CHAPTER VI
GUIDELINES FOR THE SELECTION OF PLASTIC CARD

The majority of card failures occur in the mid to long term. The failure of plastic card due to brittle fracture and cracking resulting in short service lifetime is a common problem. Consequently, the target of this chapter is to provide the guideline of new plastic card which is basis for evaluating lifetime for 10 years. It is hoped that the following information will provide the plastic failure modes and some understanding into selection of plastic cards lifetime.

6.1 Types of Failure

Most of the stresses forced on plastics cards in short service lifetime can be grouped under the headings of mechanical thermal, chemical and environmental failure (Vishu Shah et al, 2006). The classification of failure by mechanism shows that mechanical failure is the predominant mechanism although it is presented by one or more of the other classifications. For the selection of plastic card, it is a practical necessity to understand their failure modes and properties to reduce the likelihood of product failure.

6.1.1 Mechanical Failure

Mechanical failure arises from the applied external forces. In this work, the force has been applied in dynamic bending and US postal step for a short period of time. When they exceed the yield strength of the material, it might cause the product to crack.

6.1.2 Thermal Failure

Thermal failure occurs from exposing products to an extremely hot or extremely cold environment (like a thermal shock). In this work, the thermal has been applied in part of thermal storage and thermal shock. At abnormally high and low temperatures the product may warp. Plastic cards tend to get brittleness. Even the small amount of load may cause the card to crack.

6.1.3 Chemical Failure

Chemical failure occurs from exposing the products to certain chemicals is quite common. Residual stress, high temperatures, and external loading tend to aggravate the problem. In this work, the Chemical has been applied in part of short-long term of chemical storage and the salt spray tests.

6.1.4 Environmental Failure

Plastic cards exposed to ultraviolet rays, humidity, ozone, heat, and pollution are major environmental factors that seriously affect plastic cards. The effect can be anywhere from a mere loss of color, slight crazing and cracking, to a complete breakdown of the polymer structure.

6.2 Durability of Smart Card

The durability of smart card is very important, for example, the card replacement costs at population scale can represent one of the largest costs of the ID project. Especially if renewal and re-issuance involves face-to-face interviews and data cross-referencing. To re-issue 100 million ID cards every 5 years, it is very expensive than a 10-year renewal cycle. So careful evaluation of smart card durability factors to help ensure a minimum guaranteed card life can have significant financial benefits

Figure 6.1 shows the temperature range of card plot with service lifetime. As it can seen that the PVC and PETG are used for cards with a life expectancy of 3-5 years. Commonly, they have short lifetime expectancy than PC card body materials, due to a lower resistance to heat, UV and bending stress. In case of PC, it has lifetime expectancy of 10 years. PC has widely temperature rang which has a much higher resistance to damage from heat, flexing and UV. Therefore, the suitable selection of card body material is used to help the user/customer to get the long lifetime expectancy (resource: Datacard Group company).

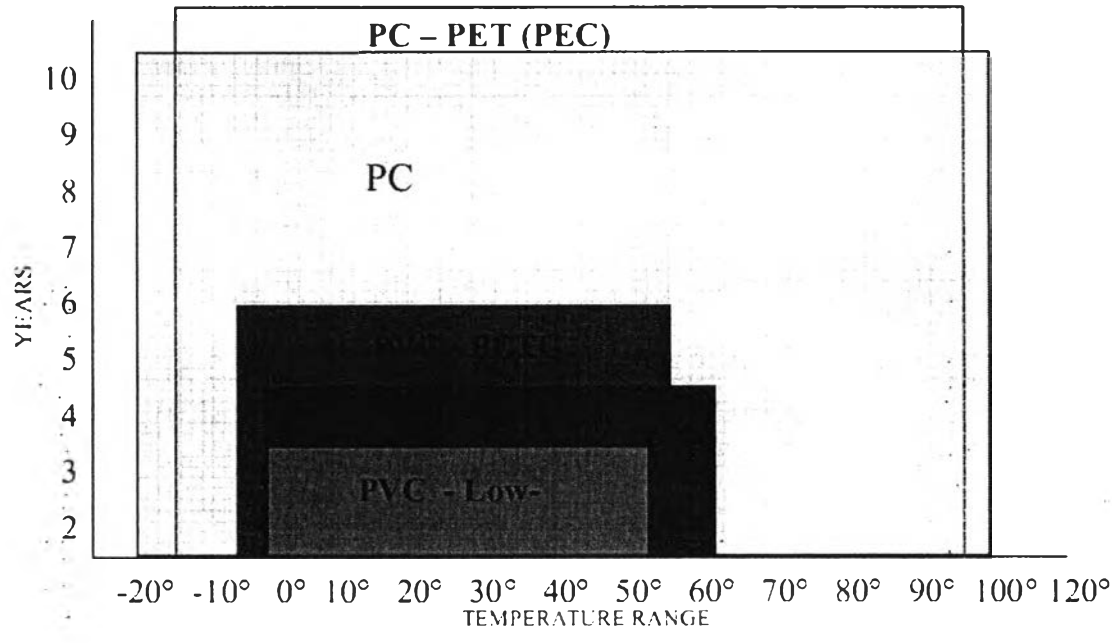

Figure 6.1 The temperature range of each plastic card plot with service lifetime (resource: Datacard Group company)

6.3 Guidelines for the Selection of Plastic Card

The plastics card failure is generally related to material selection. A systematic approach to material selection process is necessary in order to select the best material for smart card application. This guideline is designed to help the user/customer in understanding and accounting for these limitations.

Table 6.1 showed the suitable data of material expected life time for 10 years (in normal condition) which use the PC-STD for guidelines of plastic card. The PC-STD showed the best properties in visual, thermal stability and good in functional and mechanical properties. The best way to use this guideline is to fine the material which the properties closely or better than PC-STD.

Table 6.1 The technical data of material expected life time for 10 years (in normal condition)

Properties		Test methods (ASTM/ISO)	Condition
Tensile properties			
Tensile strength (MPa)	> 63.37	D-822	- At 25°C.
Modulus (MPa)	> 1047.26	D-822	- Using speed at 50 mm/min
Optical properties			
Gloss retention (%)	< 83.65		- At angle 60°
Color difference (ΔE)	< 4.77	ASTM D 65	- At angle 45°
Temperature			
Brittleness temperature (°C)	<- 35		- Storage in freezer at -35°C - Storage in oven at 50°C
Temperature range (°C)	-40 - 110		
Functional checking			
Each testing step	Pass	Modify ISO/IEC 24789-1*	
After finish testing	Pass	Modify ISO/IEC 24789-1*	
Warpage (mm)	< 0.80		
Chemical resistance (15 min/each solution)			
Salt	good	ISO/IEC 10373-1	
Acid	good		
Alkaline	good		
Fuel B	good		

- As referred in Chapter 4 and 5 (Fig 4.1 and 5.1)