klöckner pentaplast

white paper

CAN OVERLAY ORIENTATION IMPROVE SERVICE LIFE?

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How long a card remains valid is important to both consumers and issuers.

From a consumer point of view, features such as EMV chips and digital graphics are becoming familiar. As consumer comfort grows with these technologies, so do their expectations that a favorite card will be valid for a long time.

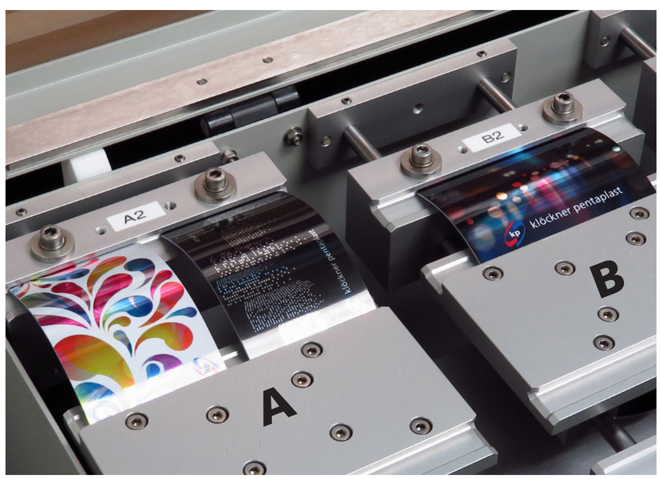
Card issuers want longer service life because, first and foremost, longer-lasting cards translate to happy customers. In addition, longer service life means more manageable replacement costs over time.

A recent International Card Manufacturers Association poll reported that 50% of issuers want a four-to-five year service life for a top-of-wallet card. However, a significant number of issuers—21%—want five years or more. Faced with this challenge, card manufacturers are exploring different ways to extend card life while maintaining margins.

DOES PVC ORIENTATION MATTER?

One possible way to extend service life is to change how the overlay layer is oriented during lamination. Overlay is oriented one of two ways. Layers may be aligned with the grain longitudinally along the same axis as the stack, or rotated 90 degrees and oriented in the transverse direction. Using flex testing, kp engineers investigated the impact both orientations had on the durability of mono core, dual core, and triple-core card structures.

Flex strength was selected as the key indicator because it reliably predicts durability and service life. It is measured by the number of cycles needed for a test card to fail.



Durability testing involves flexing cards to failure transversally (A) and longitudinally (B).

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	Mono Core		Dual Core		Triple Core			
	M1	M2	D1	D2	T1	T2	T3	T4
Overlay	→	↑	→	↑	→	↑	↑	→
Core			→	→	→	→	→	→
Core	→	→			→	→	↑	↑
Core			→	→	→	→	→	→
Overlay	→	↑	→	↑	→	↑	↑	→

Table 1. Layer orientation prior to lamination. Two laminations were tested with mono-core cards (M1 & M2), two with dual-core-cards (D1 & D2), and four with triple-core cards (T1 – T4).

Eight different card structures were selected. Two mono-core cards were tested, two dual-core cards, and four triple-core cards.

With the mono- and dual-core cards, lamination took place with the overlay layers in either the longitudinal or synchronous direction relative to the core layers or in the transverse direction relative to the core layers. For symmetry reasons, the films on either side of the card were orientated in the same way.

With the triple-core structures, laminations were made with the overlay layers in either a synchronous or transverse direction relative to the core layers. Additionally, laminations were made with the middle core in a transverse direction to the two other core layers.

Pentacard® CC- M219/08 and Pentacard® CC-M230/18 core films were tested along with Pentacard® CC-M278/01 overlay. Overall card thickness was 810-840 µm, which is within the average thickness range of an EMV card. Structures were flexed until failure occurred. The key performance indicator was flexing cycles to failure.

TO DETERMINE CARD DURABILITY, COUNT FROM D1 TO D10

Flex strength is important because it directly correlates to expected card service life.

In 2015, ANSI published a series of card durability categories. The categories were ranked from D1 to D10 with D10 being the most durable. Each category was comprised of five factors: redundancy, replacement, annual usage, expected card life, and allowable annual functional failures.

The categories allow issuers to dial in how much service life they need. A D2 rating may be sufficient for a gift card with a limited number of uses, while a D9 or higher rating may be more appropriate for a complex, difficult to replace driver's license or EMV card.

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5.1 Durability Requirements – Card Body
ANSI/INCITS 322 Method

Category (minimum cycles to stopping point)

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Card Flex A	3,600	5,300	7,800	11,300	16,600	24,300	35,500	52,000	76,100	100,000
Card Flex B	1,800	2,700	3,900	5,700	8,300	12,100	17,800	26,000	38,000	50,000

Table 2. ANSI standards call for a minimum number of cycles to failure for each durability category.

The ratings are defined by flex strength as measured by cycles to failure. A D1 rating requires a minimum of 3,600 cycles to failure along the transverse axis and 1,800 cycles along the longitudinal axis. A D10 rating requires 100,000 cycles and 50,000 cycles, respectively.

Other factors influence the ratings, but flex strength can be the difference between meeting a specification and going back to the design studio.

