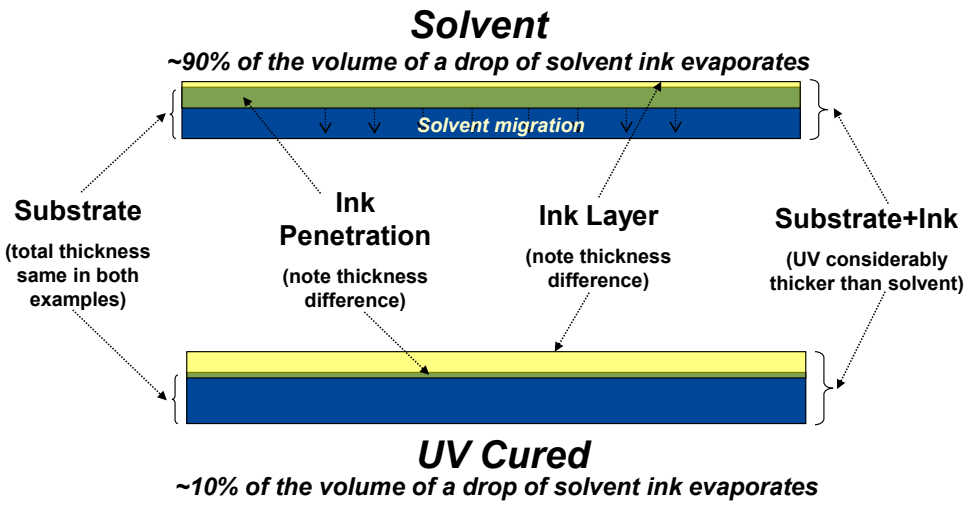
Digital Printing: Knowing and Avoiding Imaging and Application Pitfalls with Digital Graphics

3M Graphics Market Center

Piezo Ink Jet Printing

- Solvent ink
- Water-based ink
- UV curable ink

UV-Cured -vs- Solvent



Keys to Successful *Solvent* Ink Jet Printing and Application

Ink Jet Ink Solvents

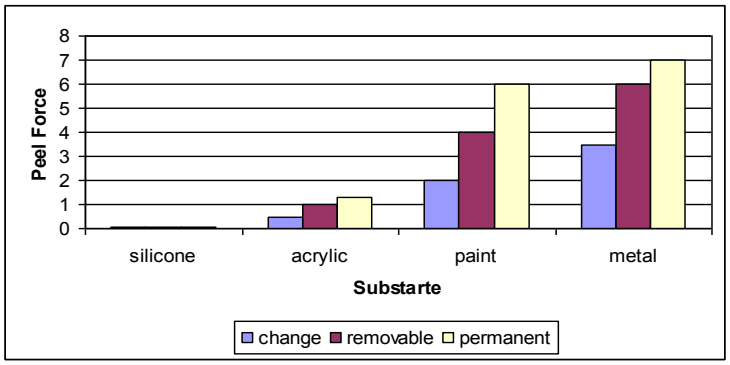
- Ink jet ink contains a high percentage of solvent
- If the solvent is not evaporated quickly through heat and air, installation and performance issues may result
- These problems are compounded when too much ink is applied to the material

Vinyl Tendencies

- Vinyl loves to absorb solvent
- High levels of solvent (i.e. heavy ink saturation):
  - can cause the film to swell and/or become "soft and gummy"
  - can migrate to the vinyl's adhesive
  - can cause failure

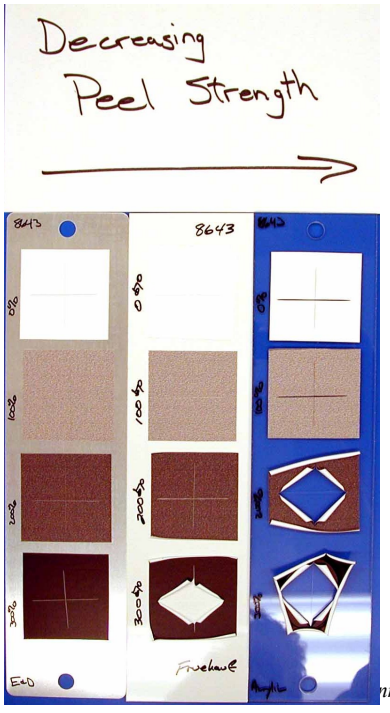
It starts with selecting the right film for the job – HINT: Think about the ***substrate***!

