[English translation of the German test report]

SEIBERSDORF LABORATORIES

TEST REPORT No. EMV-E 65/12

On:	**Characterising the protective effect of SECVEL Card Protection Sleeves against destruction of the magnetic stripe by DC magnetic fields and against unauthorised access by 13.56 MHz RFID readers (Innovation Cheque No. 836245)**
Client:	**AIT Austrian Institute of Technology GmbH**
	2444 Seibersdorf, Austria

This report contains pages 1 to 23.

Technical responsibility:	Measuring technician:
__[illegible signature]_________	__[illegible signature]_________
Gernot Schmid (qualified engineer)	Richard Überbacher (qualified engineer)

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Please note:
The test results relate exclusively to the devices under test.
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1. Summary of the measuring results

Object of investigation (device under test): ***SECVEL Card Protection Sleeves***

1.1. Protective effect against destruction of the magnetic stripe by DC magnetic fields (0 Hz)

In a **homogenous DC magnetic field (0 Hz)** of up to around 150 mT the device under test **weakens the field by up to a factor of 2**. In ranges over 150 mT the weakening factor reduces due to saturation effects to approx. 1.2 (at 500 mT).

When a magnetic stripe card was correctly and fully inserted into the device under test there was **effective protection of the magnetic stripe even in the case of direct proximity to magnets (contact with the magnets) with a surface flux density of up to approx. 90 mT** (such as most, but not all, conventional handbag clasp magnets).

However, when the card was not fully inserted or inserted improperly, destruction of the magnetic stripe was still possible by magnets with a surface flux density of less than 90 mT (Fig. 1.1). The main reason for this is that the sleeve does not fully cover the magnetic stripe if the card is inserted improperly (Fig. 1.1). This problem could be solved by shifting and possibly reducing the size of the thumb notch.

Fig. 1.1: Improper card insertion whereby destruction of the magnetic stripe is possible with direct proximity to typical handbag clasp magnets in the area outlined in red.

At a minimum distance of just a few millimetres between the *SECVEL Card Protection Sleeve* and typical permanent magnets or appliances containing permanent magnets (handbag clasps, headphones, mobile phones, etc.) it can be assumed that the static magnetic fields created inside the *SECVEL Card Protection Sleeve* are reduced to a level which no longer represents a risk to the magnetic stripe.

1.2. Protective effect against unauthorised card access using 13.56 MHz RFID readers

When the **card is fully inserted into the device under test (as far as it will go)**, the device **weakens** the magnetic field (13.56 MHz) **by approx. 22 dB** (equivalent to a factor of approx. 12.5).

This effectively prevents unauthorised reading of a card fully inserted into the device under test (as far as it will go), with **many, but not all** standard **13.56 MHz RFID readers, even when in direct contact with the reader**.

When the card is not fully inserted into the device under test (as far as it will go) this protective effect is progressively lost, so with a smart phone it was still possible (with direct contact) to read even a fully inserted card. Fig. 1.2 shows configurations (depth of insertion) with a desktop reader and smart phone (with NFC interface) in which card access was still possible in the case of contact with the reader or smart phone.

Fig. 1.2: Configurations (depth of card insertion) in which RFID access was still possible in the case of contact with the reader or smart phone.

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3. Object of investigation (device under test)

The device under test is "*SECVEL Card Protection Sleeves*" for magnetic stripe cards or contactless chip cards, designed to protect magnetic stripes against destruction by external magnetic fields and secure against unauthorised card access by RFID readers using the frequency range 13.56 MHz.

For writing of the most widespread LoCo magnetic stripe cards, writing heads with minimum flux densities of 30 mT are needed. So conversely it must be assumed that external magnetic fields of more than 30 mT can delete data on magnetic stripes and thus render the card unusable. Everyday sources of such magnetic fields, which could potentially come into close contact with magnetic stripe cards, are typically the permanent magnets built into many everyday objects (e.g. magnetic handbag clasps, mobile phones, headphones, pinboard magnets, etc.).

Fig. 3.1 shows the three technically identical devices tested (serial or batch numbers not available), consisting of a plastic sleeve sealed along three sides with an inlay of highly permeable electrically conductive material on the inside (on both large surfaces).

