwork).

- Because the cards have embedded electronics, slight surface discontinuities are unavoidable.

- When designing card artwork, the location of embedded electronics and contact smart chip modules must be considered for best results.

- Customers must be willing to print test cards, and make changes in layout or content to obtain the best results.

- Customer dissatisfaction with the results of dye sublimation printing on proximity cards is due to unreasonable expectations caused by lack of education.

1.3 Card Construction

HID PVC cards are manufactured by laminating 3-5 layers of PVC under heat and pressure, using a hydraulic press. The cards have a die-cut PVC center core with an area punched out to receive the insert (coil and PCB). The center core is sandwiched between a top and bottom white PVC cover, and additional clear PVC top and bottom layers are added if the white PVC covers are pre-printed.

PVC is used because it is the best material for dye sublimation printing, and also because it laminates into a contiguous piece of plastic, which does not de-laminate over time.

Because PVC tends to flow during the laminating process and the embedded components remain rigid, surface discontinuities can result from a basic tendency of PVC to mimic the topology of the embedded item.

1.4 Card Artwork Design

Surface discontinuities caused by embedded components in PVC access control cards may cause color variations or voids when the cards are printed with a dye sublimation printer. Accordingly, when designing card artwork, the user must be aware of the location of embedded components, and must avoid placing critical art elements in those areas. The following guidelines should be used:

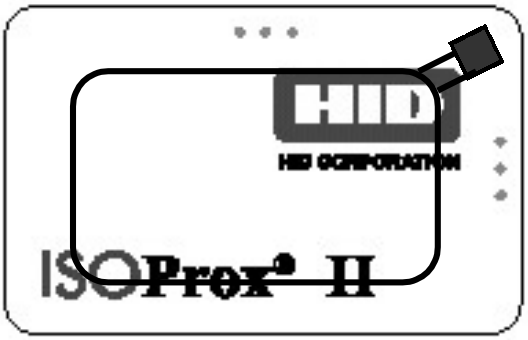
- Avoid large areas with solid or screened color backgrounds – they are likely to reveal embedded materials.
- Do not place critical elements such as a logo or a photo portrait over the chip location in a proximity card, opposite the edge of a magnetic stripe or behind a contact smart chip module.
- Use art with varied color or pattern to make embedded components less obvious.
- Avoid color half tones, particularly Grey; they are especially prone to visual artifacts due to card surface irregularities, or printer limitations.
- A white background gives a professional appearance, and is most likely to yield successful results.
- Always print a few test samples of the artwork, and be prepared to make minor adjustments to the location and content of art elements to create the best appearance.

Good Card Artwork Examples

The designs above will likely produce good results when printed on HID Proximity Cards.

Problem Card Artwork Examples

These designs will likely produce poor results when printed on HID Proximity Cards. The light blue background on both cards will reveal the antenna location.



Coil and Chip Location

This illustration shows the approximate location of the antenna coil and chip on an ISOProx II card as viewed from the front. The DuoProx is similar but a magnetic stripe is also located on the bottom reverse side. The series of dots indicates slot punch locations for vertical or horizontal orientation. Chip location may be different for various SmartProx, and IQCard models, and may also be different for custom cards made by Value Added Resellers. If you are not sure of the chip location, contact HID customer service, or print a test card using a 20% grey screened background.

1.4.1 Acceptable Print Area

- <u>HID Proximity Cards</u>

  HID Proximity cards can be printed from edge-to-edge on both sides.

  HID PVC cards are glossy / polished finish on both sides for the best quality dye sublimation printing.

- Printing on HID DuoProx cards (with Magnetic stripe)
  Edge-to-edge printing is allowed on the blank non-magnetic stripe side of the card.

  Do not print closer than 2.5 mm (0.10”) to the edge of the magnetic stripe.

  Minimize text or image on the reverse side of the magnetic stripe, so that scratches and wear from swiping the magnetic stripe will not be as noticeable.

  Do not apply a clear topcoat or overlay over or within to 2.5 mm (0.10”) of the magnetic stripe.

  HID DuoProx cards have a flush magnetic stripe - do not attempt to print on ISO Prox cards with rolled-on magnetic stripe.

- IQCard Mifare Cards

  The chip in a Mifare card is much larger and thicker than the chip in a standard HID Proximity card. Printing in the area of the chip usually results in obvious printing voids (non-printed white spots).

- Printing a Bar Code on HID proximity cards

  Edge-to-edge printing on both surfaces is allowed except for 6.35mm (0.250”) quiet zones consisting of the space before the first bar and after the last bar in the barcode – no printing should occur within the quiet zones.

