

ENGINEERING DATA AND APPLICATION GUIDE

General Magnaplate's problem solving metallurgical specialists at our Materials Technology Center in North America help engineers increase reliability, and performance of equipment by treating metal parts with one of our many "synergistic" surface enhancement coatings.

WHAT ARE "SYNERGISTIC" COATINGS?

Established in 1952, General Magnaplate's coatings met NASA's need for a new type of surface technology that would withstand the rigors of outer space. Magnaplate-applied coatings are created in multi-step processes that begin with a series of special cleaning treatments. Enhancement of the metals is then performed by conversion, deposition, thermal spray, or by a blend-matrix of all three – depending on the coating.

The process continues with a controlled infusion of selected engineered particles and/or metals. Unlike "paint-ons", these particles are mechanically cross-linked and locked in through a proprietary process to become an integral part of the new surface.

Since the resulting surface is dramatically superior in performance to both the base metal and any of the individual components used in the enhancement technology, General Magnaplate coatings are considered "synergistic".

ONE STOP SHOPPING FOR ALL YOUR COATING AND FABRICATION NEEDS

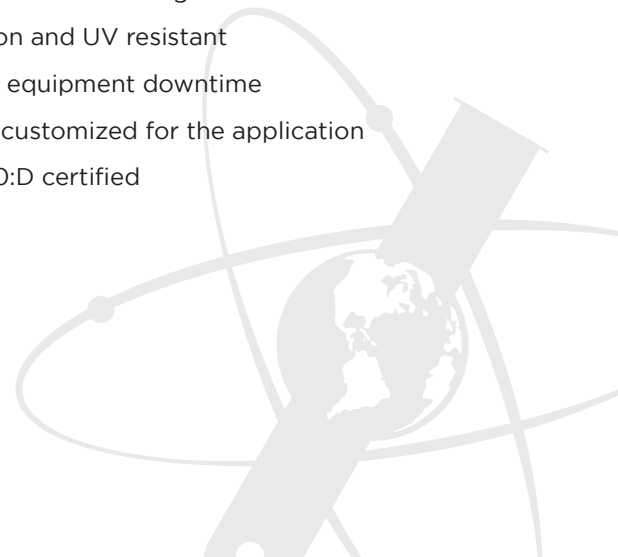
Our finishing capabilities include grinding, superfinishing, machining, polishing and diamond polishing.

Federal, industrial and MIL-SPEC coatings and platings are available.

Worn parts such as injection molds, pump impellers, rolls and platens can be coated and/or restored. In some cases, General Magnaplate can collaborate with a local partner to produce your parts complete from manufacturing to finishing. We can serve as advisor for assistance from part design to coating.

PROBLEM-SOLVING BENEFITS OF MAGNAPLATE COATINGS

- Create a harder-than-steel surface
- Allow substitution of less expensive metal
- Resist environmental and chemical corrosion
- Permanent dry lubrication
- Resist abrasion and galling
- Self-lubricating for extended wear
- Exhibit a very low coefficient of friction
- Offer superior mold release
- Eliminate sticking and product "hang-up"
- Won't chip, peel or flake off
- Creates a smooth surface on castings
- Speed cleanup and sanitation maintenance
- Many meet FDA, USDA and other Global standards
- ITAR, RoHS and REACH compliant (International)
- Impart dielectric strength
- Radiation and UV resistant
- Reduce equipment downtime
- Can be customized for the application
- AS 9100:D certified



FOR MORE INFORMATION:

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TUFRAM®

For Aluminum Alloys

NEDOX®

For Most Base Metals

COATING DESCRIPTION

These “synergistic” surface enhancement coatings create harder-than-steel, permanently dry-lubricated aluminum surfaces that resist corrosion, abrasion and galling. Treated components outwear and outperform case-hardened steel, stainless steel and hard chrome-plated parts.

Controlled infusion of various proprietary materials within a modified nickel alloy plating. Subsequent controlled treatment cycles assure thorough infusion of the proprietary material into the surface layer and concurrently increase hardness of the matrix. Meets and exceeds ASTM B656, ASTM B733, MIL-C-26074, Class 1, 2, 3 and 4, and its replacement spec AMS 2404.