RESULTS

The results suggest that flex strength and projected card life can be influenced by layer orientation. Flex strength was higher across the card width (flex A – transverse axis) when the overlay grain was laminated in the same direction as the core layers. Flex strength was higher along the card length (flex B – longitudinal axis) when the overlay grain was laminated in a transverse direction relative to the core layers.

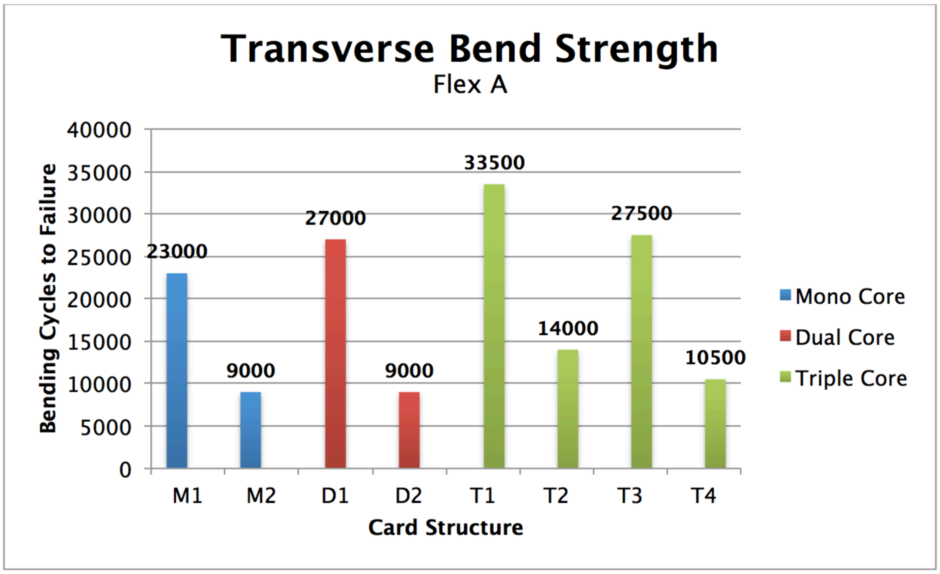

Chart 1. Card Flex A. Flex cycles to failure along card width (transverse axis).

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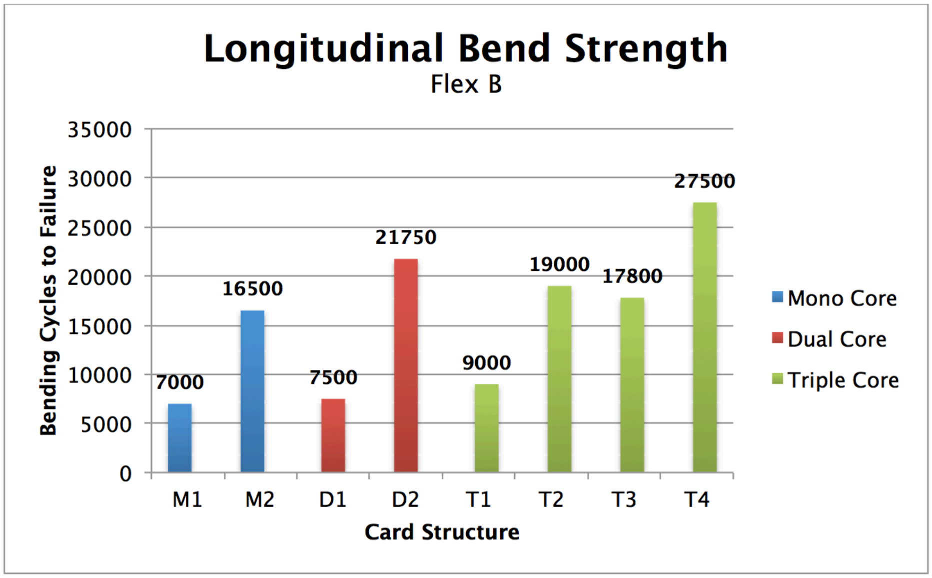

Chart 2. Card Flex B. Flex cycles to failure along the card length (longitudinal axis).

The results also suggest a direct correlation between the number of core layers and overall flex strength. Comparing Flex A results for cards with similar layer orientation, the mono-core card (M1) failed at 23,000 flex cycles, the dual-core card (D1) failed at 27,000 cycles and the triple-core card (T1) failed at 33,500 cycles. In the Flex B tests, the M1 card failed at 7,000 cycles, the D1 card at 7,500 cycles and the T1 card at 9,000 cycles.

In terms of overall flex strength, the number of core layers translated to greater flex strength. Across all tests, the average number of cycles to failure was 13,875 for the mono-core cards, 16,313 for the dual-core cards, and 19,850 for the triple-core core cards.

These results merit a closer look at how flex strength could be increased across card width or along card length depending on card usage requirements. As an example, cards failing across their width may benefit from laminating the overlay in the same direction as the core layers. Cards failing along their length may benefit from laminating the overlay in a transverse direction to the core layers. These findings are important because flex strength correlates to card durability, and an increase could result in a longer service life rating as defined by ANSI INCITS 322.

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