CHAPTER 3
AUTOMOBILE FLEXIBLE PRINTED CIRCUITS AND MANUFACTURING PROCESS

In this chapter, Automobile Flexible Printed Circuits are introduced and detailed in their applications. Next the overview of manufacturing process will be described and particularly emphasized at image printing process.

3.1 Automobile Flexible Printed Circuits

The Automobile Flexible Printed Circuits are flexible circuits consisting of a single conductor layer on a flexible dielectric film. Their circuits can be fabricated with or without protective coating such as cover layers or cover coats. The Automobile Flexible Printed Circuits are shown in figure 3.1.

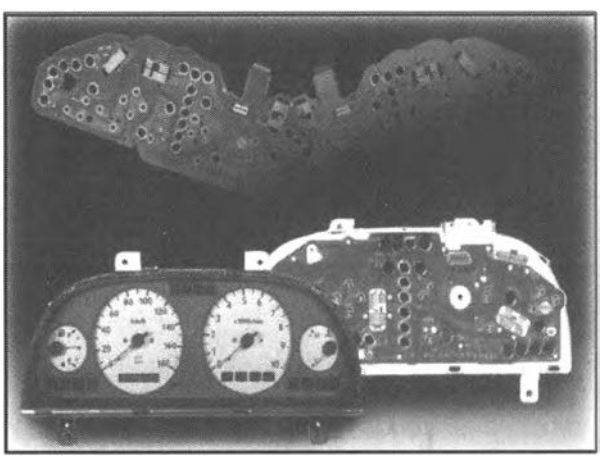


Figure 3.1 Automobile Flexible Printed Circuits

The Automobile Flexible Printed Circuits are thin, lightweight, flexible, and durable. Then they can be designed to meet a wide range of temperature and environmental boundaries. According to their properties, they are chosen to be interconnecting in advanced automotive electronics, which considers a modern automobile's function as a moving computer as well as a means of transportations. Therefore, these products are used for automobile parts particularly instrument panels enhancing both comfort and vehicle safety.

3.2 Manufacturing Process

The manufacturing processes of the Automobile Flexible Printed Circuits of the company are shown in figure 3.2.

