



## ***Plastisol Ink – Factsheet (Extract courtesy of Union Inks)***

*Plastisol inks are widely used in garment printing. They are easy to print, do not dry in the screen, can be very opaque on dark garments, and will adhere to most textiles. They are composed primarily of two ingredients, PVC resin (a white powder) and plasticizer (a thick, clear liquid). Plastisol inks have one outstanding characteristic, they must be heated to dry. They will not dry, or cure, at normal temperatures. For a complete cure, they must reach 290-330° F (143-166° C).*

*Plastisol inks can be printed on virtually any surface that can withstand the heat required to cure the ink and is porous enough to permit good ink penetration. Plastisol inks do not colour the fibres' like a dye. Instead the ink wraps around the fibres' and makes a mechanical bond with the fabric. For this reason, they will not adhere to non-porous substrates such as plastic, metal, and glass. They also will not adhere well to woven, waterproofed nylon material without adding a bonding agent.*

### **Health, Safety, and Environmental Concerns**

*Plastisol inks are innocuous when used with reasonable care. A true plastisol ink contains no air-polluting solvents or volatile organic compounds. The manufacture, transportation, storage, use, and disposal of plastisol inks do not cause injury, illness, or environmental contamination as long as the appropriate safety and environmental protection procedures are followed. Most plastisol inks have a Health Rating of 1 (hazard - slight), a Flammability Rating of 1 (hazard - slight), a Reactivity Rating of 0 (hazard - minimal) and a Personal Protection Rating of B (wear safety glasses and gloves).*

### **Emulsion Selection**

*For plastisol inks use solvent-resistant dual-cure, Photopolymers or diazo direct emulsion stencils specifically designed for plastisols. Capillary film stencils are also a good choice, particularly when printing halftones and transfers.*

### **Plastisol Ink Additives**

*A word of caution about ink additives. It's easy to upset the chemical balance of plastisol inks by using the wrong additives or by adding too much of the correct additive. The result can be a print that never cures properly, a problem that may not be discovered until your customer washes a shirt and the design falls off. To avoid this problem use only those additives recommended by Union Ink, read the Technical Data Sheets for each ink and*

additive, and carefully follow their instructions.

Never add mineral spirits to plastisol ink. Although mineral spirits will make it easier to print at first, soon the ink will become even stiffer and harder to print than before. Also, it is possible that mineral spirits will prevent the ink from curing properly.

### **Ink Storage**

Store plastisol inks at room temperature. Prolonged exposure to temperatures above 90° F (32° C) can cause the ink to start to cure while it's still in the container.

### **Screen Washup**

Clean plastisol ink off your screens with either mineral spirits or any of the various brand name screen washes available from your screen printing supplier.

### **Controlling Dye Migration**

Dye migration is likely to happen when any portion of the fabric contains polyester. This could be represented by 50/50, 70/30, 90/10 or any other possible percentage combinations. Dye migration is the problem caused when dyes in polyester fibres sublimate through the ink layer changing the colour of plastisol inks. The colours most likely to migrate are red, black, maroon, kelly green, and some of the darker blues. Dye migration may appear immediately after the ink is cured, hours, days, or up to several weeks later.

- ✔ Be sure to print with High Opacity / Low Bleed Inks.
- ✔ Print with the coarsest mesh the art will allow.
- ✔ Proper emulsion coating techniques and screen tensions will provide sufficient ink deposit resulting in better bleed blocking ability.
- ✔ Avoid printing fine lines and halftones requiring fine meshes
- ✔ Print / Flash / Print technique may be required.
- ✔ Monitor cure temperatures making sure excessive heat is avoided.
- ✔ Well made, quality fabrics will result in better end product.

### **Print Washability**

The washability of properly cured direct and transfer prints is excellent. Dry cleaning is not recommended. Do not iron the printed part of the garment.

### **Curing Plastisol Inks**

*Curing plastisol inks is a matter of exposing them to the proper amount of heat for the correct length of time. Correct curing of plastisol ink is extremely important. The most common problem encountered with plastisol inks is poor washability. In almost every case, this is due to incomplete ink cure.*

*When plastisol is heated, the resin particles absorb the surrounding liquid (plasticizer) and swell, merge with each other and form a tough, elastic film. It is generally impossible to overcure direct prints because the overcure temperature is above the scorching point of the garment. However, it is not recommended that you heat the ink layer above 350° F (176° C). Above this temperature puff inks fall like a cake when you slam the oven door and problems with dye migration are greatly increased. If the entire thickness of the ink is not brought to the correct curing temperature the ink will be under-cured (the resin has not absorbed all of the plasticizer) and the ink will crack and flake off the garment when washed.*

