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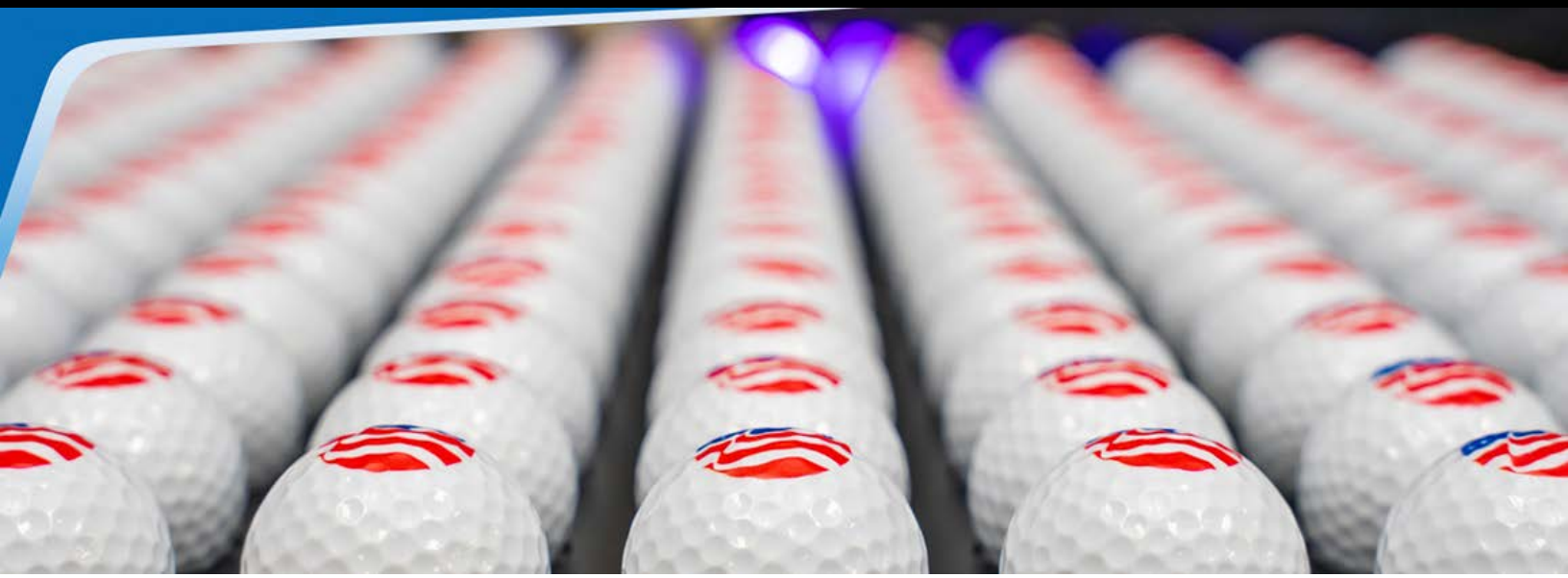


Understanding UV Printing Adhesion: Concepts, Tools, and Techniques

UV printing technology has revolutionized the printing industry with its ability to print on various substrates, including glass, metal, plastic, and more. However, one of the critical factors determining the quality and durability of UV prints is adhesion. Let's dive into the concepts of UV printing adhesion and explore tools and techniques to overcome adhesion challenges.

What is UV Printing Adhesion?

Adhesion in UV printing refers to the ability of the UV-curable ink to stick to the substrate. Unlike other inkjet technologies, UV ink does not require a porous substrate or a coating for proper adhesion. UV ink is cured or solidified on the substrate surface through exposure to UV lamps during the printing process. However, without proper adhesion, the cured ink may not be durable enough for the intended application. Think of UV ink adhesion similarly to a paint project at home. Without proper cleaning and surface preparation, you will likely have poor or undesired results. Ensuring strong adhesion is essential for producing durable and high-quality prints.

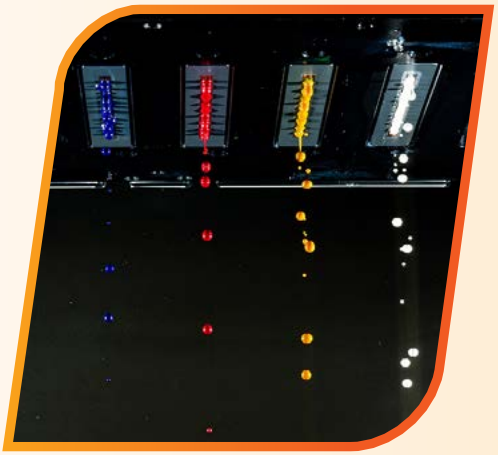
Key Concepts in UV Printing Adhesion

Surface Energy

The substrate's surface energy significantly impacts adhesion. High surface energy materials, like ABS and Polycarbonate plastics, and products coated with a polyurethane or resin-like metals, typically provide better adhesion for UV inks. Conversely, low surface energy materials, such as certain Polyethylene and polypropylene plastics, glass, and raw metals, can pose adhesion challenges if no pretreatment is applied. Porous substrates, such as wood or paper-based media, are generally not affected by surface energy. Having a dyne level kit to test surface energy (shown in photo) can be ideal, as UV digital inks generally perform best in the 40-50 dyne level range.

