Technical Specifications of Coatings for Neodymium Magnets

GüK MAGNETICS

Coating	Cost	Thickness	Appearance	Corrosion Resistance	Max Temp	Notes
Nickel-Copper-Nickel (Ni-Cu-Ni) (standard triple layer)	Low	10–25 µm	Shiny metallic silver (reflective)	Good: Passes ~24 hours neutral salt spray (adequate for indoor use; not long-term outdoor)	~200 °C	Most common coating; cost-effective general protection. Excellent against ambient air corrosion. Not recommended for prolonged outdoor use.
Nickel (Ni) (single-layer plating)	Low	~5–10 µm – single Ni layer	Bright silver metallic (coin-like polish)	Good: Better than zinc but less robust than Ni-Cu-Ni (typically similar ~24 h NSS)	~200 °C	Simple one-layer nickel electroplating. Provides a smooth, conductive finish and decent corrosion resistance. Rarely used alone for NdFeB (Ni-Cu-Ni is usually preferred for improved durability).
Nickel-Copper + Black Nickel (Ni-Cu + black Ni topcoat)	Medium	~15–25 µm (similar to Ni-Cu-Ni)	Dark charcoal/black metallic (low reflectivity)	Good: Comparable to standard Ni-Cu-Ni (~24 h NSS)	~200 °C	Multi-layer plating (usually Ni, Cu, then a black nickel alloy). Same base protection as NiCuNi with a cosmetic black finish. Maintains conductivity and hardness; used when a non-reflective or decorative black appearance is desired.
Everlube® (6102G)	High	~8–20 µm	Satin black finish	Excellent: ~500+ hours salt spray with no degradation	~150 °C	Thermoset dry-film lubricant coating (PTFE/MoS_2 in phenolic resin). Extremely durable, chemical and corrosion-resistant barrier – tested ≥500 hrs in 5% NaCl with minimal attack. Ideal for harsh environments.
Zinc (Zn)	Very Low	5–10 µm	Dull gray or bluish-silver ("white" clear zinc)	Fair: Sacrificial coating; ~12 h NSS to white corrosion (poor in wet conditions)	~120 °C	Economical galvanic coating. Zinc oxidizes to protect the magnet. Thin layer offers short-term rust protection in humidity. Best for low-cost indoor applications; will corrode in days / weeks under high humidity or salt exposure.
White Zinc (clear zinc plating)	Very Low	5–10 µm	Bright silvery (blue-clear chromate "white" finish)	Poor–Fair: ~12 h to white rust (clear chromate); red rust follows soon after	~120 °C	Standard zinc electroplate with colorless passivation. Lowest-cost option for basic indoor use. Typically used where aesthetics and cost trump longevity; not suited for wet or salty conditions.
Black Zinc (zinc with black chromate)	Low	5–15 µm	Matte black	Fair: Improved vs clear zinc (e.g. 72–96 h to white rust with trivalent seal)	~120 °C	Zinc plating with a black chromate conversion coating (often with sealant). Offers slightly better corrosion resistance than white zinc, but still primarily for indoor or mild outdoor use. Provides a sleek black look at low cost. Common in automotive hardware for moderate corrosion protection.
Epoxy (Black)	Medium	~15–25 µm	Opaque black (glossy or semi-gloss)	Excellent: Passes ≥72 h salt spray; thicker epoxy can exceed 200 h with no red rust	~200 °C (note: epoxy may yellow/soften >150 °C)	Tough polymer coating offering superior moisture and chemical resistance. Often used for magnets in marine, humid, or corrosive environments. Also provides electrical insulation. Can crack or chip under impact, and adds a slight thickness gap.
Epoxy (Grey)	Medium	~15–25 µm	Opaque grey (matte)	Excellent: Similar performance to black epoxy (72 h+ NSS)	~200 °C	Same epoxy resin coating as above, but pigmented grey. Used where a neutral-colored protective coat is desired (properties are identical to black epoxy).
