Product Information

DOW CORNING

High Performance Lubricants

Molykote® 321 Dry Film Lubricant and *Molykote*® 321 Dry Film Lubricant Spray

Dry film lubricant for components used intermittently or those exposed to unusual environments

FEATURES

- Lubricates over a wide temperature range of -290 to 840°F (-178 to 450°C)
- Has an exceptionally low coefficient of friction
- Air dries in 20 to 30 minutes; completely cures in 4 hours
- Reduces wear normally associated with running-in new or rebuilt equipment
- Remains stable in many extreme environments such as vacuum and radiation due to its dry form
- Lubricates effectively even after long periods of non-use and will not wash out or attract and hold dust or dirt
- Adheres to most clean metal surfaces
- Resists chemicals and fuels

COMPOSITION

- Solvent dispersion of MoS_2, graphite and inorganic binder
- Supplied as pourable liquid and aerosol; cures to dry lubricating film

USES

Molykote® 321 Dry Film Lubricant is designed for use on parts that are inaccessible for lubrication after assembly; require a dry, thin lubricating film; or normally experience high initial wear on running-in new or rebuilt equipment. It has also been successfully used in a variety of metal-working applications. *Molykote* 321 Dry Film Lubricant can be used on:

- Cutting tools – broaches, gear cutters, milling cutters, taps, drills, reamers, chasers, punches, etc.
- Railroad pins – brake pins and levers, roll stabilizer pins, trip pivots, eccentric bolts
- Splines, threaded connections, disconnects
- Aircraft engines for air foil lubrication
- Instruments operating in unusual environments, such as in a vacuum, near radiation or in extreme low or high temperatures
- Metal forming
- Aluminum to aluminum and aluminum to steel surfaces

TYPICAL PROPERTIES

These values are not intended for use in preparing specifications.

Method	Test	Unit	Result
As Supplied			
	Specific Gravity at 77°F (25°C)		0.97
	Viscosity at 77°F (25°C), Zahn #1	sec	32
	Density	lb / gal	8.3
	Approximate Coverage (0.0007-in thick)	sq ft / gal	780
	Flash Point, closed cup	°F (°C)	102 (39)
As Cured			
	Color		Gray-black
	Binder Type		Inorganic
CTM 0409[1]	Endurance Life[2], 1000 lb	minutes	71
CTM 0389	Load-Carrying Capacity[3]	N	11,250
CTM 0394	Coefficient of Friction[4]		0.07
	Adhesion, on metals and glass		Good
	Fluid Resistance	Ethanol, methyl isobutyl ketone, acetone, silicone fluid, water, methanol, acetone, benzene, naphtha, hydrazine (product is, however, attacked by N_2O_4)	

[1]Corporate Test Methods (CTMs) correspond to standard ASTM tests in most instances. Copies of CTMs are available upon request.

[2]Federal test method 791a-3807, falex pin and vee block.

[3]Federal test method 791-3812, falex pin and vee block.

[4]LFW-4 press fit test.

Specification Writers: Please obtain a copy of the Dow Corning Sales Specification for this product and use it as a basis for your specifications. It may be obtained from any Dow Corning Sales Office, or from Dow Corning Customer Service in Midland, MI. Call (989) 496-6000.

Table I: Recommended Pretreatments For Metal Surfaces

Pretreatment	Steel	Plated Cr or Ni	Metals Cd or Ni	Al Alloys	Cu Alloys	Mg Alloys	Ti Alloys
Degrease	X	X	X	X	X	X	X
Removes Oxides							
Bright Dip					X		
Sandblast	X	X					X
Anodize				X			
Dichromate						X	
Phosphate	X		X				

DESCRIPTION

Molykote 321 Dry Film Lubricant is a selected blend of solid lubricants of controlled particle size dispersed with an inorganic binder in a solvent system. *Molykote* 321 Dry Film Lubricant Spray is an aerosol package using bulk material solvent and propellant. After the solvent evaporates, the coating cures at room temperature to form a solid lubricant.

