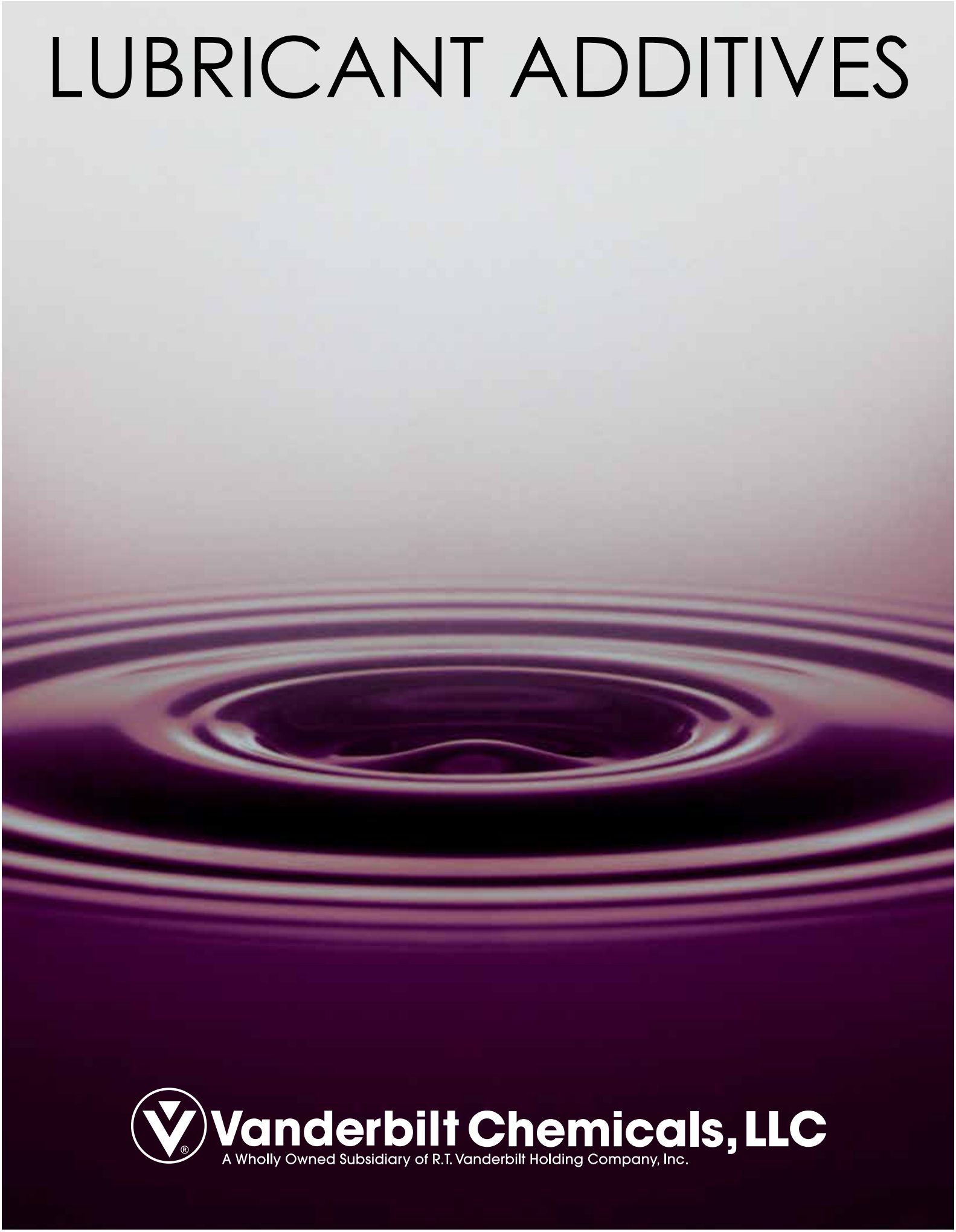
LUBRICANT ADDITIVES



Vanderbilt Chemicals, LLC

A Wholly Owned Subsidiary of R.T. Vanderbilt Holding Company, Inc.

Vanderbilt Chemicals, LLC
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rev06/08/2017

USDA CERTIFIED BIOBASED PRODUCT
PRODUCT 73%

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More Than Just a Drop in the Bucket

Antioxidants

VANLUBE® AZ	VANLUBE EZ	VANLUBE NA
VANLUBE RD	*VANLUBE 81	VANLUBE 887
*VANLUBE 961	VANLUBE 1202	*VANLUBE 7723
VANLUBE BHC	*VANLUBE 996E*	*VANLUBE 407*

Friction Reducers/EP-Antiwear Agents

MOLYVAN® L	MOLYVAN 822	**MOLYVAN 855
*VANLUBE 73	VANLUBE 73 Super Plus	*VANLUBE 829
VANLUBE 869	VANLUBE 871	VANLUBE 972M
*VANLUBE 7611M	VANLUBE 8610	*VANLUBE 9123
*VANLUBE 7723	*MOLYVAN 3000*	*MOLYVAN FEI PLUS*
VANLUBE W-324	*TPS™ 20,32 & 44*	*VANLUBE 289*
VANLUBE 972NT	*VANLUBE 0902*	

Metal Deactivators

*CUVAN® 303	CUVAN826	NACAP®
VANCHEM® NATD	VANLUBE 601	VANLUBE 601E
	VANLUBE 704S	

Rust Inhibitors

*VANLUBE RI-A	VANLUBE RI-G	VANLUBE 8912E
VANLUBE RI-BSN	*VANLUBE RI-CSN*	*VANLUBE RI-ZSN*

Today's high performance lubricants require high performance additives.

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We have over 50 lubricant additives available to meet your specific requirements.

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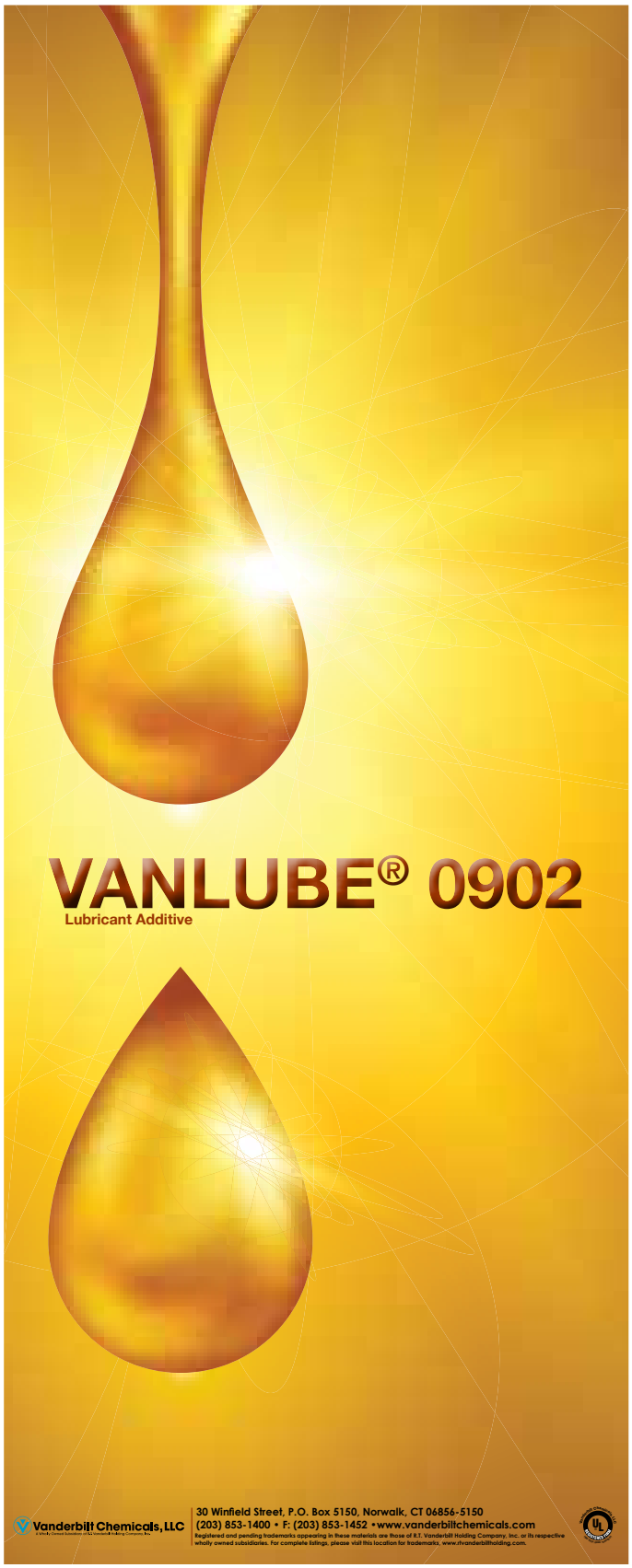


This brochure contains brief descriptions of most of the products sold by Vanderbilt Chemicals, LLC to the lubricating oil and grease industry. The products not included in this brochure are either experimental, or those that are only available on a local basis.

We also welcome inquires with regard to custom-made lubricants or joint research projects.

For more detailed information, please contact your Vanderbilt Chemicals Technical Sales Representative, or the Petroleum Department at our corporate office in Norwalk, Connecticut.

Vanderbilt Chemicals, LLC will continuously improve all products and services to consistently meet customer expectations the first time and every time.

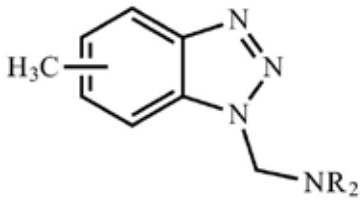
Quick-Scan Application/Function Guide

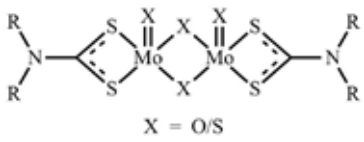
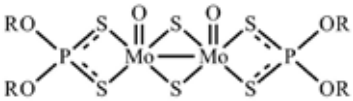
APPLICATION	CUVAN® 303	CUVAN 484	CUVAN 826	MOLYVAN® A	MOLYVAN L	MOLYVAN FEI Plus	MOLYVAN 807	MOLYVAN 822	MOLYVAN 855	MOLYVAN 2000	MOLYVAN 3000	MOLYVAN 856B	NACAP®	VANCHEM™ DMTD	VANCHEM NATD	VANLUBE® AZ	VANLUBE BHC	VANLUBE EZ	VANLUBE NA	VANLUBE RD	VANLUBE RI-A	VANLUBE RI-BSN	VANLUBE RI-CSN	VANLUBE RI-G	VANLUBE SB	VANLUBE RI-ZSN	VANLUBE SL	VANLUBE SS	VANLUBE TK-100*	VANLUBE W-324
Coolant													✓	✓	✓															
Water-Based Fluids													✓	✓	✓															
Auto Transmission Fluid	✓															✓	✓		✓								✓	✓		
Compressor Oil	✓	✓	✓													✓	✓		✓								✓	✓		
Engine Oil	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓				✓	✓		✓						✓		✓	✓		✓
Fuel	✓		✓																											
Gear Oil	✓	✓	✓		✓		✓	✓		✓	✓					✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	
Grease	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hydraulic Oil	✓	✓	✓														✓		✓		✓	✓	✓	✓		✓	✓			
Metalwork-ing	✓	✓	✓		✓				✓					✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	✓		✓	
Rust Preventive																✓					✓	✓	✓	✓		✓	✓		✓	
Synthetic Lube	✓			✓	✓		✓	✓		✓	✓					✓	✓	✓	✓	✓							✓	✓		✓
Turbine Oil	✓	✓	✓														✓		✓		✓	✓	✓			✓	✓	✓		
FUNCTION																														
Ashless	✓	✓	✓											✓			✓		✓	✓	✓			✓			✓	✓		
High Temperature				✓																								✓		1
Antioxidant		2	2	2	2	1	2	2	2	2	2		2			1	1	1	1	1							1	1		
Antiwear/ Antiscuff		2		1	1	1	1	1	1	1	1	2				2		1							2					1
Friction Reducer				1	1	1	1	1	1	1	1	1																		1
Corrosion Inhibitor	1	1	1			2							1	1	1	2					2	2	2	2		2				
Demulsifier																						2	2			2				
Chemical Intermediate													1	1	1															
Extreme Pressure				2	2		2	2		2	2							1							1					
Metal Deactivator	1	1	1										1	1	1	2														
Rust Inhibitor																					1	1	1	1		1				

