Rare Earth Magnet
Product Catalogue

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[Specifications are subject to change without notice.]

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Manufactured by an integrated process extending from raw materials to finishing, our DIANET is a samarium-cobalt (SmCo) magnet offering high performance, accuracy, and quality. DIANET is used in stepping motors for wristwatches, but it is used in other, ever-expanding, applications, including microelectronic parts for audio and telecommunications devices; reflow-mounted thin, compact devices; and microelectromechanical systems (MEMS).
Features of DIANET

- Superior heat resistance and reflow mountable
- Superior corrosion resistance, without deterioration of magnetic properties
- No processing-related deterioration of magnetic properties, thus contributing to equipment downsizing and reduced energy consumption
- Useful in applications having a dimensional tolerance on the scale of microns, made possible by our proprietary precision processing technology
- Minimum magnetic characteristic variations, made possible by our proprietary manufacturing technology, thus contributing to device stabilization
- Simple, ultra-precise compact shape, so cost performance is excellent, made possible by our proprietary near net shape processing technology

Manufacturing process

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Resolution

Pulverization

Powder processing

Vertical magnetic field molding

Horizontal magnetic field molding

Sintering

Inspection

Processing

Surface processing

Magnetization

Inspection

Packaging and shipment
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MAGNETIC PRODUCTS  
DIANET SERIES AND BASIC CHARACTERISTICS

HORIZONTAL MAGNETIC FIELD MOLDING

MOLDING MODEL SAMPLE

APPLICATIONS
- Watch rotor
- Coreless motor
- Motors such as high-performance compact actuators
- Telecommunications devices

BASIC CHARACTERISTICS

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
<th>SmCo5 1-5 based</th>
<th>SmCo17 2-17 based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetic Characteristics</td>
<td></td>
<td>DM-20</td>
<td>DM-26</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DM-30</td>
<td>DM-32</td>
</tr>
<tr>
<td>Residual magnet flux density</td>
<td>Br (T)</td>
<td>0.87–0.92</td>
<td>1.01–1.06</td>
</tr>
<tr>
<td></td>
<td>(G)</td>
<td>8700–9200</td>
<td>10100–10600*</td>
</tr>
<tr>
<td></td>
<td>bHc (kA/m)</td>
<td>676–732</td>
<td>398–557</td>
</tr>
<tr>
<td></td>
<td>(Oe)</td>
<td>8500–9200</td>
<td>5000–7000</td>
</tr>
<tr>
<td></td>
<td>IHc (kA/m)</td>
<td>&gt; 676</td>
<td>&gt; 398</td>
</tr>
<tr>
<td></td>
<td>(Oe)</td>
<td>&gt; 8500</td>
<td>&gt; 557</td>
</tr>
<tr>
<td>Maximum energy product max</td>
<td>BHmax (kJ/m³)</td>
<td>151–167</td>
<td>199–215</td>
</tr>
<tr>
<td></td>
<td>(MGOe)</td>
<td>19–21</td>
<td>25–27</td>
</tr>
<tr>
<td>Reversible permeability</td>
<td>µr</td>
<td>1.01–1.06</td>
<td>1.06–1.13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10600–11300</td>
<td>11000–11600</td>
</tr>
<tr>
<td>Mechanical Characteristics</td>
<td></td>
<td>DM-30</td>
<td>DM-32</td>
</tr>
<tr>
<td>Curie temperature</td>
<td>(°C)</td>
<td>700–750</td>
<td>800–850</td>
</tr>
<tr>
<td>Coefficient of thermal expansion</td>
<td>(×10⁻⁵/°C)</td>
<td>8.0</td>
<td>9.8</td>
</tr>
<tr>
<td>Density</td>
<td>(g/cm³)</td>
<td>8.2–8.5</td>
<td>8.3–8.5</td>
</tr>
<tr>
<td>Hardness</td>
<td>(HV)</td>
<td>&gt;530</td>
<td>&gt;550</td>
</tr>
<tr>
<td>Stiffness</td>
<td>(Kg/mm²)</td>
<td>19±2</td>
<td>16±2</td>
</tr>
<tr>
<td>Electric Resistance</td>
<td>(Ω ⋅ m)</td>
<td>0.8×10⁻⁶</td>
<td></td>
</tr>
</tbody>
</table>

Note) Magnetic characteristics may be changed depending upon customer's specified dimensions and shape.
For details, please contact us.
MAGNETIC PRODUCTS  DIANET SERIES AND BASIC CHARACTERISTICS

VERTICAL MAGNETIC FIELD MOLDING

APPLICATIONS
- Buzzer (ex: cellular phone)
- Optical isolator
- Inner phone
- Receiver (ex: cellular phone)
- Various sensors