Engineers look at the ***peel force***, i.e.
How much force it takes to remove the substrate



Scotchprint Graphics

Substrate choice impacts:
- **Durability**
- **Application properties**
- **Removal properties**



Scotchprint Graphics

The sole duty of the adhesive is to keep the film where you put it

•The film wants to move as it dries

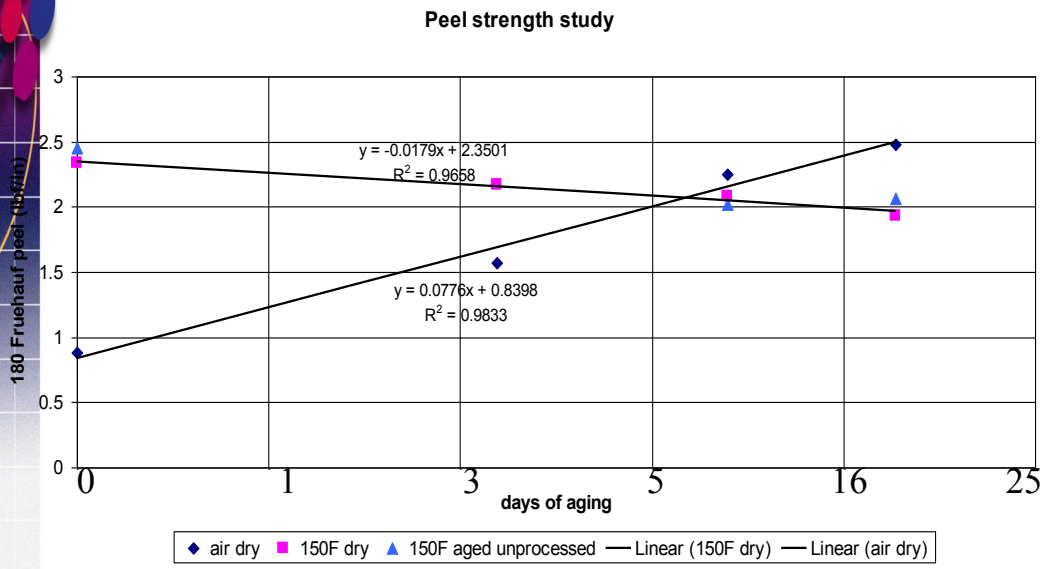
•The more ink on the film, the more it wants to move…and, the weaker the adhesive becomes

•The weaker the adhesive, the less effective it is at restraining the film

Solvent Effect on Media and the Printed Image

- Problems can show up during printing, finishing or application
- When the graphic is not sufficiently dried, the following may occur:
  - Edge curling after application
  - Shrinkage after application
  - Stretching during handling
  - Smearing or blocking during handling
  - Puckering during printing

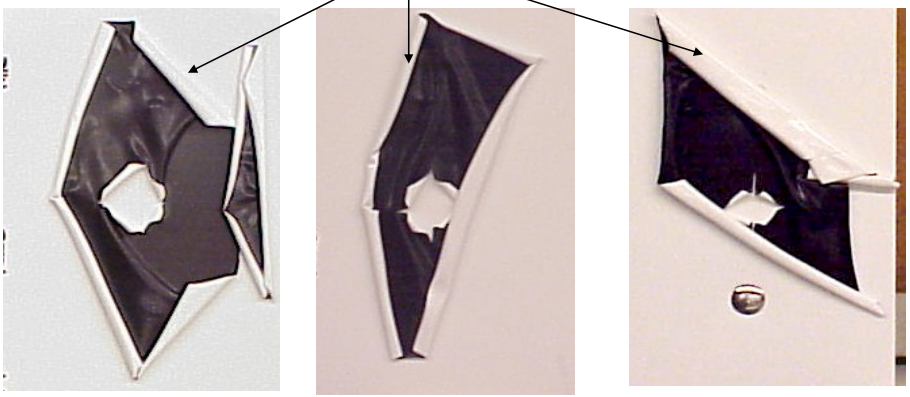
The adhesive force recovers on the same time scale.
Poor drying conditions can also degrade film properties.



