DELIVERING CARD LONGEVITY WITH OVERLAY FILMS

Demand for smarter, more secure ID and financial transaction cards are pushing manufacturers toward longer card life. New techniques offer ways to deliver longer life. At the same time, emerging industry standards and test methods make it possible to more clearly define durability.

Recognizing these trends, Klöckner Pentaplast engineers developed card structures with overlay layers which enhance durability and extend card life. kp's structures are cost effective because they run on standard collating equipment, eliminating the need for capital upgrades.

THE MARKET FOR DURABILITY

Projections show that the global card market is expected to continue its steady growth. Within the ID card segment, government and national health cards are forecast to grow 6.0% annually according to data from the International Card Manufacturers Association (ICMA). Company ID and security access cards are projected to grow 6.5% annually, financial transaction cards are expected to see a compound annual growth rate (CAGR) in the 3.0% range, and total expenditures for financial card manufacturing will be in the 10% range.[1]

Since we as a society rely on cards to carry more essential information and transact more private business, issuers and manufacturers need to ensure that cards remain secure against all of the threats of the digital age. But security advances and other features do not come without costs. To offset expenses and meet rising demand, card issuers now expect longer card life. An informal poll conducted at the 2015 ICMA Expo found that more than 64% of recipients had customers requesting card durability life of five years or longer.[2]

The purpose of this white paper is to aid card manufacturers seeking guidance about:

- clear definitions of durability – what it is and how it is achieved,
- new materials and manufacturing techniques to help achieve durability, and
- rigorous testing to demonstrate durability against a full range of real-world stressors.

[1]Vrancart, Al, "2014 -2018 Global Card Market Trends & Forecasts," presentation at ICMA Expo, March 30, 2015.

[2]Tushie, David, "Card Durability Considerations for 5 Year Life Cards," presentation at ICMA EuroForum, Oct. 9, 2015.

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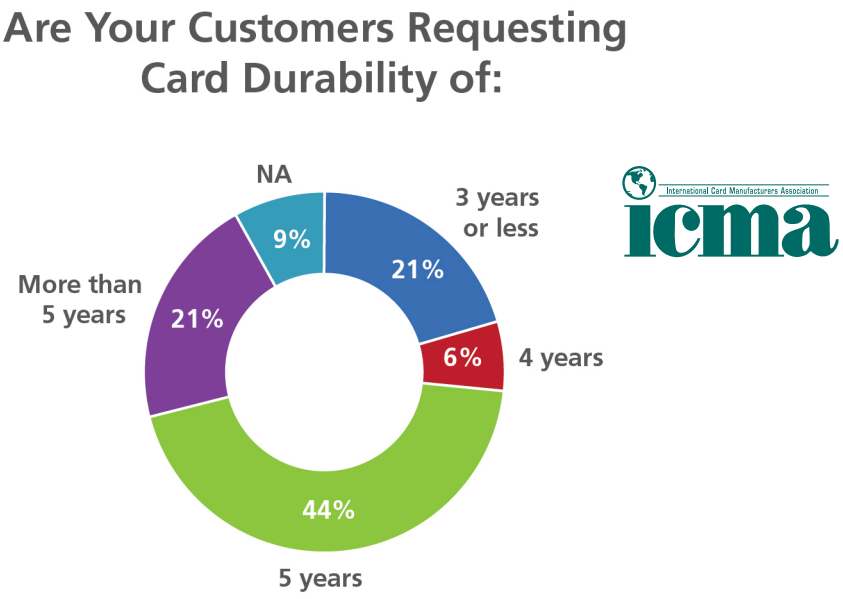

Figure 1: Percent of customers requesting card durability.
Source: ICMA Expo 2015 Poll

DEFINING DURABILITY

The governing standard for durability in the U.S. is published by the International Committee for Information Technology Standards in publication INCITS 440. The corresponding global standard is ISO/IEC 24789-1. Given the market pressures toward increased durability outlined above, the standards bodies have been busy updating and enhancing the standards to provide greater specificity and a more robust set of tools for defining and assessing durability. The current INCITS 440 revision passed through public comment in 2015. The publication may be purchased on www.ansi.org. A similar multi-year process of updating of the international standard ISO/IEC 24789 is now underway.