✓= Application/Function 1 = Primary Function 2 = Secondary Function * = Tackifier

APPLICATION	VANLUBE® 73	VANLUBE 73 Super Plus	VANLUBE 81	VANLUBE 289	VANLUBE 601	VANLUBE 601E	VANLUBE 622	VANLUBE 672	VANLUBE 692	VANLUBE 704S	VANLUBE 719	VANLUBE 727	VANLUBE 739	VANLUBE 829	VANLUBE 869	VANLUBE 871	VANLUBE 887	VANLUBE 887E	VANLUBE 961	VANLUBE 972M	VANLUBE 972 NT	VANLUBE 996E	VANLUBE 0401	VANLUBE 0902	VANLUBE 1202	VANLUBE 7611M	VANLUBE 7723	VANLUBE 8610	VANLUBE 8912E	VANLUBE 9123	VANLUBE 9317
Coolant																															
Water-Based Fluids																															
Auto Transmission Fluid			✓	✓								✓	✓				✓	✓	✓			✓				✓					
Compressor Oil	✓		✓	✓									✓				✓	✓	✓			✓			✓		✓				✓
Engine Oil	✓		✓	✓			✓					✓	✓			✓	✓	✓	✓			✓	✓		✓	✓					
Fuel					✓	✓																									
Gear Oil	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		✓	✓	✓			✓		✓			✓	✓	✓	✓	
Grease	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Hydraulic Oil					✓	✓				✓		✓	✓				✓	✓	✓			✓				✓	✓		✓		
Metalwork-ing				✓	✓	✓		✓	✓	✓	✓	✓										✓				✓			✓		
Rust Preventive																													✓	✓	
Synthetic Lube	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓		✓				✓	✓	✓	✓	✓		✓	✓	✓	✓				✓
Turbine Oil			✓		✓	✓				✓			✓				✓	✓	✓			✓			✓		✓		✓		
FUNCTION																															
Ashless			✓	✓	✓	✓		✓	✓			✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓			✓	✓
High Temperature			✓											✓			✓	✓				✓			✓		✓				✓
Antioxidant	2	2	1		2	2	2	2	2		2	2		2	2	2	1	1	1			1	1	2	1	2	1	2			1
Antiwear/ Antiscuff	2	1		1			1	1	2		2	1		2	2	1				2	2		2	1		1	2	2		1	
Friction Reducer	2			1			1							2									1				2				
Corrosion Inhibitor					1	1				1			2	2								2		2					2		
Demulsifier										2																					
Chemical Intermediate																															
Extreme Pressure	1	1					1	1	1		1			1	1					1	1			1			1	1			
Metal Deactivator					1	1				1				2						2	2	2									
Rust Inhibitor										1			1											2					1	1	

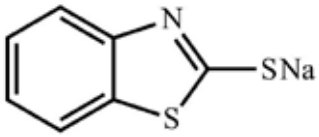
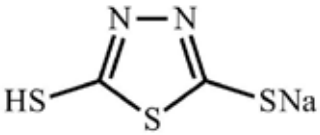
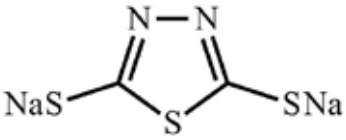
✓= Application/Function 1 = Primary Function 2 = Secondary Function

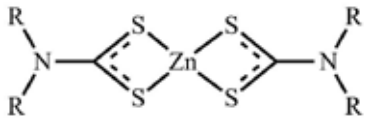
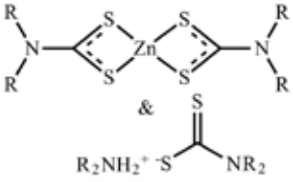
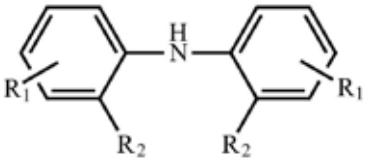
	CUVAN® 303 Metal Deactivator	CUVAN 484 Metal Deactivator	CUVAN 826 Metal Deactivator
Formula		Proprietary	Proprietary
Application	Auto Transmission Fluid, Compressor Oil, Engine Oil, Fuel, Gear Oil, Grease, Hydraulic Oil, Metalworking, Synthetic Lube, Turbine Oil	Compressor Oil, Engine Oil, Gear Oil, Grease, Hydraulic Oil, Metalworking, Turbine Oil	Compressor Oil, Engine Oil, Fuel, Gear Oil, Grease, Hydraulic Oil, Metalworking, Turbine Oil
Function	Ashless, Corrosion Inhibitor, Metal Deactivator	Ashless, Antioxidant, Antiwear/Antiscuff, Corrosion Inhibitor, Metal Deactivator	Ashless, Antioxidant, Corrosion Inhibitor, Metal Deactivator
Chemical Composition	N, N-bis(2-ethylhexyl)-ar-methyl-1H-benzotriazole-1-methanamine	2,5 dimercapto-1,3,4-thiadiazole derivative	2,5 dimercapto-1,3,4-thiadiazole derivative
Physical State	Liquid	Liquid	Liquid
Color	Amber	Amber	Amber
Density @ 15.6˚C Mg/m³ (lb/gal)	0.95 (7.9) @ 25˚C	1.07(9.0)	1.04(8.6)
Viscosity @ 100˚C mm²/S	5.81	11	3.32
Flash Point (PMCC), ˚C	125	76	192
Solubility	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum lubricating bases.
Use Concentration, % mass	0.05 - 0.20	0.10 - 0.50	0.10 - 0.50
Typical Uses	**CUVAN® 303** is an oil-soluble corrosion inhibitor and metal deactivator for lubricants, greases and metalworking fluids. As a corrosion inhibitor, it is effective in protecting copper, copper alloys, cadmium, cobalt, silver and zinc. As a metal deactivator, it is effective in precipitating ions of the same metals, thus preventing galvanic corrosion of other metal surfaces and inhibiting these ions from acting as oxidation catalysts. **NSF® Certified HX-1, 138995**	**CUVAN® 484** is an ashless oil-soluble corrosion inhibitor and metal deactivator for nonferrous metals, particularly for copper. Useful in industrial and automotive oils and greases, metalworking fluids, etc. **CUVAN 484** may also enhance the antiwear and oxidation properties of lubricants.	**CUVAN® 826** is a ashless oil-soluble corrosion inhibitor and metal deactivator for nonferrous metals, particularly for copper. It is useful in industrial and automotive oils and greases, metalworking fluids, etc. **CUVAN 826** has a unique composition enables it to suppress the corrosive action of hydrogen sulfide.

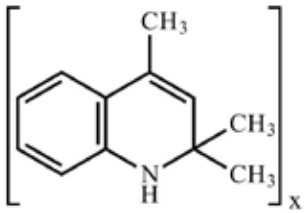
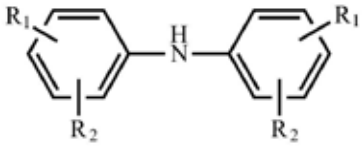
	MOLYVAN® A Friction Reducer	MOLYVAN L Friction Reducer	MOLYVAN FEI Plus Friction Reducer
Formula			Proprietary Blend
Application	Grease, Synthetic Lube	Engine Oil, Gear Oil, Grease, Metalworking, Synthetic Lube	Engine Oils
Function	High Temperature, Antioxidant, Antiwear/ Antiscuff, Friction Reducer, Extreme Pressure	Antioxidant, Antiwear/ Antiscuff, Friction Reducer, Extreme Pressure	Friction Reducer, Antioxidant, Antiwear
Chemical Composition	Molybdenum di-n-butyldi-thio-carbamate	Molybdenum di(2-ethylhexyl) phosphorodithioate	Antioxidant, Antiwear, Friction Reducer Blend
Physical State	Powder	Liquid	Liquid
Color	Yellow	Dark Green	Dark Amber to Brown
Density @ 15.6˚C Mg/m³ (lb/gal)	1.59 @ 25˚C	1.08 (9.0)	1.01 @ 25°C
Viscosity @ 100˚C mm²/S	—	8.6	10.8
Flash Point (PMCC), ˚C	—	142	178
Solubility	Slightly soluble in aromatic hydrocarbons. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant base stocks. Insoluble in water
Use Concentration, % mass	0.5 - 3.0	0.25 - 1.0	0.1 - 4.0
Typical Uses	**MOLYVAN® A** is used in long life chassis greases for ball joints, steering linkages and other lubricating greases requiring good antioxidant and antiwear at high temperatures for long periods of time. It is an organic molybdenum extreme pressure and antiwear additive for petroleum and synthetic lubricants. It has good high temperature stability. In lubricating greases it is superior to inorganic molybdenum additives for both antiwear and antioxidant properties. **MOLYVAN A** is slightly basic and does not promote rusting. It has a low specific gravity which makes it easy to disperse with simple equipment. It is used in non-petroleum base valve lubricants.	**MOLYVAN® L** is an oil-soluble organic molybdenum additive containing sulfur and phosphorus. It functions as a friction reducer, antioxidant, antiwear, and extreme pressure agent. It is used in engine oils, metalworking compositions and in a variety of industrial and automotive lubricating oils, greases and specialties. **MOLYVAN L** is an outstanding antiwear agent. It is quite useful in automotive and industrial gear oils and greases which operate under heavy load conditions. Not recommended for diesel engine oils.	**MOLYVAN® FEI Plus** is a lubricant composition that when combined with a dispersant, detergent, VI improver and base oil constitutes a low phosphorus, high molybdenum containing engine oil with enhanced fuel economy and catalyst compatibility. Not recommended for diesel engines.

