

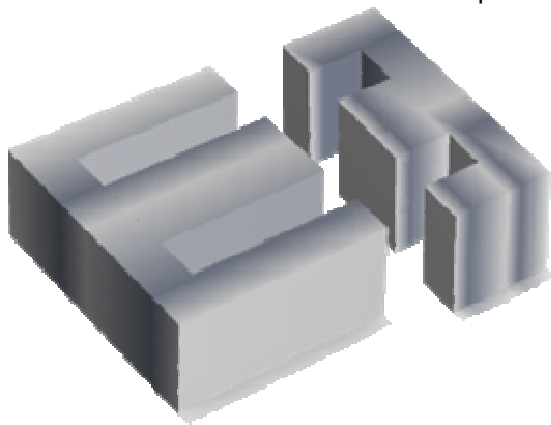
# Brochure EK Core Packages

*from MUMETALL<sup>®</sup>, PERMENORM<sup>®</sup> and TRAFOPERM<sup>®</sup>*

## Introduction

SEKELS GmbH is the exclusive distributor for core packages made of NiFe alloys (MUMETALL<sup>®</sup>, VACOPERM<sup>®</sup>, PERMENORM<sup>®</sup>) and SiFe alloys (TRAFOPERM<sup>®</sup>) from VACUUMSCHMELZE GmbH & Co. KG (Germany).

Core packages are produced by stacking single laminations and finishing the package by impregnation, welding or mechanical interlocking. This allows, combined with standard coil-formers, a fast and cost-effective production and assembly. Compared with alternated stacked individual laminations, core packages show lower effective permeabilities even when they are face grinded. They are however especially suitable for applications which need tolerated AL values, like e.g. chokes with pre-magnetization.



Standard core packages are described in DIN EN 61021. The EK types, stacked from EE laminations, are optimized for an effective build-up. They feature a square ground area, and a square cross-section of the middle leg. The ratio of the total core cross section to the winding space is 1:1,55. All EK types are geometrically similar.

Additionally SEKELS GmbH is offering customer-specific laminations and packages, from prototyping to high quantity production.

## Alloys and sizes

Out of the huge verity of soft magnetic alloys, NiFe alloys fill the gap between the SiFe alloys for standard 50/60 Hz applications, and ferrites, powder alloys or amorphous and nanocrystalline alloys for higher frequencies. They are especially suitable for applications with high demands on permeability/inductivity, iron losses or e.g. harmonic distortion. Packages from SiFe alloys are especially suitable for applications with tolerated AL-values.

The basic properties of alloys for core packages are listed in table 1. Please note that coercivity and permeability values have been measured with ring cores after optimal magnetic annealing treatment. For core packages these values are lowered by mechanical treatment and geometrical influences. Practical values are defined in the "Magnetic Qualities".

*Table 1: Basic material properties of soft magnetic alloys for core packages*

<b>Alloy</b>	<b>Composition</b>	<b><math>\mu_r</math> (0,4 A/m, 50 Hz)</b>	<b><math>H_{c, stat}</math> [A/m]</b>	<b><math>B_s</math> [T]</b>	<b><math>T_c</math> [°C]</b>	<b>Density [g/cm<sup>3</sup>]</b>
MUMETALL <sup>®</sup>	80 % NiFe	ca. 30000	3	0,8	400	8,7
VACOPERM 100 <sup>®</sup>	80 % NiFe	ca. 60000	2	0,78	400	8,7
PERMENORM 5000 H2 <sup>®</sup>	50 % NiFe	ca. 10000	10	1,55	440	8,25
TRAFOPERM N2 <sup>®</sup>	3 % SiFe	ca. 1600 (1,2 A/m)	25	2,03	750	7,65