The stated purpose of INCITS 440 is to help manufacturers and issuers "determine the suitability of a card for a particular application." INCITS 440 defines a number of the key factors that affect durability and proposes a model for ascribing quantifiable values to each of those factors. The desired longevity is included in the calculation as one of those factors. Manufacturers can use the numerical assessment to categorize the card into one of ten card durability categories. Each category carries a set of increasingly stringent performance requirements that are tied directly to the testing methods described in ANSI/INCITS 332—Card Durability Test Methods.

Understanding a card's intended use and likely stressors is the only rigorous way to build a target for its longevity. Suppliers and manufacturers speak loosely about the mythical "five-year card" or "ten-year card," but there is no such beast. A five-year card in the hands of a secure facility employee swiping in and out of the building becomes a two-year card in the hands of a student using the card daily for everything from library to cafeteria to dorm access. If it's used to scrape the ice off of a windshield, it quickly degrades to a one-year card. Ultimately, the card's use in the field will dictate the required durability.

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WAYS TO ACHIEVE DURABILITY

For decades, the industry standard card construction for ID and financial transaction cards was a 26-mil thick, white, printable PVC core stock laminated top and bottom with 2 mils of clear PVC overlay. The standard PVC card was easy to assemble with industry standard equipment, was inexpensive to produce, held ink very well and was durable enough for traditional ID application. It was also adequate for the standard two-year life cycle of a financial transaction card.

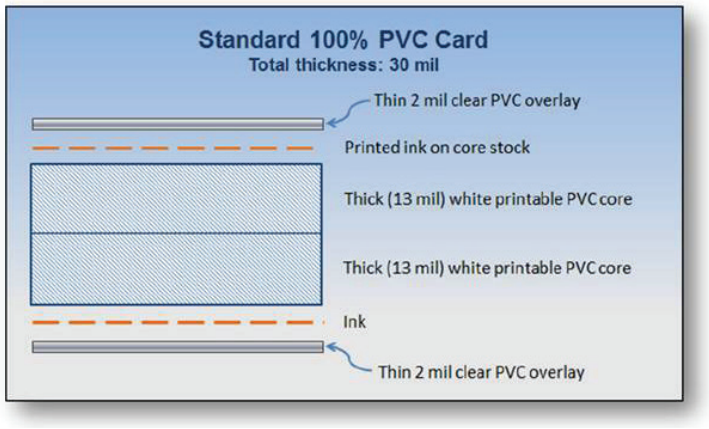

Figure 2: Industry standard, 100% PVC card structure.

However, the traditional PVC card body is not durable enough for long life or intensive use. The structure cannot withstand a great deal of repeated flexure and PVC is vulnerable to breakdown from UV exposure. For applications requiring more durability, manufacturers developed strategies for adding polyethylene terephthalate, or polyester, to the card body. Polyester is stronger than PVC, highly UV resistant and better withstands temperature extremes and the high heat of certain card printers. It is also easy to work with. On the other hand, polyester is more expensive than PVC and has significant drawbacks as a surface for holding ink.

To balance the strength of polyester with the affordability and printability of PVC, manufacturers developed a number of composite card body structures that combine the two plastics. These composite card structures provide lesser or greater proportions of polyester depending on the durability/cost equation.

For the highest durability applications, cards built out of collated layering of 60% PVC and 40% polyester became an industry standard. Casually referred to as 60:40 cards, this card type can be implemented in either of the two common structures.

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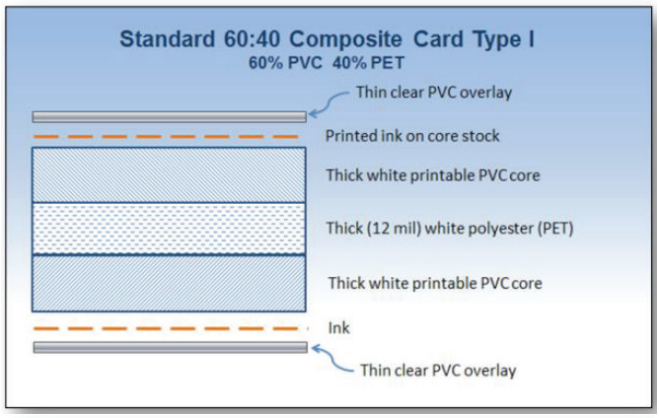

