Materials Services | Materials Germany

# Hard ferrite magnets

Product information

thyssenkrupp

Hard ferrite magnets are the most cost effective and widely used of all magnetic materials. Both isotropic and anisotropic magnets can be produced in hard ferrite. Anisotropic hard ferrite magnets have an energy density which is 300 % higher than isotropic magnets.

## Magnet shapes

In principle all shapes can be produced by mold pressing: rods, bar magnets, blocks, ring magnets and other shapes. Sharp edges and corners have to be avoided as the high brittleness level of the material can cause cracks and fractures.

Drill holes and grooves can only be applied in the direction of pressing, because the preferred direction is usually parallel to it.

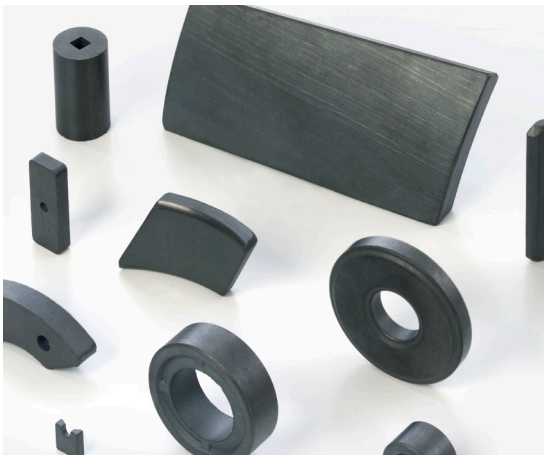
Indirect shaping is also possible. This is usually achieved by cutting from large sintered blocks (mainly for small magnets).

## Delivery program

Our range comprises a wide selection of various hard ferrite materials with differing magnetic properties. They permit material selection tailored to individual application requirements. We look forward to advising you in detail.

