

Five Bonding Techniques of Side Door Trim Insert Skin Decoration

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ABSTRACT

Interiors of past vehicles were created to satisfy specific functions with appearance being a secondary consideration, but in the present & future market with ever increasing vehicle luxury, decoration of vehicle has become a prime focus in automobile industry along with the safety & economy. Automotive interiors have evolved over the years from a collection of trims covering bare sheet metal panels to add quality & richness of interior cabin, ultimately delivering greater value to customers. One such area in interiors is Side door trims serving the dual purpose of functionality and creating a pleasing environment too. The aesthetic appeal to the Side door trim is added usually through a Door trim insert having a decorative skin pasted on to the plastic base. And the selection of pasting technique for pasting decorative film on to the plastic base insert is a challenge for an automotive interior designer. The objective of this paper will be to review technologies available for manufacturing Door trim inserts with decorative skins, and discuss a direction toward selecting an appropriate pasting technique with cost effectiveness.

In automotive industry, for Side door trim insert decoration, five bonding techniques are used ranging from Adhesive pasting, Thermo compression molding using natural fiber reinforced PP, Pressure lamination, Kimikomi, and Low pressure injection molding, all these will be discussed in this paper. A brief synopsis of the advantages and disadvantages of each process including cost effectiveness, design considerations, shape & complexity of Door trim inserts, Door trim insert skin types & their physical property requirements, process considerations and its testing methods are covered. In addition to this, the necessary tooling investment will also be discussed in this paper.

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INTRODUCTION

Door trim insert, offers an aesthetic appeal and pleasing environment inside the vehicle cabin. And to achieve this dual objective, a decorative skin is pasted on to the Door trim insert. The inherent advantages of the Door trim insert are reflected by the ever increasing vehicle luxury and cabin decoration [1]. The automotive industry has fueled much of the advancements that led to the widespread use of decorative skins [2]. To sustain this growth in the increasingly competitive global environment, improvements and innovations in manufacturing techniques are necessary. One aspect to this is the right selection of the manufacturing technique keeping in view both cost & quality of Door trim insert. This places emphasis on the shape and complexity of the Door trim insert and also the effective adhesion of the decorative skin on to the plastic base to make a good quality product. This emphasis has led to the various manufacturing techniques for pasting of decorative skin [3]. All these pasting techniques have its own minimum requirements including shape of Door trim insert and physical properties of decorative skin. Typically fabric and leather decorative skins are used on inserts with PU foam lamination on back side of skin to achieve a feeling of soft touch [4].

Pasting of decorative skin with Adhesive pasting technique requires spraying of adhesive on to the plastic base followed by pasting of decorative skin. This technique requires PU foam lamination on back side of skin which plays a role of barrier for the adhesive to reach the A-surface. With more complex shapes of Door trim insert having deep draw profiles; this pasting process is not feasible. In these cases, Compression molding technique is used with natural fiber reinforced polypropylene composite material. The accuracy of the part is less with this technique.

Kimikomi technique does not require a separate Door trim insert; it can apply decorative skin on the Door trim main board directly. This is a kind of pasting technique which uses adhesive tape/adhesive on the back side of decorative skin, and skin will be pasted on the main board. And skin is inserted inside the groove shape made on the board with help of special purpose machine.

Pressure lamination technique includes injection molding of the plastic base followed by pressure sensitive glue application. And then the substrate is heated for activation of glue. And

after activation of glue, skin is placed on to the base and pressure applied by a press for strong adhesion. Skin needs to have PU foam or non-woven barrier for glue application.

Decorative skin can be applied on the plastic base during molding process itself using Low pressure injection molding technique [5]. In this technique, Skin is inserted on the cavity side before molding, and molding happens on Low pressure so that molten plastic will not come over to A-surface. Also the pressure of the mold is kept low for proper air-venting at the time of molding. This technique requires non-woven barrier on back side of the decorative skin[6].

One of the difficult problems faced by an automotive designer is to select the skin pasting application technique. So, the study was undertaken for a Model 'X', to select the appropriate pasting technique for Door trim insert keeping in view the shape and complexity of Door trim insert, cost effectiveness & design constraints.

A. ADHESIVE PASTING

This technique requires PU foam lamination on back side of Skin which plays a role of barrier for the adhesive to reach the A-surface. PU foam lamination is done using the flame lamination technique as shown in [figure 1](#).