### **Temperature**

*Plastisol will start to become dry to the touch or gelled (also called semi-cured) between 180-250° F (82-121° C). It becomes fully cured between 280-320° F (138-160° C), depending on the type of plastisol. The temperature at which the ink becomes fully cured is called the fusion temperature. Most Union Ink plastisol inks cure at 300° F (149° C). Check the Technical Data Sheet for each Union Ink plastisol for complete instructions.*

### **Measuring Ink Temperature**

*There are several devices and techniques for measuring ink temperatures. The more accurate the device, the higher the cost, however, there is no substitute for the insurance they provide. Thermocoupler Probes, Infrared Thermometers are two of the best devices. Although the devices are accurate be sure to use them correctly and follow manufacturer's directions as they also may provide a false reading. Temperature Tapes are also available, these are inexpensive and disposable however, they can be 10-20 degrees off in reading dependent on their age and placement. To correctly use these Tapes they should be placed inside the garment under the print area. Always check ink temperature when dryer is loaded as it would be in production as multiple garments travelling through an oven chamber will always cause oven chamber temperature to drop significantly.*

### **Time**

*Once the entire ink film thickness reaches the proper temperature, the ink is fully cured. This means that with a high enough temperature in the curing unit, the plastisol could actually be cured in a few seconds.*

### **Testing a Direct Print for Cure**

*The definitive test to determine if plastisol inks are cured is a wash test, that is wash the garment in hot water with a strong detergent. Generally it will take from 5-10 washings to fully test the cure, but if the ink is seriously undercured, the print will show deterioration after only 1-3 washings. There are two other tests commonly used to check ink cure. The most popular test is to stretch the print about 2/3 of the total stretch of the T-shirt. If the print cracks badly and does not retract when the fabric is released, the ink is probably under-cured. The stretch test does not always work on thick deposits of ink, such as with on athletic jerseys, where the top layer of ink may stretch but the ink deep down in the fabric may be under-cured.*

*Another test for curing can be done by placing a few drops of ethyl acetate onto the back of the ink on the inside of the garment. This spot of ink is then placed onto an area of unprinted garment and burnished or held tightly together for two minutes. If there is a transfer of ink to the unprinted area, the ink is not fully cured and the garment should be run through the dryer again. Like the stretch test, this test is not always accurate. Ethyl acetate is a fairly hazardous chemical.*

*If the ink is undercured, you can run it through the dryer again and complete the cure.*

### **Adjusting Your Dryer**

*It's very important to understand how to adjust your dryer to achieve the correct curing temperature. It is a common misconception that you need to measure the temperature of the dryer. Actually, you must be able to determine the temperature of the ink film.*

*The temperature of the ink film is determined by the time the garment is under the heater and the temperature of the heater. This means that the temperature can be controlled with the belt speed of a conveyor dryer or time under the heater with a flash curing unit. If the heater temperature in a dryer or flash curing unit reaches 800° F (427° C), it is possible for the ink film on the garment to reach the full cure temperature (300° F, 149° C) in a matter of 20-30 seconds. Generally the temperature in the dryer is much higher than the temperature required to cure the ink. This allows the ink to cure quicker for faster printing.*

### **Flash Curing**

*Plastisol can generally be fully cured with a flash cure unit if the heater is set to the highest temperature and the unit is placed 2-3 inches (5-7.6 cm) over the garment for 20-30 seconds. For curing between colors where only a partial cure is required, the time can be less.*






## Conveyor Curing

*As a starting point, the temperature of heaters should be set at full on. If the heaters are allowed to cycle on and off there may be too long an off cycle for the dryer to maintain the proper temperature consistently. The belt speed should be set so the garments are in the tunnel 20-30 seconds. Small dryers may require a much slower belt speed than larger dryers. From this starting point, you will have to print sample garments and wash test them to determine the correct belt speed and temperature settings for your dryer for the various types of jobs you print.*

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### Important Curing Tips

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-  *White ink requires the longest cure time of any standard color. Light ink colors require longer curing periods than dark colors. Thick ink layers require longer curing periods than thin layers.*
-  *Glitter, shimmer, reflective, and metallic inks require longer curing periods because the pigments used in these inks tend to reflect infrared radiation (heat).*
-  *Prints (both on paper and garments) should be cured within a minute of printing. If you delay curing, the plasticizer in the ink may start to leach out of the ink into the substrate. This will look like an oily margin around the print.*
-  *Temperature tapes are not exact. They can vary as much as 10-20° F (5-10° C) and should be used only as a guide. The definitive test is how well the print launders.*
-  *Dryer temperatures can vary greatly with just minor changes in belt speed, garment loading, room temperature, air movement, or fluctuations in incoming voltage.*

