



Vanderbilt Chemicals, LLC

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

MOLYVAN[®] 3000

Friction Reducer



Branching Makes It Better

Friction Reducer

Antiwear Agent

Antioxidant

MOLYVAN[®] 3000

Friction Reducer

Molybdenum Dithiocarbamate Additive

Friction Reducer

Antiwear

Antioxidant

Typical Properties

Physical State	Brown Liquid
Density at 25°C, Mg/m ³	1.05
Viscosity at 100°C, mm ² /s.	53.0
Color, 1% in hexane	L5.0
Sulfur Content, %	10.7
Molybdenum Content, %	10.1

MOLYVAN[®] 3000 is an exceptional oil soluble molybdenum dithiocarbamate (MoDTC) friction reducer with antiwear and antioxidant properties. Its unique alkyl group structure allows for improved solubility in today's less polar base oils which makes it very useful in a wide range of automotive and industrial lubricants.

Table 1
Additive Solubility Performance

	90 Days		
	Ambient	15°C	-10°C
MOLYVAN[®] 3000 Friction Reducer	Clear	Clear	Clear
Competitive MoDTC with 10% Mo	Clear	Clear	Very Hazy*

*Haze developed within 1 day

This solubility study was conducted in a prototype, fully-formulated 0W-20 GF-5 engine oil containing Group III base oil, 750 ppm phosphorus and 700 ppm molybdenum, based on observation of haze and precipitate formation at various temperatures. Low temperature solubility for MoDTC additives is critical in engine oil applications.

Disclaimer:

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30 WINFIELD STREET, P.O. BOX 5150, NORWALK, CONNECTICUT 06856-5150 • (203) 853-1400