# Content





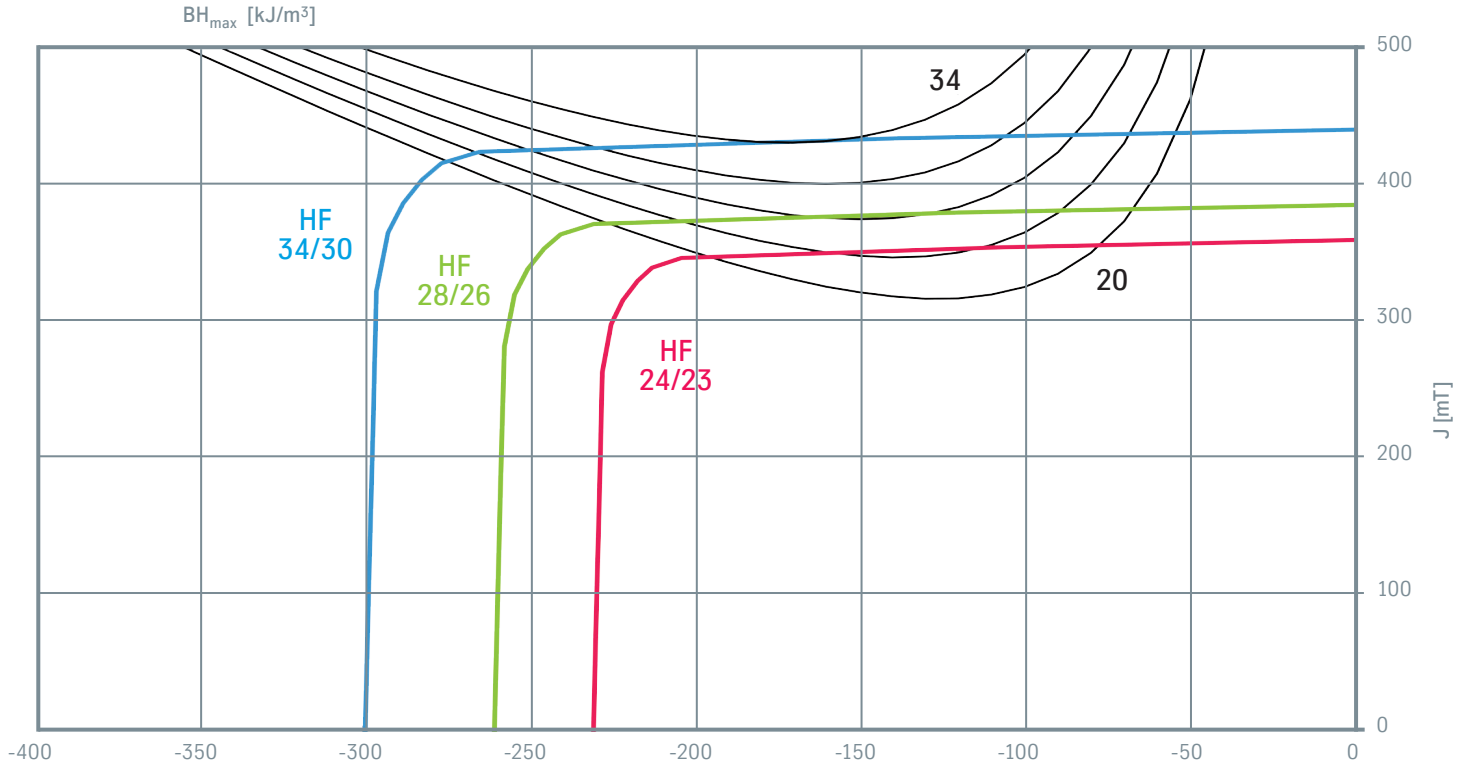
## Magnetic properties

| Raw material | | | Remanent magnetization | | Coercivity | | | | Energy product | | Temperature coefficient | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | $B_r$ | | $H_{cJ}$ | | $H_{cB}$ | | $(BH)_{max}$ | | $TK(B_r)$ | $TK(H_{cJ})$ |
| | | | mT | kG | kA/m | kOe | kA/m | kOe | kJ/m³ | MGOe | %/K | %/K |
| Hard ferrite 8/22 | i | min | 210 | 2.1 | 220 | 2.7 | 135 | 1.7 | 8 | 1.0 | -0.2 | 0.3 |
| Hard ferrite 24/23 | a | min | 350 | 3.5 | 230 | 2.8 | 215 | 2.7 | 24 | 3.0 | -0.2 | 0.4 |
| Hard ferrite 28/16 | a | min | 390 | 3.9 | 160 | 2.0 | 160 | 2.0 | 28 | 3.5 | -0.2 | 0.4 |
| Hard ferrite 28/26 | a | min | 380 | 3.8 | 260 | 3.3 | 250 | 3.1 | 28 | 3.5 | -0.2 | 0.4 |
| Hard ferrite 28/30 | a | min | 380 | 3.8 | 300 | 3.8 | 260 | 3.3 | 28 | 3.5 | -0.2 | 0.4 |
| Hard ferrite 30/16 | a | min | 400 | 4.0 | 160 | 2.0 | 160 | 2.0 | 30 | 3.8 | -0.2 | 0.4 |
| Hard ferrite 30/26 | a | min | 400 | 4.0 | 260 | 3.3 | 250 | 3.1 | 30 | 3.8 | -0.2 | 0.4 |
| Hard ferrite 30/32 | a | min | 400 | 4.0 | 320 | 4.0 | 285 | 3.3 | 30 | 3.8 | -0.2 | 0.4 |
| Hard ferrite 32/26 | a | min | 410 | 4.1 | 260 | 3.3 | 250 | 3.1 | 32 | 4.0 | -0.2 | 0.4 |
| Hard ferrite 32/40 | a | min | 420 | 4.2 | 400 | 5.0 | 300 | 3.7 | 32 | 4.0 | -0.2 | 0.4 |
| Hard ferrite 34/30 | a | min | 430 | 4.3 | 300 | 3.8 | 280 | 3.3 | 34 | 4.2 | -0.2 | 0.4 |

a = anisotropic; i = isotropic
The magnetizing field strength is at least three times the $H_{cJ}$ value.
The relative permeability ($\mu_p$) is between 1.05–1.10.