Copper (NiCu) (Nickel + Copper plating)	Low	~10–20 µm total	Bright coppery metallic	Poor: Primarily decorative; copper tarnishes and offers limited barrier	~200 °C	Thin nickel undercoat with copper plated on top. Chosen for its distinct copper appearance or for solderability. Not suitable for harsh environments – the copper layer can oxidize or rub off over time.

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Copper (NiCuNiCu) (dual Ni & Cu layers)	Medium	~20–30 µm (multi-layer)	Shiny copper finish (thicker layer)	Poor–Moderate: Slightly better thickness, but copper still oxidizes quickly	~200 °C	A less common configuration: alternating nickel and copper layers, ending in a copper topcoat. Provides a heavier copper layer for aesthetics or improved conductivity. Not recommended for long-term corrosion protection.
Tin (Sn)	Low	~5–10 µm (typically over Ni base)	Dull silver-white	Moderate: Tin is semi-noble; resists water but can oxidize (whitish tin oxide) over time	~150 °C (tin melts at 232 °C; avoid >150 °C)	Usually plated over an initial nickel layer for adhesion. Tin provides a solderable surface and good electrical contact. Corrosion protection is only moderate. Used for applications needing soldering or low contact resistance (e.g. electronic components).
(Ni-Cu-Ni + Gold)	High	~20–25 µm total (incl. ~1–2 µm Au)	Bright gold	Excellent vs oxidation, but gold layer is not suited for abrasive or long-term wet exposure	~>200 °C (gold melts ~1064 °C; magnet fails first)	Multi-layer plating: NiCuNi base with a thin gold overplate. Gold provides a biocompatible, non-tarnishing surface. Used for medical or high-end applications where appearance or bio-safety is critical. Very expensive.
Ni-Cu-Ni + Rubber(rubber-coated magnet)	Medium	~0.5–1 mm (rubber layer)	Black rubberized coating (matte)	Excellent: Magnet fully encapsulated; no exposure if coating intact	~60–80 °C (depends on rubber; many degrade >80 °C)	A standard NiCuNi-plated magnet over-molded with a rubber sleeve. The rubber completely seals out moisture and also provides impact protection and grip. Common for "weatherproof" magnets and mounting bases.
Zn + Rubber	Medium	~0.5–1 mm	Black rubber	Excellent: (rubber does the sealing; Zn underneath offers backup sacrificial protection)	~60–80 °C	Zinc-plated magnet with a molded rubber coating. Slightly lower cost base plating. As long as the rubber layer remains intact, the magnet is well protected from corrosion. Often used for outdoor holding magnets / sensors where Ni plating not required.
Zinc Chromate(Yellow zinc)	Low	5–10 µm	Iridescent yellow-gold	Fair: Better than clear zinc: ~96 h to white rust (yellow chromate)	~120 °C	Zinc electroplating with a yellow (dichromate) conversion coating. The yellow chromate provides improved corrosion resistance compared to clear/blue zinc. Often used on fasteners and parts needing moderate corrosion protection and a distinctive golden appearance. Still will corrode over time in wet/salty conditions.
Silver (Ag)(Ni-Cu-Ni + Silver)	High	~16–23 µm total (incl. ~1–2 µm Ag)	Bright silver	Good: Resists oxidation better than bare Ni (Ag doesn't rust), but will tarnish (sulfide) and thin layer means only ~24 h NSS in tests	~>200 °C	NiCuNi base with a thin silver plating. Silver provides excellent electrical conductivity and is solderable. Silver can tarnish and does not significantly extend salt-spray life versus nickel alone. Primarily chosen for solderability or biocompatibility where nickel is a concern.