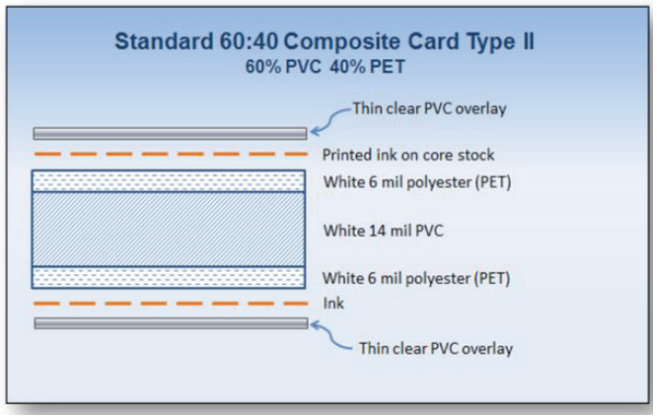

Figure 3: Two versions of the industry standard 60:40 high durability card structure.

The 60:40 card has drawbacks. The large amount of polyester in the card core adds cost. And the complex layering may require capital upgrades in collating equipment, or may lead to errors in collation that can waste valuable time, money and materials.

To address these issues, Klöckner Pentaplast introduced an innovative way to boost durability without incurring capital costs—coated PVC/PET composite overlay films. The Pentacard® kpLongLife™ 2+2 film combines 2 mils clear PVC with 2 mils clear polyester to function as a single overlay. The Pentacard® kpLongLife™ 2+3 film adds an extra thickness of polyester for even greater durability.

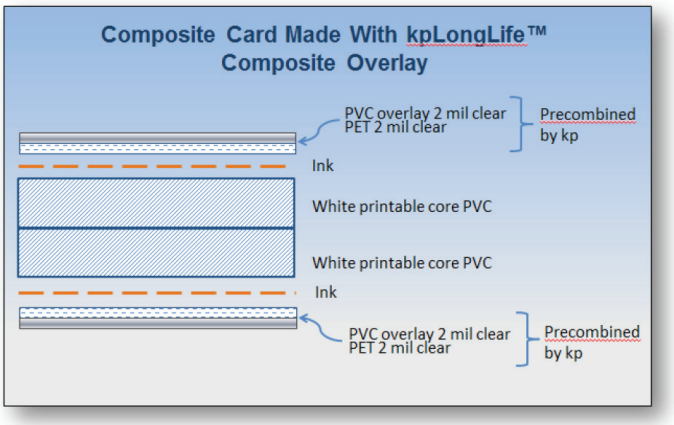

Figure 4: Composite card made with Pentacard® kpLongLife™ 2+2 film with 4 mil composite overlay (2 mil per side).

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kp's innovative durable card strategy is entirely consistent with the traditional, inexpensive PVC card structure. Because the polyester is a part of the overlay, a fully printable white PVC card core can be used which is compatible with existing collation equipment, keeping costs low. Also, because the polyester is protecting the card in the overlay, less may be needed in order to achieve the same or better durability as other, more complex, card structures.

TESTING DURABILITY

Can a smaller amount of clear polyester in the overlay deliver the same or better durability as larger amounts of polyester within the core of more complicated structures? Tests performed by kp engineers confirmed that a durable overlay film is a less expensive, easier to produce alternative for delivering the card life demanded by the marketplace.

One of the best data sets that shows the limitations of standard PVC card constructions comes from a combined laboratory/field study conducted by the USA INCITS B10.11 Standards Committee.[3] The study, conducted over multiple years at Xavier University, tracked card failures after the University had transitioned from a traditional, annually-issued student ID to a multi-use card expected to last for the full four years of a student's career. Four different card types were issued to students and their failure rates and types tracked. The cards tested included two different constructions of PVC - only cards and two different types of PVC/PET composite cards.

The results made it clear that traditional PVC cards were not up to the durability challenge of increased use and extended life. The primary modes of failure were card fracture and delamination. David Tushie, ICMA Standards and Technical Representative, described the results in *Card Manufacturing* magazine. "It was clear from the test that several composite card constructions were superior to PVC only cards.[3]"

Tushie also pointed out that the test data did not include some of the card materials that are now available. kp engineers developed a battery of tests to extend the Xavier study in the laboratory and to expand the testing to include a fuller range of card constructions. Bill Crawford, kp Technical Manager for Card/Print Coatings, said, "After the results of the Xavier study came in, we asked ourselves: what are the tests we have in our toolkit to replicate the failures that the study found?"

kp assembled that toolkit from the standards and testing regimes of INCITS 322, as well as several test methods from the comparable global standard ISO/IEC 10373. A pair of extreme temperature printing tests was added with a Fargo HDP5000 printer. The tests were selected to illustrate the performance of various card constructions and materials against some of the more significant stressors likely to be encountered by long-life cards.