USE LIMITATIONS

Molykote 321 Dry Film Lubricant may affect certain plastics, rubbers and paints. Test thoroughly before use.

This product is neither tested nor represented as suitable for medical or pharmaceutical uses.

HOW TO USE

Surface Preparation

Parts to be coated should be clean and dust-free. *Molykote* 321 Dry Film Lubricant may be applied directly to ground or to highly machined surfaces. **The best performance has been found on metal surfaces that have been abrasive-blasted so that the surface has a random orientation of 20 to 30 rms finish.** Certain surface pretreatments can further enhance the performance and endurance life of the coating (see Table I).

Application Methods

Molykote 321 Dry Film Lubricant may be applied by spraying, dipping or brushing. Spraying usually produces the most uniform and precisely controlled film thickness. Dipping is also good if a high degree of uniformity is not essential.

Because solids tend to settle rapidly, keep material agitated continuously and keep container covered to prevent resin hydrolysis and solvent loss.

Molykote 321 Dry Film Lubricant requires no dilution before use unless solvent has been lost by evaporation. If so, add naphtha solvent to restore the original viscosity. Some addition of solvent may also be desirable for dipping or brushing.

When spraying, use a commercial spray gun of 1-quart capacity or less. A spray booth is desirable. Make sure the working area is adequately ventilated and observe the usual precautions for spray painting. **Keep the product well mixed both in the reservoir and when circulating to and from the spray nozzle.** Check to see that all elastomers in the spray system can be used with a naphtha solvent.

To obtain the best adhesion and wear life, apply a coating no more than 0.001-inch thick. A single wet pass of spray usually deposits a film of about 0.0005- to 0.0008-inch thick. Where uniformity is especially important, place parts on a screen during spraying to minimize excessive coating buildup due to “flashback.” Fitting parts on a jig and rotating while spraying also helps.

When dipping, required equipment includes a pan or bath and an easily removable rack or basket. Place parts in the basket and dip briefly. **A motor-driven agitator is useful to keep solids in suspension.**

Brushing is recommended only when spraying or dipping is impractical or where uniformity is not required. Use any ordinary paint brush.

Molykote 321 Dry Film Lubricant Spray in aerosol cans may be used for small volume production runs or for final touchups.

Curing

Molykote 321 Dry Film Lubricant is dry to the touch within 30 minutes after application. However, for maximum performance, the coating must be cured by hydrolysis from contact with atmospheric moisture. In a normal room environment of 50 percent relative humidity, the film will cure in approximately four hours.

Removal of Cured Film

Ethyl acetate, toluene or xylene can be used to scrub off *Molykote* 321 Dry Film Lubricant after soaking.

STORAGE AND SHELF LIFE

When stored under normal warehouse conditions below 90°F (32°C), *Molykote* 321 Dry Film Lubricant has a useable life of 24 months from date of manufacture. *Molykote* 321 Dry Film Lubricant Spray has a useable life of 60 months from date of manufacture.

SHIPPING LIMITATIONS

Molykote 321 Dry Film Lubricant is a combustible liquid. *Molykote* 321 Dry Film Lubricant Spray is an extremely flammable gas.

PACKAGING

Molykote 321 Dry Film Lubricant is available in 1-gal and 5-gal pails.

Molykote 321 Dry Film Lubricant Spray is available in 16-oz aerosol cans containing 11 oz (312 g), net weight.

SAFE HANDLING INFORMATION

PRODUCT SAFETY INFORMATION REQUIRED FOR SAFE USE IS NOT INCLUDED. BEFORE HANDLING, READ PRODUCT AND MATERIAL SAFETY DATA SHEETS AND CONTAINER LABELS FOR SAFE USE, PHYSICAL AND HEALTH HAZARD INFORMATION. THE MATERIAL SAFETY DATA SHEET IS AVAILABLE FROM YOUR DOW CORNING REPRESENTATIVE, OR DISTRIBUTOR, OR BY WRITING TO DOW CORNING CUSTOMER SERVICES, OR BY CALLING (989) 496-6000.

