Micro Surface Corporation



Tungsten Disulfide *and* Molybdenum Disulfide Coatings

Advanced Dry Film Lubricant Coating Services From the Industry's Dry Lube Specialists

Serving many applications in Automotive • Aerospace • Energy • Military • Industrial Manufacturing & Automation • Plastics Tooling • Medical • Consumer Products • Food & Beverage • Pharmaceuticals & much more



Micro Surface – the specialists in dry lubrication coating

For many years Micro Surface Corporation has been the go-to resource for precision dry film lubricant coatings. And because the company has focused specifically on WS₂ and MoS₂ coatings, they've turned their expertise into a science – to the point of developing their own proprietary processes to optimize coating performance.

Focused and affordable

Since Micro Surface concentrates exclusively on advanced thin-film lubricant coatings they under-

stand many of the special requirements involved in dry lube applications across numerous industries, including the levels of performance professional users expect. Their unique specialization and years of experience results in consistently outstanding quality. And they know how to deliver that quality at extremely competitive prices.

Plus – fast turnaround!

Micro Surface has become known for their responsiveness and fast turnaround – in providing quotes quickly and delivering your work on time. Always coming through for the customer is Job One!

"Micro Surface is the industry's premier provider of WS₂ and MoS₂ dry lubricant coating services. They're unbeatable for quality, turnaround and affordability..."

Typical WS₂/MoS₂ applications:

- Bearings and gears
- Braking systems
- Camshafts
- Clamps, seats, seals, valves
- Compressor systems
- Fan components
- Fasteners, latches, pins, hinges
- Fuel injection systems
- Fuel pumps
- Gaskets
- Hydraulic systems
- Joints and splines
- Knives and blades
- Manifolds

- Molds
- Nuts, bolts, thread protectors
- Pins, taps, machine tools
- Piston rings and heads
- Power generation parts
- Pumps
- Riser systems
- Rollers
- Sealing rings
- Sliding Mechanisms
- Subsea connectors and seals
- Transmission plates and spacers
- Turbines
- Valves and lifters

Serving many purposes...

- To increase equipment life
- To reduce maintenance
- To reduce friction, wear, power consumption
- To reduce operation temperatures
- To reduce seizing, galling, fretting, drag
- To enhance or eliminate other lubricants
- For parts stored for long periods
- For permanent lubrication
- For parts that are inaccessible
- For frequently disassembled parts
- For loads exceeding oil and grease capacities
- To avoid attracting dirt and debris
- To provide lubrication at higher temperatures
- And much more...

Selecting the right lubricant for your application

Dry film lubricants are most often used for one of these basic purposes:

- To eliminate/reduce galling and fretting
- To extend wear life
- To minimize need for oils and greases

Our dry lubricants can each offer slightly different advantages...

WS₂ per Process SL-39

This coating is extensively used in stainless steel fastening applications, in precision bearings and gears in vacuum applications as a sole lubricant and in many industrial and automotive applications as a co-lubricant. WS₂ is also used as a semi-permanent mold release on cores, inserts, ejector pins, etc. It has the lowest coefficient of friction and the widest operating temperature range. It is also the thinnest of the dry film lubricants and does not usually affect precision machine tolerances. It does not withstand abrasive environments and delays but does not prevent corrosion.

MoS₂ per Process SL-39

MoS₂ is very similar to WS₂ and is used in many of the same applications. It is usually less expensive than WS₂ coating but it has less operating temperature range. It is a vacuum compatible lubricant and has better sliding wear resistance than WS₂. It does not withstand abrasive environments, and it delays but does not prevent corrosion.

MoS₂ per Process DL-99

This lubricant has been used extensively in military and aerospace applications and in many industrial and automotive applications requiring permanent long-term lubrication. This coating is thicker than the impinged coatings and provides excellent corrosion resistance.

Choosing the right dry film lubricant for your specific needs is often best left to your lubrication engineer. Micro Surface can assist in this determination based on our experience, and we can also provide prototype coatings for you to evaluate directly in your application.



How dry lubricants work

Dry film or "solid film" lubricants are solids applied between two surfaces in relative motion, to lower friction or reduce wear. These materials differ from oils or greases, which are solid or semi-fluid based dispersions of a thickening agent in a lubricant. Dry film lubricants are often used in extreme environments where typical hydrocarbon-based lubricants such as oil and grease are not effective. These include very high or low temperatures, extreme pressure, vacuum applications and hard to access maintenance applications where long-term lubrication is needed.

Plates that slip

The two major dry film lubricants are Tungsten Disulfide (WS₂) and Molybdenum Disulfide (MoS₂). These lubricants, along with graphite, are classed as dichalcogenides and have a lamellar lattice structure. To provide low friction these dry films feature both low shear strength and adherence to the surface. These materials have a special crystalline formation that causes them to shear into thin, flat plates that readily slide over one another and produce a "slipping" effect.