HARDNESS, WEAR AND ABRASION

Up to Rc 65. Equilibrium Wear Rate using Taber abrasion testing method #6192 of Fed. Std. #141 (CS-17 wheel): 0.5 to 1.5 mg per 1000 cycles. Exceeds AMS requirements by 3 times.

Up to Rc 68 per ASTM B-578-87. Equilibrium Wear Rate using Taber abrasion testing methods #6192 of Fed. Std. #141 (CS-10 wheel): 2.0 to 4.0 mg per 1000 cycles. Exceeds AMS requirements by 2 times.

**FRICITION PROPERTIES
ASTM D 1894-01**

(Friction values will vary based on mating surfaces.)

Coefficient of friction: as low as 0.05. Eliminates stick-slip and undesirable vibration.

Coefficient of friction: as low as 0.09. Eliminates stick-slip problems and undesirable vibration.

**CORROSION RESISTANCE
ASTM B 117**

Most TUFRAM types exceed the basic salt spray requirements of AMS 2482 and AMS 2469. Some TUFRAM coatings are resistant to alkaline and acid solutions.

Most types of NEDOX will survive 300 hours in salt spray. Selected types can withstand over 3000 hours. Coating thickness will affect corrosion resistance; special types can survive in H₂S, encountered in oil field applications.

TEMPERATURE

(Results depend upon the process specified and the alloy used.)

Operating range: -360°F (-218°C) to as high as +800°F (+427°C) for intermittent operating conditions.

Operating Range: -250°F (-157°C) to +550°F (+288°C). Some coatings will survive temperatures as high as +1400°F (+760°C).

THICKNESS

Range: 0.0004” to 0.003” per side, with tolerance as low as ±0.0002”. (Coating thickness is normally 50% growth per surface and 50% penetration per surface.)

Surface build-up from 0.0002” to 0.0015”.

**FDA/USDA
FDA 21 CFR 175.300**

Many comply with FDA and USDA codes.

Many comply with FDA and USDA codes.

APPLICATIONS

TUFRAM not only improves the performance and durability of aluminum components but often allows easily machinable aluminum to replace steel or stainless in many applications. Meets ELV requirements and is REACH compliant.

Steel, stainless, copper, brass, bronze, titanium, and aluminum are the basic metals that can be enhanced by the use of one of the many types of NEDOX. Abrasion resistance, lubricity, corrosion resistance and/or mold release can be obtained through the use of NEDOX.

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HI-T-LUBE®

For Steel, Stainless, Copper Alloys

MAGNADIZE®

For Magnesium Alloys

COATING DESCRIPTION

This multi-layer, metallic dry-film lubricant coating is recognized by the "Guinness Book of Records" as the solid with the lowest coefficient of friction. Deposited sequentially, then through a proprietary diffusion process, it produces an extremely dense, malleable lubricating surface, capable of surviving in a broad temperature range and under high loads.

A proprietary coating system that surpasses all other current methods of magnesium treatment for the prevention of oxidation and galling. Additional enhancement of this coating is achieved by an infusion of supplementary proprietary polymers or dry film lubricants.

HARDNESS, WEAR AND ABRASION

Wear rate is negligible after break-in period. Can withstand extremely high compression loads (in excess of 150,000 psi).

Up to Rc 58 to 60. Additional dry films can be applied for special longer wear characteristics.

**FRICTION PROPERTIES
ASTM D 1894-01**

(Friction values will vary based on mating surfaces.)

Coefficient of friction: after break-in burnishing, as low as 0.03. Lowest coefficient of friction of any solid in the world.

Coefficient of friction: as coated, 0.12 to 0.15; with supplementary surface coatings of dry lubricants or proprietary polymers, it can be as low as 0.04.

**CORROSION RESISTANCE
ASTM B 117**

Up to 200 hours in salt spray at 0.001" thickness.

Up to 75 hours, as coated; with supplementary proprietary treatment, 300 hours; with some grades of proprietary polymer, over 1000 hours salt spray resistance is obtainable.

TEMPERATURE

(Results depend upon the process specified and the alloy used.)

Operating Range: -360°F (-218°C) to +1000°F (+538°C). Coating can be modified to withstand higher temperatures depending on application.