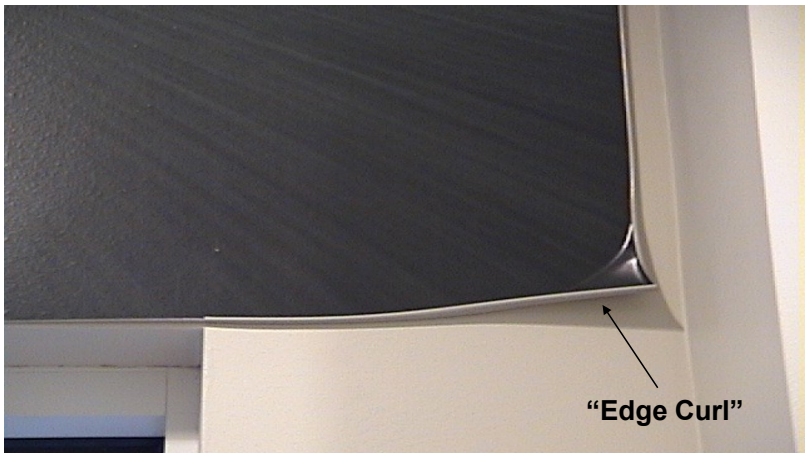
Dry heat hours 150F, test, then age at 150F.

Solvent Effect on Media and the Printed Image

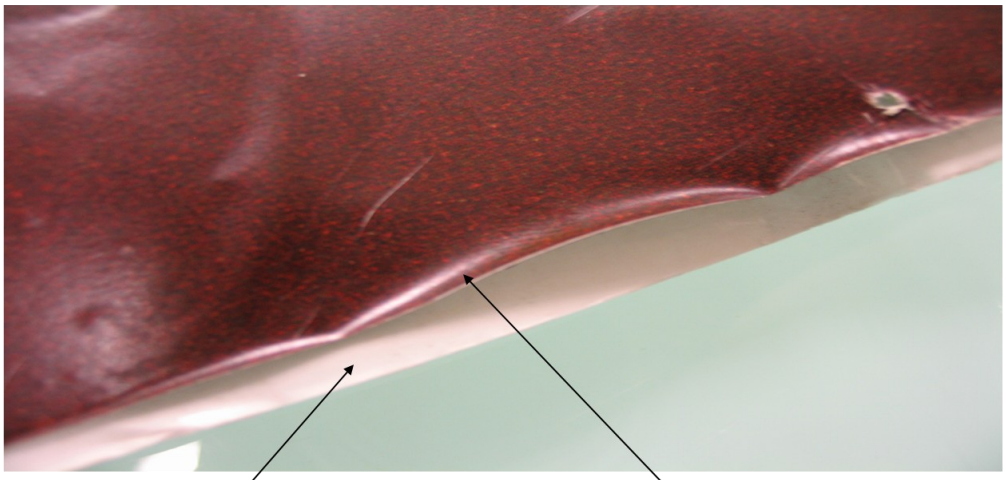
"Edge Curl"