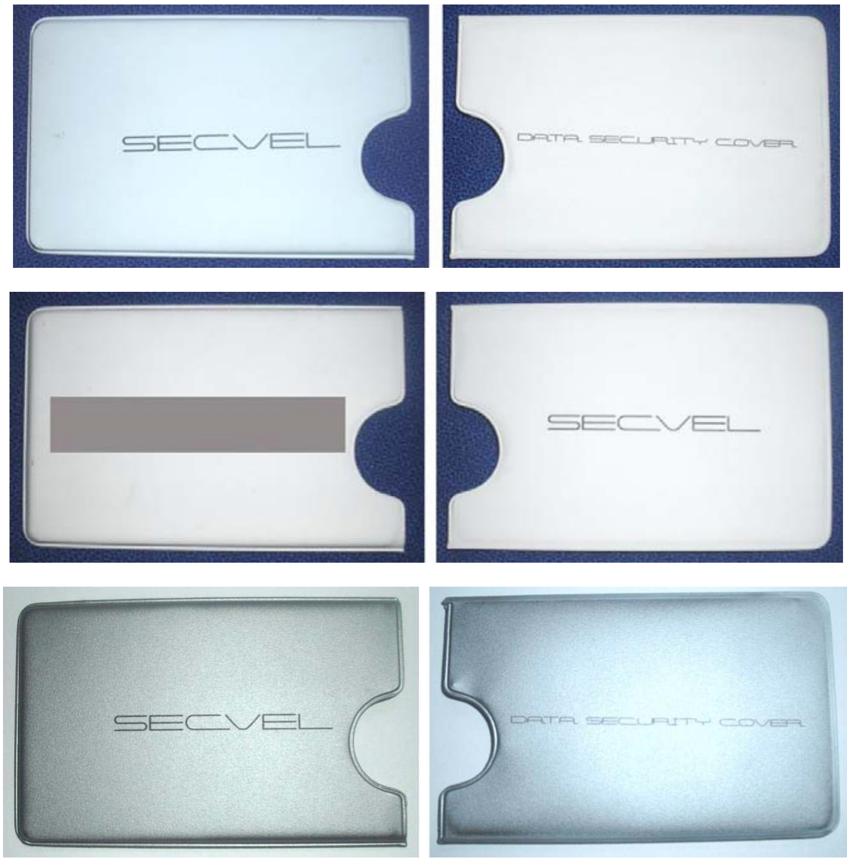


Fig. 3.1: The three technically identical devices under test (named DUT 1-3 here), each shown with back and front view.

Along the narrow open side the device has a roughly semi-circular (radius approx. 12 mm) thumb notch to enable easier removal of the card. The thumb notch is not in the centre of this narrow side but is instead approx. 5 mm off the central axis.

4. Scope of the tests

Metrological tests were conducted on the weakening of static (DC) magnetic fields (chapter 5.1 and chapter 7.1), and on 13.56 MHz magnetic fields (chapter 5.3 and chapter 7.3), as emitted by RFID readers.

In addition representative measurements were taken of the static magnetic flux densities occurring inside the *SECVEL Card Protection Sleeve* in the vicinity of the magnetic stripe with various standard permanent magnets placed up against the outside the cover (chapter 5.2 and chapter 7.2). Magnetic flux densities of more than 25-30 mT in the vicinity of the magnetic stripe must be seen as potential risks for LoCo magnetic stripe cards (write field power 30 mT).

Finally, representative tests were conducted on the response behaviour of contactless chip cards inside the *SECVEL Card Protection Sleeves* in the case of proximity to a standard 13.56 MHz RFID reader or a standard smart phone (chapter 5.4. and 7.4).

Additionally, comparative tests or measurements were carried out with other card protection sleeves available on the market (chapter 8).

5. Measuring methodology

5.1. Measuring the weakening of DC magnetic fields (0 Hz)

For these measurements a virtually homogenous magnetic field was created in the vicinity of the magnetic stripe using two neodymium magnets (20 x 20 x 10 mm^3). The homogeneity of the magnetic field around the stripe (lateral axis to the magnetic stripe) was greater than ±15%. By varying the distance between the magnets it was possible to create flux densities around the device under test of between 60 and 520 mT. A dummy card (Fig. 5.1) was placed an equal distance between the two magnets, once with and once without the protection sleeve, and the maximum level of magnetic flux density occurring in the cutaway section of the dummy card was measured (equivalent to the position of the magnetic stripe) (Fig. 5.2).