Parylene C (polymer coating)	High	5–25 µm (conformal film)	Transparent (no visible change; magnet looks gray/metallic underneath)	Excellent: Pinhole-free moisture barrier; often >1000 h in salt spray	~80–100 °C	Vapor-deposited polymer coating (chlorinated poly-para-xylylene). Yields an ultrathin, uniform and chemically inert layer. Exceptional corrosion protection (even in acid/alkali) because it seals all surfaces. Maintains magnet's original appearance and dimensions (microns thin). Used for precision electronics, medical implants, etc. Downsides: high cost and relatively low max temperature.
Ni-Cu-Ni + Parylene C	Very High	~20–35 µm (plating + parylene)	Metallic silver (Ni) with clear coating	Superior: NiCuNi provides base protection, Parylene topcoat makes it nearly impervious (for extremely harsh or wet environments)	~80–100 °C	Combination of standard triple plating with a parylene C overcoat. Nickel plating gives a hard, adherent base, and parylene adds an impermeable final seal. Dual approach yields outstanding corrosion resistance for critical applications. Common in high-reliability magnets where durability and corrosion protection are required.
Ni-Cu-Ni + Au + Parylene C	Very High	~25–40 µm (NiCuNi, plus gold & parylene layers)	Gold (slightly muted by matte polymer)	Ultimate: Gold and parylene together provide virtually zero corrosion (even in saltwater or body fluids)	~80 °C (parylene limit)	An ultra-premium multilayer coating: NiCuNi for adhesion, then gold plating for biocompatibility, topped with parylene for a hermetic seal. Used in niche cases like implantable magnets or sensors where absolutely no corrosion or metal leaching can be tolerated. Extremely costly.

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Phosphate Passivation	Low	~1–5 µm (conversion layer)	Matte gray or black	Poor: Provides only temporary flash rust protection (magnets will oxidize in humidity if uncoated beyond this)	~300 °C+ (stable inorganic)	A light phosphate chemical coating on the magnet. Used mainly to improve adhesion for adhesives or as a very short-term rust inhibitor. Porous and thin – by itself it does not prevent corrosion for long (magnets will still corrode if exposed to moisture). Often used when magnets will be glued into assemblies or when additional coatings will be applied later.
PTFE (“Teflon”) – white	High	Thick: ~1.5–3 mm if fully molded (thin PTFE sprays of a few µm are less common)	Opaque white plastic coating	Excellent: PTFE is chemically inert; effectively waterproof and very corrosion-proof	~250 °C	Often achieved by molding a Teflon sleeve or shell around the magnet. PTFE encapsulation gives an extremely robust barrier – magnets can withstand exposure to acids, solvents, saltwater, etc., with no corrosion. Also reduces friction and prevents wear. The coating is relatively thick, which can reduce magnetic flux at the surface.
PTFE (“Teflon”) – silvery	High	~1.5–3 mm	Opaque silvery-gray	Excellent: Same PTFE barrier performance	~250 °C	Same PTFE coating as above, but with a metallic gray/silver pigment or filler. Properties and protection are identical to white PTFE. Choice of color is cosmetic or for identification. PTFE coatings (all colors) offer the highest level of corrosion resistance among coatings listed, at the cost of added thickness and expense.
PTFE (“Teflon”) – grey	High	~1.5–3 mm	Opaque gray	Excellent: (see above)	~250 °C	Grey-pigmented PTFE encapsulation. Like other PTFE variants, provides an inert, non-reactive shield around the magnet. Suitable for harsh industrial or chemical environments where a neutral color is preferred.
PTFE (“Teflon”) – black	High	~1.5–3 mm	Opaque black	Excellent: (see above)	~250 °C	Black PTFE-coated magnets offer the same supreme corrosion protection and non-stick surface as other PTFE coatings. Black color can help magnets blend into equipment. Often used where both high durability and low visibility are required.
Titanium (Ti)	High	~2–5 µm (PVD metallic film)	Silvery-gray metal sheen	Excellent: Titanium metal is highly corrosion-resistant (forms protective TiO_2 film)	~>200 °C (Ti stable to very high temp)	A thin pure titanium layer, usually applied via vacuum deposition (sputtering). Yields a biocompatible, non-magnetic and corrosion-resistant surface. Very uncommon due to cost. May be used for specialized medical magnets or where nickel/copper must be avoided. The coating is very thin, so it adds protection without much bulk, but any pinholes or damage can compromise it.