Solvent Effect on Media and the Printed Image

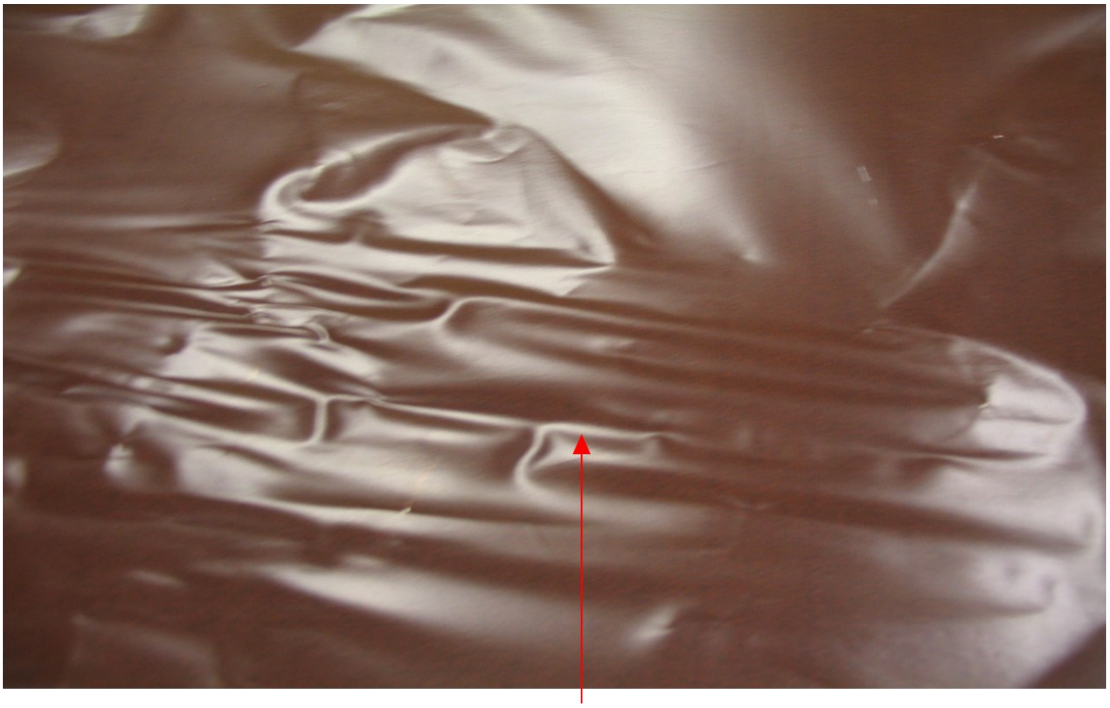


Solvent Effect on Media and the Printed Image



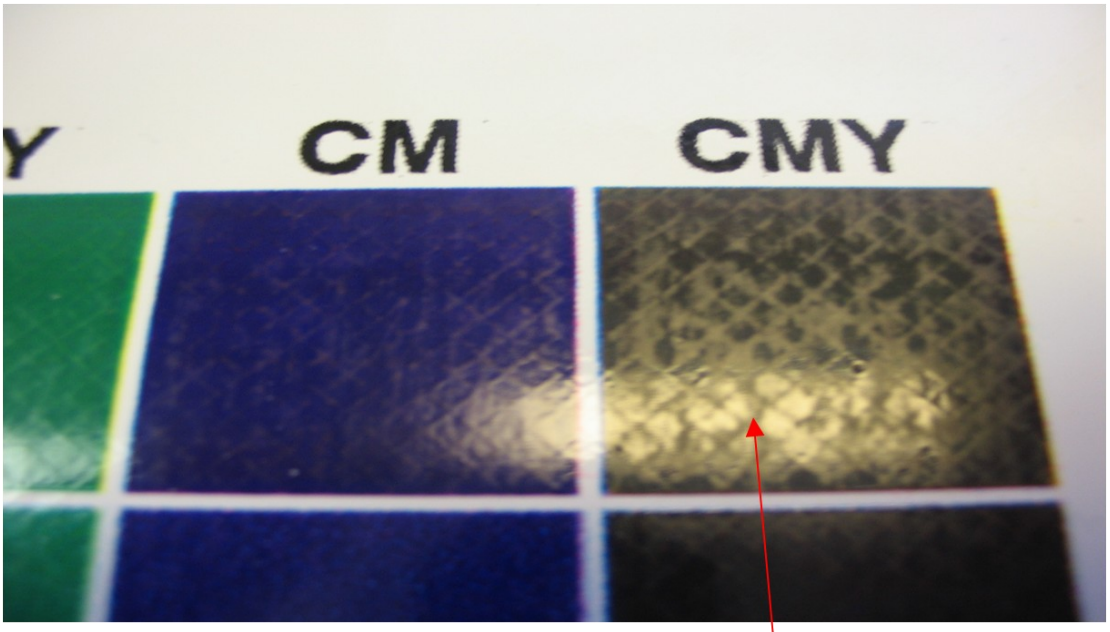
Solvent Effect on Media and the Printed Image

"Puckering"



"Shrinkage"

Solvents Affect on Media and the Printed Image



Solvent Effect on Film – Cast vs. Calendared

•Thicker films (i.e. calendared v. cast) act as "bigger sponges" and can typically handle more solvent – i.e. the ink is diluted throughout more film

•However, thicker films typically don't conform as well (stiffness).

Solvent Effect on Film - Shrinkage

• More ink makes the film shrink more
• Dry time (fast or slow) does not affect the amount of shrinkage
• Cast behaves similarly in both directions - cross and down web
• Calendered is pretty stable cross-web but moves a lot down-web

So far, we know…

• IT is critical to pick the right film for the job – thickness, adhesive, etc.