WARRANTY INFORMATION – PLEASE READ CAREFULLY

The information contained herein is offered in good faith and is believed to be accurate. However, because conditions and methods of use of our products are beyond our control, this information should not be used in substitution for customer's tests to ensure that Dow Corning's products are safe, effective, and fully satisfactory for the intended end use.

Dow Corning's sole warranty is that the product will meet the Dow Corning sales specifications in effect at the time of shipment. Your exclusive remedy for breach of such warranty is limited to refund of purchase price or replacement of any product shown to be other than as warranted. Dow Corning specifically disclaims any other express or implied warranty of fitness for a particular purpose or merchantability. Unless Dow Corning provides you with a specific, duly signed endorsement of fitness for use, Dow Corning disclaims liability for any incidental or consequential damages. Suggestions of use shall not be taken as inducements to infringe any patent.

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DOW CORNING

DOW CORNING CORPORATION
Material Safety Data Sheet

Version: 1.3
Revision Date: 2006/08/14

MOLYKOTE(R) 321 DRY FILM LUBRICANT

1. IDENTIFICATION OF THE SUBSTANCE AND OF THE COMPANY

Dow Corning Corporation
South Saginaw Road
Midland, Michigan 48686

24 Hour Emergency Telephone: (989) 496-5900
Customer Service: (989) 496-6000
Product Disposal Information: (989) 496-6315
CHEMTREC: (800) 424-9300

MSDS No.: 02412241 Revision Date: 2006/08/14

Generic Description: inorganic compound in solvent
Physical Form: Liquid
Color: Charcoal gray
Odor: Solvent odor.

NFPA Profile: Health 2 Flammability 2 Instability/Reactivity 0

Note: NFPA = National Fire Protection Association

2. HAZARDS IDENTIFICATION

POTENTIAL HEALTH EFFECTS

Acute Effects

Eye: Direct contact may cause severe irritation. Vapor may cause eye irritation.

Skin: No significant irritation expected from a single short-term exposure.

Inhalation: Vapor may irritate nose and throat. Overexposure by inhalation may cause drowsiness, dizziness, confusion or loss of coordination.

Oral: May cause vomiting. Aspiration of liquid while vomiting may injure lungs seriously.

Prolonged/Repeated Exposure Effects

Skin: Repeated or prolonged contact may cause defatting and drying of skin which may result in skin irritation and dermatitis. Repeated or prolonged exposure may cause irritation.

Inhalation**:** No known applicable information.

Oral: Repeated ingestion or swallowing large amounts may injure internally.

Signs and Symptoms of Overexposure

No known applicable information.

Medical Conditions Aggravated by Exposure

No known applicable information.

The above listed potential effects of overexposure are based on actual data, results of studies performed upon similar compositions, component data and/or expert review of the product. Please refer to Section 11 for the detailed toxicology information.

3. COMPOSITION/INFORMATION ON INGREDIENTS

CAS Number	Wt %	Component Name
8052-41-3	> 60.0	Stoddard solvent
1317-33-5	15.0 - 40.0	Molybdenum disulfide
9022-96-2	10.0 - 30.0	Polybutyl titanate
7782-42-5	5.0 - 10.0	Graphite
60580-61-2	1.0 - 5.0	5-Nitro-1,3- benzenedicarboxylic acid, zinc salt

The above components are hazardous as defined in 29 CFR 1910.1200.

4. FIRST AID MEASURES

Eye:	Immediately flush with water for 15 minutes. Get medical attention.
Skin:	Remove from skin and wash thoroughly with soap and water or waterless cleanser. Get medical attention if irritation or other ill effects develop or persist.
Inhalation:	Remove to fresh air. Get medical attention if ill effects persist.
Oral:	Get immediate medical attention. Only induce vomiting at the instructions of a physician. Never give anything by mouth to an unconscious person.
Notes to Physician:	Treat according to person's condition and specifics of exposure.