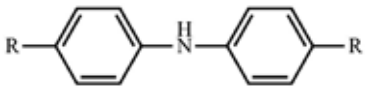
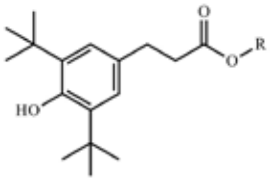
	MOLYVAN® 807 Friction Reducer	MOLYVAN 822 Friction Reducer	MOLYVAN 855 Friction Reducer
Formula	Proprietary	Proprietary	Proprietary
Application	Engine Oil, Gear Oil, Grease, Synthetic Lube	Engine Oil, Gear Oil, Grease, Synthetic Lube	Engine Oil, Grease, Metalworking
Function	Antioxidant, Antiwear/ Antiscuff, Friction Reducer, Extreme Pressure	Antioxidant, Antiwear/ Antiscuff, Friction Reducer, Extreme Pressure	Antioxidant, Antiwear/ Antiscuff, Friction Reducer
Chemical Composition	Molybdenum dialkyldithio-carbamate in oil	Molybdenum dialkyldithiocarbamate in oil	Organomolybdenum complex
Physical State	Liquid	Liquid	Liquid
Color	Dark Green	Brown	Brown
Density @ 15.6˚C Mg/m³ (lb/gal)	0.97 (8.1)	0.97 (8.1)	1.08 (8.9)
Viscosity @ 100˚C mm²/S	13	13	55
Flash Point (PMCC), ˚C	135	135	193
Solubility	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water	Soluble in petroleum and synthetic lubricant bases. Insoluble in water
Use Concentration, % mass	0.25 - 0.5	0.25 - 0.5	0.1 - 1.0
Typical Uses	**MOLYVAN® 807** offers a unique molybdenum-sulfur combination in an oil-soluble form which is easy to blend into lubricants. It can be used to maintain the antifriction properties of an engine oil while reducing the phosphorus content. To obtain significant increases in extreme pressure properties and to impart improved antiwear performance. **MOLYVAN 807** can be used in combination with **VANLUBE® 7723** Antioxidant, a nonmetallic dithiocarbamate which functions as an antioxidant and extreme pressure agent. Not recommended for diesel engine oils.	**MOLYVAN® 822** may be used to maintain or improve the antifriction properties of an engine oil while reducing the phosphorus content. Not recommended for diesel engine oils.	**MOLYVAN®855** is a liquid organomolybdenum friction reducer specifically designed for crankcase oils. **MOLYVAN 855** provides engine oils with a substantial reduction in the coefficient of friction. Not recommended for diesel engine oils. USDA CERTIFIED BIOBASED PRODUCT PRODUCT 73%

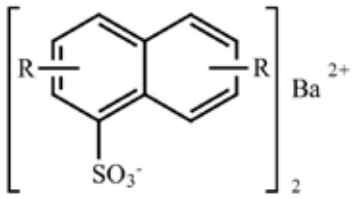
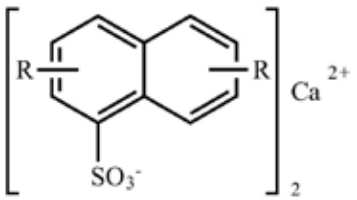
	MOLYVAN® 856B Friction Reducer	MOLYVAN 2000 Friction Reducer	MOLYVAN 3000 Friction Reducer
Formula	Proprietary	Proprietary	Proprietary
Application	Engine Oil	Engine Oils, Gear Oils, Synthetic Lubricants, Grease	Engine Oils, Gear Oils, Greases, Synthetic Lubes
Function	Antioxidant, Antiwear/ Antiscuff	Friction Reducer, Antioxidant, Antiwear	Friction Reducer. Antiwear/ Antiscuff, Extreme Pressure
Chemical Composition	Organomolybdenum complex	Molybdenum dialkyldithiocarbamate in oil	Molybdenum Dithiocarbamate in oil
Physical State	Liquid	Liquid	Liquid
Color	Dark Amber	Brown	Brown
Density @ 15.6˚C Mg/m³ (lb/gal)	0.98 (8.2)	1.01 @ 25°C	1.05
Viscosity @ 100˚C mm²/S	15.0	21.2	50 - 100
Flash Point (PMCC), ˚C	174	153	> 145
Solubility	Soluble in petroleum and synthetic lubricating bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant base stocks. Insoluble in water	Soluble in petroleum and synthetic base oils. Insoluble in water
Use Concentration, % mass	0.1 - 0.5	0.1-1.0	0.1-1.0
Typical Uses	**MOLYVAN® 856B** is specifically designed for crankcase oils to significantly modify the coefficient of friction. Not recommended for diesel engine oils.	**MOLYVAN® 2000** may be used to maintain or improve the antifriction, antiwear and antioxidant properties of an engine oil while reducing the phosphorus content. Not recommended for diesel engines.	**MOLYVAN ® 3000** may be used to maintain or improve the antifriction properties of an engine oil while reducing the phosphorus content.

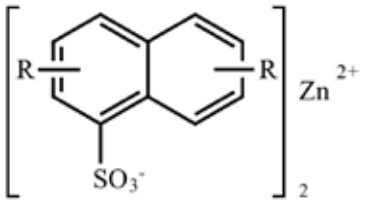
	NACAP® Corrosion Inhibitor	VANCHEM™DMTD Metal Deactivator	VANCHEM NATD Metal Deactivator
Formula			
Application	Coolant, Water-Based Fluids	Coolant, Water-Based Fluids, Metalworking	Coolant, Water-Based Fluids, Metalworking
Function	Antioxidant, Corrosion Inhibitor, Chemical Intermediate, Metal Deactivator	Ashless, Corrosion Inhibitor, Chemical Intermediate, Metal Deactivator	Corrosion Inhibitor, Chemical Intermediate, Metal Deactivator
Chemical Composition	Sodium 2-mercaptobenzothiazole, 50% aqueous solution	2,5-dimercapto-1,3,4-thiadiazole	Disodium 2,5-dimercapto-thiadiazole, 30% aqueous solution
Physical State	Liquid	Powder	Liquid
Color	Light Amber	Cream to Light Yellow	Amber
Density @ 15.6˚C Mg/m³ (lb/gal)	1.27 (10.6)	1.79	1.22 (10.2)
Viscosity @ 100˚C mm²/S	—	—	—
Flash Point (PMCC), ˚C	—	—	—
Solubility	Soluble in water, alcohols and glycols. Insoluble in petroleum hydrocarbons.	Soluble in water, ethanol, acetone and diesters. Slightly soluble in petroleum lubricant bases, hexane, petroleum ether, chloroform and toluene.	Soluble in water.
Use Concentration, % mass	0.1 - 0.6	Chemical Intermediate	0.1 - 0.25
Typical Uses	**NACAP®** is a corrosion inhibitor for water, alcohol and glycol systems. It is particularly effective in preventing corrosion of copper and brass. Widely used in antifreeze, where it functions as a copper corrosion inhibitor and alkaline buffer. It is an excellent corrosion inhibitor for aluminum in systems where aluminum is used in the presence of copper and copper alloys. **NACAP** is one of the standard copper corrosion inhibitors for the antifreeze industry. Used as a chemical intermediate.	**VANCHEM™ DMTD**'s common reactions are double decomposition reactions with soluble metal salts, salt formation with alkaline metal hydroxides, oxidation reactions involving mercaptans, addition reactions with organic compounds containing activated double bonds, reactions with epoxy groups, reactions with aldehydes and alcohols, salt formation with amines and ammonia and reactions with acyl chlorides. The two active sites on **VANCHEM DMTD** can generally be reacted successively.	**VANCHEM™ NATD** is a corrosion inhibitor and metal deactivator for nonferrous metals in aqueous systems. It is particularly indicated for the protection of solder, aluminum, copper and copper alloys. It is stable and active at lower pH values than many mercapto compounds. **VANCHEM NATD** as a stable reactive dimercaptide which is readily alkylated, oxidized to the disulfide, or converted to metal salts.

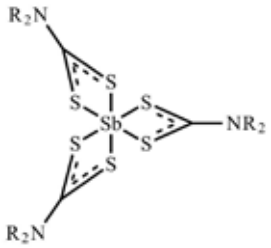
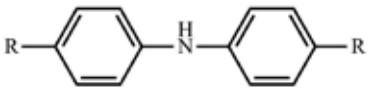
	VANLUBE® AZ Lubricant Additive	VANLUBE® EZ Antioxidant	VANLUBE NA Antioxidant
Formula		Mixture of: 	
Application	Auto Transmission Fluid, Compressor Oil, Engine Oil, Gear Oil, Grease, Metalworking, Rust Preventive, Synthetic Lube	Gear Oil, Grease, Metalworking, Synthetic Lube	Auto Transmission Fluid, Compressor Oil, Engine Oil, Gear Oil, Grease, Hydraulic Oil, Metalworking, Synthetic Lube, Turbine Oil
Function	Antioxidant, Antiwear/ Antiscuff, Corrosion Inhibitor, Metal Deactivator	Antioxidant, Antiwear/ Antiscuff, Extreme Pressure	Ashless, Antioxidant
Chemical Composition	Zinc diamyldithiocarbamate in oil	Zinc diamyldithiocarbamate and diamyl ammonium diamyldithiocarbamate	Alkylated diphenylamines
Physical State	Liquid	Liquid	Liquid
Color	Amber	Yellowish/Amber	Brown
Density @ 15.6˚C Mg/m³ (lb/gal)	1.02 (8.2)	1.1	0.94 (7.8)
Viscosity @ 100˚C mm²/S	9.8	40 - 70	15
Flash Point (PMCC), ˚C	136	93	213 (COC)
Solubility	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.
Use Concentration, % mass	0.25 - 4.0	0.1 - 2.0	0.25 - 1.5
Typical Uses	**VANLUBE® AZ** is used in engine oils, in industrial oils, and in soap and clay-thickened greases. Used in both gasoline and diesel crankcase oils to inhibit oxidation, bearing corrosion and wear. Used in combination with detergents, it inhibits corrosion and wear by inhibiting oxidation of the oil and also by the formation of protective films on metal surfaces. Used as a partial replacement for zinc dithiophosphates. Because of its effectiveness at high temperatures, it is a good additive for crankcase oils in heavy duty service. In industrial oils and automatic transmission fluids it functions as a high temperature oxidation and corrosion inhibitor. Used in lubricating greases both as an oxidation inhibitor and metal deactivator. An excellent copper corrosion inhibitor of film-forming type.	**VANLUBE® EZ** is a multifunctional additive that imparts excellent antiwear, extreme pressure, corrosion resistance and antioxidant properties to industrial lubricants and greases. It is a concentrated version of **VANLUBE AZ**.	**VANLUBE® NA** is a versatile liquid amine antioxidant with several advantages over other antioxidants of this type. The amine group in **VANLUBE NA** is hindered by oil-soluble alkyl groups which contribute to antioxidant efficiency by reducing some of the undesirable properties of other amines. **VANLUBE NA** is a general purpose antioxidant for turbine, hydraulic, circulating, compressor and other industrial oils. It is an effective non-discoloring grease antioxidant and is applicable to ashless crankcase oils for automotive, aviation, diesel and gas engine service. Synergistic effects are obtained with **VANLUBE PCX**, **VANLUBE AZ** and **VANLUBE 73**.

	VANLUBE RD Antioxidant	VANLUBE® SB Lubricant Additive	VANLUBE® SL Antioxidant
Formula		Proprietary	
Application	Grease, Synthetic Lube	Engine Oil, Gear Oil, Grease, Metalworking	Auto Transmission Fluid, Compressor Oil, Engine Oil, Gear Oil, Grease, Hydraulic Oil, Metalworking, Rust Preventive, Synthetic Lube, Turbine Oil
Function	Ashless, Antioxidant	Antiwear/Antiscuff, Extreme Pressure	Ashless, Antioxidant
Chemical Composition	Polymerized 1,2-dihydro-2,2,4-trimethylquinoline	Sulfur-based additive	Mixture of alkylated diphenylamines
Physical State	Small Pastilles	Liquid	Liquid
Color	Amber	Amber	Reddish Brown
Density @ 15.6˚C Mg/m³ (lb/gal)	1.06	1.14 (9.5)	1.01 (8.4)
Viscosity @ 100˚C mm²/S	—	10	16.28
Flash Point (PMCC), ˚C	—	79	210 (COC)
Solubility	Soluble in diesters, polyglycols and Ucon® fluids. Insoluble in water and petroleum oils.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.
Use Concentration, % mass	0.1 - 1.0	1.0 - 2.0	0.25 - 1.5
Typical Uses	**VANLUBE® RD** inhibits oxidation in polyglycols, Ucon® fluids and diester synthetic lubricants. Good high temperature inhibitor for both petroleum and synthetic lubricants. Widely used in Ucon and polyglycol brake fluids at concentrations of 0.1 to 0.25%. Prevents the depolymerization of polyoxyethylene and similar polymers. Used as a high temperature oxidation inhibitor in both petroleum and synthetic base lubricating greases. Effective in both static (ASTM grease bomb and dynamic (bearing life or spindle) oxidation tests.	**VANLUBE® SB** is a sulfur-based additive used in the formulation of industrial gear oils, automotive and industrial greases of various types, and other formulations where noncorrosive sulfur is desired. **VANLUBE SB** is an economical source of sulfur in a form that provides good load-carrying and antiwear properties combined with low copper corrosion.	**VANLUBE® SL** is a general-purpose antioxidant for industrial lubricants including compressor, hydraulic, turbine, gas engine and circulating oils. One of the most versatile amine antioxidants available for use in petroleum products. Used in greases of all types. Effective in both static and dynamic oxidation tests. Often used in combination with **VANLUBE PCX** in turbine and hydraulic oils. An outstanding oxidation inhibitor in solvent-refined oils that are high viscosity improvers. A good ashless antioxidant for use in automotive, diesel and aviation crankcase oils.

