

Magnetic Silicone Elastomers: Integrating Ferrite Fillers for Custom Sensor Applications

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1. Executive Summary: The Rise of Soft Electromechanical Elements

In modern industrial automation, robotic sorting networks, and automotive position diagnostics, the requirement for soft, compliant, and non-contact electromechanical components is increasing rapidly. Traditional rigid magnets wrapped in hard plastics are prone to stress fractures under cyclical impacts and lack the structural compliance needed for micro-space installations. Mechanical engineers are increasingly deploying Magnetically Active Polymers, specifically **Magnetic Silicone Elastomers**.

Reemane engineered the RM-MG specialized compound series to serve these high-value applications. By embedding ultra-fine permanent magnetic ferrite micro-particles within a stable polysiloxane carrier gum, we deliver custom-molded elastomeric components that operate simultaneously as robust fluid seals and active magnetic field triggers for non-contact Hall-effect sensor modules.

Engineering Directive: Traditional solid metal magnets are brittle and hard to form; magnetic silicone provides omnidirectional flexible movement while maintaining a stable magnetic remanence signature.

2. Material Formulation: Ferrite Loading Boundaries & Matrix Stability

The development of a high-performance magnetic rubber depends on a precise balance between particle volume fraction and matrix cross-linking integrity. Reemane uses high-purity, synthetic Strontium Ferrite ($\text{SrFe}_{12}\text{O}_{19}$) and Barium Ferrite ($\text{BaFe}_{12}\text{O}_{19}$) micro-powders as the functional magnetic filler agents.

To secure a strong magnetic flux response, filler concentration must surpass a 65% weight ratio baseline. However, introducing such massive powder volumes significantly increases raw compound shear viscosity, which can compromise material elongation and accelerate polymer matrix brittleness. Reemane resolves this processing limitation by treating the ferrite core particles with organic silane coupling agents. This surface treatment wraps individual grains in a hydrophobic shield, lowering internal compounding friction, optimizing dispersion uniformity, and preventing micro-fissuring under cyclic dynamic flexure.

3. Magnetic Alignment Pathwise: Isotropic vs. Anisotropic Matrices

Depending on the structural requirements of the end sensor network, custom components can be processed via two distinct magnetic pathways:

- **Isotropic Formulations:** The embedded ferrite particles maintain a random spatial configuration inside the cross-linked siloxane web. Isotropic magnetic silicone features symmetric magnetic properties in all dimensional directions, which makes it ideal for flexible proximity gaskets, standard encoder sheets, and low-profile tactile keys.
- **Anisotropic Alignment:** During the active hot vulcanization injection cycle, the un-crosslinked liquid rubber tool cavity is subjected to a powerful localized external magnetic field. This forcing matrix tilts the magnetic domains of the fluid-suspended ferrite grains, freezing them into a fixed parallel line configuration before cross-linking is completed. This specialized processing increases remanence and coercivity values along the active working direction by over 150%.

4. Technical Specification Matrix: RM-MG Magnetic Product Series

Technical Performance Index	Testing Protocol	RM-MG60 (Isotropic)	RM-MG70 (Anisotropic)
Base Hardness (Durometer)	ASTM D2240	60 ± 5 Shore A	72 ± 5 Shore A
Tensile Strength	ASTM D412	5.2 MPa	6.8 MPa
Elongation at Break	ASTM D412	240%	160%
Residual Magnetic Flux (B_{ext})	ASTM A977 (Vibrating Sample)	320 Gauss	850 Gauss
Magnetic Coercivity (H_{ext})	ASTM A977	1.8 kOe	2.6 kOe
Maximum Thermal Operating Limit	Internal Hot Thermal Audit	+160°C	+160°C

5. Advanced DFM Considerations: Tool Wear & Magnetic Fields

Processing compound batches with heavy permanent ferrite particle loads creates a highly abrasive mixture inside industrial molding systems. Standard steel cavities suffer from accelerated scratching and gouging near high-velocity进胶口 (gate channels), which can alter tight component tolerances over long production runs. Reemane protects tool geometry by cutting our magnetic-series molds from ultra-hard **H13 tool steel blocks hardened beyond Rockwell C 54**, backed by hard-chrome electroplated surfaces.

Furthermore, designing an anisotropic part requires advanced electromechanical synchronization between the tool steel base and the external electromagnetic coils. Tool boundaries must incorporate non-magnetic

isolation blocks (such as specialized copper alloys or premium stainless grades) to restrict the magnetic field paths to the active rubber forming channels. This ensures uniform domain alignment without generating thermal hot-spots during the injection run.

Deploy Precision Magnetic Silicone Components Globally

Integrate soft non-contact switching tracks, protect delicate Hall-effect sensor positions from fluid intrusion, and secure verified anisotropic magnetic alignment properties for your automation projects. To review our custom compounding profiles, map out electromagnetic isolation tools, or request certified material datasets, contact our component engineering office directly at sales@siliconefactories.com or visit our online material center at www.siliconefactories.com.