

# WIRES & RODS

## HIGH-PERFORMANCE ALLOYS



- **Soft Magnetic Alloys**
- **Ductile Permanent Magnets**
- **Spring Materials**
- **Materials with Controlled Thermal Expansion**
- **Special Alloys**

ADVANCED MATERIALS – THE KEY TO PROGRESS

**VAC**<sup>®</sup>  
VACUUMSCHMELZE



## THE COMPANY VACUUMSCHMELZE

VACUUMSCHMELZE is the right partner if high performance materials are what you require. We are experts in the field of magnetic technology where we develop, produce and market special materials with enhanced properties.

We are a leading global manufacturer of high performance alloys and related value-added products. VACUUMSCHMELZE has a workforce of about 3000 employees spread over 40 countries and on all continents.

In 1923 we were the first company to melt alloys under vacuum on an industrial scale. Today our product range contains well over 100 special alloys. Alongside the crystalline alloys which are melted under vacuum we are also producing rapidly solidified amorphous and nanocrystalline alloys.

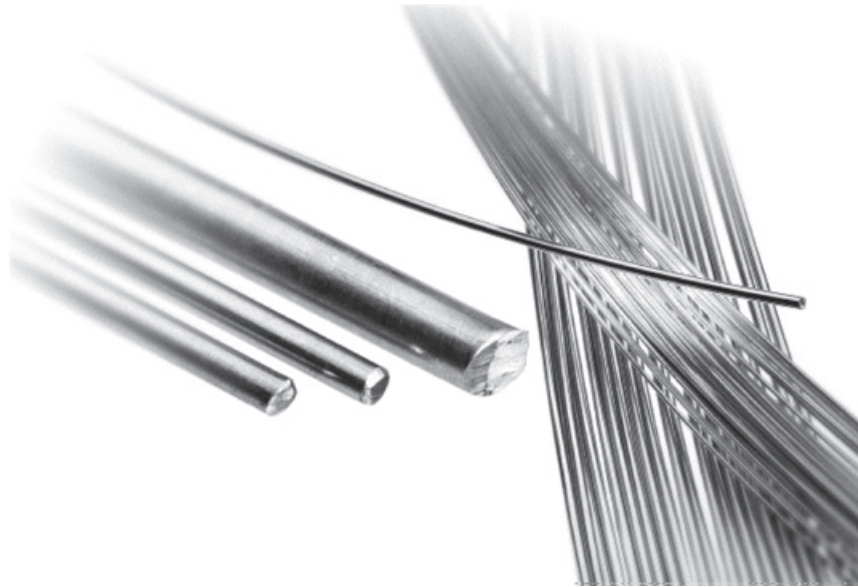
Our strength lies in the development and production of innovative products with a high degree of customer benefit. By utilizing our know-how on defined material properties, and in close cooperation with our customers, we develop tailor-made solutions for a wide field of applications. Research and development play a central role in the company by continuously optimizing our materials.

State-of-the-art production and inspection technology together with a certified quality management system to DIN EN ISO 9001, assures a consistently high quality standard. VACUUMSCHMELZE is also certified to ISO/TS 16949 and EN 9100, for automotive and aerospace applications respectively. Environmental protection aspects related to material selection, production and warehousing are naturally an integral part of our company policy (DIN EN ISO 14001).

With our products and service it is our constant aim to give our customers a competitive advantage. At VACUUMSCHMELZE we control the entire production chain from material through to sophisticated components. Our speciality is customised tailor-made solutions.

# MATERIALS & PARTS

We produce crystalline, amorphous and nanocrystalline materials. Our alloys play a crucial role in many devices, assemblies and components.