Table 2: Nominal sizes of the EK type series

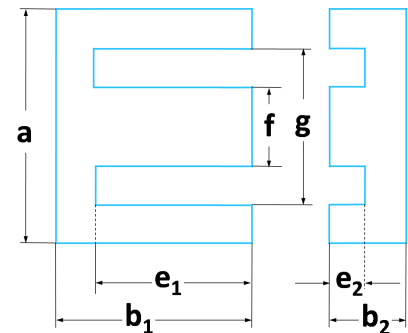
DIN-type	a	b1	b2	b3	e1	e2	e3	f	g	h <sub>p</sub> for strip thickness (mm)			
										0,1	0,2	0,35	
EK 12,6	12,6	8,6	4	12,6	6,7	2,1	8,8	-	3,8	8,8	3,8	3,8	-
EK 16	16	11	5	16	8,6	2,6	11,2		4,8	11,2	4,8	4,8	
EK 20	20	14	6	20	11	3	-	14	6	14	6	6	6
EK 25	25	17	8	25	13,2	4,2	-	17,4	7,6	17,4	7,6	7,6	7,6
EK 25 L	25	17	17	34	13,2	13,2	-	26,4	7,6	17,4	7,6	7,6	7,6
EK 32	32	22	10	32	17,2	5,2	-	22,4	9,6	22,4	9,6	9,6	9,6
EK 32L	32	22	22	44	17,2	17,2	-	34,4	9,6	22,4	9,6	9,6	9,6
EK 40	40	28	12	40	22	6	-	28	12	28	12	12	12
EK 40L	40	28	28	56	22	22	-	44	12	28	12	12	12
Mass- toleranzen	± 1/2 IT13	-	-	± 1/2 IT14	-	-	± 1/2 IT13	± 1/2 IT14	± IT11	± 1/2 IT12	0/- IT13	0/- IT14	0/- IT15

Terms see drawing.

**h<sub>p</sub>** is the height of the core package.

$$b_3 = b_1 + b_2$$

$$e_3 = e_1 + e_2$$



## Magnetic Quality

The Magnetic Quality defines the magnetic limiting values and the testing conditions. The standard qualities for packages without air gap (face grinded) appoint a lower limiting  $A_L$  value (for historical reasons -15 %). The standard qualities for packages with air gap define the nominal  $A_L$  value and the allowed tolerances.

Special qualities are available on request, either with higher  $A_L$  values, or with additional measurements of e.g. the iron losses, or the apparent power. Please contact us, if you require further information.

Table 3: Standard magnetic qualities for core packages without air gap. Lower tolerance limit -15 %, measuring frequency 50/60 Hz, excitation  $B_{peak} = 2$  mT for MUMETALL<sup>®</sup> and PERMENORM<sup>®</sup>, 6 mT for TRAFOPERM<sup>®</sup>.

Type	Contact pressure $\pm 10\% N$	A - 066		H2 - 066		N2 - 066	
		MUMETALL <sup>®</sup>		PERMENORM <sup>®</sup> 5000 H2		TRAFOPERM <sup>®</sup> N2	
		$A_L$ (nH)	$\mu$	$A_L$ (nH)	$\mu$	$A_L$ (nH)	$\mu$
EK 12,6	6,3	2000	3630	1000	1820	-	-
EK 16	10	3150	4500	1250	1780	-	-
EK 20	16	5000	5750	2000	2300	1000	1150
EK 25, 25L	25	6300	5730	2500	2270	1250	1140
EK 32, 32L	40	10000	7140	3150	2250	1600	1140
EK 40, 40L	63	12500	7350	4000	2350	2000	1170

Table 4: Standard magnetic qualities for core packages with air gap. Measuring frequency 50 Hz or 300 Hz, excitation  $B_{peak} = 2$  mT. Contact pressure as in table 3.

Type	Magnetic Quality	MUMETALL <sup>®</sup> : A - 060 ; PERMENORM <sup>®</sup> 5000 H2: H2 - 060 ; TRAFOPERM <sup>®</sup> N2: N2 - 060 $\pm$ tolerance in % for $A_L$ -values in nH									
		$A_L$ -values	160	200	250	315	400	500	630	800	1000
		EK 12,6	A - 060	16	16	20	20	25	-		
	H2 - 060	12,5	-								
	N2 - 060	10	-								
EK 16	A - 060	12,5	12,5	12,5	16	16	20	20	25	-	
	H2 - 060	10	10			20	-				
	N2 - 060					-					
EK 20	A - 060	10	10	12,5	12,5	12,5	16	16	16	20	
	H2 - 060	8		10	10			10	20	-	
	N2 - 060				-						
EK 25 EK 25L	A - 060	10	10	10	10	12,5	12,5	12,5	16	16	
	H2 - 060	8	8			10	10			20	
	N2 - 060					-					
EK 32 EK 32L	A - 060	10	10	10	10	10	10	10	10	12,5	
	H2 - 060	8	8	8	8			10	10	12,5	
	N2 - 060							8	8	8	8
EK 40 EK 40L	A - 060	-	10	10	10	10	10	10	10	10	
	H2 - 060	-	8	8	8	8		10	10	10	
	N2 - 060	8						8	8	8	8

## Form parameters and calculation data

The form parameters and calculation data allow to determine the maximum number of turns, the copper resistance, wire length, inductivity and the dc time constant for different wire diameters. Please note that due to variances of the coil formers and tolerances of the core package, practical values may deviate.