Fax (203) 853-1452 • Internet Address: www.vanderbiltchemicals.com

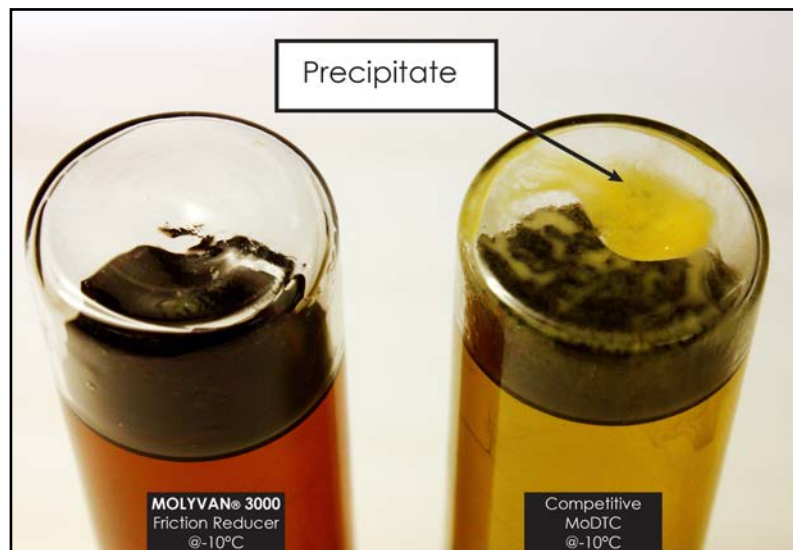
Figure 1

Low Temperature Solubility Performance

Photograph 1



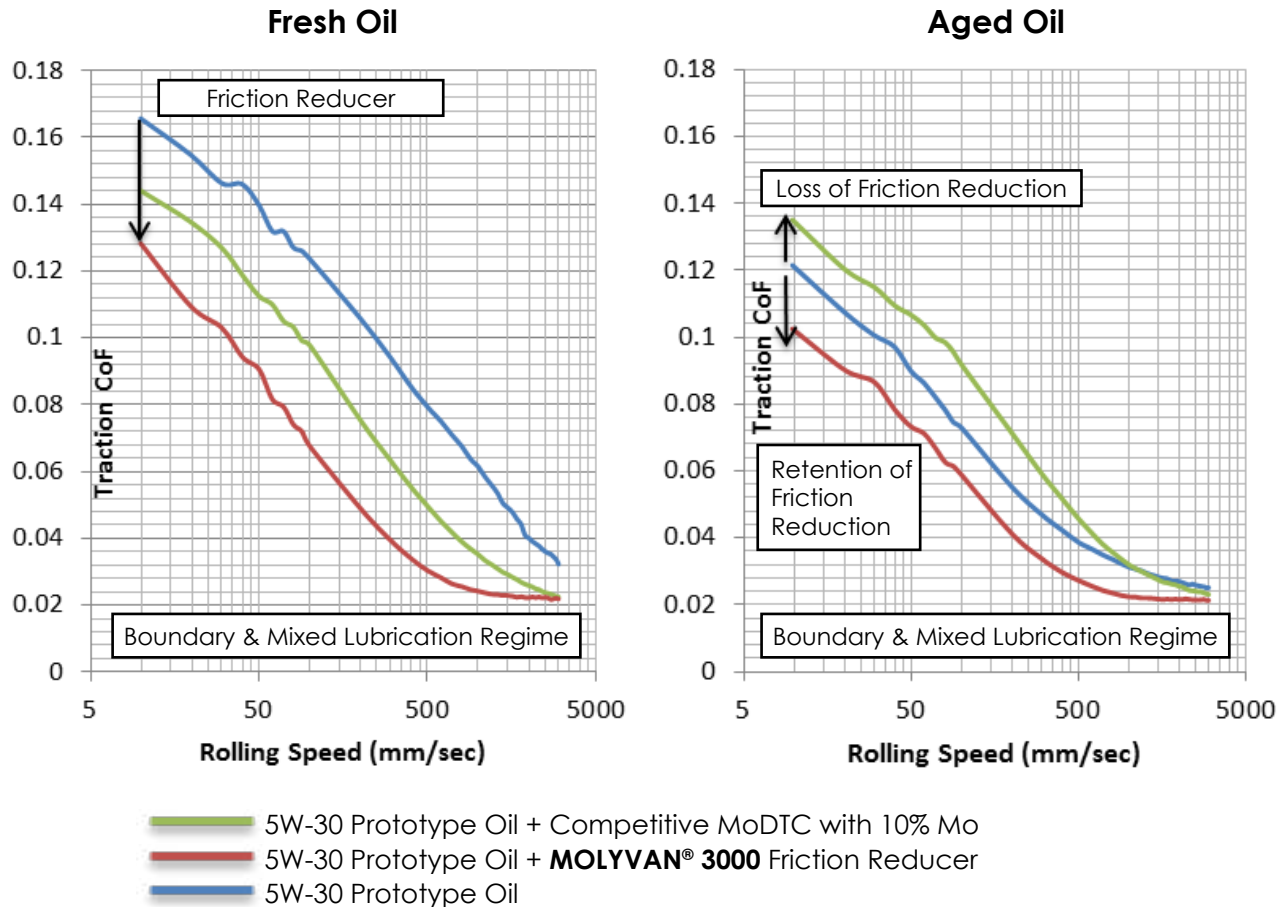
Photograph 2



MOLYVAN® 3000 Friction Reducer demonstrates improved oil solubility versus the competitive product, a similar commercial molybdenum dithiocarbamate friction reducer that contains 10% molybdenum, when stored at -10°C for 90 days by virtue of the absence of haze and precipitate in the oil.