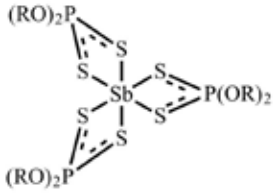
	VANLUBE SS Antioxidant	VANLUBE® BHC Antioxidant	VANLUBE® RI-A Lubricant Additive
Formula			Proprietary
Application	Auto Transmission Fluid, Compressor Oil, Engine Oil, Grease, Synthetic Lube, Turbine Oil	Auto Transmission Fluid, Compressor Oil, Engine Oil, Gear Oil, Grease, Hydraulic Oil, Metalworking, Synthetic Lube, Turbine Oil	Gear Oil, Grease, Hydraulic Oil, Rust Preventive, Turbine Oil
Function	Ashless, High Temperature, Antioxidant	Ashless, Antioxidant	Ashless, Corrosion Inhibitor, Rust Inhibitor
Chemical Composition	Octylated diphenylamines	Butylated hydroxy-hydrocinnamate	Dodecenylsuccinic acid reaction product
Physical State	Powder	Liquid	Liquid
Color	Light Tan	Yellowish	Amber
Density @ 15.6˚C Mg/m³ (lb/gal)	1.02	0.9665	0.96 (8.0) @ 25˚C
Viscosity @ 100˚C mm²/S	–	6.2	19
Flash Point (PMCC), ˚C	–	152	165
Solubility	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum lubricant bases.
Use Concentration, % mass	0.5 - 2.0	0.1 - 2.0	0.05 - 0.25
Typical Uses	**VANLUBE® SS** is a general-purpose antioxidant. It is used as a high temperature antioxidant in petroleum and synthetic lubricants. Effective as an antioxidant and corrosion inhibitor in silane and siloxane synthetic lubricants - both in fluids and greases. Used in hydraulic fluids, various industrial oils, automatic transmission fluids and synthetic and petroleum-based engine oils.	**VANLUBE® BHC** is an effective general purpose, nonstaining, ashless antioxidant that provides excellent oxidative stability to wide range of automotive and industrial lubricants. It has excellent solubility in mineral and non conventional base stocks, and contains no diluents. It is easy to handle and will not crystallize at low temperatures. It has low volatility and helps control oxidation and high temperature deposits especially when combined with alkylated diphenylamines, molybdenum compounds, sulfur-containing antioxidants and/or phosphites in many industrial oils and automotive lubricants.	**VANLUBE RI-A** is an oil-soluble rust inhibitor recommended for steam turbine oils, circulating oils and hydraulic oils. In industrial gear oils with extreme pressure additives, levels of approximately 0.25% are recommended. **VANLUBE RI-A** is most effective in greases when used with a sulfonate such as **VANLUBE RI-BA** in a 50/50 ratio. **NSF® Certified H2, 139738**

	VANLUBE RI-BSN Lubricant Additive	VANLUBE® RI-CSN Lubricant Additive	VANLUBE RI-G Lubricant Additive
Formula			Proprietary
Application	Gear Oil, Grease, Hydraulic Oil, Metal Working Fluid, Rust Preventive, Turbine Oil	Gear Oil, Grease, Hydraulic oil, Metal Working Fluid, Rust Preventive, Turbine Oil	Gear Oil, Grease, Hydraulic Oil, Rust Preventive
Function	Corrosion Inhibitor, Rust Inhibitors, Demulsifer	Corrosion Inhibitor, Rust Inhibitor, Demulsifier	Ashless, Corrosion Inhibitor, Rust Inhibitor
Chemical Composition	Neutral barium dinonylnaphthalene sulfonate in light mineral oil	Neutral calcium dinonyl-naphthalene sulfonate in light mineral oil	Fatty acid derivative of 4,5-dihydro-1H-imidazole
Physical State	Liquid	Liquid	Liquid
Color	Dark Brown	Dark Brown	Amber
Density @ 15.6˚C Mg/m³ (lb/gal)	1.01 (8.4) (@20˚)	0.980	0.94 (7.8)
Viscosity @ 100˚C mm²/S	65.0	125	117
Flash Point (PMCC), ˚C	>165 (COC)	>165 (COC)	271
Solubility	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum lubricant bases. Insoluble in water.
Use Concentration, % mass	0.05 - 10.0	0.1 -20.0	0.25 - 0.50
Typical Uses	**VANLUBE® RI-BSN** is an effective general purpose rust inhibitor recommended for use where excellent rust inhibition and water resistance are needed. It can be used in industrial lubricants operating in the presence of moisture such as paper machine oils, rock drill oils, turbine, hydraulic and circulating oils. It can also be used as rust inhibitor in lubricating greases and as rust preventive for metal parts from metalworking processes.	**VANLUBE® RI-CSN** is an effective general purpose rust inhibitor recommended for use where excellent rust inhibition and water resistance are needed. It can be used in industrial lubricants operating in the presence of moisture such as paper machine oils, rock drill oils, turbine hydraulic and circulating oils. It can also be used as rust inhibitor in lubricating greases and as rust preventive for metal parts from metalworking processes.	**VANLUBE® RI-G** was specifically designed to provide excellent rust inhibition for greases. It is compatible with other **VANLUBE** extreme pressure, antioxidant and antiwear additives.

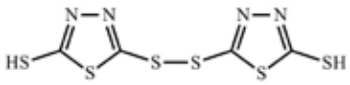
	VANLUBE RI-ZSN Lubricant Additive	VANLUBE® TK-100 Lubricant Additive	VANLUBE W-324 Lubricant Additive
Formula		Proprietary	Proprietary Tungsten Complex
Application	Gear Oil, Grease, Hydraulic oil, Metal Working Fluid, Rust Preventive, Turbine Oil	Gear Oil, Grease, Metalworking, Rust Preventive	Engine Oils, Gear Oils, Grease, Synthetic Lubricants
Function	Corrosion Inhibitor, Rust Inhibitor, Demulsifier	Tackifier	Antiwear, Antioxidant and high temperature Friction Reducer
Chemical Composition	Neutral zinc dinonylnaphthalene sulfonate in light mineral oil	Solution of a copolymer of ethylene and propylene	Dialkylammonium Tungstate
Physical State	Liquid	Liquid	Liquid
Color	Dark Brown	Amber	Amber to Black
Density @ 15.6˚C Mg/m³ (lb/gal)	0.971	0.89	—
Viscosity @ 100˚C mm²/S	32.0	4,500	11.6
Flash Point (PMCC), ˚C	>160 (COC)	121	>140
Solubility	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Only soluble in lubricants using dispersants. Insoluble in water
Use Concentration, % mass	0.1 -20.0	0.5 - 5.0	0.01 – 0.5
Typical Uses	**VANLUBE® RI-ZSN** is an effective general purpose rust inhibitor recommended for use where excellent rust inhibition and water resistance are needed. It can be used in industrial lubricants operating in the presence of moisture such as paper machine oils, rock drill oils, turbine hydraulic and circulating oils. It can also be used as rust inhibitor in lubricating greases and as rust preventive for metal parts from metalworking processes.	**VANLUBE® TK-100** is used to provide adherence in way oils, chain lubricants and greases. It provides excellent aerosol resistance in pneumatic system lubricants.	**VANLUBE® W 324** is a liquid additive that enhances the antioxidant, antiwear and friction properties of greases, engine oils and other lubricating oils.

	VANLUBE 73 Lubricant Additive	**VANLUBE® 73** **Super Plus** Lubricant Additive	**VANLUBE® 81** Antioxidant
Formula		Proprietary	
Application	Compressor Oil, Engine Oil, Gear Oil, Grease, Synthetic Lube	Gear Oil, Grease	Auto Transmission Fluid, Compressor Oil, Engine Oil, Grease, Synthetic Lube, Turbine Oil
Function	Antioxidant, Antiwear/ Antiscuff, Friction Reducer, Extreme Pressure	Antioxidant, Antiwear/ Antiscuff, Extreme Pressure	Ashless, High Temperature, Antioxidant
Chemical Composition	Antimony tris(dialkyldithiocarbamate) in oil	Proprietary blend of dialkyldithiocarbamates	p,p'-dioctyldiphenylamine
Physical State	Clear to Hazy Liquid	Liquid	Powder
Color	Dark Amber	Amber	Off White
Density @ 15.6˚C Mg/m³ (lb/gal)	1.03 (8.6)	1.0987 @ 25˚C	1.01
Viscosity @ 100˚C mm²/S	11	33.34	–
Flash Point (PMCC), ˚C	171	> 118	–
Solubility	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.
Use Concentration, % mass	0.1 - 1.0 as antioxidant 2.0 - 5.0 as extreme pressure agent.	2.0 - 4.0	0.5 - 2.0
Typical Uses	**VANLUBE® 73** is one of the most versatile of the dithiocarbamate additives. It has excellent antiwear, extreme pressure and antioxidant properties. It is used as an antiwear additive, a bearing corrosion inhibitor in motor oils, gas engine oil, compressor oils, etc. It is used in lubricating greases of all types as an antioxidant, antiwear and extreme pressure additive. **NSF® Certified HX-2,137553**	**VANLUBE® 73 Super Plus** is a proprietary mixture of dialkyldithiocarbamates. Based on equivalent antimony content, the load-carrying capability of **VANLUBE 73 Super Plus** is superior to that of antimony dialkyldithiocarbamate (SDDC), and comparable to that of combinations of SDDC and sulfurized olefin. As an antioxidant, **VANLUBE 73 Super Plus** outperforms both SDDC and SDDC/sulfurized olefin and, unlike sulfurized olefin, it does not lower the dropping point of lithium complex grease. **VANLUBE 73 Super Plus** does not have the pungent order of sulfurized olefin.	**VANLUBE® 81** is similar chemically to **VANLUBE SS** but is a better high temperature oxidation inhibitor because of its high purity and high p,p'-dioctyldiphenylamine content. VANLUBE 81 can be used in a variety of petroleum and synthetic lubricants where an ashless oxidation inhibitor with good high temperature properties is needed. Effective in silane, siloxane, silicone and diester fluids at concentrations of 0.5 to 2.0% and temperature of 400 to 500˚F. In lubricating greases, **VANLUBE 81** is effective in both oxidation pressure vessel tests and in high speed spindle tests. Siloxane greases containing 2% VANLUBE 81 have given outstanding results in bearing performance tests at 350˚F. Has a good color stability. Widely used as a high temperature antioxidant in jet engine oils. **NSF® Certified HX-1, 143815**