Table 5: Form parameters of EK core packages. The values are valid for PERMENORM® 5000 H2 in strip thickness of 0,35 mm. For other thicknesses or alloys, the core cross section  $A_{Fe}$  need to be corrected by the stacking factor, and the core weight  $m_{Fe}$  need to be corrected by the specific weight. For details see Table 6.

<b>DIN-Type</b>	<b><math>h_{p,min}</math></b>	<b><math>l_{Fe}</math></b>	<b><math>A_{Fe}</math></b>	<b><math>m_{Fe}</math></b>	<b><math>l_{Cu}</math></b>	<b><math>A_{Cu}</math></b>	<b><math>m_{Cu}</math></b>	<b><math>A_R</math></b>
	<i>mm</i>	<i>cm</i>	<i>cm<sup>2</sup></i>	<i>g</i>	<i>cm</i>	<i>cm<sup>2</sup></i>	<i>g</i>	<i><math>\mu\Omega</math></i>
EK 12,6	3,8	3,0	0,14	3,4	2,8	0,06	1,6	74,7
EK 16	4,8	3,8	0,22	6,9	3,5	0,12	3,7	49,8
EK 20	6,0	4,8	0,34	13,4	4,3	0,19	7,3	38,8
EK 25	7,6	6,0	0,54	26,8	5,3	0,31	14,8	29,0
EK 25L		7,8		34,8		0,49	23,0	18,4
EK 32	9,6	7,7	0,87	54,9	6,8	0,53	32,0	21,9
EK 32L		10,0		72,0		0,83	50,0	13,9
EK 40	12,0	9,6	1,35	107,2	8,4	0,86	64,0	16,7
EK 40L		12,7		142,9		1,39	104,0	10,3

$h_{p,min}$  is the minimum core height according to DIN EN 61021

$l_{Fe}$  is the mean magnetic path length

$A_{Fe}$  is the effective core cross section, calculated for PERMENORM® 5000 H2 in strip thickness of 0,35 mm, and a stacking factor of 94 %

$m_{Fe}$  is the core mass, calculated for PERMENORM® 5000 H2 in strip thickness of 0,35 mm, a specific weight of 8,25 g/cm<sup>3</sup>, and a stacking factor of 94 %

$l_{Cu}$  is the mean copper path length

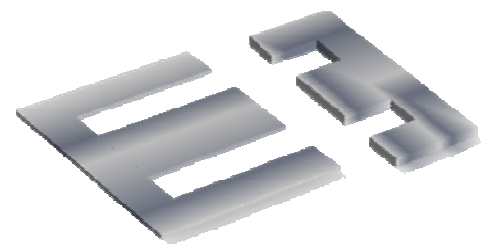
$A_{Cu}$  is the effective copper cross section, calculated with a copper filling factor of 50 %

$m_{Cu}$  is the copper mass.  $m_{Cu} (g) = l_{Cu} (cm) \times A_{Cu} (cm^2) \times \bar{\delta}_{Cu} (g/cm^3)$ .  
 $\bar{\delta}_{Cu} = 8,92 g/cm^3$

$A_R$  is the so-called resistance factor.  $A_R = \rho_{Cu} * l_{Cu}/A_{Cu}$ . The ratio  $A_L/A_R$  is the dc time constant. The dc time constant is the time to reach 63,2 % of the final value after switching on a dc current.

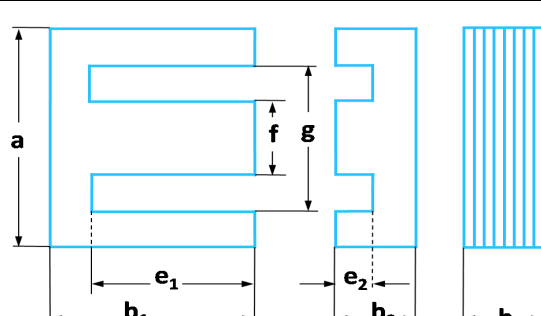
Table 6: Stacking factors and specific weight, correction factors for core mass  $m_{Fe}$