5. FIRE FIGHTING MEASURES

Flash Point:	107.6 °F / 42 °C (Closed Cup)
Autoignition Temperature:	Not determined.
Flammability Limits in Air:	Not determined.
Extinguishing Media:	On large fires use dry chemical, foam or water spray. On small fires use carbon dioxide (CO2), dry chemical or water spray. Water can be used to cool fire exposed containers.

Fire Fighting Measures:	Self-contained breathing apparatus and protective clothing should be worn in fighting large fires involving chemicals. Determine the need to evacuate or isolate the area according to your local emergency plan. Use water spray to keep fire exposed containers cool.
Unusual Fire Hazards:	Static electricity will accumulate and may ignite vapors. Prevent a possible fire hazard by bonding and grounding or inert gas purge.

6. ACCIDENTAL RELEASE MEASURES

Containment/Clean up:	Remove possible ignition sources. Determine whether to evacuate or isolate the area according to your local emergency plan. Observe all personal protection equipment recommendations described in Sections 5 and 8. For large spills, provide diking or other appropriate containment to keep material from spreading. If diked material can be pumped, store recovered material in appropriate container. Clean up remaining materials from spill with suitable absorbant. Clean area as appropriate since spilled materials, even in small quantities, may present a slip hazard. Final cleaning may require use of steam, solvents or detergents. Dispose of saturated absorbant or cleaning materials appropriately, since spontaneous heating may occur. Local, state and federal laws and regulations may apply to releases and disposal of this material, as well as those materials and items employed in the cleanup of releases. You will need to determine which federal, state and local laws and regulations are applicable. Sections 13 and 15 of this MSDS provide information regarding certain federal and state requirements.

Note: See section 8 for Personal Protective Equipment for Spills. Call (989) 496-5900, if additional information is required.

7. HANDLING AND STORAGE

Use with adequate ventilation. Product evolves n-butyl alcohol when exposed to water or humid air. Provide ventilation during use to control n-butyl alcohol within exposure guidelines or use respiratory protection. Avoid eye exposure. Avoid skin contact. Do not take internally. Avoid breathing vapor. Keep container closed.

Static electricity will accumulate and may ignite vapors. Prevent a possible fire hazard by bonding and grounding or inert gas purge. Keep container closed and away from heat, sparks, and flame.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Component Exposure Limits

CAS Number	Component Name	Exposure Limits
8052-41-3	Stoddard solvent	OSHA PEL (final rule): TWA 500 ppm and ACGIH TLV: TWA 100 ppm.
9022-96-2	Polybutyl titanate	See n-butyl alcohol comments.

7782-42-5	Graphite	OSHA PEL (final rule): TWA 15 mg/m3 total dust, 5 mg/m3 respirable fraction. ACGIH TLV: TWA 2 mg/m3 respirable fraction.

n-Butyl alcohol is formed on contact with water or humid air. Provide adequate ventilation to control exposures within guidelines of OSHA PEL (final rule): TWA 100 ppm and ACGIH TLV: 20 ppm.

Engineering Controls

Local Ventilation:	Recommended.
General Ventilation:	Recommended.

Personal Protective Equipment for Routine Handling

Eyes:	Use chemical worker's goggles.
Skin:	Wash at mealtime and end of shift. Contaminated clothing and shoes should be removed as soon as practical and thoroughly cleaned before reuse. Chemical protective gloves are recommended.
Suitable Gloves:	Teflon(R). Polyvinylalcohol. Silver Shield(R). Viton(R). 4H(R).
Inhalation:	Use respiratory protection unless adequate local exhaust ventilation is provided or exposure assessment demonstrates that exposures are within recommended exposure guidelines. IH personnel can assist in judging the adequacy of existing engineering controls.
Suitable Respirator:	General and local exhaust ventilation is recommended to maintain vapor exposures below recommended limits. Where concentrations are above recommended limits or are unknown, appropriate respiratory protection should be worn. Follow OSHA respirator regulations (29 CFR 1910.134) and use NIOSH/MSHA approved respirators.