Figure 1. Flame lamination of PU foam

This is a very non-conventional technique of skin application on Door trim insert. In this technique, skin is cut into required sizes using clicking process (See [figure 2](#)).

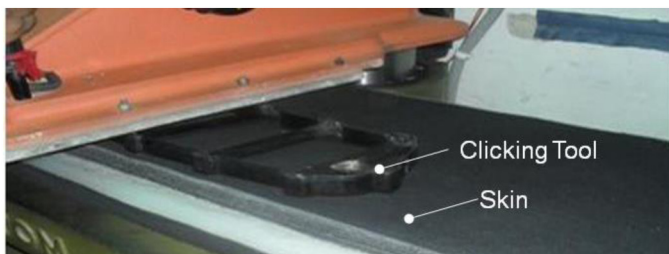


Figure 2. Fabric cutting with Clicking process

Now, primer is applied on to the Door trim insert plastic base followed by adhesive spray using spray gun.

After application of adhesive, skin and Door trim insert are located into the press die as shown in [figure 3](#). And pressure is applied with hydraulic press.

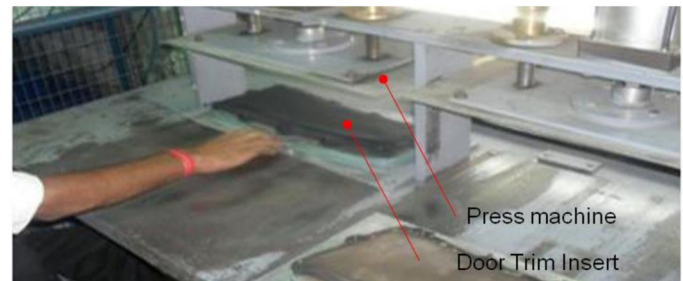


Figure 3. Pressing of skin on Door trim insert base

With more complex shapes of Door trim insert having deep draw profiles; this pasting process is not feasible.

B. THERMO COMPRESSION MOLDING

Compression molding technique requires 'natural fiber reinforced PP composite' material as a base of Door trim insert. In this technique, 'PP composite' sheet is heated in oven before compression molding for the softening of the Door trim insert base (See [figure 4](#)).

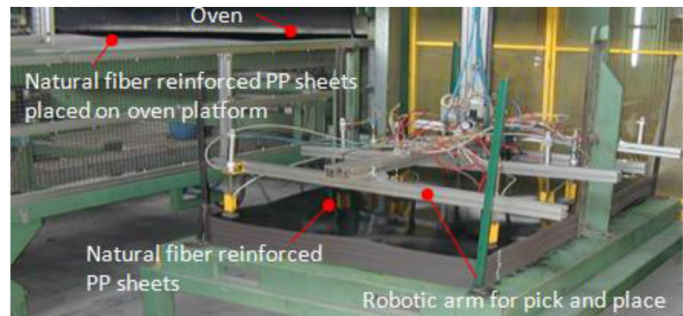


Figure 4. Softening of Door trim insert base

Now, soften 'PP composite' sheet and skin is loaded on the compression molding machine as shown in [figure 5](#).

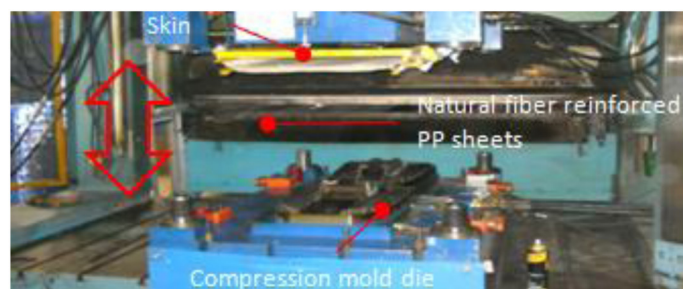


Figure 5. Thermo compression molding technique

After compression molding and curing at 25~35 degree temperature, Door trim insert is ready (See [figure 6](#)).

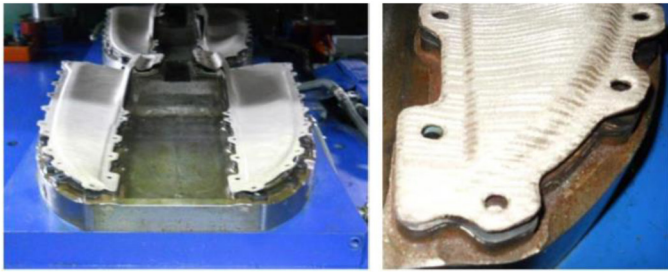


Figure 6. Thermo compression molded Door trim inserts

In this technique, forming, periphery trimming & punching completed in compression molding itself. No additional adhesive required for pasting of skin. No secondary operation is required for trimming and punching.