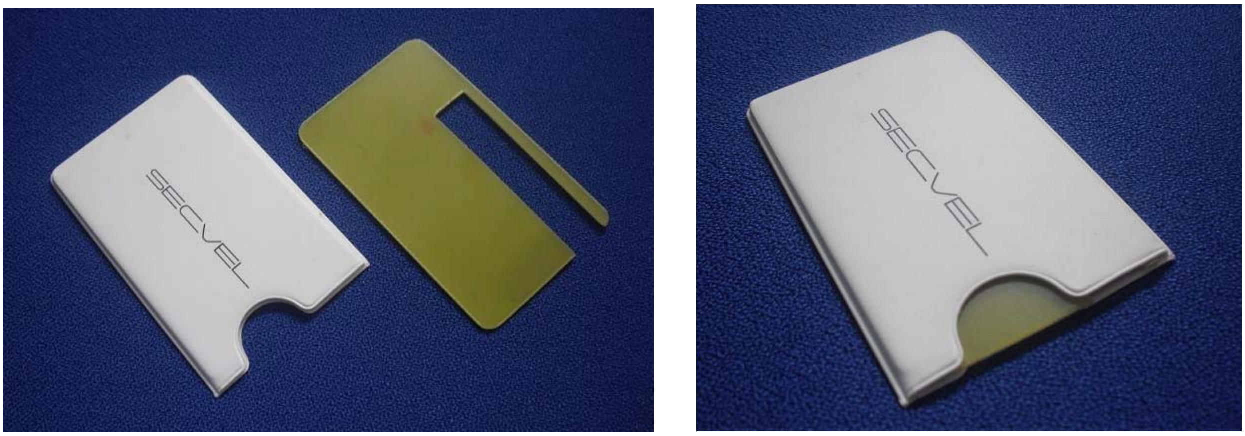


Fig. 5.1: Device under test and non-metal dummy card

Fig. 5.2: Measuring setup to determine the extent to which the device under test weakened an external magnetic field in the vicinity of the magnetic stripe.

5.2. Representative measurements of the magnetic flux density inside the *SECVEL Card Protection Sleeve* in proximity to various permanent magnets

For these tests the standard permanent magnets listed in Table 5.1 were used. In each case the permanent magnets were placed directly on the surface of the protection sleeve over the cutaway area of the dummy card which was fully inserted into the device under test and the following two different positions of the permanent magnets in relation to the long axis of the card were investigated in each case (Figs. 5.3 to 5.5):

- Outer edge of the permanent magnet flush with outer edge of the highly permeable inlay (Pos. 1)
- Centre of the permanent magnet approx. central to the long side of the device under test (Pos. 2)

The maximum flux density around the cutaway area of the dummy card (position of the magnetic stripe) was established metrologically.

	Maximum flux density (mT) at distance			
	0 mm (surface)	1 mm	2 mm	5 mm
Pinboard magnet 1	75	60	40	16
Pinboard magnet 2	72	53	28	6
Pinboard magnet 3	82	53	30	6
Door magnet	70	25	10	2.6
Magnetic toy element	325	196	102	33
Neodymium magnet 6 x 6 x 1 mm^3	245	155	71	18
Neodymium magnet 20 x 20 x 10 mm^3	460	390	335	230
Handbag clasp magnet 1	90	63	40	19
Handbag clasp magnet 2	85	56	38	18
Handbag clasp magnet 3	88	60	40	18

Table 5.1: The permanent magnets used for the tests and the maximum flux densities created by them at various distances.

Note with regard to the magnetic handbag clasps studied:

The handbag clasp magnets used for the tests represent a selection of typical magnets used in many handbags, but by no means worst case scenarios. The maximum surface of the handbag clasp accessible for the magnetic stripe was around 80-90 mT. It should be stated explicitly that there are also considerably more powerful handbag clasp magnets on the market for handbags, camera cases, etc.

Pinboard magnet 1

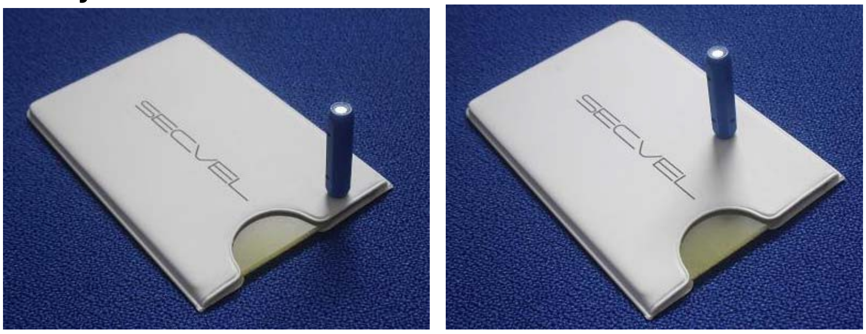
Pinboard magnet 2

Pinboard magnet 3

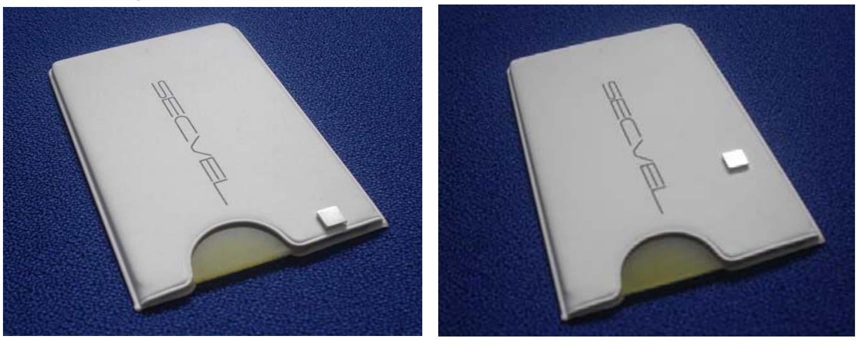
Door catch magnet

Fig. 5.3: Position of the pinboard magnets and door catch magnet on the *SECVEL Card Protection Sleeve* during measurement of the magnetic field inside the sleeve.