## Alloy Production

The melting of highly-purified alloys in a vacuum-induction furnace forms the basis for the outstanding properties of VACUUMSCHMELZE products. Based on the elements iron, nickel and cobalt, highly diverse materials are produced:

- soft magnetic alloys
- magnetically semi-hard materials and ductile permanent magnets
- spring alloys
- materials with controlled thermal expansion
- special alloys

## Manufacturing of Rods and Wires

Our materials are further processed into strip, rod and wire forms. The significant benefit to customers lies in the individualised production of the desired dimensions. In this context, VACUUMSCHMELZE offers a wide range of dimensions. Typically, round stock is produced with the following diameters (additional dimensions and profile cross-sections are available upon request):

- hot forged rods:  $\varnothing$  30 - 200 mm
- hot rolled rods:  $\varnothing$  15 - 70 mm
- cold-drawn rods:  $\varnothing$  3 - 15 mm
- wires  $\varnothing$  0.2 - 3 mm

# SOFT MAGNETIC ALLOYS

VACUUMSCHMELZE offers a broad spectrum of optimised softmagnetic alloys for all application areas. Depending on the application requirements, the working point of the design can range from extremely low to very high magnetic field strengths.



## MUMETALL®

at low magnetic field strengths, e.g. for supersensitive sensors

- maximum permeability
- lowest coercivity

## PERMENORM® 5000 H2

at medium magnetic field strengths, e.g. for flux guiding elements

- low coercivity
- high saturation polarization

## VACOFLUX® 17 AND VACOFLUX 50

at high magnetic field strengths, e.g. for actuators

- maximum saturation polarization

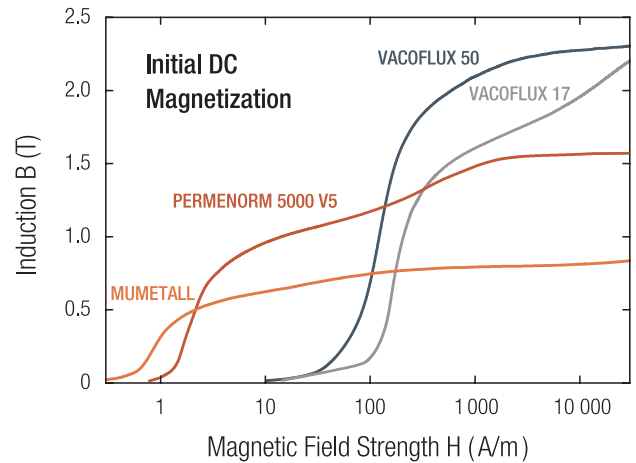
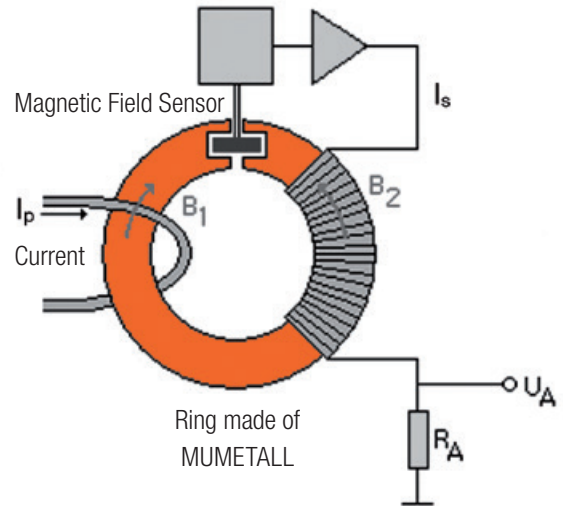
## FORMS OF DELIVERY:

### MUMETALL, PERMENORM 5000 H2, VACOFLUX 17

- wires  $\varnothing$  0.2 - 3 mm
- cold-drawn rods  $\varnothing$  3 - 15 mm
- hot rolled rods  $\varnothing$  15 - 70 mm parts, e.g. final annealed rings