Personal Protective Equipment for Spills

Eyes:	Use full face respirator.
Skin:	Wash at mealtime and end of shift. Contaminated clothing and shoes should be removed as soon as practical and thoroughly cleaned before reuse. Chemical protective gloves are recommended.
Inhalation/Suitable Respirator:	Respiratory protection recommended. Follow OSHA Respirator Regulations (29 CFR 1910.134) and use NIOSH/MHSA approved respirators. Protection provided by air purifying respirators against exposure to any hazardous chemical is limited. Use a positive pressure air supplied respirator if there is any potential for uncontrolled release, exposure levels are unknown, or any other circumstance where air purifying respirators may not provide adequate protection.

Precautionary Measures:	Avoid eye exposure. Avoid skin contact. Do not take internally. Avoid breathing vapor. Keep container closed. Use reasonable care.
Comments:	Product evolves n-butyl alcohol when exposed to water or humid air. Provide ventilation during use to control n-butyl alcohol within exposure guidelines or use respiratory protection.

Note: These precautions are for room temperature handling. Use at elevated temperature or aerosol/spray applications may require added precautions. For further information regarding aerosol inhalation toxicity, please refer to the guidance document regarding the use of silicone-based materials in aerosol applications that has been developed by the silicone industry (www.SEHSC.com) or contact the Dow Corning customer service group.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical Form:	Liquid
Color:	Charcoal gray
Odor:	Solvent odor.
Specific Gravity @ 25°C:	0.97
Viscosity:	> 50 cSt
Freezing/Melting Point:	Not determined.
Boiling Point:	> 35C/95F
Vapor Pressure @ 25°C:	Not determined.
Vapor Density:	Not determined.
Solubility in Water:	Not determined.
pH:	Not determined.
Volatile Content:	Not determined.
Flash Point:	107.6 °F / 42 °C (Closed Cup)
Autoignition Temperature:	Not determined.
Flammability Limits in Air:	Not determined.

Note: The above information is not intended for use in preparing product specifications. Contact Dow Corning before writing specifications.

10. STABILITY AND REACTIVITY

Chemical Stability:	Stable.
Hazardous Polymerization:	Hazardous polymerization will not occur.
Conditions to Avoid:	None.
Materials to Avoid:	Oxidizing material can cause a reaction.

Hazardous Decomposition Products

Thermal breakdown of this product during fire or very high heat conditions may evolve the following decomposition products: Carbon oxides and traces of incompletely burned carbon compounds. Metal oxides. Nitrogen oxides. Sulfur

oxides. Formaldehyde.

11. TOXICOLOGICAL INFORMATION

Special Hazard Information on Components

No known applicable information.

12. ECOLOGICAL INFORMATION

Environmental Fate and Distribution

Complete information is not yet available.

Environmental Effects

Complete information is not yet available.

Fate and Effects in Waste Water Treatment Plants

Complete information is not yet available.

Ecotoxicity Classification Criteria

Hazard Parameters (LC50 or EC50)	High	Medium	Low
Acute Aquatic Toxicity (mg/L)	<=1	>1 and <=100	>100
Acute Terrestrial Toxicity	<=100	>100 and <= 2000	>2000

This table is adapted from "Environmental Toxicology and Risk Assessment", ASTM STP 1179, p.34, 1993.

This table can be used to classify the ecotoxicity of this product when ecotoxicity data is listed above. Please read the other information presented in the section concerning the overall ecological safety of this material.

13. DISPOSAL CONSIDERATIONS

RCRA Hazard Class (40 CFR 261)

When a decision is made to discard this material, as received, is it classified as a hazardous waste? Yes

Characteristic Waste:
Ignitable: D001
State or local laws may impose additional regulatory requirements regarding disposal.Call (989) 496-6315, if additional information is required.