Magnetic toy element



Neodymium magnet 6 x 6 x 1 mm^3



Neodymium magnet 20 x 20 x 10 mm^3

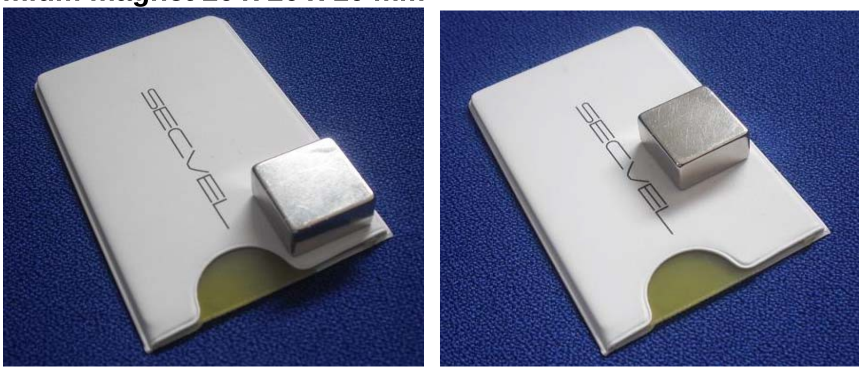


Fig. 5.4: Position of the toy magnet and the other neodymium magnets on the *SECVEL Card Protection Sleeve* during measurement of the magnetic field inside the sleeve.

Handbag clasp magnet

Fig. 5.5: Position of the handbag clasp magnets on the *SECVEL Card Protection Sleeve* during measurement of the magnetic field inside the sleeve (only one of the three handbags pictured).

5.3. Measuring the weakening of the 13.56 MHz magnetic fields

Measurements were taken at a distance of 5 cm from the surface of a 13.56 MHz RFID desktop reader with a receiving antennae in the form of a bank card (in each case once with and once without *SECVEL Card Protection Sleeve*) (Figs. 5.6 and 5.7). The output signal of the receiving antennae was measured with a spectrum analyser. The weakening factor was established from the difference between the measurements with and without the *SECVEL Card Protection Sleeve*.

Fig. 5.6: 13.56 MHz RFID desktop reader with 5 cm separator made of rigid foam (left) and measuring antennae in the form of a bank card inserted into the *SECVEL Card Protection Sleeve* (right, rigid foam separator on top of the RFID reader).

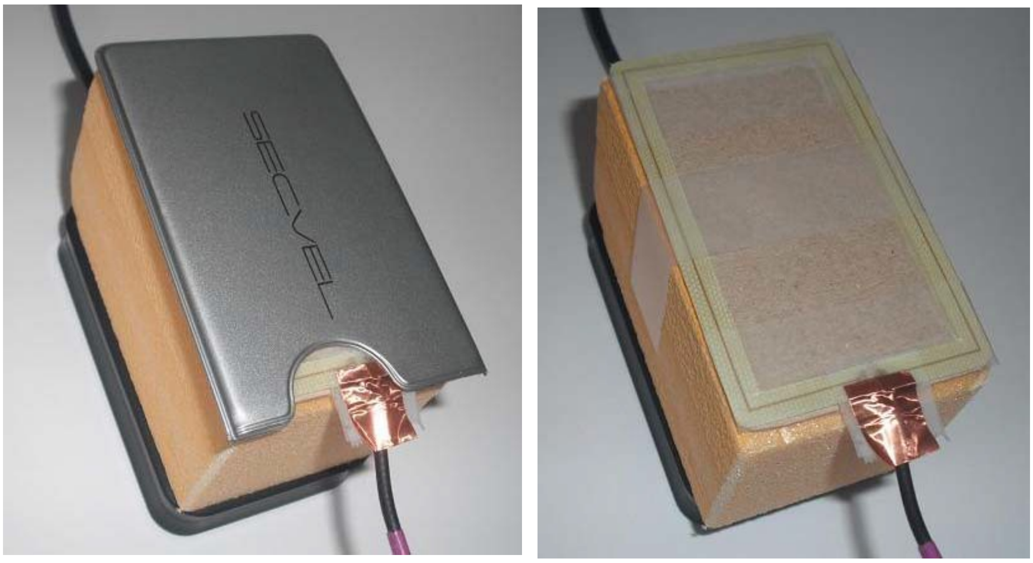


Fig. 5.7: Measuring setup to establish the weakening of the 13.56 MHz magnetic field from the RFID reader by the *SECVEL Card Protection Sleeve*. Left: measurement with antennae fully inserted into the *SECVEL Card Protection Sleeve*. Right: measurement without *SECVEL Card Protection Sleeve.*