Titanium Nitride (TiN)	Medium	~2–6 µm	Gold-colored metallic finish (bright yellow-gold)	Excellent: Extremely hard, inert ceramic layer; resists most chemicals and wear	~500 °C	A ceramic PVD coating known for its hardness. TiN gives magnets a distinctive gold appearance with superb durability. It protects against corrosion even in harsh chemicals and can withstand high temperatures. Cost and lead time are higher than standard plating.
Chrome – bright (standard)	Medium-High	~15–25 µm total (Ni/Cu underlayer + thin Cr topcoat)	Bright reflective chrome (mirror-like)	Very Good: Chrome is hard and inert; among the best metal coatings for corrosion	~200 °C	A nickel (and sometimes copper) plated magnet with an additional chromium plating on top. The thin chrome layer enhances surface hardness and wear resistance, and provides a highly durable finish. Chrome-plated magnets have excellent resistance to rust and maintain luster well. Used when a decorative, robust finish is needed. Higher cost due to the extra plating step.
Chrome – black	Medium-High	~15–25 µm (incl. underplating)	Dark gunmetal-black metallic	Very Good: Similar corrosion resistance to bright chrome	~200 °C	A black chromium plating over nickel. Typically achieved with special additives in the chrome bath or a post-treatment to turn the chrome layer black. Used for aesthetic purposes when a high durability black finish is desired. Relatively uncommon.
Ni-Cu-Ni + Everlube	Very High	~25–35 µm (plating + coating)	Satin black (Everlube topcoat over silver base)	Outstanding: Tested >500 hrs salt spray with no magnet corrosion	~150 °C	Conventional Ni-Cu-Ni plating with an Everlube fluoropolymer coating on top. NiCuNi underlayer provides a smooth, adherent surface and backup protection. Everlube yields a tough, chemically resistant outer film. Improves corrosion resistance and chemical compatibility, at increased cost. Used in high-performance magnets exposed to salt, fuel, or chemicals.

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Ni-Cu-Ni + Epoxy	High	~30–50 µm (15–25 µm plating + ~15–25 µm epoxy)	Typically black or colored epoxy over metallic base	Excellent: Survives hundreds of hours in salt spray (e.g. >200 h without failure reported)	~150–180 °C	A dual-protection strategy - plating ensures micro-cracks in epoxy don't expose bare magnet, extending life. Yields good protection even in very harsh environments (outdoor, marine). Used for industrial and renewable energy magnets. Epoxy layer can insulate magnet electrically and provides extra safety against chipping.
Ni-Cu-Ni + PTFE	Very High	~20–30 µm (plating + thin PTFE film)	Metallic silver with slight sheen (if clear PTFE; can be pigmented)	Superior: Essentially zero rust; PTFE topcoat prevents water ingress entirely (beyond NiCuNi's protection)	~250 °C	A composite coating: standard NiCuNi plating for adhesion and strength, finished with a thin PTFE (Teflon) layer. The PTFE fluoropolymer adds an ultra-hydrophobic, chemically inert skin, making the magnet extremely corrosion-proof and also reducing friction. Used in extremely corrosive or cleanliness-critical settings. Rare + expensive process.
Zn + Everlube	High	~15–25 µm (Zn ~10 µm + Everlube ~10 µm)	Satin black	Outstanding: Comparable to NiCuNi+Everlube (Everlube provides primary protection; Zn underlayer offers sacrificial backup)	~150 °C	A cost-optimized variant using zinc plating under the Everlube coating (instead of NiCuNi). Delivers nearly the same corrosion resistance benefits. If any pinhole or scratch occurs, the zinc beneath will corrode sacrificially, helping protect the magnet. Suitable for extremely harsh environments where Ni plating is not required or to avoid nickel.