Operating Range: -100°F (-73°C) to +550°F (+288°C).

THICKNESS

Range: 0.0007" to 0.0015". Control of coating is ± 0.0003 " for 0.001" thickness. Thickness may vary with application load.

Meets the requirements of MIL-M-45202 and AMS-2476. Thickness range 0.0002 to 0.003". Surface growth is up to 70% of total thickness, depending on type and class.

**FDA/USDA
FDA 21 CFR 175.300****APPLICATIONS**

A solid, multi-metal lubricant that can operate in a vacuum with no outgassing or in high radiation environments. Ideal for use on splines, gears, bearings, rails, aircraft impellers, etc.

Ideal for use on frames, housings, gear boxes, wheels and any light weight, low inertia-required components. Sealed MAGNADIZE coatings prevent outgassing in vacuum applications.

CANADIZE®

For Titanium Alloys

MAGNAPLATE HCR®/HCR-F™

For Aluminum Alloys

MAGNAPLATE HMF®

For Most Base Metals

A hydrogen-free, super-hard, fracture-free coating process specifically developed to prevent hydrogen absorption, a major problem often encountered in the surface treatment of titanium and titanium alloys. Exceeds performance requirements of AMS 2488.

High-technology coatings that increase atmospheric corrosion protection beyond all known methods of aluminum treatment while also providing superior coefficient of friction.

The coating creates an ultra-hard, mirror-smooth, highly reflective surface that exhibits a uniquely low coefficient of friction, exceptional wear properties and high temperature resistance.

Up to Rc 45.

Up to Rc 48. Equilibrium Wear Rate using Taber abrasion testing method #6192 of Fed. Std. #141 (CS-17 wheel): .0275 mg per 1000 cycles. Exceeds AMS requirements by 5 times.

Up to Rc 68. Equilibrium Wear Rate using Taber Abrasion testing methods (CS-10 wheel): 0.2 to 0.4 mg per 1000 cycles.

Coefficient of friction: as coated 0.15; with dry film lubricants, as low as 0.04. Available with a variety of dry lubricants or can be combined with proprietary polymers.

Coefficient of friction: as low as 0.09.

Coefficient of friction as low as 0.05 without the use of polymers. Eliminates "stick slip" and undesirable vibration.

Titanium's natural resistance to corrosion is enhanced by the CANADIZE process.

Total maximum achieved on 6061-T6 has exceeded 15,000 hours.

Exceeds 336 hours when thickness is 0.001" or greater. Cosmetics of chrome, but with greater corrosion resistance, and without the environmental concerns normally associated with chrome plating.

Operating Range: -200°F (-129°C) to +1200°F (+649°C).

Operating Range: -110°F (-79°C) to as high as +600°F (+316°C) in intermittent operating conditions.

Operating Range: -250°F (-157°C) to +950°F (+510°C).

Range: 0.0001" to 0.0006". Titanium 6AL4V produces the best oxide coating.

Range: 0.001" to 0.0025" per side (±10%). Growth is approximately 50% of the thickness value.

Range: 0.001" to 0.002" growth per surface.

Can be FDA and USDA compliant.

Complies with FDA and USDA codes.

CANADIZE enhances surface hardness, eliminates galling, binding and seizing, and does not absorb hydrogen during processing. Provides permanent dry lubricity. Used extensively on aerospace and aircraft components.

MAGNAPLATE HCR on aluminum offers optimum service life for most applications — particularly where corrosion is a problem. Excellent dielectric properties—up to 2000V.

Recommended for packaging machines, closure devices, chutes, hoppers, folders, rolls, lathe beds, ball valves, and areas where high wear is encountered, as well as for products where a microfinish and/or static reduction is vital.

PLASMADIZE®

For Most Base Metals

LECTROFLUOR®

For Most Base Metals or
Mixed Metal Combinations

NEDOX PF-F™

Low Friction and Wear Resistance
without Polymers for Most Metals

This next generation of thermal spray coatings features high levels of wear and corrosion resistance, dry-lubricity and mold release not possible with conventional spray methods. Infused matrix of metals, ceramics, proprietary polymers and/or dry lubricants creates structural integrity and a non-porous surface.

