

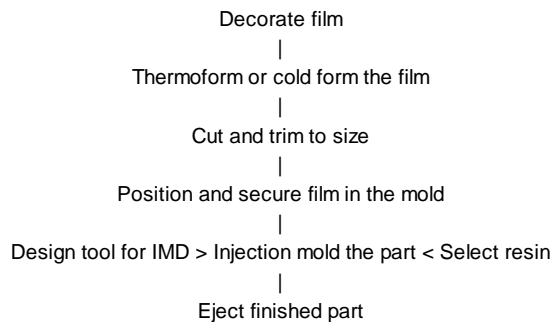


Insert Molded In-Mold Decorating (IM-IMD)/ In-Mold Labeling (IM-IML)

For over 25 years, CPX Inc. has been on the cutting edge of development in Insert Molded In-Mold Decorating (IM-IMD) / In-Mold Labeling (IM-IML).

In its simplest form, Inert Molded IMD involves a flat screen printed label that is positioned in an injection mold and bonded in place during the molding process. In its most advanced form, Insert Molded IMD / IML utilizes a hard-coated, formable film which is screen printed on the second (interior) surface. A selected texture is then applied to the first (outer) surface, the film deep formed (thermoformed) to fit the mold cavity, and placed in the mold cavity. During the molding process, the film forms a complete skin over the surface of the part complete with graphics, multiple colors, and textures that are completely encapsulated by the molded plastic.

A flowchart depicting a typical insert molded decorating process is depicted below:



Insert Molded In-Mold decorating / labeling offers significant advantages over alternative decorating techniques such as:

- » Capable of deep formed applications – true 3D applications.
- » Can be used to apply graphics in close proximity / register to the mold profile – within +/- 0.2mm positional tolerance or better.
- » Images or graphics can be applied to the second surface (or interior) where the printing or graphics become completely encapsulated during the molding process; rendering the graphics virtually indestructible.
- » Selective first surface (or outer) printing can be used to apply texture or modify the gloss level of the finished product.

Design Considerations

There are several design factors that must be addressed when utilizing In-Mold Decorating such as the choice of inks, the image or graphic design, film consistency and clarity, ink drying characteristics, substrate resin selection, and mold design.

Ink

For first surface (outer) printing, the choice of ink is straightforward as long as the ink employed is formable. However, since the graphics will be on the outer surface of the finished part and subjected to wear, some sort of secondary protective coating will, most likely, need to be employed.

Second surface (interior) printing will require inks that can survive the extreme temperatures and pressures common with injection molding – remember that the ink will come into direct contact with the molten resin during the molding cycle. The main areas of concern are around the “gate” areas where the pressures and temperatures are at their extremes.

Some conventional inks are adequate for In-Mold Decorating / Labeling applications as long as the graphics are far removed from the gates. In areas close to the gates however, very few conventional inks can stand up to the high temperatures of the molten resin. Here, temperature resistant inks need to be employed and fall into three general categories: thermal-cure inks, UV curable inks, and high melt resistant inks.

Thermal cure inks resist high melt temperatures well but require long curing cycles. However, these inks tend to have excellent adhesion to the molten polymer resin. UV curable inks offer good temperature resistance but any residual monomers must be baked out to prevent issues during molding. Melt resistant inks are difficult to apply and tend to be very expensive.

Graphic Design

Proper design of the graphic image can help overcome some of the limitations of the ink. At the gate area for instance, extending the print area into the gate region can help to minimize ink washout. Placement of the graphic is also critical as they should not be placed too close to sharp edges as this will make registration of the graphic more difficult. Deep draw details where the width is less than or equal to the detail height are not recommended. Symbols should be located in the flat regions where distortion will be kept to a minimum.

Film

Typically the film is either a polycarbonate or polycarbonate alloy. It is essential that the film has consistent gage thickness, good clarity, and is free of internal stresses.

Ink Drying

In-Mold Decorating / In-Mold Labeling requires that the inks used for the graphics are completely cured and are free of any residual solvent. This is a critical factor as any residual solvent present will be trapped by the film and will vaporize during the molding cycle – resulting in poor ink adhesion and in the most extreme cases, trapped bubbles.

Resin

High temperature molding resins are typically required to achieve a good bond with the graphics film.

Polycarbonate, Acrylonitrile Butadiene Styrene (ABS), and blends of the two are used. Ideally both the film and resin substrate should be sourced from the same material supplier to eliminate or minimize compatibility issues and to draw upon any technical resources of the material supplier if needed.

Mold Design

Probably the most critical factor in the success of your In-Mold Decorating / In-Mold Labeling program is the correct tool design. The tool should be designed for In-Mold Decorating / In-Mold Labeling from the onset of the program. Although modifying an existing tool is possible, the best results will be achieved with a tool specifically designed for IMD / IML. Wall thickness is critical especially near the gate(s). Too thin of a wall section will result in excessive shearing of the material during injection. This will cause the melt temperature to increase resulting in damage to the film and/or ink. The gates should be positioned as far away as possible from the graphics. If this is not possible, the gates should be designed to minimize shearing. Turbulent flow or jetting of the material during the molding cycle will damage the film – design the gating to balance the flow throughout the mold cavity. Venting of the tool must be from the back of the tool and reverse ejection should be used if at all possible.