BASIC CHARACTERISTICS

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
<th>SmCo5 1-5based</th>
<th>Sm2Co17 2-17based</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>DM-16</td>
<td>DM-18</td>
</tr>
<tr>
<td>Residual magnet flux density</td>
<td>Br</td>
<td>0.77–0.82</td>
<td>0.81–0.87</td>
</tr>
<tr>
<td></td>
<td>(T)</td>
<td>(G)</td>
<td>(Oe)</td>
</tr>
<tr>
<td></td>
<td>(kA/m)</td>
<td>(Oe)</td>
<td>(Oe)</td>
</tr>
<tr>
<td></td>
<td>iHc</td>
<td>&gt; 716</td>
<td>&gt; 696</td>
</tr>
<tr>
<td></td>
<td>(kA/m)</td>
<td>(Oe)</td>
<td>(Oe)</td>
</tr>
<tr>
<td>Maximum energy product max</td>
<td>BHmax</td>
<td>111–135</td>
<td>119–143</td>
</tr>
<tr>
<td></td>
<td>(KJ/m³)</td>
<td>(G)</td>
<td>(Oe)</td>
</tr>
<tr>
<td>Reversible permeability</td>
<td>(µ)</td>
<td>1.05</td>
<td>(µ)</td>
</tr>
</tbody>
</table>

Note) Magnetic characteristics may be changed depending upon customer’s specified dimensions and shape.
For details, please contact us.
TEMPERATURE CHARACTERISTIC

DM16 B-H

DM18 B-H

DM20 B-H

DM22 B-H

DM26 B-H

DM30/32 B-H

TEMPERATURE CHARACTERISTIC

RELIABILITY DATA
SURFACE PROCESSING

Depending on usage, we recommend Ni plating to be conducted.
- Guards against magnetic powder from being generated by breaking or chipping
- Improves magnetic strength

THE EFFECT OF GRINDING TO MAGNETIC PROPERTIES

Before grinding:
- \( \varphi \times 10 \times 10 \text{mm} \)

After grinding:
- \( \varphi \times 0.5 \times 0.5 \text{mm} \)

The properties of samarium-cobalt (SmCo) magnets do not deteriorate, even if they are processed with micromagnets.

ENVIRONMENTAL TEST

For guaranteed reliability of contents, please arrange a separate meeting.
**MEASURING METHOD OF DIANET**

**MEASUREMENT OF DEMAGNETIZATION CURVES**

Vibrating sample magnetometer

Vibrating sample magnetometers measure residual flux density, coercive force, and maximum energy product.

![Diagram of Vibrating Sample Magnetometer]

**SIMPLE MEASUREMENT**

Measurement of finished products (magnets as actually used)

Flux meters are often used for measuring total flux and gauss meters are often used for measuring surface flux density. Calibration of search coils and hole probes is essential for these measurements. The following two methods are generally used for calibration.

1) Measure and select the best calibration.
2) Calibrate, using a high-accuracy standard sample. We recommend using a standard sample when setting magnetic characteristics.

![Diagram of Simple Measurement]

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CAUTIONS WHEN USING MAGNETS

WARNING

- It is extremely dangerous to place magnets near persons who have electronic medical devices such as pacemakers installed. There is a risk of damage to normal operation status of the medical device. Please use with highest caution.