### VACOFLUX 50

- hot rolled rods  $\varnothing$  15 - 70 mm



	Coercivity $H_c$ (A/m)	Maximum Permeability $\mu_{max}$	Saturation Polarization $J_s$ (T)
MUMETALL	1.5	250 000	0.80
PERMENORM 5000 H2	5.0	120 000	1.55
VACOFLUX 17	150	4 000	2.22
VACOFLUX 50	140	9 000	2.30

all data: typical values after final magnetic annealing

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# MAGNETICALLY SEMI-HARD MATERIALS & DUCTILE PERMANENT MAGNETS

The unique property of the magnetically semi-hard materials produced by VACUUMSCHMELZE lies in their high ductility. Unlike the brittle rare-earth permanent magnets and Al-Ni-Co alloys, CROVAC and VACOZET can be cold-formed – and can thus be supplied in the form of wires and rods. In addition, these parts are easy to bend and process.

## VACOZET® 258

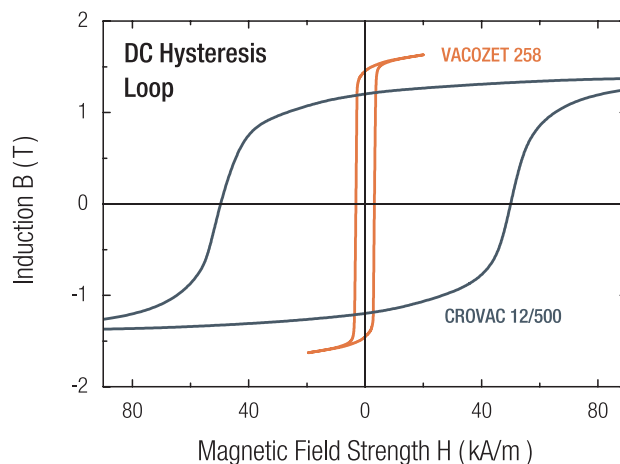
Magnetically semi-hard alloy, e.g. for pins in bistable relays

## CROVAC® 12/500

Ductile permanent magnet, e.g. as a geometrically optimised rod magnet for position sensors

### FORMS OF DELIVERY:

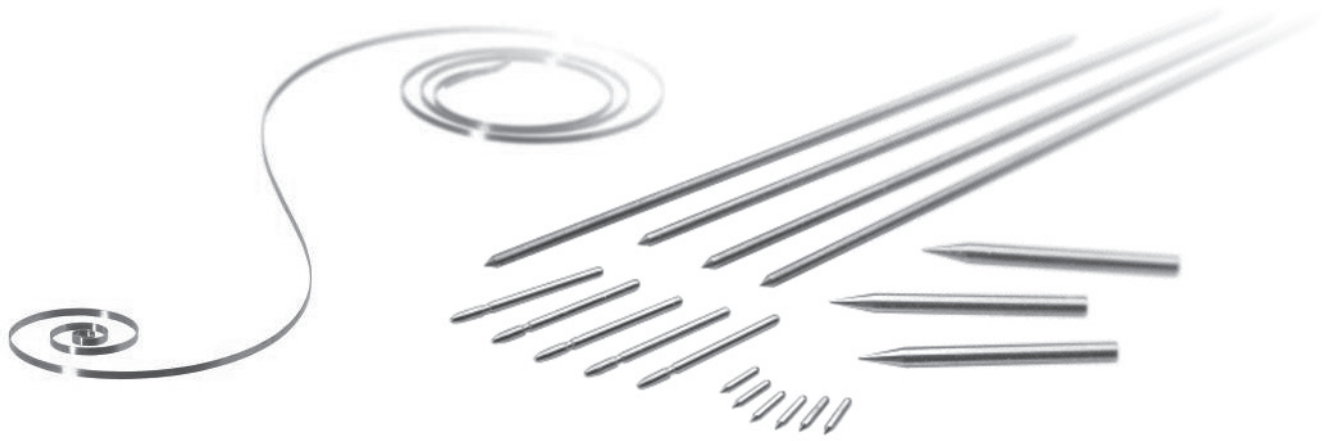
- wires  $\varnothing$  0.2 - 3 mm
- cold-drawn rods  $\varnothing$  3 - 7 mm
- parts, e.g. cut and end-annealed pins