## Plastisol Transfer Printing

*Most plastisol heat transfers fall into one of three categories, hot-split, cold-peel, or puff. When hot-split transfers are applied, the paper is stripped off the garment immediately after the heat transfer press is opened. The ink layer splits, leaving part of the ink on the garment and part on the transfer paper. Hot-split transfers are nearly indistinguishable from a soft-hand direct print. When cold-peel transfers are applied, the transfer is allowed to cool before the paper is removed. All of the ink transfers from the paper to the garment. Cold-peel transfers have a glossy surface and are preferred for glitter and athletic transfers. Some transfers can be either hot-split or cold-*

*peel. Puff transfers are printed with special puff transfer inks and when properly applied, produce a puff design. Transfers that have been properly printed and applied are as durable as a direct print.*

### **Curing Transfer Prints**

*When printing heat transfers, the ink is only gelled or brought to a semi-cure. This occurs between 180-250° F (82-121° C), just past the wet state. Transfers that have been semi-cured become fully cured when they are applied to the garment. If they are over-cured, the ink will not transfer well.*

### **Testing for Cure**

*To determine the correct dryer settings for gelling the ink, increase the conveyor speed, or decrease the temperature of the curing unit until the stacked prints begin to stick together or show a slight amount of set-off on the back of the upper sheet. Then decrease the conveyor speed enough to eliminate the sticking. Another test for gel (though not always accurate) is to peel the ink off the release paper and roll it into a ball. If the ball unrolls when laid down, the transfer is overcured. A third test is the stretch test. The gelled ink layer should be cured just enough that you can peel it off the paper, but if you try to stretch it, it should break with very little stretch.*

### **Hot-Split Transfer Tips**

*For puff transfers, use Transpuff (TRPF) ink printed through a 60 thread/inch (25 thread/cm) mesh. Print a very thick layer of ink onto Soft Trans 90 paper. After printing the transfer, apply a transfer adhesive powder such as Union's Unilon Heat Transfer Powder (ULON), either by sprinkling the powder over the print, or by passing the transfer through a tray containing the transfer adhesive powder. Curing puff transfers is very critical. The ink should be cured enough that it does not smear or offset in the stack, but not enough to puff. The temperature window for curing puff transfers is 180-200° F (82-93° C). Apply the transfer at 375° F (190° C) for 5-10 seconds at 30-40 lbf/in<sup>2</sup> (2.1-2.8 kgf/cm<sup>2</sup>). Remove the paper from the garment immediately after opening the transfer press.*

### **Cold-Peel Transfer Tips**

*Use the same inks, mesh, and curing procedures as for hot-split transfers. Use TransFrench T-75, Super-Trans, or TransLith paper, available from Union Ink. Transfer to the garment at 350° F (177° C) for 10-20 seconds at 25-30 lbf/in<sup>2</sup> (1.75-2.1 kgf/cm<sup>2</sup>). Allow the transfer to cool completely before stripping off the paper.*

### **Glitter Transfer Tips**

*For glitter transfers, use Super Glitter (PAGL-S) printed through a 30 thread/inch (12 thread/cm) mesh. Cure as for hot-split transfers. You can use TransFrench T-75 or TransLith papers, but for the highest gloss transfers, use a high-gloss transfer paper such as Warren O Duplex paper. Glitter transfers are generally applied using the cold-peel procedure.*

### **Puff Transfer Tips**

*For puff transfers, use Transpuff (TRPF) ink printed through a 60 thread/inch (25 thread/cm) mesh. Print a very thick layer of ink onto Trans-55 paper. After printing the transfer, apply a transfer adhesive powder such as Union's Unilon Heat Transfer Powder (ULON), either by sprinkling the powder over the print, or by passing the transfer through a tray containing the transfer adhesive powder. Curing puff transfers is very critical. The ink should be cured enough that it does not smear or offset in the stack, but not enough to puff. The temperature window for curing puff transfers is 180-200° F (82-93° C). Apply the transfer at 375° F (190° C) for 5-10 seconds at 30-40 lbf/in<sup>2</sup> (2.1-2.8 kgf/cm<sup>2</sup>). Remove the paper from the garment immediately after opening the transfer press.*

### **Testing for Transferability**

*It is essential that you test your heat transfers for transferability at the start of each production run. This is particularly important when using a new paper or ink. You should also do accelerated aging tests which will indicate how well the transfer will release after 6-12 months on the shelf. Accelerated aging tests can be done by placing the printed transfer in an environment of 120° F (49° C) for 100 hours. This will simulate approximately one year of shelf storage. While this test does not exactly duplicate the effects of aging, it will definitely help you determine whether a particular transfer will release well after aging.*

### **Always Test Inks Before Using In Production**

*Always test inks to determine their fitness for your particular applications, particularly new types of inks and when printing on new products. Before printing a production run, print a sample for testing for adhesion, crocking, opacity, washability and any specific job requirements.*