14. TRANSPORT INFORMATION

DOT Road Shipment Information (49 CFR 172.101)

Proper Shipping Name:	Combustible liquid, n.o.s.
Hazard Technical Name:	PETROLEUM DISTILLATES/ORGANOTITANATE
Hazard Class:	C
UN/NA Number:	NA 1993
Packing Group:	III
Hazard Label(s):	None
Remarks:	Above applies only to containers over 119 gallons or 450 liters.

Ocean Shipment (IMDG)

Proper Shipping Name:	FLAMMABLE LIQUID, N.O.S.
Hazard Technical Name:	PETROLEUM DISTILLATES/ORGANOTITANATE
Hazard Class:	3
UN/NA Number:	UN 1993
Packing Group:	III
Hazard Label(s):	flammable liquid

Air Shipment (IATA)

Proper Shipping Name:	Flammable liquid, n.o.s.
Hazard Technical Name:	PETROLEUM DISTILLATES/ORGANOTITANATE
Hazard Class:	3
UN/NA Number:	UN 1993
Packing Group:	III
Hazard Class:	Flammable Liquid

Call Dow Corning Transportation, (989) 496-8577, if additional information is required.

15. REGULATORY INFORMATION

Contents of this MSDS comply with the OSHA Hazard Communication Standard 29 CFR 1910.1200.

TSCA Status: All chemical substances in this material are included on or exempted from listing on the TSCA Inventory of Chemical Substances.

EPA SARA Title III Chemical Listings

Section 302 Extremely Hazardous Substances (40 CFR 355):
None.

Section 304 CERCLA Hazardous Substances (40 CFR 302):
None.

Section 311/312 Hazard Class (40 CFR 370):

Acute:	Yes
Chronic:	No
Fire:	Yes
Pressure:	No
Reactive:	No

Section 313 Toxic Chemicals (40 CFR 372):

CAS Number	Wt %	Component Name
60580-61-2	1.0	5-Nitro-1,3- benzenedicarboxylic acid, zinc salt

Note: Chemicals are listed under the 313 Toxic Chemicals section only if they meet or exceed a reporting threshold.

Supplemental State Compliance Information

California

Warning: This product contains the following chemical(s) listed by the State of California under the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) as being known to cause cancer, birth defects or other reproductive harm.

None known.

Massachusetts

CAS Number	Wt %	Component Name
8052-41-3	> 60.0	Stoddard solvent
1317-33-5	15.0 - 40.0	Molybdenum disulfide
7782-42-5	5.0 - 10.0	Graphite
60580-61-2	1.0 - 5.0	5-Nitro-1,3- benzenedicarboxylic acid, zinc salt

New Jersey

CAS Number	Wt %	Component Name
8052-41-3	> 60.0	Stoddard solvent
1317-33-5	15.0 - 40.0	Molybdenum disulfide
9022-96-2	10.0 - 30.0	Polybutyl titanate
7782-42-5	5.0 - 10.0	Graphite
60580-61-2	1.0 - 5.0	5-Nitro-1,3- benzenedicarboxylic acid, zinc salt

Pennsylvania

CAS Number	Wt %	Component Name
8052-41-3	> 60.0	Stoddard solvent
1317-33-5	15.0 - 40.0	Molybdenum disulfide
9022-96-2	10.0 - 30.0	Polybutyl titanate
7782-42-5	5.0 - 10.0	Graphite
60580-61-2	1.0 - 5.0	5-Nitro-1,3- benzenedicarboxylic acid, zinc salt

16. OTHER INFORMATION

Prepared by: Dow Corning Corporation

These data are offered in good faith as typical values and not as product specifications. No warranty, either expressed or implied, is hereby made. The recommended industrial hygiene and safe handling procedures are believed to be generally applicable. However, each user should review these recommendations in the specific context of the intended use and determine whether they are appropriate.

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