Strip thickness (mm)	Stacking factors for core packages			Correction factors for core mass		
	0,35	0,2	0,1	0,35	0,2	0,1
MUMETALL <sup>®</sup> , VACOPERM <sup>®</sup> 100	94 %	94 %	92 %	1,05	1,05	1,03
PERMENORM <sup>®</sup> 5000 H2	94 %	94 %	92 %	1,00	1,00	0,98
TRAFOPERM <sup>®</sup> N2	92 %	92 %	90 %	0,91	0,91	0,89



## Data sheets

For each available core packages SEKELS GmbH supplies a data sheet with all important information on request. Please see the following example:

SEKELS		Datenblatt für Blechpakete Data sheet for lamination packages					
Dieses Datenblatt wurde auf Basis der technischen Unterlagen der Vacuumschmelze GmbH & Co. KG generiert <i>This data sheet was generated on basis of the technical data from Vacuumschmelze GmbH &amp; Co. KG</i>							
Sachnummer (Bestellnummer) / Part Number :			S60311-G5125-V002		plan / face-ground		
Typ type	Material alloy	Banddicke strip thickness (mm)	$A_L$ (nH):	Toleranz tolerance	Magnetqualität magnetic quality		
EK 25	Trafoperm N2	0,1	1600	- 15%	N2 - 065	Spezial	
<b>Abmessungen (mm) und Toleranzen/dimensions (mm) and tolerances :</b>							
a	b1	b2	e1	e2	f	g	h
25,00	17,00	8,00	13,20	4,20	7,60	17,40	7,60
$\pm 1/2 IT13$	-	-	-	-	$\pm IT11$	$\pm 1/2 IT12$	$?/? IT15$
 <p style="text-align: right;">Skizze ohne Maßstab Draft w/o scale</p>							
<b>Kern - Kenngrößen (Richtwerte, nur zur Information):</b> <i>Form parameters and core constants (guideline values, for information only):</i>							
Eisenquerschnitt <i>iron cross section</i>	$A_{Fe}$ (cm <sup>2</sup> ):	<b>0,52</b>	Kupferquerschnitt <i>copper cross section</i>	$A_{Cu}$ (cm <sup>2</sup> ):	<b>0,31</b>		
Mittl. Eisenweg <i>mean iron path</i>	$l_{Fe}$ (cm):	<b>6,00</b>	Mittl. Kupferweglänge <i>mean copper path</i>	$l_{Cu}$ (cm):	<b>5,30</b>		
Kerngewicht <sup>1)</sup> <i>core mass <sup>1)</sup></i>	$m_{Fe}$ (g):	<b>23,86</b>	Kupfergewicht <i>copper mass</i>	$m_{Cu}$ (g):	<b>14,66</b>		
Widerstandsfaktor bei 20 °C <i>resistance factor at 20 °C</i>	$A_R$ (μΩ):	<b>29,1</b>	DC-Zeitkonstante bei 20 °C <sup>2)</sup> <i>DC time constant at 20 °C <sup>2)</sup></i>	$\tau_0$ (ms):	<b>55,0</b>		
Widerstandsfaktor bei 100 °C <i>resistance factor at 100 °C</i>	$A_R$ (μΩ):	<b>39,3</b>	DC-Zeitkonstante bei 100 °C <sup>2)</sup> <i>DC time constant at 100 °C <sup>2)</sup></i>	$\tau_0$ (ms):	<b>40,7</b>		

<sup>1)</sup> gerechnet mit Nenn-Banddicke. Produktionsbedingte Gewichtsschwankungen sind möglich

<sup>1)</sup> calculated with the nominal strip-thickness. Process depending mass tolerances are possible

<sup>2)</sup> gerechnet mit  $A_L$  - Nennwert

<sup>2)</sup> calculated with nominal  $A_L$  - value

## | About us

SEKELS GmbH develops, produces and trades technical products which are mostly related with magnetism. With a team of about 20 employees, more than half of them being physicists or engineers, SEKELS presently serves more than 500 customers worldwide.

As an expert distributor of German VACUUMSCHMELZE GmbH & Co. KG we are offering an in-depth knowledge of their product lines and the applications, are available for technical consultation and provide the fast availability of samples and series deliveries through comprehensive stock keeping and worldwide logistics.

SEKELS develops, designs and produces customer-specific laminations and core packages, magnetic shielding and shielding systems, inductive components and magnet systems - from prototyping to series deliveries.

All parts, components and systems are either produced in Germany, or with quality partners in Eastern Europe based on our technical specifications. We are DIN EN ISO 9001:2008 certified and familiar with the relevant norms and standards.

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