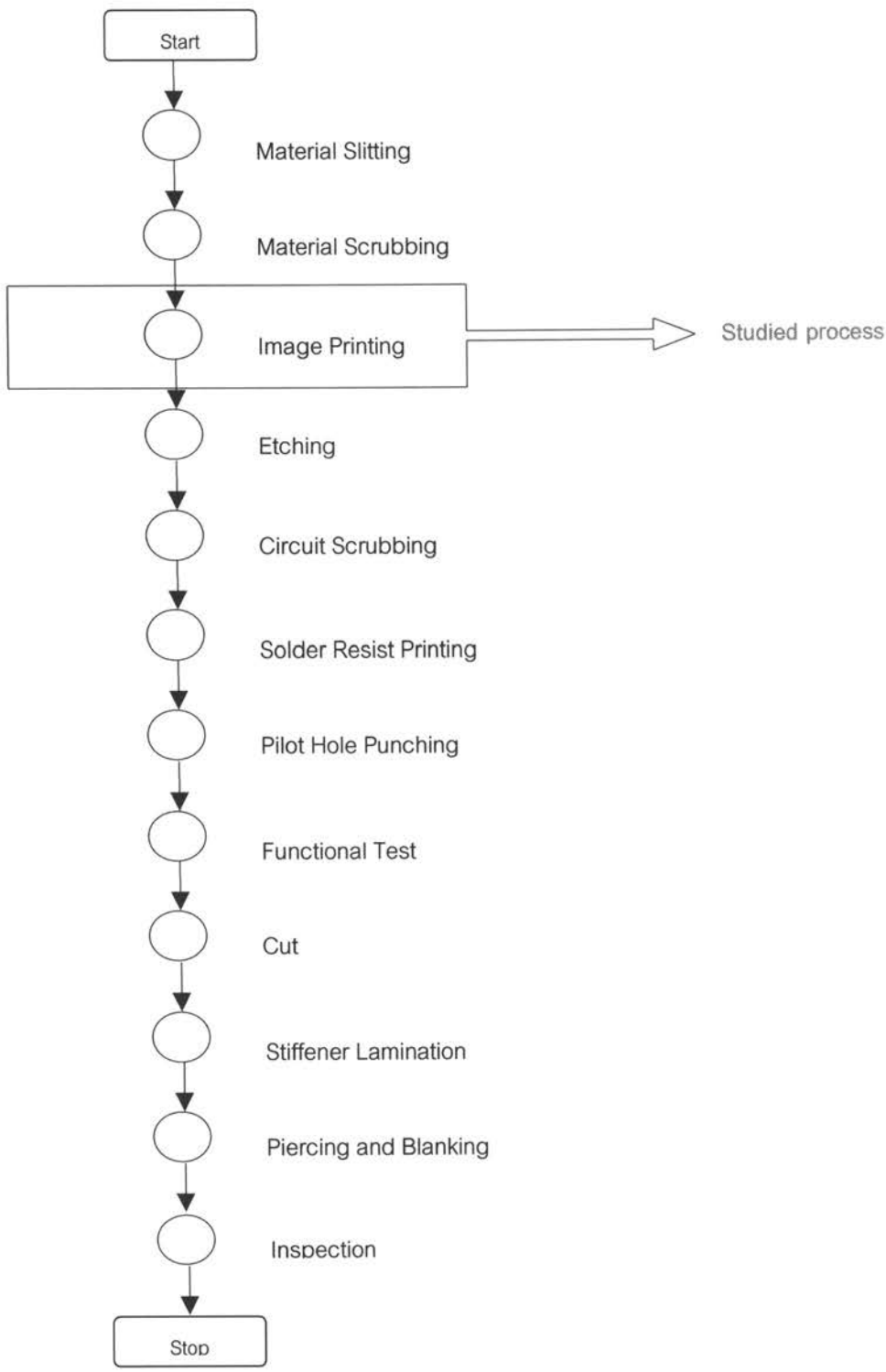


Figure 3.2 The manufacturing processes of the Automobile Flexible Printed Circuits

According to figure 3.2, at the beginning, a roll pattern of copper clad layer (CCL) as a raw material is cut to be required width at material slitting process. Next it is carried to clean its surface at material scrubbing process. After that it is taken to image printing process to print circuit pattern and then passed etching process to remove excess copper with chemical solution. At that process, circuit pattern is fully created. Next it was covered with resist ink at solder resist process. Then the product will be sent to pilot hole punching process to create guide hole for punching and pass functional testing of circuit pattern at functional test process.

Next the product is cut from roll pattern to be sheet type and then laminated stiffener as a supporting board for reinforcement. Next the product is sent to cut outline's pattern at piercing and blanking process. Finally, products will berecieved in piece type and passed to the inspection process to perform visual inspection before it will be sent to customers.

3.3 Image Printing Process

The image printing process is chosen to be studied process. This process is very important in the Automobile Flexible Printed Circuits manufacturing because it will create pattern of circuit on copper clad substrate by used screen-printing technique. The screen-printing is an excellent image-transfer process because of its relatively low material costs and its high volume output. The screen-printing technique is as figure 3.3.

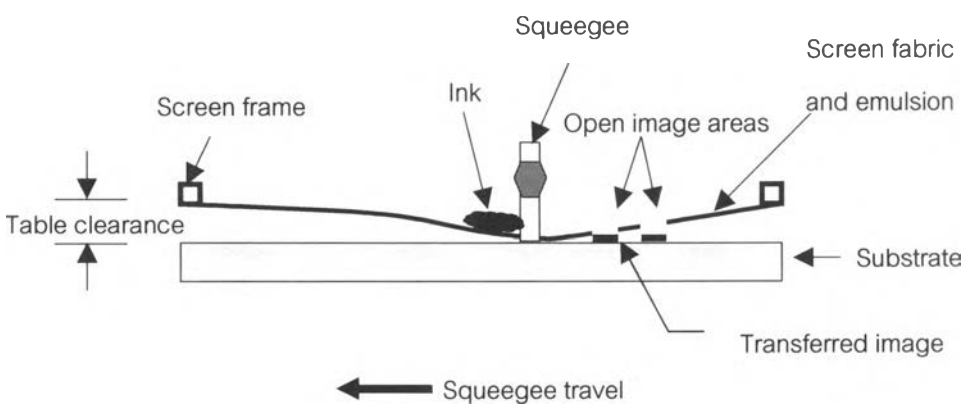


Figure 3.3 The screen-printing technique

Refer to figure 3.3, the squeegee presses down on the screen and forces the ink through open image areas in the screen to transfer image pattern onto the substrate. After the ink has been deposited, the screen peels away or snaps off immediately behind the squeegee and returns to its original position.