	VANLUBE 289 Lubricant Additive	VANLUBE® 601 Lubricant Additive	VANLUBE 601E Lubricant Additive
Formula	Proprietary	Proprietary	Proprietary
Application	Auto Transmission Fluid, Compressor Oil, Engine Oil, Gear Oil, Grease, Metalworking	Fuel, Gear Oil, Grease, Hydraulic Oil, Metalworking, Synthetic Lube, Turbine Oil	Fuel, Gear Oil, Grease, Hydraulic Oil, Metalworking, Synthetic Lube, Turbine Oil
Function	Ashless, Antiwear/Antiscuff, Friction Reducer	Ashless, Antioxidant, Corrosion Inhibitor, Metal Deactivator	Antioxidant, Corrosion Inhibitor
Chemical Composition	Borate ester	Heterocyclic sulfur-nitrogen compound	Heterocyclic sulfur-nitrogen compound
Physical State	Liquid	Liquid	Liquid
Color	Yellowish	Dark Amber	Dark Amber
Density @ 15.6˚C Mg/m³ (lb/gal)	0.99	0.98 (8.1)	0.98 (8.1)
Viscosity @ 100˚C mm²/S	22.3	10.5	7
Flash Point (PMCC), ˚C	191	122	157
Solubility	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.
Use Concentration, % mass	0.5 - 1.0	0.02 - 1.0	0.02 - 1.0
Typical Uses	**VANLUBE® 289** is an oil-soluble borate ester that is an effective antiwear additive, by itself or in synergistic combinations with other antiwear/extreme pressure additives such as dithiophosphates, dithiocarbamates and alkyl thiadiazoles. It contains no phosphorous, sulfur or metals. It is therefore useful in eliminating and/or reducing levels of these elements in lubricants and greases while maintaining cost-effective performance.	**VANLUBE® 601** is a copper passivator, corrosion and rust inhibitor of the film-forming type. It exhibits synergistic properties with various metal organic extreme pressure additives such as the dithiocarbamates. Used in petroleum fuels and solvents at concentration of 1 to 10 pounds per 1,000 barrels to prevent copper stain and corrosion. Used in petroleum base oils and greases and in synthetic base greases at concentrations of 0.02 to 0.5% to protect copper. **VANLUBE 601** has color stabilizing properties in oils and greases stored at elevated temperatures. It is useful EP/ synergist with a variety of extreme pressure and antiwear additives.	**VANLUBE® 601E** is a copper passivator, corrosion and rust inhibitor of the film-forming type. It exhibits synergistic properties with various metal organic extreme pressure additives such as the dithiocarbamates. Used in petroleum fuels and solvents at concentrations to 1 to 10 pounds per 1,00 barrels to prevent copper stain and corrosion. Used in petroleum base oils and greases and in synthetic base greases at concentrations of 0.02 to 0.5% to protect copper. **VANLUBE 601E** has shown color stabilizing properties in oils and greases stored at elevated temperatures. It is a useful extreme pressure/synergist with a variety of extreme pressure and antiwear additives.

	VANLUBE 622 Lubricant Additive	VANLUBE® 672 Lubricant Additive	VANLUBE 692 Lubricant Additive
Formula		Proprietary	Proprietary
Application	Engine Oil, Gear Oil, Grease, Synthetic Lube	Gear Oil, Grease, Metalworking, Synthetic Lube	Gear Oil, Grease, Metalworking, Synthetic Lube
Function	Antioxidant, Antiwear/ Antiscuff, Friction Reducer, Extreme Pressure	Ashless, Antioxidant, Antiwear/Antiscuff, Extreme Pressure	Ashless, Antioxidant, Antiwear/Antiscuff, Extreme Pressure
Chemical Composition	Antimony o,o-dialkylphosphorodithioate in oil.	Amine phosphate	Aromatic amine phosphate
Physical State	Clear to slightly hazy liquid	Viscous Liquid	Viscous Liquid
Color	Amber	Light Amber	Dark Amber
Density @ 15.6˚C Mg/m³ (lb/gal)	1.20 (10.0)	1.02 (8.5)	0.99 (8.2)
Viscosity @ 100˚C mm²/S	5	250	53
Flash Point (PMCC), ˚C	150	113	≥65
Solubility	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in water, petroleum and synthetic lubricant bases.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.
Use Concentration, % mass	0.5 - 3.0	1.0 - 3.0	1.0 - 3.0
Typical Uses	**VANLUBE® 622** is an antiwear and extreme pressure additive for steel mill and other industrial gear oils. **VANLUBE 622** has outstanding extreme pressure and antiwear properties in a variety of base lubricants. It will give unusually high Timken, Falex and 4-Ball extreme pressure values at economical concentrations of 1 to 3%. It shows promise as an extreme pressure and antiwear additive in automotive gear oils.	**VANLUBE® 672** is an extreme pressure and antiwear additive for industrial lubricants, including lubricating oils, greases and synthetic fluids. Used as an extreme pressure and antiwear additive in various metalworking lubricants such as drawing, stamping and forming compounds. Improves extreme pressure performance of conventional extreme pressure materials such as sulfurized olefins, fatty oils, chlorinated paraffins, metal dithiocarbamates and phosphorodithioates. Effective in low concentrations as an antiwear additive in synthetic lubricants.	**VANLUBE® 692** is used in nonmetallic industrial gear oils to give high load carrying properties. Extreme pressure and antiwear additive for lubricants based on petroleum oils and synthetics. **VANLUBE 692** enhances the extreme pressure properties of sulfurized olefins, chlorinated paraffins, dithiocarbamates and phosphorodithioates.

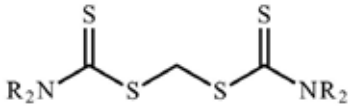
	VANLUBE 704S Lubricant Additive	VANLUBE® 719 Lubricant Additive	VANLUBE 727 Lubricant Additive
Formula	Proprietary	Proprietary	Proprietary
Application	Gear Oil, Grease, Hydraulic Oil, Metalworking, Synthetic Lube, Turbine Oil	Gear Oil, Metalworking, Synthetic Lube	Auto Transmission Fluid, Engine Oil, Grease, Hydraulic Oil, Metalworking, Synthetic Lube
Function	Corrosion Inhibitor, Demulsifier, Metal Deactivator, Rust Inhibitor	Antioxidant, Antiwear/ Antiscuff, Extreme pressure	Ashless, Antioxidant, Antiwear/Antiscuff
Chemical Composition	Barium sulfonate blend	Amine phosphate package	Organosulfur-phosphorus compound
Physical State	Viscous Liquid	Liquid	Liquid
Color	Dark Amber	Dark Amber	Light Amber
Density @ 15.6˚C Mg/m³ (lb/gal)	1.03 (8.5)	0.99 (8.2)	1.01 (8.4)
Viscosity @ 100˚C mm²/S	72	48	2.6
Flash Point (PMCC), ˚C	188	85	100
Solubility	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.
Use Concentration, % mass	0.05 - 0.25	1.0 - 4.0	1.0 - 2.0
Typical Uses	**VANLUBE® 704S** is used in petroleum and synthetic lubricants as a multifunctional rust and corrosion inhibitor. **VANLUBE 704S** is a synergistic blend of polar additives capable of forming films or complexes on metal surfaces, particularly copper and copper alloys that might be exposed to free sulfur of active sulfur compounds. It is used in a variety of lubricants based on petroleum oils or synthetics. Economical concentrations enhance antioxidants by passivating catalytic metal surfaces in the lubricant system.	**VANLUBE® 719** was developed primarily for steel mill and similar industrial gear oils. It gives good extreme pressure and antiwear properties, good high temperature stability, and good demulsibility. **VANLUBE 719** at a concentration range of 2 to 3% will meet the requirements of most steel mill gear oil specifications. It is also used in 2-cycle engine oils.	**VANLUBE® 727** is a versatile additive for various types of automotive and industrial lubricating oils. **VANLUBE 727** functions as an antiwear agent and antioxidant. Its nonmetallic nature makes it of interest for ashless or low ash applications. Some suggested applications are: automotive engine oils, railroad diesel oils, compressor oils, gas engine oils, antiwear hydraulic and turbine oils, and various types of industrial oils. Bench tests indicate that the performance of **VANLUBE 727** is competitive with that of commonly used zinc dithiophosphates. One percent in SAE 90 gear oil gives a 12-stage pass in the FZG test.

	VANLUBE 739 Lubricant Additive	VANLUBE® 829 Lubricant Additive	VANLUBE® 869 Antioxidant
Formula	Proprietary		Proprietary
Application	Auto Transmission Fluid, Compressor Oil, Engine Oil, Gear Oil, Grease, Hydraulic Oil, Turbine Oil	Grease, Synthetic Lube	Gear Oil, Grease
Function	Ashless, Corrosion Inhibitor, Rust Inhibitor	Ashless, High Temperature, Antioxidant, Antiwear/ Antiscuff, Friction Reducer, Corrosion Inhibitor, Extreme Pressure, Metal Deactivator	Antioxidant, Antiwear/ Antiscuff, Extreme Pressure
Chemical Composition	Ashless rust inhibitor in oil	5,5-dithiobis(1,3,4-thiadiazole-2(3H)-thione)	Zinc dithiocarbamate/ sulfurized olefin blend
Physical State	Liquid	Powder	Liquid
Color	Light Amber	Yellow	Amber
Density @ 15.6˚C Mg/m³ (lb/gal)	0.92 (7.7)	2.09	1.14 (9.5)
Viscosity @ 100˚C mm²/S	5	–	28
Flash Point (PMCC), ˚C	130	–	100
Solubility	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Dispersible in grease.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.
Use Concentration, % mass	0.05 - 0.5	1.0 - 3.0	1.25 - 2.0
Typical Uses	**VANLUBE® 739** was designed to improve rust protection in lube oils and greases.	**VANLUBE® 829** possesses excellent extreme pressure properties when dispersed in various greases. It also functions as an antiwear agent and an antioxidant. **VANLUBE 829** should be used in greases in applications where extreme pressures prevail, such as steel mills and heavy equipment lubrication. **NSF® Certified HX-2,138302**	**VANLUBE® 869** is an effective extreme pressure/antioxidant suitable for lubricating oils and greases. **VANLUBE 869** is compatible with other **VANLUBE** rust inhibitors/ antioxidants and metal deactivators.

	VANLUBE 871 Antioxidant	VANLUBE® 887 Antioxidant	VANLUBE 887E Antioxidant
Formula	Proprietary	Proprietary	Proprietary
Application	Engine Oil, Grease	Auto Transmission Fluid, Compressor Oil, Engine Oil, Gear Oil, Grease, Hydraulic Oil, Turbine Oil	Auto Transmission Fluid, Compressor Oil, Engine Oil, Gear Oil, Grease, Hydraulic Oil, Synthetic Lube, Turbine Oil
Function	Ashless, Antioxidant, Antiwear/Antiscuff	Ashless, High Temperature, Antioxidant	Ashless, High Temperature, Antioxidant
Chemical Composition	2,5-dimercapto-1,3,4-thiadiazole alkyl polycarboxylate	Tolutriazole compound in oil	Tolutriazole compound in ester
Physical State	Liquid	Liquid	Liquid
Color	Amber	Amber	Light Amber
Density @ 15.6˚C Mg/m³ (lb/gal)	1.10 (9.3)	1.00 (8.36)	1.01 (8.4)
Viscosity @ 100˚C mm²/S	19.6	17	20
Flash Point (PMCC), ˚C	178	146	180
Solubility	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.
Use Concentration, % mass	0.5 - 2.0	0.5 - 1.0	0.5 - 2.0
Typical Uses	**VANLUBE® 871** is a liquid ashless antioxidant/ antiwear agent. Possible uses include both gasoline and diesel engine oil formulations to improve existing additive packages.	**VANLUBE® 887** is a liquid ashless antioxidant. It is most effective as an antioxidant synergist with mixtures of hindered phenols and /or ashless dithiocarbamates such as **VANLUBE 7723**. **VANLUBE 887** possesses excellent high temperature stability. Combined with **VANLUBE 7723** and a suitable base stock, it will pass the Cincinnati Milacron Thermal Stability Test, Procedure A.	**VANLUBE® 887E** is a liquid ashless antioxidant. It is most effective as an antioxidant synergist with mixtures of hindered phenols and /or ashless dithiocarbamates such as **VANLUBE 7723**. **VANLUBE 887E** possesses excellent high temperature stability.