5.4. Representative tests of the protective effect against unauthorised card access using standard 13.56 MHz RFID or NFC readers

As well as determining the weakening factor for 13.56 MHz magnetic fields, representative tests were also completed with a RFID desktop reader and a smart phone with NFC interface to investigate the response of contactless smart cards inside the *SECVEL Card Protection Sleeve*. The question of particular interest was the extent to which incomplete insertion of the card into the sleeve undermined the field weakening effect of the *SECVEL Card Protection Sleeve*. Fig. 5.8 shows examples of two of the scenarios investigated with the *SECVEL Card Protection Sleeve*.

Fig. 5.8: Examples of scenarios used to investigate the extent to which incomplete insertion of cards into the *SECVEL Card Protection Sleeve* undermines the field weakening effect of the sleeve. Left: tests with a RFID desktop reader. Right: tests with a smart phone with NFC interface.

6. Measuring devices used and uncertainties

6.1. Measuring devices

The devices used to measure the magnetic fields are listed in Table 6.1.

	Device type	Manufacture r	Calibration uncertainty
Gaussmeter	CYHT201 (Y110734)	Chen Yang Technologies	± 5%
Hall probe	CYTP-T08A (S/N D1210275)	Chen Yang Technologies	± 5%
Spectrum analyser	4405B (S/N 40520766)	Agilent Technologies	-
Test antennae	bank card format, 1 coil	Seibersdorf Laboratories	-

Table 6.1: Measuring devices used for the tests

6.2. Other devices used

For the representative measurements within the 13.56 MHz range, the devices listed in Table 6.2 were used as RFID readers.

	Device type	Manufacturer
13,56 MHz RFID desktop reader	TWN3 MultiISO USB (S/N 44200044)	Elatec
Smart Phone	Google Nexus S (S/N 383457DBDF3C00EC)	Samsung

Table 6.2: Other measuring devices used

6.3. Overall measuring uncertainty

DC field measurements:

For measurements in large field gradients, as in this case, the overall measuring uncertainty is determined predominantly by the positioning accuracy of the field probe as well as its calibration uncertainty (see Table 6.1). Taking account of the facts stated, the overall uncertainty of the measuring results given in this report can be estimated at approx. ±20% (CI 95%).

13.56 MHz measurements:

Because the results are derived exclusively from relative measurements, the overall measuring uncertainty of these results derived from reproduction tests can be estimated at less than ±10% (CI 95%).

7. Measuring results

7.1. Measuring the weakening of DC magnetic fields (0 Hz)

Fig. 7.1 shows the weakening effect of the *SECVEL Card Protection Sleeve* on DC magnetic fields (0 Hz) for the three devices examined, based on the measuring methods described in chapter 5.1. The results show good result consistency (within the limits of reproducibility) for the three different protective sleeves tested, i.e. only negligible representative distribution.

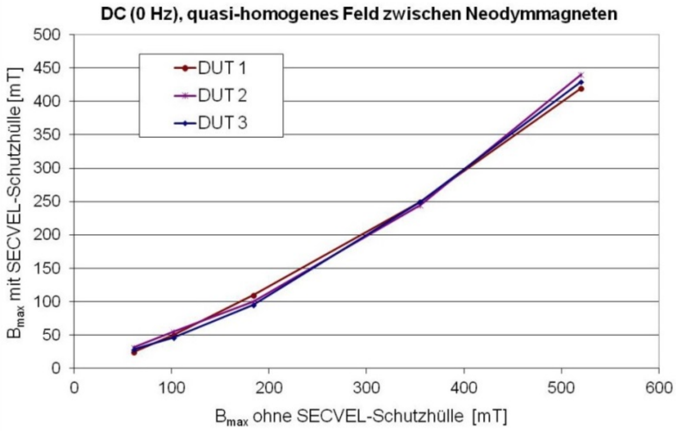


Diagram text:
DC (0 Hz), quasi-homogenous field between neodymium magnets
B_{max} with SECVEL protection sleeve [mT]
DUT 1
DUT 2
DUT 3
B_{max} without SECVEL protection sleeve [mT]

Fig. 7.1: Result of magnetic field tests (0 Hz).
Maximum magnetic flux density B_{max} in the vicinity of the magnetic stripe with and without *SECVEL Card Protection Sleeves* (DUT 1-3).

From the diagram, weakening factors of between approx. 2 (in the case of external magnetic flux densities < approx. 100 mT) and approx. 1.2 (in the case of external magnetic flux densities of approx. 500 mT) can be derived. The reduction of the weakening factor is attributable to saturation effects in the highly permeable inlay of the protection sleeves.