  Avoid aligning bar codes opposite an image/photo or magnetic stripe on the opposite side of the card.

  Bar codes must be printed using the K (Black) panel if infrared readers are used; only visible light readers can read bar codes printed with the C, M or Y panels.

  Pre-test sample cards with the user’s bar code readers before printing all cards.

- HID Wiegand and Proximity-Plus Wiegand cards
  Recent quality improvements in Wiegand cards allow printing edge-to-edge, and in the area of the Wiegand code strip.

  Avoid locating critical art elements near the edges of the code strip to prevent printing voids due to occasional “sink.”

  Specify glossy/polished finish when ordering Wiegand cards.

HID Smart ISOProx II and Smart DuoProx II Cards
On the blank side of the card, edge to edge printing is allowed. On the side of the card that contains the smart chip module, text or image should be to 2.5 mm (0.10") from the edge of the chip.

When module implantation is done properly, the module should be flush with the surface of the card, and there should be no burrs. If the module exceeds 0.050 mm (0.002) above the surface of the card, printing should not be done; the module could damage the print head.

Also note that when a "pocket" is milled into the card to hold the smart chip module, the remaining plastic is very thin. This may result in a visible bump or depression in the back of the card in the area of the module. It is not recommended to print in this area.

If using a clear topcoat, adjust so that the smart chip module is not coated.

- HID Prox cards with Signature panels
  Print only on HID cards with factory-installed mylar signature panels. Do not align signature panels opposite an image/photo on the reverse side. Do not print within to 2.5 mm (0.10") of the signature panel, or pixel damage may occur in the print head. If a signature panel has a raised surface, a guideline of 2.5 mm (0.10") border for each 0.025 mm (0.001") of raised surface height must be followed.

1.4.2 Alternative Printing Methods

If the end user absolutely cannot change the artwork design, there are other alternatives. An adhesive-backed plain PVC card can be printed and adhered to the card with excellent results.

Other alternatives include peel and stick polyester labels (removable to allow card re-use) or various reverse-printed, transparent film overlays which can be permanently bonded or laminated to PVC cards.

1.5 Card Thickness

Most dye sublimation printers are designed to print on magnetic stripe cards which are 0.50 mm (30 mils) thick. Some printers can accept cards up to 40 mils, and a few can print cards up to 60 mils thick.

HID Plain White ISOProx and DuoProx cards are typically 30-33 mils thick. HID Pre-printed ISOProx and DuoProx are 34-37 mils thick due to the addition of a 2 mil clear layer on each side of the card to protect the printing. Wiegand cards are 41-44 mils thick.

Custom laminated cards will be .002 to .004 inches thicker than standard plain white cards due to the addition of an overlay on both sides of the card that allows for post printing over the custom laminated artwork.

1.6 Environmental Conditions

Store or print HID PVC cards only in the following temperature and humidity range:

- 18.3 to 29.4 degrees C (65 to 85 degrees F)
- 20 to 80% relative humidity, non-condensing

1.7 Print Head Pressure

Dye sublimation printing requires a certain print head pressure to keep the head and ribbon in continuous intimate contact with the card. Do not increase print head pressure to compensate for printing voids or color changes due to surface anomalies on the card – damage to the head may result. Print head pressure should only be adjusted by a factory technician.

1.8 Print Head Temperature

Dye sublimation printing requires a specific print head temperature to heat and transfer the dye to the card. Despite popular misconceptions, print head temperature has a negligible effect on the PVC card surface and on the internal card components.

1.9 Twisting or Bending the Cards

Do not twist or bend HID PVC cards prior to printing - this may form a crease or bow in the card, which results in poor image quality. Extreme bending may also cause functional damage to the card.

1.10 Card Contamination

Contamination, such as PVC dust, other dust, lint, oils, hair and scratches to the card's surface can result in reduced print quality. Any debris on the card may affect card printing, and may cause permanent damage to the print head.

The cards should be treated like photographic film. If you touch or damage the card surface in any way you will have a poor quality print. Use of surgical gloves without talcum powder, thin cotton gloves, and finger cots will help prevent both smudges from fingerprint oils as well as scratches from fingernails. Discard any cards with surface scratches. Use hair nets, or tie long hair back to prevent hair from getting onto the cards surface.