•When we print, the modulus (stiffness) of the film drops, making application tougher

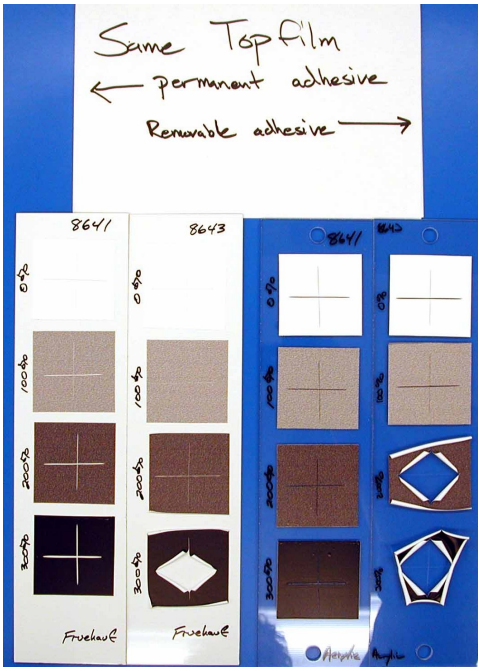
• Solvents degrade adhesive strength making it harder to keep the film in place (curl, shrinkage, etc.)

Properly drying the film allows the film to recover to it's "unprinted performance levels" – *BUT THAT TAKES TIME!*

Keys to Successful Printing and Application

- The two most essential factors for successful solvent printing are:
  - Setting the correct total ink coverage; i.e. ***ink limiting***
  - Proper ***drying*** of the printed graphic

Effect of Retained Solvent in Graphic Films



Ink Limiting: How to Manage the Total Physical Amount of Ink

- Properly managing the total amount of ink laid down on the graphic results in:
  - Better image quality
  - Less ink usage
  - Quicker drying times
  - Greater throughput
  - Improved performance
  - Improved install ability

Ink Limiting: How to Manage the Total Physical Amount of Ink

- Best results can be achieved when total ink coverage is taken into consideration by the graphic designer and **limited during pre-press operations**
- Total ink coverage is the total percentage of all ink (CMYK) used in the darkest shadow regions of the graphic

Ink Limiting: How to Manage the Total Physical Amount of Ink

- Common methods for limiting ink include using utilities within Photoshop, ICC based color management, third party color separation packages and direct conversion to CMYK at the time of scanning
- If the RIP software supports *ink limiting*, this function can be used to reduce the total amount of ink on the media

Drying

Film can be dry to the touch, but if we wait a while…

- The solvents from the ink will evaporate
- The properties of the film and adhesive return to unprinted levels – and behave like unprinted film
- The price: time (and maybe a little extra work/equipment)

What does "DRY" really mean?

- "Dry to the touch?" i.e.
  - No transfer
    - No blocking
      - No smudging
- Free of solvent?
  - No impact on modulus (no stretch)
    - No impact on adhesive
      - Film consistency
        - Behaves like unprinted film

But, really, how long ‘til it’s dry?

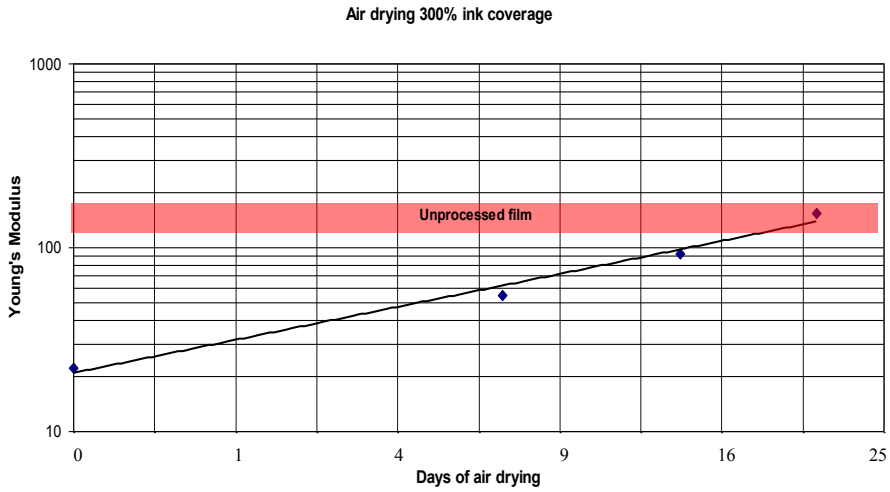
“It depends!”

- How much solvent do I have to remove?
- How warm is it in the shop?
- Is it humid?
- How thick is the film?
- How much surface is exposed?
- Do I have to get all the way back to original?

Scotchprint Graphics

How dry is dry?