Ink Chemistry

The formulation of UV-curable inks affects their adhesion properties. Inks are designed with specific chemistries to adhere to different substrates, while providing the right flexibility or rigid needs. Choosing the right ink for the material is crucial for achieving optimal adhesion.



Surface Preparation

Properly preparing the substrate surface enhances adhesion. This involves cleaning the surface to remove contaminants like dust, oils, grease and in some cases even static, which can hinder ink bonding and print quality. Proper materials like clean, lint-free wipes will help prepare the surface without scratching sensitive materials.

Tools and Tricks to Overcome Adhesion Challenges

Primers and Adhesion Promoters

Applying an adhesion promoter can significantly improve ink adhesion, especially on difficult substrates like plastics. These products create a bondable surface, enhancing the ink's ability to stick. This process is best applied manually by applying the liquid pretreatment to a lint-free microfiber cloth and applying to printable area before printing. This process is fast, drying within a few seconds, and in some cases can be applied in advance up to 24 hours before printing if the applied area is not handled with fingerprints.

Always be sure to follow the manufacturers' application suggestions and guidelines. There is no single best adhesion promoter, as they are each designed for specific substrates and applications. Also, pay close attention to storing instructions and expiry dates, as some have a 6-12 month shelf life.

Surface Treatments

Flame treating, corona, and plasma treatments are all methods used to prepare surfaces for better adhesion of UV digital ink. Here's how they compare:

Flame Treating

Surface Cleaning: Removes dust, oils, and contaminants.

Surface Activation: Oxidizes the surface, enhancing ink receptivity.

Mold Release Removal: Eliminates mold release agents for better adhesion.

DIY Feasibility: Can be done in-house with the appropriate equipment, making it accessible for various applications.

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Corona and Plasma Treatments

Application: Typically applied during the manufacturing process.

Surface Activation: Modify the surface at a molecular level to improve adhesion.

Industrial Use: Often used in large-scale production; standalone devices can be integrated into workflows for continuous treatment.

DIY Feasibility: Generally not a DIY option due to the complexity and cost of the equipment.

In summary, while corona and plasma treatments are more industrial and integrated into manufacturing, flame treating offers a flexible and accessible method for improving print adhesion in a variety of settings, including those with mold release coatings.

Mechanical Abrasion

Lightly sanding or abrading the surface can create a rough texture, providing more surface area for the ink to adhere. This method is particularly effective for metals and hard plastics.

Proper Curing

Proper curing of UV ink is crucial for ensuring strong adhesion and durable prints. Insufficient curing can lead to poor adhesion and print durability issues. Adjusting the curing parameters, such as UV lamp intensity and exposure time, based on print speeds, can help achieve optimal results. Regular maintenance of the lamps, including cleaning the UV lamp glass, is essential for proper UV light emission. Additionally, maintaining the correct distance between the UV lamp and the printing surface is important. UV printers are calibrated to have the UV curing lamps at an optimal distance from the product for proper curing. Increasing that distance can result in improper curing, leading to poor adhesion and print durability.

Environmental Control

Maintaining a controlled printing environment helps in achieving consistent adhesion. Factors such as temperature, humidity, and dust levels can impact the printing process and adhesion quality.

Testing and Quality Control

Regularly testing the adhesion of prints ensures that any issues are detected early. Regular testing is highly recommended, considering materials can change across various batches, and printing with expired inks can also impact durability. Traditional nail scratch, cross-hatch adhesion tests, tape tests, and pull-off tests are commonly used methods to evaluate adhesion strength.

Consideration of Substrate and Application

Understanding the intended use of the printed object is crucial. For example, printed artwork displayed in a museum typically isn't exposed to abrasion, moisture, or extreme conditions, making most substrates suitable. On the other hand, a printed mug, which undergoes frequent handling and exposure to wear and tear, demands the best possible adhesion. Offering customers various materials with different adhesion levels (poor, better, best) can be beneficial, especially if the item is for novelty or daily use. Additionally, some materials may have hydrophobic coatings applied during manufacturing, designed to repel liquids and hinder ink adhesion. In such cases, the aforementioned methods may have little or no effect on improving ink adhesion.

Conclusion

Achieving strong adhesion in UV printing involves selecting the right materials, preparing the substrate, and fine-tuning the printing process. By understanding the concepts of UV printer adhesion and employing the tools and tricks discussed, you can overcome adhesion challenges and ensure high-quality, durable prints.

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Matrix of Materials and Pretreatment Requirements

By applying the appropriate pretreatment methods, you can ensure high-quality, durable prints on a wide range of substrates. Understanding and implementing these techniques will help overcome adhesion challenges on your product application.

The matrix below shows options for increasing adhesion when required. These methods should not be used together. For example, when applying corona treatment, additional pretreatment is not necessary.