Similarly, in image printing process, the etching resist ink is forced through open image areas in the screen to form the desired circuit pattern on the copper clad substrate by the wiping motion of a squeegee. As the result, the ink is printed on copper-clad substrate through the openings in the screen.

In the manufacturing process, the image printing process requires machine and etching resist ink as follows.

3.3.1 Image printing machine

Now the company uses high precision screen printing press. Its machine model is Sakurai Mycrony-102. Its general technical data are shown as below.

Max. print size : 1,020 mm. x 720 mm.

Print base size : 1,300 mm. x 800 mm.

Printable thickness : up to 20 mm.

Available frame dimensions:

Max. size : 1,20 mm. x 1,140 mm.

Min size : 600 mm. x 600 mm.

Squeegee speed : 0.1-1.0 m/sec.

Squeegee angle : 0-30 degree

Press running speed : 900-950 pcs./hour (max.)

Screen off-contract amount : 0-30 mm.

Pneumatic air required : 30 litter/min., 6 kg/cm^2

Machine net weight : 1,800 kgs.

Machine dimensions : 1,860 mm. x 2,382 mm. x 1,200 mm.

The image printing machine is shown in figure 3.4.

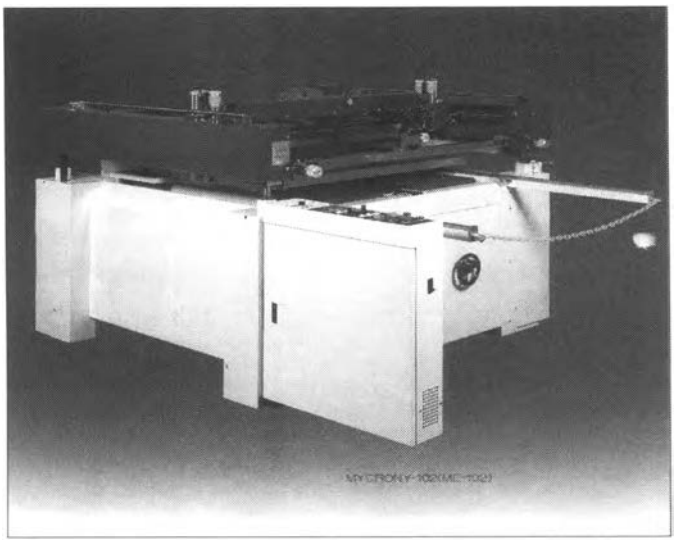
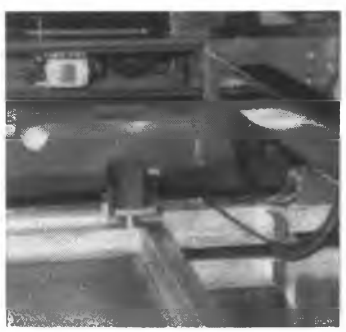
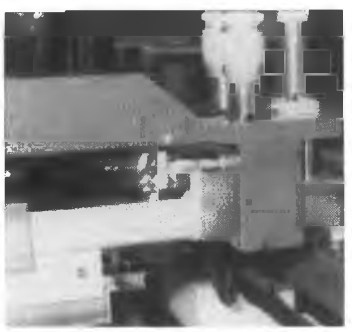


Image printing machine



Screen flame air lock



Squeege & Flo-coater pressure adjusters

Figure 3.4 The image printing machine

3.3.2 Etching resist ink

The company uses etching resist ink that excellent in successive printability and etching resistance. Ink type is AS-500LY. Its general properties are shown as below.

Color : Blue

Viscosity : 150 ps (E model viscometer 5 rpm/25 ^{o}C)

Gravity : 1.5

Curing : 900mj/cm^{2}

Shelf life : 6 months after manufacturing (stored below 25^{o}C)

The etching resist ink is shown in figure 3.5.

Figure 3.5 The etching resist ink

In addition, process conditions of this ink are shown as below.

Surface treatment : Acid treatment -> Buff (#600+#1000)

Print : 300 mesh counts per inch

Curing : 900 mj/cm^2

End properties:

Items	Test condition	Result
Adhesion	JIS Do202 Tape peeling after cross cut	100/100
Pencil harness	JIS K5400 No scratch on the surface	H
Etching resistance	Cupric Chloride 200g/litre HCL 150 g/litre	Pass
Stripping	50*C/20 min. Immersion method 3%NaOH/40*C Immersion method	15 sec.

Table 3.1 End properties of etching resist ink

In this thesis research, the same type of image printing machine and the etching resist ink used in manufacturing process will be used in the experiment also. The experiment will be described in next chapter.