It could take weeks before the film will handle like unprinted film



Scotchprint Graphics

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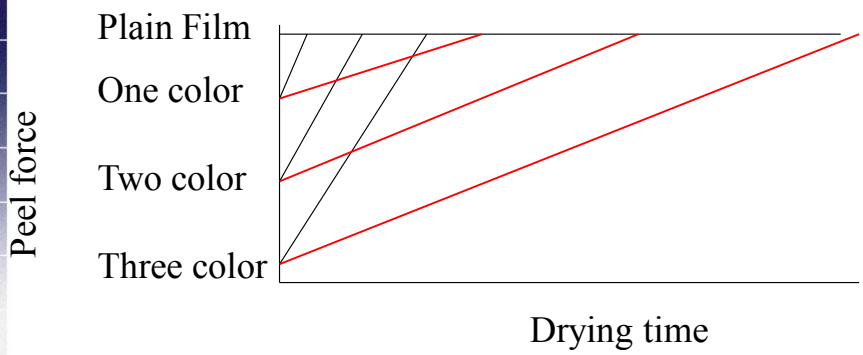
Drying guidelines…

Black lines – 150º oven – done in hours
Red lines – 70° shop – done in days to weeks



If the graphic is dried first…

- It still may shrink, but on the liner not the final substrate
- The adhesive returns to full strength
- The film doesn't really move much more
- A strong adhesive will restrain a film that isn't going to move around - the graphic stays where you put it

Keys to Successful Printing and Application

- In addition to ***ink limiting*** and ***drying***, the following items should be considered:
  - Discuss the project with the graphic designer
  - Discuss the project with the media applicator
  - Select the right media for the type of graphic and application
  - Make sure that your pre-press operators have good pre-press skills, including knowledge of RGB to CMYK color conversion using ICC profiles

Keys to Successful Printing and Application

- Don't take short cuts when drying graphics!
- Testing for dryness:
  - Touch a printed sheet face to face (KISS test)
  - Place the touched area close to your ear and separate it - - - If the graphic is dry, there will be either a slight or no discernible sound when the surfaces are separated

Keys to Successful Printing and Application

- If the graphics fail the dryness test:
  - Increase the drying time by slowing down the printer
  - Increase the printers drying temperature (care needs to be taken not to blister the graphic with too much heat)

Keys to Successful Printing and Application

- If the graphics are still not dry:
  - Consider using a auxiliary dryer to complete the drying; i.e. when ovens were common – 2 hours @ 150F was usually sufficient
  - If an auxiliary dryer is not available roll the graphics out on a table and air dry for 24+ hours at approximately 70ºF

We can get a long way back toward unprinted film…the price:

- Retained Solvents are destructive to many printing substrates…film and adhesive
- The good news is you can recover the film properties, typically the cost is:
  - Time: With heat = ~ 2-24+ hours
  - Equipment (dryers, fans, ovens…)

Difference w/UV Inks in General

No solvents

-minimal impact on adhesive
-minimal film shrinkage impact
-thicker layer on ink (no dry-down)

Cured on the printer w/UV lamps

Flexibility traditionally not as high (ink is more “brittle”), however this is changing

UV Inks

Primary complication to watch for is adhesion issues of clear coat or PSA overlaminate to inks

Slightly ‘undercuring’ of inks can improve bond

Clearcoats typically won’t smooth out the texture

Overlaminates with PSA tend to unify the gloss level

Clears and overlaminates will generally improve the durability of the finished graphics and may carry warranties

UV Inks – Realties

Generally, UV inks are specialized based on application:

- ‘Rigid’ Inks
- ‘Flexible’ Inks
- White Inks
- Durable / Premium Inks

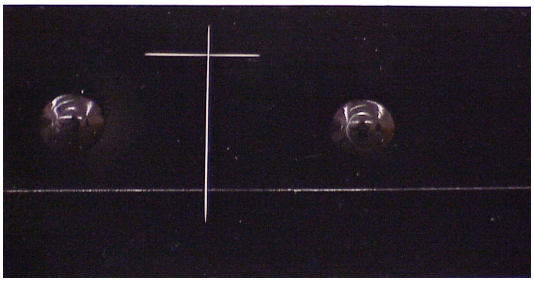
UV Inks – Realties

Differences between types include:

- Adhesion characteristics – surface energy
- Flexibility
- Stetchability / Conformability
- Weatherability

If you are producing Fleet graphics you want your system to perform like this…

3M Premium UV Ink



'Standard' UV Ink

Not like this….