Figure 2

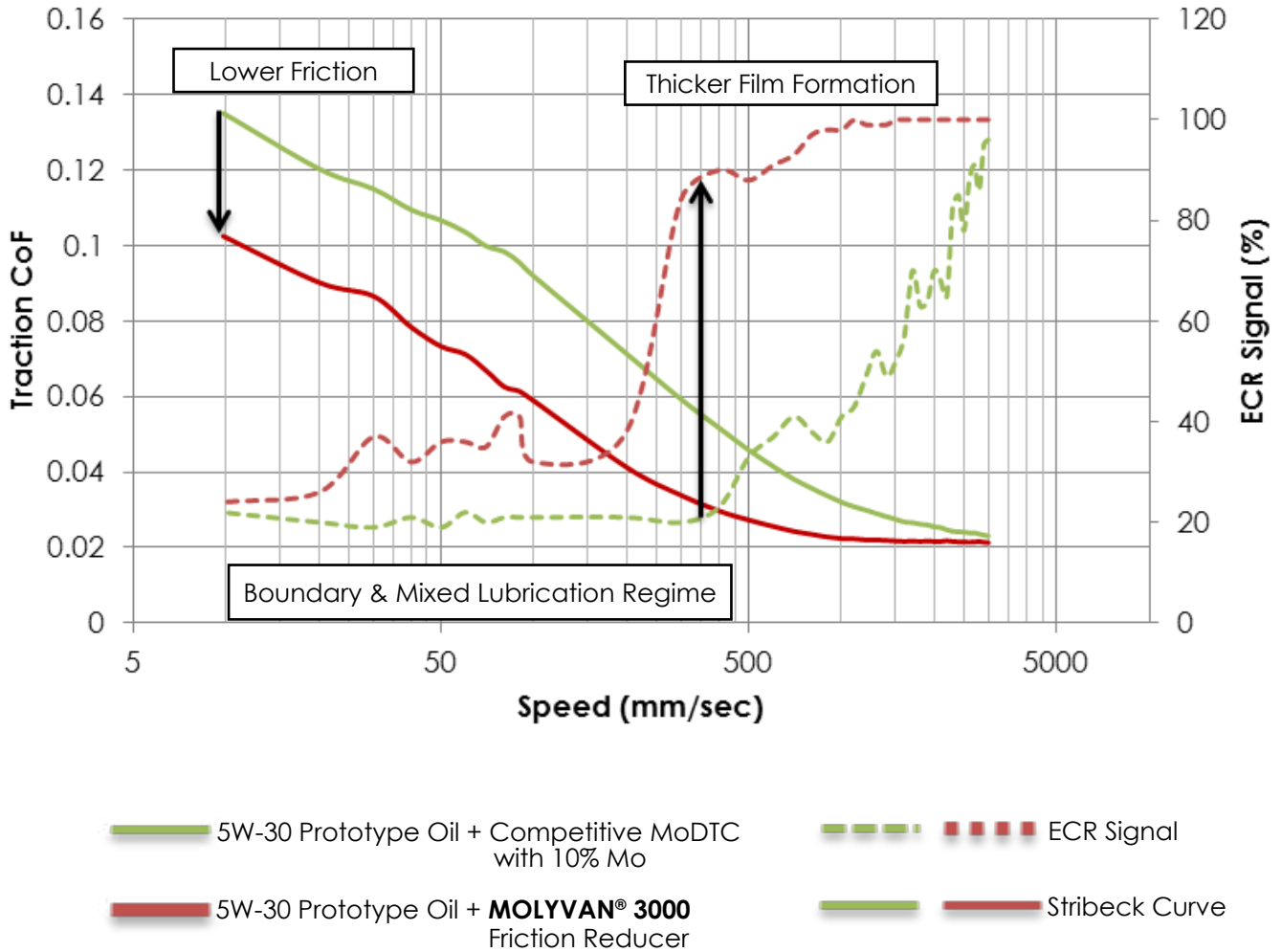
MTM Stribeck-Curve Comparison



MOLYVAN® 3000 Friction Reducer demonstrates improved friction reduction and retention properties in a prototype SAE 5W-30 fully formulated GF-5 engine oil containing 750 ppm phosphorus and 320 ppm molybdenum using a Mini Traction Machine (MTM). The MTM bench test uses the ball-on-disc configuration with a slide-to-roll ratio of 50%, 35 N load at 120°C. Test oils are aged in a modified High Temperature Corrosion Bench Test for 48 hours at 165°C (provides similar FTIR oxidation level as Sequence VID aging after 100 hours or 6500 miles).

Figure 3

MTM ECR Film Formation Performance Comparison



MOLYVAN® 3000 Friction Reducer demonstrates improved film formation tendencies using the MTM as measured by Electrical Contact Resistance (ECR) in the boundary and mixed lubrication regimes versus the competitive MoDTC with 10% Mo. ECR measures the resistance to electrical current flow between ball and disc. High ECR values are an indication of thicker film formation whereas low ECR values are associated with thinner and incomplete film formation. Test oils and test conditions for oil aging and friction tests are the same as in Figure 2.



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30 Winfield Street, P.O. Box 5150, Norwalk, CT 06856-5150

(203) 853-1400 • Fax: (203) 853-1452

www.vanderbiltchemicals.com • petro@vanderbiltchemicals.com