	VANLUBE® 961 Lubricant Additive	VANLUBE® 972M Lubricant Additive	VANLUBE 972 NT Lubricant Additive
Formula	Proprietary	Proprietary	Proprietary
Application	Auto Transmission Fluid, Compressor Oil, Engine Oil, Gear Oil, Grease, Hydraulic Oil, Synthetic Lube, Turbine Oil	Grease, Synthetic Lube	Grease, Synthetic Lube
Function	Ashless, Antioxidant	Ashless, Antiwear/Antiscuff, Extreme Pressure	Ashless, Extreme Pressure, Antiwear / Antiscuff
Chemical Composition	Mixed octylated and butylated diphenylamines	Thiadiazole derivative in polyalkylene glycols	Thiadiazole derivative in polyalkylene glycols
Physical State	Liquid	Liquid	Liquid
Color	Light Amber	Amber	Dark Amber
Density @ 15.6˚C Mg/m³ (lb/gal)	0.98 (8.2)	1.24 (10.2)	1.30 (10.8)
Viscosity @ 100˚C mm²/S	9.9	6.0	20
Flash Point (PMCC), ˚C	190	110	188
Solubility	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble PAG fluids. Insoluble petroleum lubricant bases and water.	Soluble in PAG fluids. Insoluble in petroleum lubricant bases and water.
Use Concentration, % mass	0.5 - 1.0	0.5 - 3.0	0.5 – 3.0
Typical Uses	**VANLUBE® 961** is a liquid ashless antioxidant for use in oils and greases of various types. It may be used in industrial lubricants, including compressor, hydraulic, turbine, gas engine and circulating oils. **VANLUBE 961** may be used as an ashless antioxidant in all types of crankcase oils. **NSF® Certified HX-1, HX-2, 135573**	**VANLUBE® 972M**, a thiadiazole derivative in polyalkylene glycol, is an ashless extreme pressure additive recommended for use in grease and some polyalkylene glycols (PAG) and some synthetic esters. The advantages this product offers are that it contains no metals, is easily handled, is readily biodegradable, is a cost effective alternative to other metal-containing EP additives and does not have the strong sulfur odor that is typical of the other sulfur EP additives.	**VANLUBE® 972 NT** is a thiadiazole in a polyalkylene glycol. It is an ashless extreme pressure additive recommended for use in grease, some polyalkylene glycols, and some synthetic esters. Advantages of **VANLUBE 972 NT** are that it contains no metals, is easily handled, and is a cost effective alternative to other metal-containing EP additives. It does not have the strong sulfur odor that is typical of other sulfur EP additives. This product is HAPs (Hazardous Air Pollutants) free.

	VANLUBE® 996E Antioxidant	VANLUBE® 0401 Lubricant Additive	VANLUBE 0902 Lubricant Additive
Formula	Proprietary	Proprietary	Proprietary
Application	Auto Transmission Fluid, Compressor Oil, Engine Oil, Gear Oil, Grease, Hydraulic Oil, Metalworking, Synthetic Lube, Turbine Oil	Engine Oil	Grease and Industrial Gear Oils
Function	Ashless, High Temperature, Antioxidant, Corrosion Inhibitor	Multifunctional blend composition with antiwear, friction reducer and antioxidant properties.	Multifunctional additive package for both greases and industricial gear oil.
Chemical Composition	Methylene bis (dibutyldithiocarbamate) and tolutriazole derivative	Blend of alkylated diphenylamine, organo molybdenum and organo zinc compounds	Metal-free multifuctional additive package, phosphorus containing sulfurized hydrocarbon
Physical State	Liquid	Liquid	Liquid
Color	Amber	Dark Amber	Light Amber
Density @ 15.6˚C Mg/m³ (lb/gal)	1.06 (8.8)	1.01 (8.4)	1.06 (8.8)
Viscosity @ 100˚C mm²/S	16.4	13.6	10 - 30
Flash Point (PMCC), ˚C	191	>200	>90
Solubility	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in engine oils.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.
Use Concentration, % mass	0.1 - 1.0 as antioxidant; 1-4 as extreme pressure agent	0.25 - 4.0	1.5 - 4.0
Typical Uses	**VANLUBE® 996E** is a liquid ashless antioxidant that finds application in petroleum lubricants of all types. It possesses excellent high temperature stability and is noncorrosive despite having high sulfur content. **VANLUBE 996E** also exhibits extreme pressure performance alone and in combination with other additives.	**VANLUBE® 0401** is a phosphorus-free synergistic blend of additives recommended for energy-conserving low phosphorus engine oils in order to control high temperature deposits, reduce friction and provide excellent wear and oxidation protection. It can also be used in greases and other applications where friction wear and oxidation control are needed.	**VANLUBE® 0902** is a multifunctional additive package recommended for use at 1.5 to 2.25 % in suitable base stocks to formulate industrial gear oils. It is also recommended for use at 3.0 to 4.0% to formulate high performance greases.

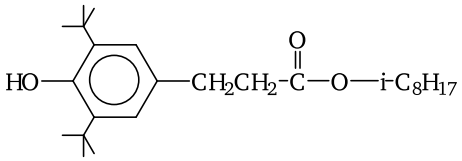
	VANLUBE 1202 Lubricant Additive	VANLUBE® 7611M Lubricant Additive	VANLUBE 7723 Lubricant Additive
Formula	Proprietary	Proprietary	
Application	Engine Oils, Gear oil, Grease, Metal Working Fluids and Synthetic Lubricants	Auto Transmission Fluid, Engine Oil, Grease, Hydraulic Oil, Metalworking, Synthetic Lube	Compressor Oil, Gear Oil, Grease, Hydraulic Oil, Synthetic Lube, Turbine Oil
Function	Antioxidant	Ashless, Antioxidant, Antiwear/Antiscuff.	Ashless, High Temperature, Antioxidant, Antiwear/ Antiscuff, Friction Reducer, Extreme Pressure
Chemical Composition	Alkylated PANA	Ashless phosphorodithioate	Methylene bis(dibutyldithiocarbamate)
Physical State	Solid, Powder	Liquid	Liquid
Color	Yellow to Brown	Light Amber	Amber
Density @ 15.6˚C Mg/m³ (lb/gal)	N/A	1.08 (9.0)	1.06 (8.8)
Viscosity @ 100˚C mm²/S	N/A	2.54	15
Flash Point (PMCC), ˚C	186	142	177
Solubility	Soluble in petroleum and synthetic lubricant base stocks. Insoluble in water	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.
Use Concentration, % mass	0.1 – 1.0	1.0 - 2.0	0.1 - 1.0 as antioxidant; 2.0 - 4.0 as extreme pressure agent.
Typical Uses	**VANLUBE® 1202** is a solid ashless antioxidant for use in lubricating oils and greases of various types and is especially effective in engine oils and other high temperature applications.	**VANLUBE 7611M** is an organic liquid additive containing sulfur and phosphorus. 4-Ball Wear tests show that **VANLUBE 7611M**, at a 20 kg load, performs equivalently to typical zinc dialkyldithiophosphates. At a 40 kg load it is superior to these products. **VANLUBE 7611M** will improve the antiwear properties of sulfurized extreme pressure additives. It is a useful component for extreme pressure/antiwear lubricant formulations and additive packages. **VANLUBE 7611M** does not contain metallic elements. Thus, it is applicable to ashless and low ash formulations. **NSF® Certified HX-2, 136048**	**VANLUBE 7723** is a general purpose, ashless antioxidant which should find application in petroleum lubricants of all types. It is effective at economical concentrations, readily soluble, and easy to blend. **VANLUBE 7723** has been tested in a variety of base stocks commonly used in compounding turbine, hydraulic and circulating oils. In addition to being an effective antioxidant, **VANLUBE 7723** also exhibits good extreme pressure performance alone and in combination with other additives. Useful as a component of additive packages. **NSF® Certified HX-1, HX-2, 136049**

	VANLUBE 8610 Lubricant Additive	VANLUBE® 8912E Lubricant Additive	VANLUBE 9123 Lubricant Additive
Formula	Proprietary	Proprietary	Proprietary
Application	Gear Oil, Grease	Gear Oil, Grease, Hydraulic Oil, Metalworking, Rust Preventive, Turbine Oil	Gear Oil, Grease, Rust Preventive
Function	Antioxidant, Antiwear/ Antiscuff, Extreme Pressure	Corrosion Inhibitor, Rust Inhibitor	Ashless, Antiwear/Antiscuff, Rust Inhibitor
Chemical Composition	Antimony dithiocarbamate/ sulfurized olefin blend	Calcium sulfonate	Amine phosphate
Physical State	Liquid	Liquid	Liquid
Color	Amber	Dark Brown	Amber
Density @ 15.6˚C Mg/m³ (lb/gal)	1.16 (9.42)	0.97	0.94 (7.8)
Viscosity @ 100˚C mm²/S	28.5	19	24
Flash Point (PMCC), ˚C	100	150 (COC)	96
Solubility	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.
Use Concentration, % mass	1.25 - 2.0	0.05 - 0.10	0.10 - 1.0
Typical Uses	**VANLUBE® 8610** is an extreme pressure/ antioxidant useful for various lubricating oils and greases. Impressive Timken loads of 90 to 100 lbs. are achieved with 2% treatment levels. **VANLUBE 8610** is compatible with other **VANLUBE** rust inhibitors/ antioxidants and metal deactivators.	**VANLUBE® 8912E** is an oil-soluble calcium sulfonate with excellent rust-inhibiting and water-resistant properties.	**VANLUBE® 9123** is an excellent antiwear additive and rust inhibitor in a wide range of industrial oils and lubricating greases. **NSF® Certified HX-1, HX-2,135575**

	VANLUBE® 9317 Antioxidant		
Formula	Proprietary		
Application	Synthetic Lube		
Function	High Temperature, Antioxidant		
Chemical Composition	Organic amine compounds in a synthetic ester		
Physical State	Liquid		
Color	Dark Brown		
Density @ 15.6˚C Mg/m³ (lb/gal)	0.98 (8.1)		
Viscosity @ 100˚C mm²/S	128		
Flash Point (PMCC), ˚C	254		
Solubility	Soluble in petroleum and synthetic lubricant bases. Insoluble in water.		
Use Concentration, % mass	0.5 - 4.0		
Typical Uses	**VANLUBE® 9317** is an amine antioxidant designed to give excellent high temperature performance in synthetic polyolester based lubricants. At high temperatures, it significantly reduces the sludge and varnish typically seen with more conventional amine antioxidants.		