The cards used in the tests included a standard PVC card and composite construction PVC/PET cards from different manufacturers. The cards in tests were labeled 60:40, composite 5, composite 6 and composite 7. The tests also included two cards constructed with PVC core and two different versions of the Pentacard® kpLongLife™ durable overlay film in the 2+2 and 2+3 thicknesses. The test methods and results are displayed in fig. 5 in Appendix A.

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[3]Tushie, David, "Longer Card Expiration Requires Better Card Durability," *Card Manufacturing* magazine (June 2015; Vol 24;4 pgs 22-23)

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The results of this testing confirmed the basic conclusions of the Xavier University test and extended those conclusions to begin to apply them to a number of different approaches to durable card construction:

- The basic PVC card shows itself ill-suited to the demands of durable applications, substantially underperforming the other card types in almost every category.
- The various composite card types show good durability with a few notable variations. For example, the 60:40 card underperformed the others in the Corner Impact test.
- The kp approach to the durable card, using Pentacard® kpLongLife™ durable overlay film over a PVC card core, at least matches the performance of the composite cards in almost every criterion.

By incorporating polyester layers in the outside card layers, kpLongLife™ overlay is a viable alternative method to manufacturing and delivering durability in the ever-evolving market for ID and financial transaction cards.

CONCLUSION: THE VALUE OF A DURABLE OVERLAY

As the card industry transitions to customer demands for longer life in more intensive and challenging applications, the onus is on suppliers and manufacturers to come to market with new products that deliver durability. With more approaches to achieve durability, card issuers have options to find the right materials and construction techniques for a particular card application. Rigorous testing can help make it clear what approach to durability is right for a particular card issuer and a distinct card application.

The use of a durable overlay film can significantly enhance the durability characteristics of a standard PVC card, giving it performance that matches or exceeds many of the traditional forms of composite cards. kp Technical Manager Bill Crawford concludes, "Testing shows that a small amount of polyester in the overlay is as effective at creating a durable card as a larger quantity amount of polyester in the card body."

This approach minimizes the premium component (polyester) needed to achieve durability goals. It also has the added benefit of not requiring costly manufacturing process changes or new equipment investments.

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APPENDIX A

Card Body Durability Test Summary

	Test Method	Units	PVC Card	Composite Card 5	Composite Card 6	Composite Card 7	kpLL2+2 Card	kpLL2+3 Card	60:40 Card	ANSI 440 D10 Requirement
Peel Strength - Junction 1	ISO/IEC 10373	N/cm	na	destruct	destruct	destruct	9.5	9.1	6.2	4.8
Peel Strength - Junction 2			na	destruct	destruct	destruct	10.3	7.4	5.1	4.8
Card Flexure A axis	INCITS 322 5.4	Cycles to stopping point	50,000	>100,000	>500,000	>500,000	>500,000	>500,000	>100,000	100,000
Card Flexure B axis	INCITS 322 5.4	Cycles to stopping point	30,000	>100,000	>100,000	>100,000	>100,000	>100,000	>100,000	50,000
Stress and Plasticizer Exposure A&B	INCITS 322 5.6	Hours to stopping point	5-7 hours	240+ hours	100+ hours	100+ hours	240+ hours	100+ hours	240+ hours	100 hrs
Linear Dimension Change - width	INCITS 322 5.24	% change	11%	0.40%	0.47%	1.20%	1.30%	1.70%	1%	1% max
Linear Dimension Change - length		% change	-2%	1.40%	1.14%	0.32%	1.29%	1.19%	0.92%	1% max
Heat Resistance 198F 4 hr	ISO/IEC 10373 5.15	Deflection in mm	73	12	17	7	7	5	2	none
Heat Resistance 325F 10 min	ISO/IEC 10373 5.15	Deflection in mm	73	43	40	23	36	16	13	none
Fargo Extreme Temp Print 190°C	HDP5000	Pass/Fail	P	P	P	P	P	P	P	none
		Deflection in mil	240	150	150	150	90	120	60	none
Fargo Extreme Temp Print 210°C	HDP5000	Pass/Fail	0/4	0/4	out	0/6	0/7	1/9 delam	3/4 delam	none
		Deflection in mil	240	180	out	90	120	150	150	none

Figure 5: Card body durability test summary for PVC, selected composite and durable overlay cards. Source: Klöckner Pentaplast.