Application Note

Inks and supplies

Inkjet inks for plastics

Plastic is a very common substrate for printing inkjet codes. It is a general term that covers a large variety of materials, including high density polyethylene (HDPE), biaxially oriented polypropylene (BOPP), and polyester (PET). Understanding the different plastic material types, their surface conditions, and the different environmental printing conditions, will help select the best ink for the application.

What affects ink adhesion to plastic

Ink adhesion is simply defined as the tendency of an ink to remain attached to a substrate when acted on by different forces. Forces of most concern are mechanical in nature such as rubbing or abrading. Adhesion is the result of the physical and chemical interaction between the ink and the substrate.

A major factor in adhesion is the contact surface area between the ink and the substrate. The higher the area of contact, the better the adhesion. The area of contact is influenced by the substrate's surface energy, smoothness, and cleanliness.

Effects on ink adhesion

- Substrates with high surface energies will exhibit good drop spreading, while low surface energies will have poor drop spreading. Solvent based inks typically have a surface tension around 22-25 dynes/cm^2 and a general guideline is the surface energy of the substrate should be 10 units higher than the ink to get good drop spreading. Using surface treatments such as corona or plasma treatment can raise the surface tension of many types of plastics and promote improved adhesion.

Good drop spreading **Poor drop spreading**

- A rougher or more textured surface will allow the ink more surface area to adhere and improve adhesion.

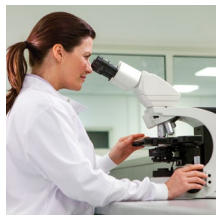
More contact area compared to a smooth surface

- Even small amounts of surface contamination from water, oil or dust will prevent the ink from getting 100% contact to the substrate. Air knives can be used to blow off contamination to improve adhesion.

Surface contamination

Chemical interactions are influenced by the substrate and ink's chemical compositions which then interact at the ink/substrate interface.

- Inks are formulated with a variety of different resins, each of which has more or less interaction with different plastic types based on its own chemical structure.
- The ink's solvent type dramatically affects its drying time but has very little influence over adhesion.
- Choosing the ink with the best interaction for the application is done through a combination of known resin chemistry, identifying the target plastic type, and testing for confirmation.



Testing ink adhesion to plastic

Since adhesion is the result of the physical and chemical interaction between the ink's resin and the substrate material, each pair of ink and plastic substrate is unique.

Therefore, testing is the best way to assess if the resulting adhesion is acceptable.

There are different methods to test for adhesion and some can be more severe than others. There can also be variation within a specific type of test method so it is important to keep those variables consistent from test to test. The table below summarizes three common tests for adhesion along with the variables that can affect the results.

Test method	Summary of method	Important variables
Thumb rub	Rub thumb across the code and look for smearing or removal of ink drops	Amount of pressure applied Number of rubs Moisture or oil on thumb Skin texture (e.g. callouses are more abrasive then smooth skin)
Tape test	Apply a piece of tape on top of the code and pull off rapidly. Look for ink removal of ink drops.	Type of tape Angle of pull off Amount of time after printing
Abrasion test	Rub an abrasive material across code. Most common is kraft paper or cardboard, but also can be done with cloth, tissue or a fingernail scratch	Amount of pressure applied Number of rubs Variation in abrasiveness with material

Choosing the right ink

Since there is a multitude of different plastic material available, Videojet offers a number of different ink formulations in order to achieve good adhesion to the widest variety of plastic material types. The following chart is a good starting point for choosing the right Videojet ink for your application. The inks are listed from top to bottom in order of best choice.

Test Criteria	BOPP Flexible Film	Polypropylene	Rigid HDPE
Thumb Rub	V4230/V5245 (Excellent) V4262 (Very good) V4264 (Very good) V4231 (Good)	V4230/V5245 (Excellent) V4231 (Excellent) V4262 (Excellent) V4264 (Excellent)	V4230/V5245 (Excellent) V4231 (Very good) V4262 (Very good) V4264 (Very good)
Tape Test	V4231 (Good) V4230/V5245 (Good) V4262 (Good) V4264 (Good)	V4230/V5245 (Excellent) V4231 (Excellent) V4262 (Good) V4264 (Good)	V4231 (Excellent) V4230/V5245 (Very good) V4262 (Very good) V4264 (Very good)
Abrasion Test	V4230/V5245 (Best) V4231 (Good) V4262 (Good) V4264 (Good)	V4230/V5245 (Very Good)	V4230/V5245 (Very good)

Best = No change in code appearance in 100% of the tests performed.
Excellent = No change in code appearance in more than 75% of the tests performed
Very Good = Slight fading or smearing noted, but 100% of codes remained legible
Good = Codes remained legible in more than 75% of the tests performed

The bottom line

Packaging professionals will be well-served by partnering with a coding and marking supplier that can guide their ink selection. The best ink suppliers study the evolution of packaging materials, understand the range of manufacturing environments, and proactively apply rigorous ink development processes to ensure code performance and integrity. With over 40 years of ink jet experience, Videojet is ideally suited to help with your coding and printing needs.

For further assistance with ink selection, contact Videojet Fluids Support via phone at +971 4 550 8756 option #2, or email fluidssupport@videojet.com.

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