7.2. Representative measurements of the magnetic flux density inside the *SECVEL Card Protection Sleeve* in proximity to various permanent magnets

Table 7.1 summarises the results of the tests, each with direct contact between the outside of the *SECVEL Card Protection Sleeve* and a permanent magnet. The values given are the maximum levels of magnetic flux density measured around the magnetic stripe inside the *SECVEL Card Protection Sleeve* (DUT 1). Values to be seen a critical with regard to destruction of the magnetic stripe (> 25 mT) are printed in colour and bold type in Table 7.1.

Type of permanent magnet (direct contact)	B_{max} (mT)	
	Pos. 1	**Pos. 2**
Pinboard magnet 1	18	6.0
Pinboard magnet 2	3.5	1.5
Pinboard magnet 3	10	2.0
Door magnet	5.0	4.0
Toy magnet	**100**	**55**
Neodymium magnet 6 x 6 x 1 mm^3	**78**	**35**
Neodymium magnet 20 x 20 x 10 mm^3	**415**	**400**
Handbag clasp magnet 1	**30**	15
Handbag clasp magnet 2	**28**	15
Handbag clasp magnet 3	**30**	15

Table 7.1: Results of representative measurements of the magnetic flux densities occurring inside the *SECVEL Card Protection Sleeve* (DUT) in the vicinity of the magnetic stripe in direct proximity to standard permanent magnets outside the sleeve

Table 7.2 summarises the results of the additional measurements taken at various distances between the outside of the *SECVEL Card Protection Sleeve* and a magnetic handbag clasp. The values given in each case are maximum figures for the magnetic flux density measured around the magnetic stripe inside the *SECVEL Card Protection Sleeve* (DUT 1). Values to be seen as critical with regard to destruction of the magnetic stripe (> 25 mT) are again shown in colour and bold type.

Type of permanent magnet	B_{max} (mT)	
	Pos. 1	**Pos. 2**
Handbag clasp magnet 1 (d=0 mm)	**30**	15
Handbag clasp magnet 1 (d=1 mm)	19	10
Handbag clasp magnet 1 (d=2 mm)	12	4.5
Handbag clasp magnet 1 (d=5 mm)	5.5	2.9

Table 7.2: Results of representative measurements of the magnetic flux densities occurring inside the *SECVEL Card Protection Sleeve* (DUT) in the vicinity of the magnetic stripe in the case of standard handbag clasp magnets outside placed at various distances away

The results show the reducing effect upon the magnetic flux density to be expected inside the protection sleeve based upon measurement of the weakening factor (chapter 5.1 and chapter 7.1). This reduction can be considered **adequate** with regard to **protection of the magnetic stripe** against magnetic destruction in **many, <u>but not all</u>** everyday **situations** to be expected (e.g. handbag clasp magnets in direct proximity and unfortunate position).

In addition, there is **no protective effect in the case of improperly or not fully inserted cards**. For instance, in the course of the tests it was shown that a magnetic stripe card inserted improperly into the *SECVEL Card Protection Sleeve* can be destroyed by a handbag clasp magnet 1 placed directly outside (Fig. 7.2).

Fig. 7.2: Improper card insertion whereby destruction of the magnetic stripe is possible with direct proximity to typical handbag clasp magnets in the area outlined in red.

The risk of improper card insertion as shown in Fig. 7.2, whereby the magnetic stripe is not fully covered by the protection sleeve, can be avoided if the thumb notch is positioned in the centre of the open short side and possibly made a little smaller (example, see Fig. 7.3).

A version of the *SECVEL Card Protection Sleeve* shaped as shown below is currently being developed according to information from the manufacturer.

Fig. 7.3: Outline of an improved design *SECVEL Card Protection Sleeve* with regard to covering the magnetic stripe, whereby the improper insertion shown in Fig. 7.2 is no longer possible and therefore better protection of the magnetic stripe can be achieved in practice.

7.3. Measuring the weakening of the 13.56 MHz magnetic fields

Table 7.3 summarises the results of metrological tests with respect to shielding from 13.56 MHz magnetic fields. The weakening values (ratio of receptive field strength with and without *SECVEL Card Protection Sleeve*) are shown in dB and linear units.

Test conditions	Weakening factor	
	[dB]	[l]
Antennae inserted fully (as far as it will go) into DUT 1	22	12.6
Antennae protruding 1 cm from DUT 1	10	3.2

Table 7.3: Weakening of 13.56 MHz magnetic fields by the *SECVEL Card Protection Sleeve*

The relatively minor weakening effect is mainly a result of the (relatively large) thumb notch which, even in the case of a fully inserted card, still allows relatively extensive magnetic flooding of the receiving antennae.

7.4. Representative tests of the protective effect against unauthorised card access using standard 13.56 MHz RFID or NFC readers

Fig. 7.4 shows a configuration in which the **reading of a card not fully inserted** into the *SECVEL Card Protection Sleeve* was **still possible** with the desktop reader in the case of contact with the reader surface.