Selected material qualities
(according EN 60404-8-1:2015).
Further qualities on request.

## Demagnetizing curves




Demagnetizing curves of selected hard ferrite material qualities

**Physical properties**

| Raw material | Density | Young's modulus | Compressive strength | Vickers hardness | Electrical resistivity | Heat capacity | Thermal conductivity | Coefficient of linear thermal expansion in magnetizing direction | Coefficient of linear thermal expansion normal to mag. direction |
|---|---|---|---|---|---|---|---|---|---|
| | ρ g/cm³ | E kN/mm² | $F_P$ N/mm² | $H_v$ | ρ Ω mm²/m | C J/kg K | λ W/m K | Δ $dl_0$ $10^{-6}$/K | Δ $dl_0$ $10^{-6}$/K |
| Hard ferrite | 4.7–4.9 | 120–180 | 300–700 | ~ 500 | ∞ | 500–800 | 5–10 | 9.2–13.3 | 9.2–10 |

Operating temperature
Tmax = 250 °C

Curie temperature
Tc = 450 °C

## Chemical resistance

Permanent ferrite magnets are to a great extent chemical resistant. They are also resistant to oxidation and climatic influences. In particular to weak organic acids like water, petrol, organic solvents, caustic potash solution, soda lye and common salt.

They are not resistant to concentrated inorganic acids (hydrochloric, sulphuric, phosphorous, hydrofluoric and oxalic).

They have a very limited resistance against acetic acid, diluted sulphuric and nitric acids.

**Chemical resistance**

| Minor effect Good | Moderate effect Fair | Sever effect Not recommended |
|---|---|---|
| Ozone | Nitric acid, diluted | Hydrochloric acid |
| Water | Sulphuric acid, diluted | Sulphuric acid |
| Petrol | Acetic acid | Phosphorous acid |
| Organic solvent | | Hydrofluoric acid |
| Caustic potash solution | | Oxalic acid |
| Soda lye sodium | | |
| Chloride solution | | |
| Developer | | |
| Fixing bath | | |
| Weak organic acids | | |

## Production

After goods inwards inspection, the raw materials (mainly iron oxide and strontium carbonate) are weighed, blended, pre-sintered and ground to a fine powder with crystals. For isotropic magnets, the raw material is consequently pressed. There are two procedures in the production of anisotropic magnets. Firstly, the raw material is dried and then pressed in a magnetic field (dry pressing). Secondly, the raw material is wet pressed under the influence of a magnetic field (wet pressing); the pressing is followed by sintering, finishing and cleaning. The surface can be machined, marked, magnetized or coated to customer requirements.

## Temperature behavior

Irreversible damage of a limited nature can occur up to 250 °C; the extent of same increases as the temperature rises. Depending on the application of the magnet, irreversible losses can also occur at lower temperatures. With regard to the crystalline structure of the magnet, only temperatures exceeding 1000 °C result in grain structure changes and therefore irreversible losses.

Contrary to this, the magnetic parameters greatly depend on temperature. As a general rule for hard ferrite magnets – at increased temperatures the remanence decreases by 0.2 % per Kelvin and the coercive field strength increases by 0.3–0.4 %. At decreased temperatures, the remanence increases and the coercive field strength decreases. For this reason, selecting the correct magnet for the specific application is vitally important.

## Toxicity

Ferrite magnets are non-toxic and environment friendly when disposed off on landfills. Ferrite magnets are unaffected by incineration.

Even direct contact with foodstuffs is harmless. According to foodstuff legislation, direct and continuous contact between ferrite materials and potable water is permitted.



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