Provides unsurpassed abrasion resistance for diffuse loads. PLASMADIZE coatings exhibit improvement in wear resistance over conventional plasma-applied tungsten carbide coatings, and up to 30% over surfaces produced by plasma-applied ceramic coatings. Long-term wear resistance is exceptional for all PLASMADIZE coatings.

PLASMADIZE provides a highly lubricious, non-stick surface with a coefficient of friction as low as 0.06 compared to a COF of 0.22 for thermal sprayed tungsten carbide.

PLASMADIZE coatings can exceed 1000 hours salt spray, depending on the coating type used. Resists most acids, alkalis, and organic solvents.

Operating Range: -200°F (-129°C) to +1300°F (+704°C).

Normal coating thicknesses range from 0.002" to 0.010". Thicker coatings can be applied for salvage and repair of parts, depending on the application.

Many comply with FDA and USDA codes.

PLASMADIZE is ideal for protecting or restoring all types of metal parts. Available as a release (non-stick) or gripping surface up to +1300°F (+704°C). Ideal for a wide range of food, packaging and oil and gas industries.

A series of proprietary polymer and copolymer based coatings that exhibit superior chemical and corrosion resistance in extremely hostile environments, at both high and low temperatures. Coatings have excellent mold release properties, very low COF.

A series of surface coatings with basic hardness ranging from Shore D 75 – 85.

Coefficient of friction: as low as 0.048.

Resistance to most acid and alkaline environments is excellent. For specific chemical environments, consult General Magnaplate for the recommended LECTROFLUOR coating.

Operating Range: -400°F (-240°C) to +600°F (+315°C).

Range: 0.001" to 0.030".

Many comply with FDA and USDA codes.

Recommended for use wherever lubrication, protection against corrosion, release, radiation- and UV-resistance are required. Also used in dielectric applications. 600-2000 V/mil ASTM D 149. Breakdown voltage 700v-8400v.

When particulate generation from polymers and dry lubricants are undesirable, NEDOX PF-F minimizes heat buildup and friction, and provides corrosion, wear and abrasion resistance at temperatures up to 1500°F. Non-shedding and non-outgassing.

Excellent wear and abrasion resistance. Hardness ranges from Rc51 (as plated), to greater than Rc 68 (with heat treatment). Taber abrasion tests per ASTM D4060 with CS10 wheel, weight loss ranges in mg/10,000 cycles from 21.5 (as plated) to 65.7 (with heat treatment).

COF ranges from Static 0.119, Kinetic 0.106 as plated; to Static 0.150 and Kinetic 0.143 with heat treatment.

Exceeds 1000 hours salt spray (salt fog).

Operation Range: up to 1500°F (815°C)

0.0003-0.0015"

FDA compliant

Applications include composite tooling, plastic molding and semiconductor equipment, high temperature valve applications, aerospace components.

MAGNAPLATE TNS™/TNSF™

For Most Base Metals and
Fiberglass/Plastics

MAGNAPLATE 10K™ SERIES

The Next Generation of High Temperature
Coatings – Beat the Heat – Get Release

MAGNAGOLD® / GOLDENEDGE®

For Most Base Metals

Non-stick release coatings prevent residue buildup on labeling equipment and metal parts in contact with tapes, adhesives or hot melt glue.

Each of the three types of Magnaplate 10K can be applied to select coating families. 10K series offers many benefits including release at high temperatures, low surface energy, excellent hydrophobic properties and have no PFOA or fluoropolymers.

Enhanced PVD coatings. MAGNAGOLD is processed at lower temperatures, allowing the coating of a greater variety of materials without causing loss of hardness or distortion of the substrate. GOLDENEDGE provides an ultra-hard, micro-thin surface enhancement for blades or other sharp-edged devices. Lengthening service life by as much as 20 times.

Typically Rc 35. Nominal abrasion resistance as measured by Taber Abrasion using CS-17 wheel; can be as low as 0.5 mg per 1000 cycles depending on surface roughness.

Excellent abrasion resistance through a wide range of operating temperatures.

Up to a hardness equivalent of Rc 85. Equilibrium Wear Rate using Taber abrasion testing methods #6192 of Fed. Std. #141 (CS-10 wheel): 0.5mg per 10,000 cycles. A thin, dense surface coating that wears better than most metals.

