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
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.
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: ø 30 - 200 mm
- hot rolled rods: ø 15 - 70 mm
- cold-drawn rods: ø 3 - 15 mm
- wires ø 0.2 - 3 mm
SOFT MAGNETIC ALLOYS

VACUUMSCHMELZE offers a broad spectrum of optimised soft magnetic 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 ø 0.2 - 3 mm
- cold-drawn rods ø 3 - 15 mm
- hot rolled rods ø 15 - 70 mm
- parts, e.g. final annealed rings

**VACOFLUX 50**
- hot rolled rods ø 15 - 70 mm

<table>
<thead>
<tr>
<th>Material</th>
<th>Coercivity $H_c$ (A/m)</th>
<th>Maximum Permeability $\mu_{\text{max}}$</th>
<th>Saturation Polarization $J_s$ (T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUMETALL</td>
<td>1.5</td>
<td>250000</td>
<td>0.80</td>
</tr>
<tr>
<td>PERMENORM 5000 H2</td>
<td>5.0</td>
<td>120000</td>
<td>1.55</td>
</tr>
<tr>
<td>VACOFLUX 17</td>
<td>150</td>
<td>4000</td>
<td>2.22</td>
</tr>
<tr>
<td>VACOFLUX 50</td>
<td>140</td>
<td>9000</td>
<td>2.30</td>
</tr>
</tbody>
</table>

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 Ø 0.2 - 3 mm
• cold-drawn rods Ø 3 - 7 mm
• parts, e.g. cut and end-annealed pins

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

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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 ø 0.2 - 3 mm
• cold-drawn rods on request

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

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 ø 0.2 - 3 mm
• cold-drawn rods upon request

<table>
<thead>
<tr>
<th></th>
<th>Thermal Coefficient $\alpha$ (20-400 °C) (10⁻⁶ K⁻¹)</th>
<th>Critical Temperature $T_c$ (°C)</th>
<th>Specific Electric Resitivity $\rho$ (µΩm)</th>
<th>Thermal Conductivity $\lambda$ (W/mK) at 20 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>VACOVIT 485</td>
<td>10.3</td>
<td>335</td>
<td>0.92</td>
<td>14</td>
</tr>
<tr>
<td>VACOVIT 540</td>
<td>11.4</td>
<td>525</td>
<td>0.35</td>
<td>17</td>
</tr>
<tr>
<td>VACON CF 25</td>
<td>11.3</td>
<td>800</td>
<td>0.07</td>
<td>100</td>
</tr>
<tr>
<td>VACON 11</td>
<td>5.1</td>
<td>425</td>
<td>0.48</td>
<td>18</td>
</tr>
</tbody>
</table>

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