Tin (Sn) + Parylene C	High	~10–20 µm (Sn ~5–10 µm + Parylene ~5–10 µm)	Essentially transparent (parylene over dull tin)	Excellent: Parylene provides hermetic-level seal; tin underlayer protects magnet if coating is breached	~80–100 °C	Tin-plating the magnet then applying parylene C coating. Chosen to avoid any nickel/copper while still achieving high corrosion resistance. Tin layer offers good adhesion for parylene and is solderable. Parylene ensures no moisture can reach the magnet. Used where Ni must be avoided but maximum protection is needed.
Rhodium (Rh)	Very High	~1–2 µm (over Ni undercoat)	Brilliant mirror-silver (chrome-like)	Excellent: Rhodium is a noble metal; no tarnish or corrosion in normal environments	~>200 °C (melts ~1964 °C; no coating limit)	A precious-metal plating sometimes offered for special applications. Rhodium is extremely hard, shiny, and corrosion-proof. Typically applied over a nickel strike for adhesion. It provides a long-lasting, non-oxidizing finish (common in jewelry). In magnets, it's rarely used except where a highly reflective, non-tarnishing surface is needed and cost is no object.
Potted (various) (Fully resin-encapsulated)	Medium-High	N/A (magnet fully embedded in potting compound)	Depends on potting material (usually opaque resin)	Excellent: Magnet is entirely encased; effectively no exposure to environment	Varies, e.g. epoxy potting ~120 °C, silicone ~200 ° C)	The magnet is sealed within a block or shell of polymer. This creates a continuous barrier around the magnet. Corrosion protection is as good as the integrity of the potting. Increases magnet size and weight. Used when coating alone is insufficient or when integrating magnet into a larger sealed part.
Coloured (red, green, blue, etc) (Painted or pigmented coating)	Medium	~10–30 µm (paint or powder-coat layer)	Various colors (opaque paint)	Moderate: Provides initial protection, but paint can chip or wear (exposed areas will corrode)	~120 °C (typical paints)	Magnets can be powder-coated or painted in different colors for identification or aesthetic reasons. Often an epoxy-based paint is used. While the coloured coating will protect the magnet from humidity when intact, it is generally less durable than electroplated or thick epoxy coatings. Any scratch or pinhole in the paint can lead to corrosion starting at that site.
Paint (various)	Medium	~10–25 µm	Any color or clear (per requirement)	Moderate: Similar to above; paint layers are thin and not as resilient as specialized coatings	~120 °C (standard paints)	Usually done over a base plating (like zinc or nickel) to add another layer of protection or for cosmetic purposes. The corrosion resistance depends on the paint quality – typically good for dry environments, but not meant for long-term submersion or salt spray.
Ni-Cu-Epoxy (Nickel + Copper + Epoxy)	High	~25–40 µm (Ni+Cu ~15 µm, Epoxy ~10–25 µm)	Usually black or grey epoxy topcoat	Excellent: Similar to Ni-Cu-Ni + Epoxy (multi-hundred-hour salt spray protection)	~150 °C	A variant dual-coating: the magnet is electroplated with nickel and copper, then coated with epoxy. The copper outer layer can improve epoxy adhesion and provides some interim protection until epoxy is applied. Performance in corrosive environments is nearly as good as NiCuNi+epoxy.
Plastic Encased (Magnet in plastic housing)	High	Varies – plastic wall may add 1–2+ mm around magnet	Depends on plastic (often black, can be any color)	Excellent: Magnet is physically isolated from environment (not hermetic, but highly resistant to moisture ingress)	Varies (by plastic; e.g. ABS ~100 °C, Nylon ~120 °C)	The magnet is either overmolded or inserted into a pre-made plastic container which is then sealed. While standard plastics are not vapor-tight, in practice a plastic-encased magnet is extremely well protected in normal use. Not intended for high-temperature use unless high-temp plastics are used.