Generally 0.2 to 0.35 depending on surface roughness. Lower surface roughness will have lower COF at some reduction in release.

The 10K Series of coatings have excellent coefficient of friction values. Samples were tested per ASTM D1894, and results show that 10K coatings function after being exposed to temperatures well beyond the capabilities of standard polymer coatings.

As low as 0.11 depending on original microfinish or mating surface.

Resistance may vary depending on materials used.

Salt spray tests on 10K3 showed corrosion protection exceeds 2400 hours.

Resistant to most acids, alkalis, fluxes, solders, and weld splatter.

Service temperature up to 300°F (149°C). TNSF can withstand 600°F without significant thermal degradation.

10K1 operating temperatures up to 1000°F
10K2 operating temperatures up to 1000°F
10K3 operating temperatures up to 850°F

Operating range: -360°F (-218°C) to as high as +800°F (+427°C) for intermittent operating conditions, depending upon the process specified and the alloy used.

0.002" to 0.005".

0.0002-0.002"

MAGNAGOLD – A thin uniform coating ranging in thickness from 0.00004" to 0.00030" or 1 to 7.5 microns. Meets performance requirements of AMS 2444. GOLDENEDGE – A thin uniform coating ranging in thickness from 0.00004" to 0.00006" or 1.0 to 1.5 microns.

MAGNAPLATE TNSF has been formulated to provide adhesive and glue release along with offering FDA compliance for direct food contact. Can be engineered to comply with USDA codes.

Complies with FDA and USDA codes.

Comply with FDA and USDA codes.

Most parts used in the manufacture or handling of adhesives or hot melt glue. Increases service life of machinery where sticking or buildup is a problem.

Seal jaws, griddles, autoclaves, turbines, mandrels, molds and dies.

Typical MAGNAGOLD applications include punches, hobs, dies, bearings, taps and more; also used on aerospace components. GOLDENEDGE enhances sanitation in cutting, dicing, grinding, slicing, and sawing operations, among others. Reduces blade changing by keeping edges sharper longer.

MAGNAPLATE HTR®

For Extreme Temperatures

MAGNAMAX-HT™

For Extreme Temperatures

DYNALLOY®

For Most Base Metals

MAGNAPLATE HTR dramatically increases release efficiency and resistance to wear at high pressures and very high temperatures.

MAGNAMAX-HT is a solid dry film lubricant that can withstand high temperatures while providing a low coefficient of friction. Provides high oxidation resistance.

An extremely thin, enhanced proprietary chrome process for most base metals and protects against wear, galling, friction and corrosion. DYNALLOY creates a micro-surface that aids in lubricant dispersion.

MAGNAPLATE HTR can be used as an additional enhancement for TUFRAM, NEDOX, or PLASMADIZE coatings.

MAGNAMAX-HT can be used as an additional enhancement for TUFRAM, NEDOX, or PLASMADIZE coatings.

The coating's hardness is in excess of Rc 67 and resists attack by most organic and inorganic compounds.

As low as 0.13 dynamic, 0.14 static.

MAGNAMAX-HT was tested in accordance with ASTM G 99 05 and ASTM D 1894-01. Pin on Disk test results showed an average COF of 0.266 at 800°C.

Some HTR coatings will survive 1000 hours in ASTM B-117 salt spray.

MAGNAMAX-HT exhibits resistance to most acids and alkaline environments.

Operating Range: 330°F (-165°C) to +950°F (+510°C).

Intermittent: over +1100°F (+593°C). Vacuum: to +2400°F (+1316°C).

The maximum operating temperature for MAGNAMAX-HT is 1500°F (815°C)

High temperature resistance up to 1700°F (927°C).

Surface build-up is from 0.0002" to 0.002".

Surface build-up is from 0.0002" to 0.002".

With a thickness ranging from 0.0001" - 0.0003", Dynaloy does not affect tolerances.

HTR is recommended for use on injection molds, seal bars, roll dies, gears and bearings, and bag formers.

MAGNAMAX-HT is ideal for applications which require a low coefficient of friction at high temperatures.

Typical applications include bearings, blades, clamps, conveyors, molds, pistons, rollers, pumps, tooling, valves and wear plates.

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