Dry Lubricants in the dichalcogenide family have weak Van Der Waals forces and strong ionic bonds in the basal planes. At a micro level, the dry lubricant functions like a series of vertically stacked plates (basal planes) supported by long unstable legs (weak Van Der Waals forces). Under applied lateral force, the legs collapse and the plates slip out of place. A strong ionic bond between the plates (basal plane) forces the slippage to be perpendicular to the basal planes. The low-friction characteristic is actually not determined by metal-to-metal or metal-to-coating contact but within the lubricant itself, particle to particle.

To avoid abrasive wear, the dry film coating must be softer than the bearing material. Generally, friction will be slightly reduced if only one surface is coated, rather than both surfaces. But wear life can increase if both surfaces are coated.

Optimizing WS₂ coating with proprietary *Process SL-39*

Through years of experience, Micro Surface Corporation has developed its own proprietary technique for optimizing the application of tungsten disulfide (WS₂). This is *Process SL-39*, and it meets DOD-L-85645 and AMS 2530.

Process SL-39 has been developed for the diffusion bonding of high-purity synthetic tungsten disulfide to all common metal surfaces. This process coats bearing surfaces without binder materials and with no detrimental effects to the treated surfaces. This WS₂ thin film is suitable for use on high-precision assemblies without causing measurable interference or requiring additional tolerances. Once applied, the film becomes an integral part of the substrate and does not crack, peel or wipe off.

WS₂ per *Process SL-39* Is virtually inert and remains stable and insoluble in almost all atmospheres. The coating is impervious to most solvents and is non-toxic and noncorrosive. it is insensitive to liquid oxygen and nitrogen and unaffected by radiation. WS₂ coating can be attacked by free fluorine gas and by hot sulfuric and hydrofluoric acids. It is not designed to provide substantial corrosion protection to the substrate.

Optimizing MoS₂ coating with proprietary *Process DL-99*

To optimize the application of molybdenum disulfide (MoS₂) Micro Surface has developed its own proprietary *Process DL-99* which meets MIL-PRF-46010 and AS5272.

The unique *Process DL-99* incorporates resins, binders and a heat-curing process, and it gives the benefit of corrosion protection in addition to lubricity. This coating is slightly thicker than some of Micro Surface's other dry film lubricant coatings such as tungsten disulfide (WS₂) per *Process SL-39* and molybdenum disulfide (MoS₂) processed in the same manner (AMS2530/AMS2526).

This bonded dry film lubricant starts out as a highperformance, paint-like coating consisting of the lubricating ingredient, molybdenum disulfide, blended with binders and proprietary additives. After application and proper curing, these lubricants bond to the substrate to create a solid film lubricant that reduces friction, greatly increases wear life and gives corrosion protection in harsh environments.

Applications for WS₂ per Process SL-39

AMS2530 and DOD-L-85645A Type I

Tungsten Disulfide coating, binder-less, impingement applied per specification:

This product has been used typically on metal parts and selected nonmetallic parts where a friction-reducing coating under 0.00002" thick is required and where wear, galling, seizure and fretting need to be minimized, but usage is not limited to such applications.

This lubricating film has been shown to be compatible with such fluids as reagent grade water, petroleum based hydraulic fluid, petroleum based oils and greases, SAE phosphate ester test fluid #1, silicone fluid, UDMH compatible grease, IFRNA compatible grease, solid rocket propellants, nitrogen tetroxide, liquid oxygen and hard radiation environments.

Applications for MoS₂ per Process SL-39 AMS2526

Molybdenum Disulfide coating, impingement applied per specification:

This product has been used on metal parts and selected nonmetallic parts requiring a coating under 0.0001" thick for reducing wear or minimizing galling, but usage is not limited to such applications.

This dry lubricating film may be applied to surfaces of ferrous and nonferrous metals and alloys, thermoplastic and thermosetting polymers and rubber. Aluminum, magnesium and ferrous alloys, other than corrosion resistant types, either coated or in contact with other parts having this coating, may be susceptible to corrosion.

This film has been shown to be compatible with such fluids as distilled water, petroleum based hydraulic fluid, SAE phosphate ester test fluid #1, silicone fluid, UDMG compatible grease, IFRNA compatible grease, solid rocket propellants, nitrogen tetroxide and liquid oxygen.

Applications for MoS₂ per Process DL-99

AS5272 Type I, II and III

Molybdenum Disulfide coating, heat-cured, corrosion-inhibiting, per manufacturer:

These dry film lubricants are paint-like coatings containing molybdenum disulfide and corrosion inhibiting pigments. These heat-curing materials prevent corrosion, galling, seizing and fretting. They are low-friction coatings that can operate in a wide temperature range and in extreme pressure environments.