Fig. 7.4: With the card not fully inserted into the *SECVEL Card Protection Sleeve*, reading of the card was still possible with the desktop reader in the case of contact with the reader's surface.

Table 7.4 shows the reading distances for various depths of insertion into the *SECVEL Card Protection Sleeve* using the desktop reader compared to reading distances without the *SECVEL Card Protection Sleeve*.

Reading distance without *SECVEL Card Protection Sleeve* (Mikare 1k card with desktop reader Elatec TWN3 MultiISO USB)	**70 mm**
Card protruding from *SECVEL Card Protection Sleeve* [mm]	Reading distance
3	0
5	1
10	10
20	15
40	35

Table 7.4: Reading distances with a standard 13.56 MHz RFID desktop reader at various depths of card insertion into the *SECVEL Card Protection Sleeve* (Mifare 1k).

Fig. 7.5 shows a configuration by which it was **even** still **possible to read a card fully inserted** into the *SECVEL Card Protection Sleeve* with a smart phone in the case of direct contact with the surface of the phone.

Fig. 7.5: Even with a card fully inserted into the *SECVEL Card Protection Sleeve* it was still possible to read the card with the smart phone used when the smart phone was touching the surface.

Table 7.5 shows the reading distances ascertained for various depths of card insertion into the *SECVEL Card Protection Sleeve* with the smart phone used, compared to the reading distances without *SECVEL Card Protection Sleeve*.

Reading distance without *SECVEL Card Protection Sleeve* (Mikare 1k card with smart phone Samsung Google Nexus S)	**45 mm**
Card protruding from the edge of the *SECVEL Card Protection Sleeve* [mm]	Reading distance [mm]
Fully inserted	0
0 (card flush with DUT edge)	3
3	6
10	12
20	18
40	25

Table 7.5: Reading distances with a standard 13.56 MHz smart phone with NFC interface at various depths of card insertion into the *SECVEL Card Protection Sleeve* (Mifare 1k).

The limited protective effect shown by the results is mainly due to the (relative large) thumb notch which, even in the case of a fully inserted card, still allows a relatively extensive magnetic flooding of the receiving antennae.

It must be assumed that with stronger readers or different readers to those used in the course of these tests, even greater reading distances can be achieved that those shown in Tables 7.4 and 7.5.

8. Comparative tests with other products

8.1. Representative measurements of the magnetic flux densities inside the *SECVEL Card Protection Sleeve* in direct proximity to various permanent magnets

In order to compare the device under test with other card protection sleeves on the market, additional measurements were also taken in line with the measuring methodology described in chapter 5.2 (only for position 1, i.e. with the permanent magnets at the edge of the covers) using the products shown in Fig. 8.1.

SECVEL
Card Protection Wallet

CRYPTALLOY
protective sleeve

CRYPTALLOY
protective wallet

Leather
card protection walle

Stainless steel
protection case

Fig. 8.1: The products used for the comparative measurements or testing, each shown in two different aspects.

Table 8.1 summarises the measuring results. Values to be seen a critical with regard to destruction of the magnetic stripe (> 25 mT) are printed in colour and bold type in Table 8.1.

Type of permanent magnet (direct contact)	B_{max} (mT)					
	SECVEL Card Protection	*SECVEL Card Protection*	*CRYPT. protective sleeve*	*CRYPT. protective wallet*	*Leather card protection*	*Stainless steel protection case*
Pinboard magnet 1	18	11	**65**	**42**	15	**60**
Pinboard magnet 2	3.5	1.2	**63**	**38**	18	**69**
Pinboard magnet 3	10	2.0	**60**	**35**	15	**62**
Door magnet	5.0	3.1	**50**	**20**	12	**55**
Toy magnet	**100**	**95**	**240**	**125**	**49**	**255**
Nd M. 6 x 6 x 1 mm³	**78**	**40**	**220**	**110**	**45**	**200**
Nd M. 20 x 20 x 10 mm³	**415**	**400**	**390**	**360**	**300**	**420**
Handbag clasp mag. 1	**30**	**26**	**65**	**49**	**36**	**80**

Table 8.1: Results of the comparative measurements taken within the various protective covers of the magnetic flux densities in the vicinity of the magnetic stripe with standard permanent magnets in direct proximity outside

From the test results it can be concluded that in contrast to the products *SECVEL Card Protection Sleeve and SECVEL Card Protection Wallet, the products*

- *CRYPTALLOY protective sleeve*
- *CRYPTALLOY protective wallet*
- *Leather card protection wallet*
- *Stainless steel protection case*

contain no effective components for weakening DC magnetic fields. The reduction of the magnetic flux density in comparison to the situation without the protective cover for these products is due solely to the gap the cover creates between card and the permanent magnets outside the cover (material thickness of the card cover).