VANLUBE® BHC

PHENOLIC ANTIOXIDANT



	Typical Properties
Composition:	Butylated hydroxy-hydrocinnamate
Physical State:	Yellowish liquid
Specific Gravity, 25°C	0.96
Viscosity at 40°C, mm²/s	140
Ash content, %	< 0.1

VANLUBE BHC is an effective general-purpose, nonstaining, ashless antioxidant that provides excellent oxidative stability to a wide range of automotive and industrial lubricants. It has excellent solubility in mineral oil and non-conventional base stocks, and contains no diluents. It is easy to handle and will not crystallize at low temperatures like some commercial phenolic antioxidants.

VANLUBE BHC has low volatility and helps control oxidation and high temperature deposits/sludge. It is effective at concentrations of 0.1% to 2.0% and works well when combined with alkylated diphenylamines, molybdenum compounds, sulfur-containing antioxidants, or phosphites in many industrial oils and automotive lubricants, especially modern engine oils.

Figure 1

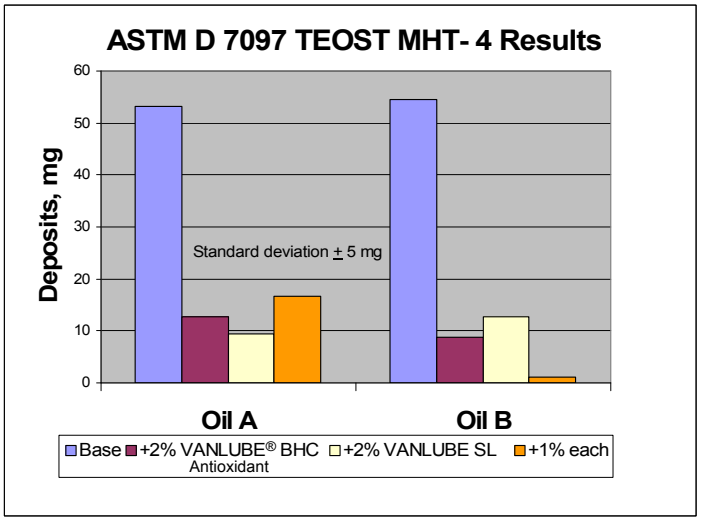
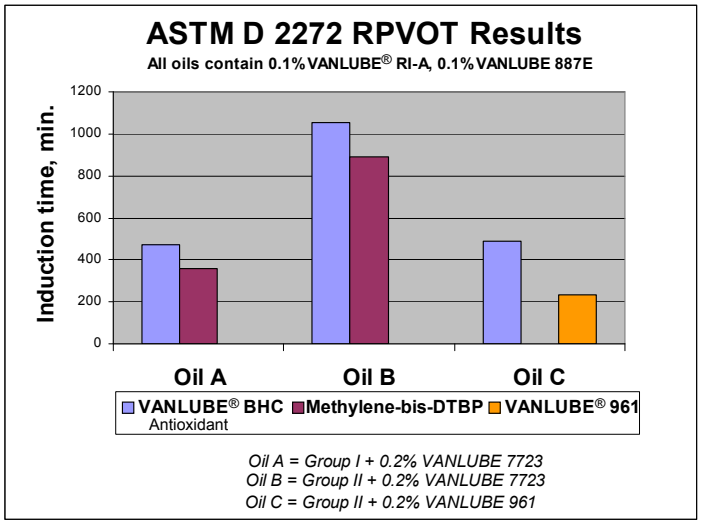


Figure 2



VANLUBE SL and **VANLUBE 961** are alkylated diphenyamines; **VANLUBE 7723** is methylene-bis-dibutyl-dithiocarbamate

Fig. 1 **VANLUBE BHC** controls deposits in TEOST MHT- 4 as well as diphenylamine antioxidants.
Fig. 2 **VANLUBE BHC** boosts RPVOT induction time better than methylene-bis-2'6'-di-tert-butyl phenol.

VANLUBE® 289

Lubricant Additive

Ask about our new boron antiwear additive, **VANLUBE 289** and its synergistic performance with ZDDP.
Please e-mail us at: petro@vanderbiltchemicals.com

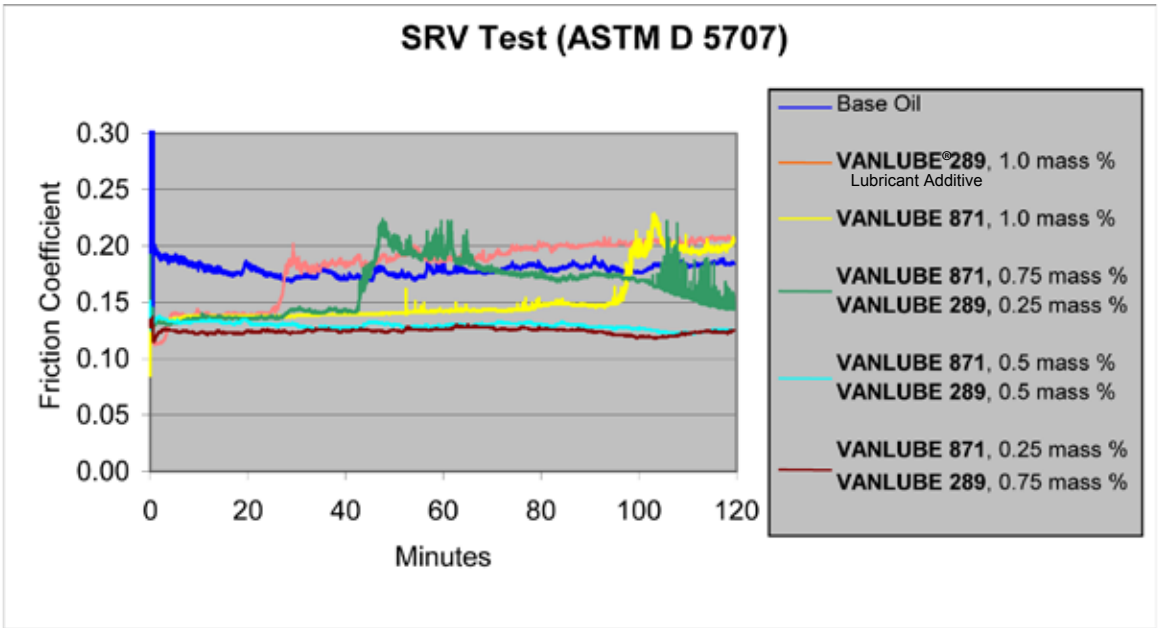


Figure 4. Test Parameters: 80°C; 50 N break-in load; 200 N test load; 50 HZ; 1.00 mm stroke; test duration of 120 minutes.

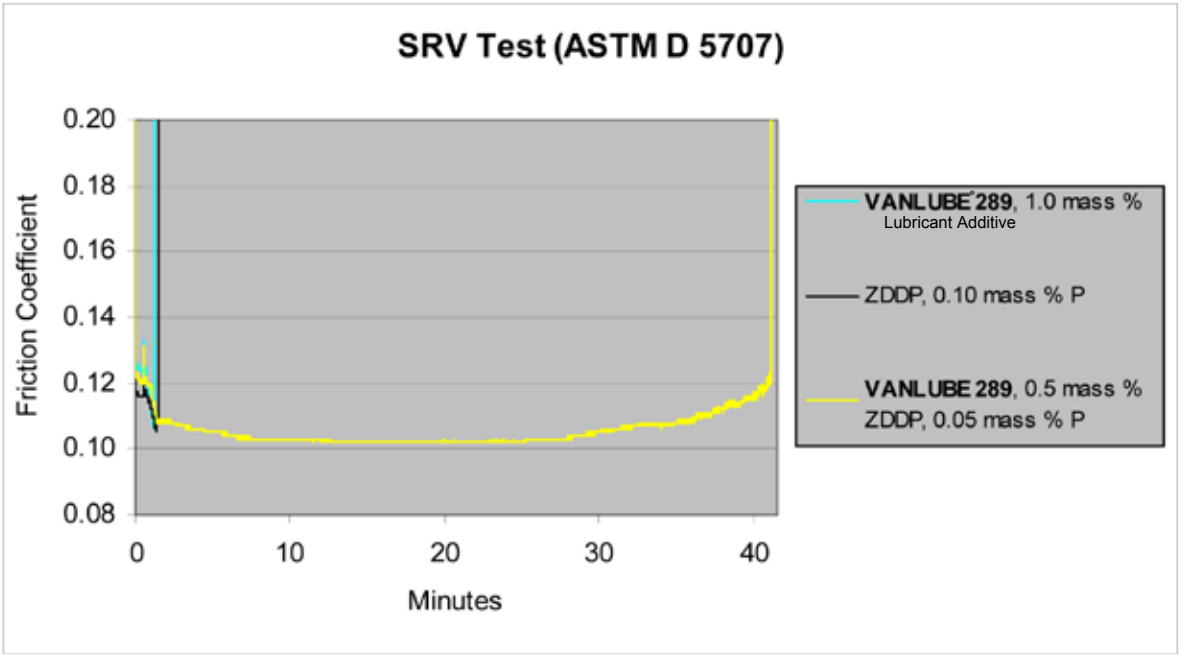


Figure 5. Test Parameters: 25°C; 50 N break-in load; 1000 N test load; 50 HZ; 1.00 mm stroke. Experiments ran until failure as indicated by a large and sudden increase in the friction coefficients

VANLUBE® 996E

Antioxidant

Looking for effective antioxidants with proven synergism in Group I-III base oils?
Please e-mail us at: petro@vanderbiltchemicals.com

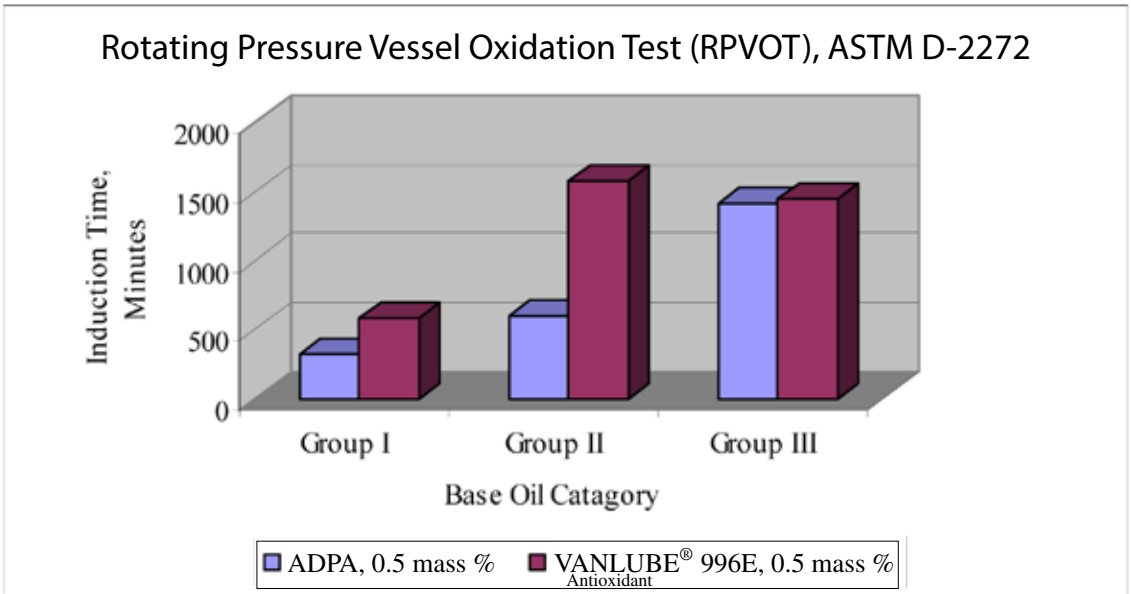


Figure 1. Rust inhibitor (**VANLUBE® RI-A** Lubricant Additive, 0.05 mass %) was added to all test oils. ADPA is acronym for alkylated diphenylamine. The ADPA that was used for this study consisted of a mixture of butylated/octylated DPA components.