	Coercivity $H_c$ (kA/m)	Remanence $B_r$ (T)	Energy Density $(BH)_{max}$ (kJ/m <sup>3</sup> )	Max. Temperature $T_{max}$ (°C)
VACOZET 258	3.0	1.4	2.5	400
CROVAC 12/500	50	1.2	35	480

all data: typical values after final magnetic annealing

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## SPRING MATERIALS

The age hardenable spring materials of VACUUMSCHMELZE enable the highest durability values. Each spring alloy has a variety of additional properties (see table) allowing precise matching to the application requirements. Further details are available on request.

### NIVAFLEX® 45/5 AND 45/18

with extremely high strength, e.g. for main springs in mechanical watches and pivot pins for water meters and smallest-scale motors

### DURATHERM® 418

as an implant material for dental braces

### DURATHERM 600

as corrosion-resistant retainer springs – e.g. in the chemical industry

### DURACON® 17A

as a contact-spring material – e.g. for test tips and temperature-resistant connector assemblies

### THERMELAST® 4002

as a constant modulus alloy, e.g. for positioning sensors

### FORMS OF DELIVERY:

- wires  $\varnothing$  0.2 - 3 mm
- cold-drawn rods on request

	max. Yield Strength $R_m$ (MPa)	max. Hardness HV	Additional Properties
NIVAFLEX 45/5	3000	800	Corrosion-resistant, non-magnetic
NIVAFLEX 45/18	2900	800	Corrosion-resistant, non-magnetic
DURATHERM 418	2900	800	Corrosion-resistant, non-magnetic, implant-manufacturing material
DURATHERM 600	2200	600	Corrosion- and temperature-resistant, non-magnetic
DURACON 17A	1800	480	Electrical conductivity, temperature resistance
THERMELAST 4002	1400	420	Constant modulus alloy between -30 °C and +70 °C

all data: typical values after age-hardening

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# MATERIALS WITH CONTROLLED THERMAL EXPANSION



The increasing demands imposed upon the precision, reliability and quality of glass to metal and ceramic to metal alloys – together with the reproducible thermal expansion properties – can be met by using VACOVIT or VACON. These alloys set themselves apart with tightly controlled linear expansion coefficients.

## VACOVIT®

alloys for use in all types of projects – particularly in combination with soft glasses (e.g. for a reed relay)

## VACON CF 25

with very high electrical conductivity for use in high-current applications

## VACON® 11

for use in semiconductor engineering – e.g. diodes, transistors, ICs, etc.

## FORMS OF DELIVERY:

- wires  $\varnothing$  0.2 - 3 mm
- cold-drawn rods upon request

	Thermal Coefficient $\alpha$ (20-400 °C) ( $10^{-6}$ K <sup>-1</sup> )	Critical Temperature $T_c$ (°C)	Specific Electric Resistivity $\rho$ ( $\mu\Omega\text{m}$ )	Thermal Conductivity $\lambda$ (W/mK) at 20 °C
VACOVIT 485	10.3	335	0.92	14
VACOVIT 540	11.4	525	0.35	17
VACON CF 25	11.3	800	0.07	100
VACON 11	5.1	425	0.48	18

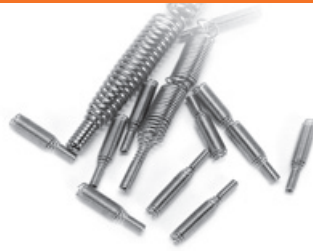
Additional materials with controlled thermal expansion available upon request (custom production)

all data: typical values after final magnetic annealing

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As a supplement to the extensive selection of alloys and the manufacture or round stock in the form of rods and wires, VACUUMSCHMELZE offers the capacity for further products and services:



- Custom materials (iron, nickel and cobalt based)
- Profile wire via cold drawing or rolling of round wires
- Contracted work: cold drawing of rods and wires

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