MATERIAL	Pre-Treatment Recommended	Pre-Treatment	Flame	Corona or Plasma	Pyrosil	Mechanical Abrasion
Glass – for display purposes	Yes	x				
Glass – for dish wash applications	Yes			x	x	
Metal (example: aluminum, stainless steel) – uncoated	Yes	x		x		x
Metal (example: aluminum, stainless steel) – coated	No					
Aluminum Composite Material (DiBond, MaxMetal, AluPoly)	No					
Injection Molded Plastics – Polypropylene, Polyethylene, Nylon	Yes	x	x	x		
Corrugated Polypropylene for Signage (corona treated i.e. Coroplast)	No					
Plastic – ABS, Polycarbonate	No					
PET (polyethylene terephthalate)	No					
HDPE (high density polypropylene)	Yes					
Nylon	Yes	x	x	x		
Foam Board	No					
PVC	Yes	x		x		
Kydek	No					
Tyvek	No					
Adhesive Vinyl	No					
Banner Material	No					
Wood	No					
Ceramic - Glazed	Yes	x				
Ceramic - Non-Glazed	No					
Acrylic - cast	No					
Acrylic - extruded	Yes	x				
Laser engravable plastic stock*	Yes	x				
Laser engravable UV coated plastic stock	No					
Paper/Cardboard	No					
Fabrics	No					
Genuine Leather	No					
Synthetic Leather	Yes	x				
Polished Stone (example: marble, granite)	Yes	x				
Porous Unfinished Stone (tumbled travertine, slate, botticino)	No					
Rubber	Yes	x				
Soft Rubber	Yes	x	x			
Sublimation blank materials (polyester coated)	Yes	x				

Always test the material, as not every substrate is obvious and may contain blends, coatings, mold releases, or other factors affecting adhesion.

**no pretreatment required for engravable stock developed and designed for printing with UV LED cured inks.*
(Example: Digimark,Trotec Digital Print Series, etc)

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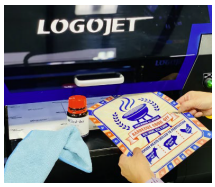
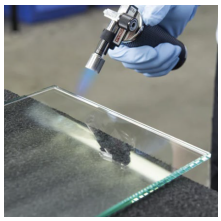
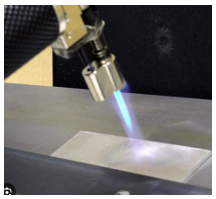
Pretreatment Methods

MANUAL HAND APPLICATION TOOLS

	**Pretreatment:** a liquid that is manually applied to a microfiber cloth before printing. Improves UV bond to surface.
	**Isopropyl Alcohol:** commonly used to clean most materials before printing to remove contaminants, in some cases increase adhesion and prepare surface.
	**Flame Treatment:** Alters the surface of plastics like polyethylene to improve ink bonding.
	**Mechanical Abrasion:** Roughens the surface, increasing the area for ink to adhere, especially useful for metals.
	**Pyrosil Treatment:** Especially effective for glass, creating a durable, dishwasher-proof bond.

INDUSTRIAL APPLICATION TOOLS

	*__Plasma Treatment:__ Enhances surface energy and cleans the substrate, improving adhesion for various materials. *__Corona Treatment:__ Increases surface energy, particularly useful for low-energy plastics. **typically can be applied during product manufacturing process*

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Essential Pretreatment Tools for Your Printing Mix

TOOL	PURPOSE	RESOURCES
Adhesion Promoter	Low odor, general all purpose	www.logojet.com
Bohle Metal Adhesion Promoter	Best for metals and other materials that have sensitive coatings or other promoters ruins the surface, the Bohle is less aggressive	www.logojet.com
Marabu P2 Poly adhesion Promoter	Best for plastics, especially PP/PE	www.logojet.com
Marabu P4 Stainless Steel Promoter	Best for metals	www.logojet.com
Supply 55 (AP2155)	Best for plastics, especially PP/PE	www.supply55.com
Supply 55 (AP3155) LogoJET	General all purpose	www.supply55.com
RedHot Adhesion Promoter	General all purpose	www.mimakiinkjet.com
Dyne Level Test Kit	To test surface energy	Amazon – Accu Dyne Test – Full Set
Pyrosil – Handheld Kit for Flame Treatment	Best to treat glass that is intended for dishwash purposes	www.chemical-concepts.com
Corona Treatment Equipment	For increasing surface energy of plastics	www.tantec.com
Plasma Treatment Equipment	For increasing cleaning and activation	www.tantec.com
Flame Treatment Tools	For materials like polyethylene	Handheld – Local Hardware Store Automatic/Professional Series -
Mechanical Abrasion Tools (sand paper or scouring pad)	For creating texture on metals and hard plastics	Local Hardware Store
UV Curing system	To ensure proper curing of UV inks	Built into UV printers
Isopropyl alcohol (91 or 99%)	Used to wipe materials of dust, debris, fingerprints before printing	Local Hardware Store

To summarize, using the correct pretreatment methods ensures superior adhesion and durability in UV printing. Scan the QR code here to read the full blog article for more details or contact LogoJET to speak with a Technical Specialist about your project.

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