Keep the environment both contaminant and static free. Keep the cards sealed in their plastic wrapping material until printing begins. Do not allow rubber bands to touch cards – they contain a petroleum-based substance which can contaminate the card surface, resulting in printing voids. Place the cards on a dry lint free cloth when preparing to print. Do not move stacked cards around unnecessarily – they can rub together and scratch or transfer substances from one card to another, affecting printing quality. If a card should become dirty prior

to printing, clean it using a soft lint-free cloth with either water or 99% pure alcohol.

Cleaning of the printer mechanism should be done at least as often as recommended by the printer manufacturer, and more frequently if necessary. If the printer is equipped with card cleaning rollers, they should be cleaned as often as recommended, or sooner as debris is observed, using the cleaner or cleaning cards recommended by the printer manufacturer. Some manufacturers also provide cleaning ribbons and a cleaning pen for the print head.

1.11 Slot Punching

Slot punching a card should only be done after the card has already been printed. Printing of slot punched cards may result in damage to the printer ribbon (due to edge burrs), misalignment due to mistracking by card transport rollers, or false triggering of the end-of card sensor, causing interruption of the printing process. Care should be taken to align the punch with the pre-printed slot punch targets as the internal components that may be damaged by a slot punch. If your card does not have slot punch targets, or if you are not sure about where to punch the card, contact HID for the proper locations to slot punch.

1.12 Post Printing Handling

Printed cards should not be placed in plastic see-through badge clips or holders to avoid dye transfer to and from the holder, which causes smudging, and to avoid the effects of plasticizers (which may be incorporated into some flexible plastic materials) on the PVC, causing softening, hardening or deformation. If placed in a storage box, printed cards should be arranged so that they all face in the same direction to minimize dye transfer and smudging occurring from card-to-card.

If a card becomes smudged or dirty after printing has occurred, you may clean the card using a lint free cloth with either water or alcohol.

1.13 Color Printing Quality

During the printing process, background colors can vary in intensity across the card. As the printhead travels down the card, it gets hotter, and the heat may not dissipate quickly enough, resulting in more color being applied at the trailing end of the card.

As numerous consecutive cards are printed, the color from card to card will vary, because heat accumulates within the printer. As color changes are observed, the user may wish to stop printing periodically to allow the printer to cool down.

It is recommended to avoid artwork design with large flat areas or blocks of mid or half-tone colors to avoid color variance on the card.

Some printer manufacturers provide a test card to aid in the calibration of printing colors.

Some printer software allows adjustment of print head temperature (expressed as color print intensity). Other printers can only be adjusted by factory trained technicians.

Most printer manufacturers do not guarantee that print colors will match those shown on the monitor, nor do they guarantee that Pantone colors can be matched.

1.14 Overlay Application

Although most color dye sublimation printers include the option for applying a clear overlay coating, many users require additional protection of the dye sublimation printed image.

A clear layer of polyester can be applied to the printed card under heat and pressure. The polyester has an adhesive backing, which melts, adhering the polyester to the PVC surface.

Unfortunately, polyester overlay is designed to be used with composition magnetic stripe cards with a PVC surface and Polyester core. The polyester core prevents the PVC from warping under the extreme heat of lamination.

Access control cards with internal electronics are made with pure PVC. When overlay lamination is used with HID cards they will exhibit warpage ranging from mild curvature to severe twisting, depending on the laminator used, as well as temperature and dwell settings.

For this reason, HID does not guarantee that its cards will not warp if polyester lamination is applied – the user does so at their own risk.

Note that lamination on both sides does not counteract the warpage caused by laminating one side – the second lamintion will cause more warpage than single-sided lamination, and will often result in a twisting warpage.

Before purchasing any laminator, the user should test HID PVC cards with the various types of overlay materials and laminators.

Note that special overlay material is available from some printer manufacturers with openings for smart card chips and magnetic stripes (which cannot function when covered with overlay material).

1.14.1 Alternative Methods of Protecting the Printed Image

Where the need for protection of the printed image is a concern, there are alternatives:

- Two-step lamination, using reverse-printed overlays: A special printer, made by Atlantek, prints the image in reverse on the back of a special clear overlay. The overlays are manually die-cut and then sandwiched around the PVC card inside a stationery laminator which keeps all the pieces flat during lamination. This process is slow, but results in a flat card with a thick protective layer over the printed image. Printing voids due to surface anomalies are eliminated.

- Automated reverse-print overlays. New printer/laminators made by Fargo and Datacard, reverse print on thin clear overlays. The back and front overlays are simultaneously laminated onto the card in a continuous process, resulting in a flat card with a protected image. Printing voids due to surface anomalies are eliminated.