

## VACODUR® 49 Annealed Sheets for Rapid Prototyping

- Composition 49 % Co – 2 % V – Fe  
Balance – Nb (present) / ASTM A801  
Alloy Type 1
- Sheet size 0.2 x 280 x 400 mm<sup>3</sup>
- Magnetically annealed for optimum magnetic properties
- No final heat treatment required when carefully processed, e. g. by LASER cutting, bonding, etc.
- Anisotropic length increase of up to 0.2 % (in the rolling direction) after annealing needs not to be considered when producing parts



VACODUR® 49 is an ASTM compatible variant of VACOFLUX® 50. An important feature is the option to vary the yield strength via an appropriate annealing treatment. This makes the material especially suitable for applications in electric motors: Stators and rotors can be stamped from the same material and then undergo different heat treatments in order to attain a magnetically optimized stator and a rotor with **defined yield strength**.

The typical process of LASER cutting or stamping followed by the heat treatment needs to consider the permanent anisotropic length increase of up to 0.2 % (in the rolling direction) which is typical for the VACOFLUX® and VACODUR® alloys. Furthermore, the heat treatment under dry hydrogen is specific and can be time consuming.

Annealed sheets from VACODUR® 49 allow to simplify and shorten the production of prototypes or low quantity parts. The sheets are heat treated for optimum magnetic properties. They are suitable e. g. to LASER cut single or bonded parts.

Please note however that every processing of the finally annealed material has an influence on the soft-magnetic properties. When manufacturing parts from annealed sheets this needs to be done as gently as possible. It must also be considered that annealed sheets are more brittle than before annealing.

Therefore the magnetic properties of parts made from pre-annealed VACODUR® 49 sheets are slightly worse compared to parts which are heat treated after the cutting or stamping process. Please see fig. 1 for typical properties.

The sheets have been coated with a thin insulation layer, designated as DL1, before annealing to avoid thermal welding or stiction. After the annealing, this coating is reduced to an insulating layer of magnesium oxide (MgO), with a typical layer thickness below 1 µm.

Property		Value (typical)	Unit
Saturation polarisation	$J_s$	2.3	T
Static coercivity	$H_c$	< 60*	A/m
Curie temperature	$T_c$	950	°C
B (300 A/m)		> 1.8*	T
B (800 A/m)		> 2.1*	T
B (1600 A/m)		> 2.2*	T
B (8000 A/m)		> 2.25*	T
Density	$\rho$	8,12	g/cm <sup>3</sup>
Specific electrical resistivity	$\rho_{el}$	0.4	$\mu \Omega m$
Thermal expansion coefficient (20...200 °C)	$\alpha$	$9.15 \cdot 10^{-6}$	1/K
Tensile strength	$R_m$	400	MPa
Yield strength	$R_{p0,2}$	210	MPa
Young's Modulus	E	200	GPa
Hardness	HV 10	185	

\* typical values of ring samples annealed in final shape

Table 1: Typical properties of annealed sheets of VACODUR® 49

**Static Hysteresis curves of rings lasered/stamped from VACODUR 49 pre-annealed sheets**

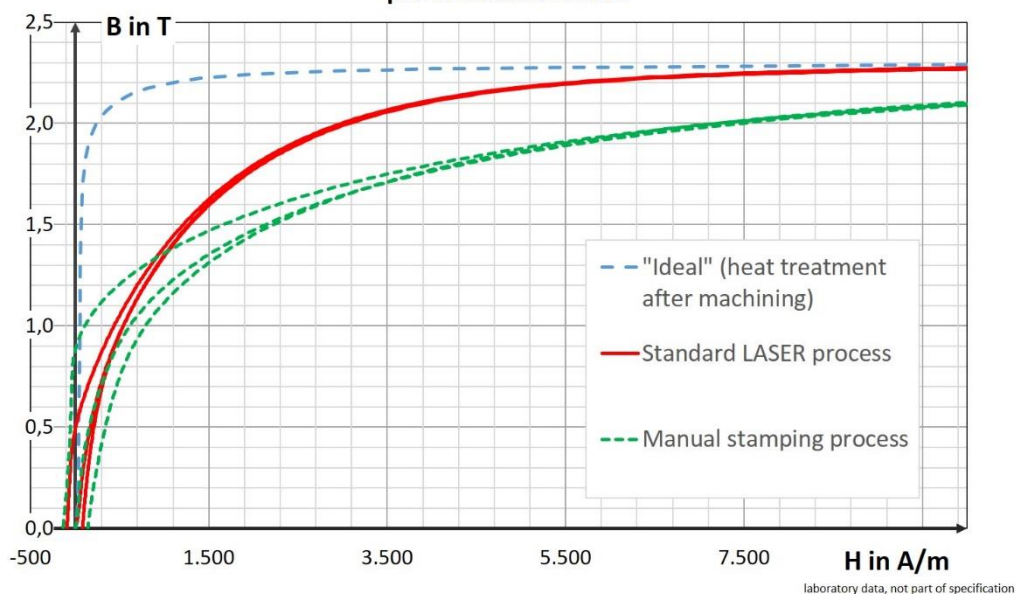


Fig. 1: Typical magnetic properties of ring samples from annealed VACODUR® 49 sheets

VACODUR® 49 is a product of Vacuumschmelze GmbH & Co. KG (VAC), Germany. Sekels GmbH is an official distributor of VAC with focus on nanocrystalline and amorphous cores and soft magnetic semi-finished materials. We offer a comprehensive stock of most articles and materials, technical consulting and value-adding. For more information please see [www.sekels.com](http://www.sekels.com).

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