CAUTION

- Depending on the size and shape used, a magnet may not achieve the magnetic characteristics values noted in the catalogue. Confirm in advance by using a sample, etc.
- When magnetization is performed by the customer, allocate sufficient magnetic field for the material and coercive force. When the strength of the magnetic field is insufficient, magnetic characteristics of the original design specifications may not be obtained. Consult with the manufacturer for the size of the magnetic field needed for magnetization.
- Avoid using and storing magnets in the following environments. Weather resistance differs according to the material of each magnet, so consult in advance about corrosion prevention, etc.
  1. Corrosive gas atmosphere (Cl, NH3, SOx, NOx)
  2. Highly conductive environment (in water containing electrolytes, etc.)
  3. Hydrogen atmosphere
  4. Acidic, alkaline, or organic solvents, etc.
  5. In water or oil
- When using an adhesive to bond the yoke and hole piece, etc., of two magnets, confirm reliability by inspecting the type, volume, conditions, and strength, etc., of the adhesive.
- When performing processes such as press fitting or shrink fitting, there is a risk of degradation of the magnetic characteristics or cracking of the magnet or its counterpart materials. Be sure to confirm in advance by using a sample.
- A magnetized magnet absorbs debris such as iron powder, so remove it from its packing case in a dust free environment.
- Magnets are susceptible to shock, and cracking and chipping occur easily, so handle with care. When cracking or chipping occur during handling, there is a risk of degradation of characteristics or strength.
- Magnets are generally made from materials that chip easily, so handle with care. Store in a place where shock will not occur. In addition, be sure to store in a location where the magnet will not come into contact with rain-water, etc.
- Be careful not to swallow magnets. If a magnet has been swallowed, consult a physician immediately. Keep magnets out of the reach of children.
- Magnetized magnets should be covered with a non-magnetic material such as a wooden box after clearly marking the fact that the magnet is magnetized.
- When a magnet is placed close to a magnetic tape, floppy disk, prepaid card, ticket, or electronic watch, there is a risk that the magnetic recording will be damaged and that the item will become magnetized and no longer be usable. There is also a risk of cards and tickets becoming unusable due to the effect of an electronic key, so do not place electronic keys in your pocket together with cards, tickets, etc.
- Persons who are sensitive to or have allergic reactions to metal may develop rashes or redness of the skin if they come into contact with a magnet. If such reactions are known to occur, do not touch magnets.
- Typically, components of a magnet may begin to dissolve in water, so do not drink water that has been in contact with a magnet.
- Magnets typically crack easily. A magnet fragment may enter the eye or cause injury, so use caution in handling.
- The absorption force of magnets is strong, so be careful not to let your hand get pinched.
- The alloy powder of rare earth magnets is specified by fire safety law as class II (flammable solid) and class I hazardous materials. There is a danger of ignition or inflammation of fine powder generated due to friction during use of a magnet, so do not use in such a way that risks generating magnetic powder.
- There is a danger of auto-ignition with fine particles of rare earth magnets, so when processed by the customer, do not leave chips or filings in the atmosphere, and be sure to store these in a container filled with water. As a preparation in case a fire starts, have sand available for use. If a fire begins, cover the fire with the sand, and remove flammable objects.
- Avoid storing in locations with high temperature and high humidity.

All data, dimensions, characteristics and values shown in this catalogue are for reference only. Please contact your local Seiko Instruments Representative for current detailed specifications.

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Environmental Activities

Environmental Activities at Micro-Energy Division

Environment & Quality Policy

Seiko Instruments Inc., Micro-Energy Division is located in Ayashi, a city with beautiful nature, in Miyagi Prefecture. Our aim is to provide customer satisfaction and harmony with the environment through all our products, from Micro battery to other electronic products, and sales activities.

1. We adhere firmly to laws, regulations and customers' specified requirements.
2. We aim to prevent pollution, to reduce CO₂ and to conserve biodiversity.
3. We set goals, take actions, conduct regular reviews, and improve the system and performance continuously.
4. We contribute to the society by supporting green procurement, developing green products, and promoting green life activity.
5. We adhere to regulations and recommendations regarding Chemical substance content in our products and will promote reduction and replacement.
6. We vigorously educate ourselves and try to engage voluntarily in green life activity.

Based on the above policy, the following six environmental approaches are now being implemented throughout Micro-Energy Division.

1. Enrich the line up of Eco-Products
   • We introduced the SII Green Product Label System which is equivalent to the ISO 14021 Type II environmental label. At the end of FY2006, 100% of our products are certified as SII Green Products. In addition, 36 products are certified as SII "High Grade" Green Products.

2. Reduction of Greenhouse Gas
   • We practice various CO₂ reduction measures like using Eco-machinery. Since 1997, we have successfully reduced a total of 50,300 tons of CO₂. We believe our efforts contribute to the prevention of global warming.

3. 3R Promotion Activity
   • We have promoted the "reduce and reuse" activities and also promoted recycling at the end of the production process. With these activities, we achieved “Zero-emission” in 2004. We have reduced the non-recyclable wastes to less than 1 ton - less than 1% of our 1997 results.

4. Biodiversity Conservation
   • We endeavor to deepen our understanding on the relevancy between biodiversity and our business activities, and to contribute to the conservation of biodiversity by participating local community activities.

5. Green Purchasing
   • We adhere to a green purchasing campaign through the purchase of ingredients, manufacturing materials, and other necessary products, whenever appropriate.

6. Green Life
   • With the participation of all of Micro-Energy Division members, we deploy a clean-up and beautification campaign in all areas surrounding our factory twice a year. In addition, we participate in the clean up activity at Hirose River once a year.

7. Conflict Minerals
   • Recognizing the international importance of conflict minerals issue, we prohibit the use of such minerals.
Manufactured by an integrated process extending from raw materials to finishing, our DIANET is a samarium-cobalt (SmCo) magnet offering high performance, accuracy, and quality. DIANET is used in stepping motors for wristwatches, but it is used in other, ever expanding, applications, including microelectronic parts for audio and telecommunications devices; reflow-mounted thin, compact devices; and microelectromechanical systems (MEMS).
Micro-Energy Division who manufactures the products described in this catalog holds the ISO 9001 quality management system certificate, and the ISO 14001 environmental management systems certificate.

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