8.2. Measuring the weakening of the 13.56 MHz magnetic fields

In order to compare the device under test with other card protection covers on the market additional measurements in line with the measuring method described in chapter 5.3 were also taken using the products shown in Fig. 8.1.

Table 8.2 summarises the measuring results with the receiving antennae placed or inserted fully inside the covers.

Card protection wallets with metal inlay on both sides (*SECVEL Card Protection Wallet* and *CRYPTALLOY protective wallet*) achieve as expected a considerably more powerful weakening of the field than insert sleeves with a thumb notch (*SECVEL Card Protection Sleeve* and *stainless steel protection case*) and protective covers with only a single-sided metal inlay (*CRYTPALLOY protective sleeve*). The reason for the best results for protective sleeves with double-sided metal inlays is above all that the card is shielded from the effect of the magnetic field along its entire length and thus no magnetic flux coupling with the antennae is possible (no access).

Test conditions	Weakening factor	
	[dB]	[l]
SECVEL Card Protection Sleeve	22	12.6
SECVEL Card Protection Wallet	34	50
CRYPTALLOY protective wallet	35	56
CRYPTALLOY protective sleeve (clear side to reader)	24	15.8
Leather card protection wallet	3.5	1.5
Stainless steel protection case	22	12.6

Table 8.2: Comparison of the various products with regard to weakening of 13.56 MHz magnetic fields

8.3. Representative tests of the protective effect against unauthorised card access using standard 13.56 MHz RFID or NFC readers

The other products examined were also investigated using the measuring methodology described in chapter 5.4.

With all the protective wallets with double-sided metal inlay (*SECVEL Card Protection Wallet* and *CRYPTALLOY protective wallet*), and with the *CRYPTALLOY protective sleeve*, card access was not possible with the desktop reader or the smart phone when the card was fully inserted (no protrusion over the edge of the cover), even in the case of direct contact with the reader or smart phone.

Similarly, the stainless steel case also successfully prevented access to the card data when the card was fully inserted (as far as it would go), even in the case of direct contact with the reader or smart phone. In the case of a not fully inserted card, from a protrusion extent of approx. 10 mm and 5 mm respectively, card access by a desktop reader or smart phone could no longer be prevented in the case of direct contract with the device.

As expected, the leather cover proved ineffective as regards protection from unauthorised reading.

The *SECVEL Card Protection Sleeve* thus proves less effective in a practical comparative test as regards protection from unauthorised access to contactless smart cards than comparable products with a metal inlay. The reason for this must be seen above all as the relatively large thumb notch for card removal.

9. Evaluation and interpretation of the results

The main device under test investigated, the *SECVEL Card Protection Sleeve*, proved that in the case of correct and full insertion of a magnetic stripe card into the device under test, this provided **effective protection of the magnetic stripe even in the case of direct proximity to magnets (contact with magnets) with a surface flow density of up to approx. 90 mT.**

However, in the case of an incompletely or improperly inserted card, destruction of the magnetic stripe cannot be ruled out even with magnets with surface flow densities of less than 90 mT, such as typical magnetic handbag clasps (see Fig 7.2).

Thus, overall the device under test proved **adequate** with regard to **protection of the magnetic stripe** from magnetic destruction in **many, <u>but not all</u> situations** imaginable in practice (e.g. handbag clasp magnets in direct proximity and unfavourable position).

At a minimum distance of just a few millimetres between the SECVEL Card Protection Sleeve and typical permanent magnets or devices containing permanent magnets (magnetic handbag clasps, headphones, mobile phones, etc.) it can be assumed that the DC magnetic field created within the SECVEL Card Protection Sleeve is reduced to a level which is no longer a risk to the magnetic stripe.

In comparison to the other products tested without highly permeable metal inlay (see chapter 8) the device under test SECVEL Card Protection Sleeve, and a similar product by the same manufacturer (SECVEL Card Protection Wallet), proved significantly better with regard to destruction of the magnetic stripe by DC magnetic fields.

As regards the **protective effect of the device under test *SECVEL Card Protection Sleeve* against unauthorised access to 13.56 MHz contactless smart cards**, there was only **a limited protective effect**, so that although the effective reading distances were able to be considerably reduced, card access cannot be ruled out in the case of direct proximity to readers. This is due above all to the relatively large thumb notch for card removal.

In comparison to the other products tested with metal inlays (see chapter 8) the device under test ***SECVEL Card Protection Sleeve*** proved **less effective with regard to** protection against **unauthorised card access using RFID readers**.

The product *SECVEL Card Protection Wallet* of a similar type to the primary device under test (see Fig. 8.1) by the same manufacturer proved considerably more effective in this respect (card access not possible at all, even in the case of direct contact with the reader).

Measuring technician:

[illegible signature]

Richard Überbacher
(qualified engineer)