Typical uses are for parts that are operated in corrosive environments, that may be stored for long periods of time, that are seldom lubricated and permanent lubrication is desired, where operating pressures exceed the load bearing capabilities of ordinary oils and greases, or where clean operation is desired.

These films have been shown to be compatible with or resistant to isopropyl and ethyl alcohol, mineral spirits/paint thinners, toluene, acetone, Skydrol 500, hydraulic fluids, anti-icing fluids, diethanolamine, hydrochloric acid (10%), sodium hydroxide (10%), distilled water, jet fuels and trichloroethylene.



	WS ₂ per Process SL-39	MoS ₂ per Process SL-39	MoS ₂ per Process DL-99
Mil Spec	DOD-L-85645A TYPE I / AMS 2530	AMS 2526	AS5272 TYPE 1,2,3 / MIL-PRF-46010 (AS5272 Type III and MIL-PRF-46010 are technically equivalent)
Curing	Not required	As required, not to exceed 310°F	Type I: 1 Hr @ 302°F Type II: 1 Hr @ 400°F Type III: 1 Hr @ 400°F or 2 Hr @ 302°F
Thickness	0.00002"	< 0.0001"	0.0002 - 0.0007"
Color	Bluish gray, reflects substrate	Bluish gray, reflects substrate	Flat matte gray
Coefficient of Friction	0.025-0.065	0.03 - 0.06	0.02 - 0.09
Maximum Operating Temp (In Air)	1200°F	662°F	Type I: 400°F Type II: 500°F Type III: 500°F
Maximum Operating Temp (In Vacuum)	2400°F	1200°F	Type I: 400°F Type II: 500°F Type III: 500°F
Wear Rate	Not specified, similar to AMS 2526	>15 Minutes ASTM D 2714 Procedure A	Type I: 298 Minutes Type II: 496 Minutes Type III: 508+ Minutes ASTM D 2625A
Corrosion Resistance	Minimal, will delay corrosion but not prevent it	Minimal, will delay corrosion but not prevent it	Excellent for Types I, II and III

Coating Performance Comparisons









Timesaver Lapping Compounds

In addition to dry film lubricants, Micro Surface also offers two series of Timesaver lapping compounds: Green Label Timesaver for harder metals and Yellow Label Timesaver for softer metals. Timesaver lapping compounds are specially formulated to act first as an abrasive, then diminish to a polish and finally to an inert material. These lapping compounds will not imbed into metal surfaces and will not continue to cut. Timesaver compounds are designed to be mixed with oil to the desired consistency by the user at the time of application.

Green Label Timesaver can be used on hard metals such as cast iron, steel, stainless steel and hard bronze friction surfaces where accurate fits are required. such as valve seats, machine tool ways, tool room applications, gear units, cylinder walls, cast iron bearings, precision fitting of steel parts and similar uses. Yellow Label Timesaver is intended for softer metals such as babbitt, brass, bronze and aluminum — for split bearings, sleeve bearings, hot bearings and gears, for fitting bearings, valves, bushings, worm gears, fitting metal guides, and more.

Green Label and Yellow Label Timesaver Compounds both come in a range of grades, from coarse to very fine, for rough lapping to finish lapping and polishing.

Micro Surface Corporation, quality since 1919

The company began operation in 1919 as Timesaver Products Company Inc., makers of Timesaver brand lapping compounds, serving military and automotive industries worldwide with products for lapping bearings, machine tools, molds and more.

In the early 1980s, we added advanced dry lubricants and the company became Micro Surface Corporation. We were able to transfer lubricant technology developed by NASA to high-tech commercial applications, and we expanded our offerings to include WS, coating services. WS, was originally developed as a permanent lubricant for the Mariner Space Mission; today it is used on countless applications from gears and bearings to molds and robotics automation. Our next major advance was the introduction of our proprietary Process SL-39, which dramatically improved the finish and quality of WS, coating. Later, we began utilizing a similar process to enhance our molybdenum disulfide (MoS₂) coatings.

Today, Micro Surface is located in San Jose, California, the heart of Silicon Valley. We provide dry film lubricant coating services to customers across the country, and we ship our Timesaver Lapping Compounds around the world. Current ownership has been in place since 2003, and we continue to build upon our decades-long reputation for guality dry lubricant coatings, fast turnarounds and very attractive pricing.



Micro Surface Corporation

270 Hillsdale Avenue, San Jose, CA 95136 (408)723-0700 • info@ws2coating.com www.ws2coating.com

Friction as a Function of Pressure