C. KIMIKOMI TECHNIQUE

Kimikomi process for Door trim insert involves injection molding a door trim board and then gluing a fabric over it and tucking the edges of fabric into the groove which is molded into the door trim board itself. There is no separate Door trim insert; it will be made in Door Trim main board only (See figure 7).

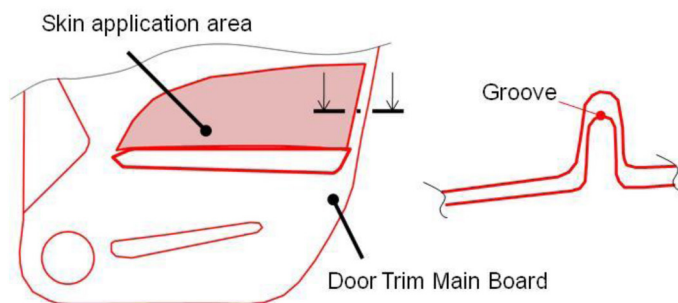


Figure 7. Construction of Door Trim main board for Kimikomi technique

This technique requires PU foam lamination on back side of skin which plays a role of barrier for the adhesive to reach the A-surface. PU foam lamination is done using the flame lamination process.

In this technique, skin is prepared by double side adhesive tape on the back side with a release paper. Now, skin is cut into required sizes using press machine.

First, skin is placed on to the fixture keeping back surface on the top, and now, the Door trim main board is placed over the skin back surface as shown in figure 8.

Now the tool closes and air is sucked through the suction holes to ensure that there is no air entrapment or wrinkle in the final part. (See figure 9)

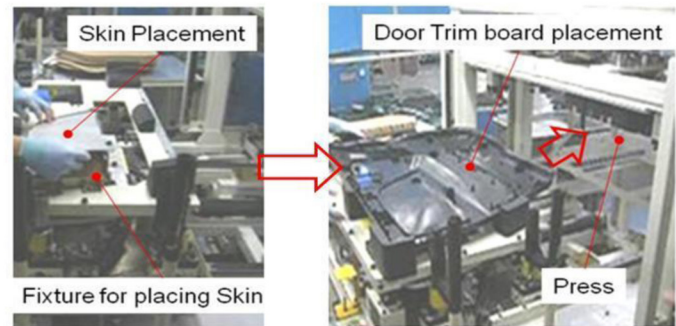


Figure 8. Locating the skin & Door trim main board on assembly fixture



Figure 9. Pressing and Kimikomi blade tool operation

Special kind of blade tool is used in this technique for tucking the skin in the groove. Total number of strokes depends on the type of skin and glue. With each stroke of blade the stroke length is increased, so more fabric keeps sticking to the side wall of the groove.

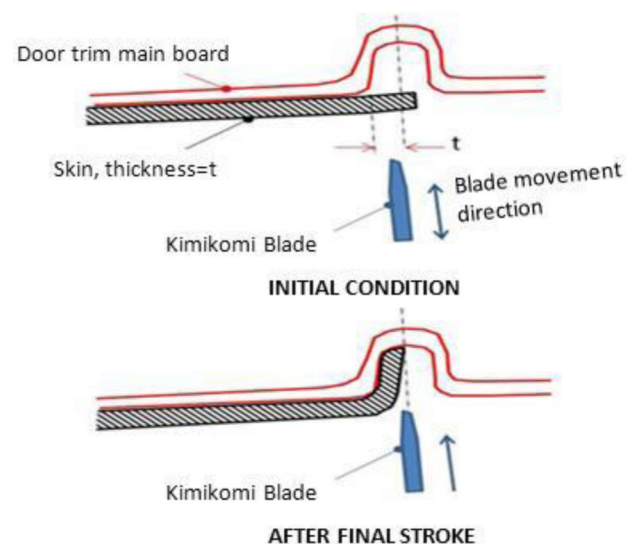


Figure 10. Skin tucking into Door Trim main board using Kimikomi blade tool

There are some limitations of this technique. Door trim design should have a character groove around the periphery of skin area. Groove side walls should have at least 3 to 5° of draft to ensure proper actuation of blade tool.