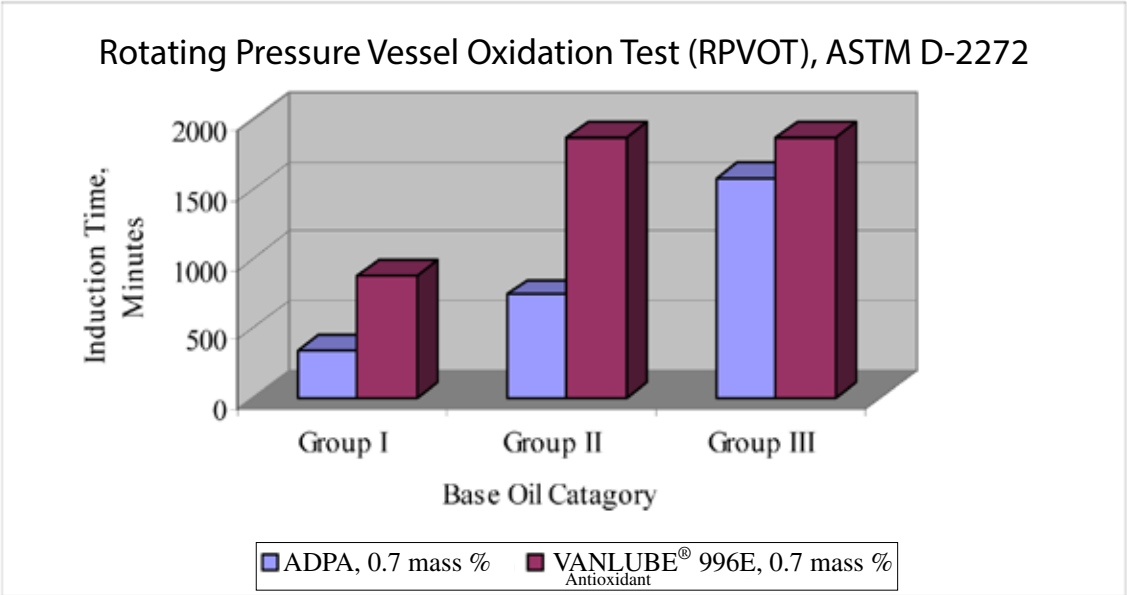


Figure 2. Rust inhibitor (**VANLUBE RI-A** Lubricant Additive, 0.05 mass %) was added to all test oils. ADPA is acronym for alkylated diphenylamine. The ADPA that was used for this study consisted of a mixture of butylated/octylated DPA components.

VANLUBE® 0401

Lubricant Additive

Are you working on GF-5 formulations for PCMO that require low phosphorus and low sulfur but improved antiwear, antioxidant and friction retention properties?

Please e-mail us at: petro@vanderbiltchemicals.com

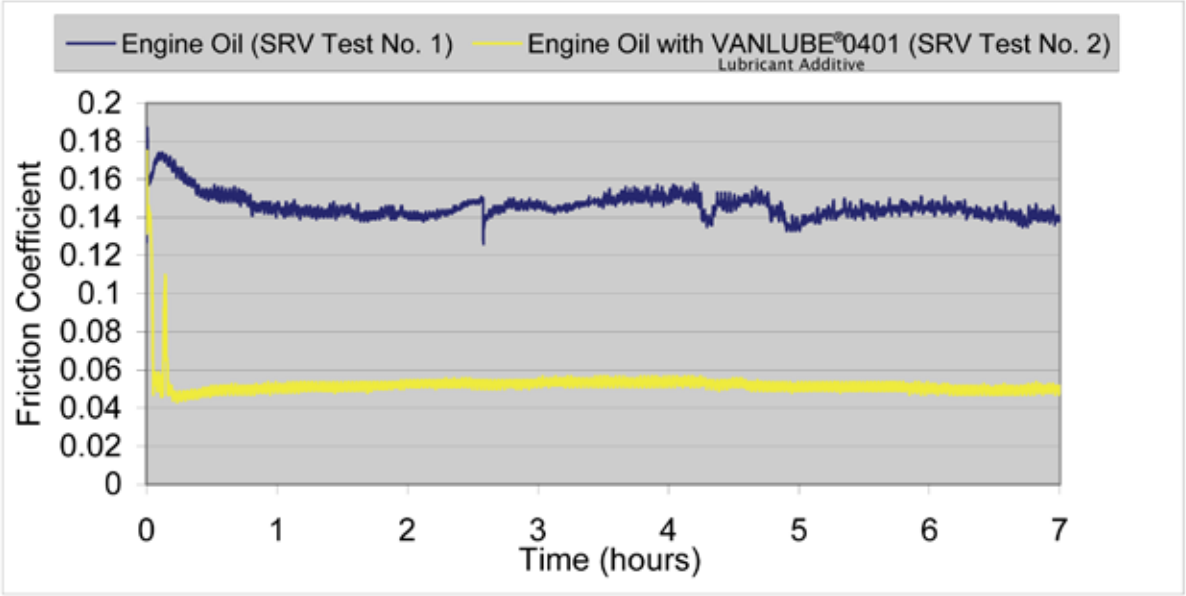


Figure 1. Test Parameters: ball on disk; 120N; 40 Hz; 4.00 mm stroke; 7 hours. The engine oil is 5W-30 grade containing 0.05 mass percent of phosphorus.

Figure 2. Image of the wear scar on disk for SRV Test No. 1. The mirror finish and the removal of the surface features of the disk, i.e. the deep etching marks, are evidence of polishing wear.

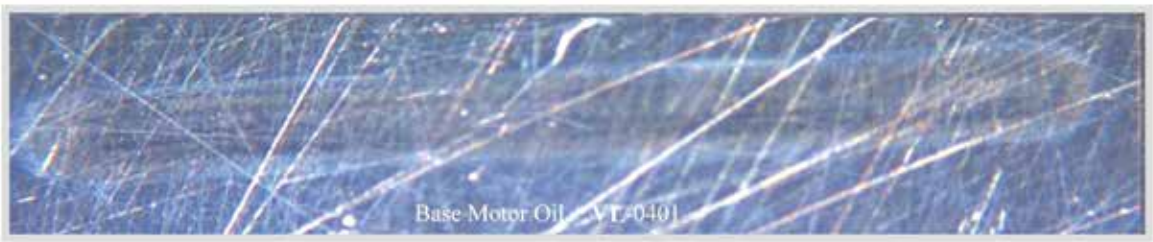


Figure 3. Image of the wear scar on disk for SRV Test No. 2. The surface features of the disk are intact; the dark coloration indicates the protective surface film.

VANLUBE® 73 Super Plus

Lubricant Additive

Extreme Pressure *Antiwear* *Antioxidant*

Typical Properties

Composition:	Metal dialkyldithiocarbamate mixture
Physical State:	Liquid
Color, ASTM D 1500:	7.0 maximum
Density at 25°C, Mg/m^3:	1.05
Viscosity at 40°C, mm^2/s:	1.190
Viscosity at 100°C, mm^2/s:	33.34
Flash Point, PMCC, °C:	245 minimum
Antimony Content, %:	5.8
Zinc Content, %:	4.5
Sulfur Content, %:	18.5
Nitrogen Content, %:	4.5

VANLUBE 73 Super Plus is a proprietary mixture of dialkyldithiocarbamates. Based on equivalent antimony content, as shown in the table below, the load-carrying capability of **VANLUBE 73 Super Plus** is superior to that of antimony dialkyldithiocarbamate (SDDC), and comparable to that of combinations of SDDC and sulfurized olefin. As an antioxidant, **VANLUBE 73 Super Plus** outperforms both SDDC and SDDC/sulfurized olefin and, unlike sulfurized olefin, it does not lower the dropping point of lithium complex grease. **VANLUBE 73 Super Plus** does not have the pungent odor of sulfurized olefin.

Component	Treat Rate, Mass Percent				
VANLUBE® 73 Super Plus Lubricant Additive	3.0				
Compound A (SDDC)		2.5			
Compound B (SDDC)			2.5		
Compound C (SDDC/sulfurized olefin 1:1 blend)				2.3	
Lithium Complex Grease, NLGI 2	97.0	97.5	97.5	97.7	100
Antimony content in grease, %	0.17	0.17	0.17	0.17	0
Timken OK Load (ASTM D 2509), lb	70	25	Fail 20	60	<20
4-Ball Wear (ASTM D 2266), 1200 rpm, 75 °C, 40 kgf, 1h, mm	0.57	0.54	0.56	0.60	0.69
4-Ball EP (ASTM D 2596), Weld Point, kgf	400	400	400	400	250
Dropping Point (ASTM D 2265), °C	283 273	277	267	252 247	273
PDSC Oxidation Induction Time (ASTM D 5483), minutes at 180 °C	76.6	61.7	54.1	45.4	0.8

Do You Need Rust Protection?

Vanderbilt's dinonylnaphthalene sulfonates are excellent rust inhibitors.

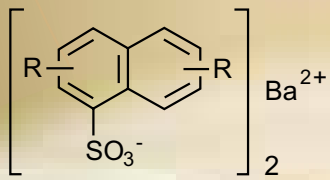
They are recommended for use where rust inhibition and water resistance are needed.

They can be used in environments that are exposed to large amounts of water, such as paper machine oils and rock drill oils. They also provide rust protection and water separability properties in turbine oils, hydraulic fluids and circulating oils.

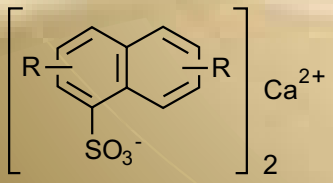
They can also be used in greases and in-process rust preventive temporary coatings in metalworking processes.

Contact us for more information.

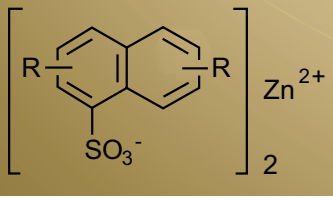
VANLUBE® RI-BSN



VANLUBE® RI-CSN



VANLUBE® RI-ZSN



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More Than Just a Drop in the Bucket

MOLYVAN® 855

Friction Reducer

Today's high performance lubricants require special additives to perform successfully. MOLYVAN® 855 is an organo-molybdenum additive that contains no phosphorus or sulfur and is more cost effective than traditional molybdenum dithiocarbamates.

Lubricants formulated with MOLYVAN® 855 exhibit enhanced oxidation and wear protection, as well as reduced timing chain wear and improved low speed pre-ignition (LSPI) performance, two new requirements proposed for GF-6.

Order a sample and discover the many benefits of this unique additive component in your lubricant formulation.

Vanderbilt Chemicals, LLC
A Wholly Owned Subsidiary of R.T. Vanderbilt Holding Company, Inc.

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Branching Makes It Better with

MOLYVAN® 3000

Friction Reducer

MOLYVAN® 3000 Friction Reducer is an exceptional oil soluble MoDTC friction modifier containing 10% molybdenum with antiwear and antioxidant properties.

Its unique molecular branching provides superior fluid compatibility/stability at low temperature and enhanced robustness for improved retention of friction reduction in aged oil.

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