

DURAD® 310M

Mixed Alkyl / Aryl Phosphates

DESCRIPTION

DURAD® 310M is a 100% active phosphate ester multifunctional extreme pressure and antiwear additive for lubricants.

TYPICAL PROPERTIES

The values given in the tables are typical and do not constitute specification limits.

PHYSICAL PROPERTIES	UNIT	TEST METHOD	DURAD® 110B
Colour	Hazen mgPt/Co	ASTM D1209 / ISO 2211	40
Kinematic viscosity		ASTM D445 / ISO 3104	
at 100°C	mm ² /s		8.3
at 40°C	mm ² /s		130
at 25°C	mm ² /s		117.4
Specific gravity at 20°C	g/ml	ISO 3675	1.1
Pour Point	°C	ISO 3016	-10
Acid number	mgKOH/g	ISO 6619	0.1
Water Content	%ww	ISO 760	0.082
Phosphorous Content	%	ASTM D4052 / ISO 12185	



FIRE RESISTANCE AND THERMAL PROPERTIES	UNIT	TEST METHOD	DURAD® 310M
Fire Testing			
Flash point (open cup)	°C	ASTM D92	254
Fire point (open cup)	°C	ASTM D92	352
Thermogravimetric Analysis (TGA)			
Onset of thermal decomposition	°C		277
5% weight loss at	°C	N ₂ 50mL/min 30-500°C @10°C/min	202/213
10% weight loss at	°C	N ₂ 50mL/min 30-500°C @10°C/min	223/229
Onset of oxidation	°C		280.6
5% weight loss at	°C	O ₂ 50mL/min 30-500°C @10°C/min	209.4
10% weight loss at	°C	O ₂ 50mL/min 30-500°C @10°C/min	225

APPLICATIONS

The recommended addition level is 0.5-1.0% by weight for formulating in a broad range of lubricant base stocks. A higher **DURAD® 310M** loading or use in combination with other extreme pressure additives may be required to meet specific lubricant requirements.

DURAD® 310M has demonstrated excellent synergism with sulfur-containing EP additives, making the combination a desirable replacement for chlorinated additives.

FORMULATING WITH PHOSPHATE ESTERS

DURAD® 310M displays excellent antiwear and extreme pressure performance in laboratory tests. It also shows high resistance to micropitting wear in the FZG test.

As a multifunctional additive, **DURAD® 310M** has shown the additional benefits of excellent rust and corrosion protection. It also possesses good solubility and stability in a wide range of lubricant base stocks.

BENEFITS

- Excellent extreme pressure/antiwear performance.
- Excellent rust/corrosion protection.
- Good oxidation stability.
- Excellent FZG performance.
- High resistance to micro-pitting wear.
- Ash-free.

PERFORMANCE DATA

DURAD® 310M gives excellent antiwear and extreme pressure performance in a broad range of gear oil base stocks, including high resistance to micro-pitting wear in the FZG test. Gear oils formulated with **DURAD® 310M** have also shown excellent rust and corrosion protection. **DURAD® 310M** alone appears not to significantly affect oxidation stability or the surface active properties of the oil.

0.5% **DURAD® 310M** treatment in an ISO VG 220 Group I base stock.



BENCH TESTS

	METHOD	BASE OIL	DURAD® 310M
Oxidation stability by rotating bomb (min)	ASTM D2272	40	41
Wear prevention (4-ball method) - wear scar at 40 kgf/1 hour/1200 rpm (mm)	ASTM D4172	1.35	0.37
Extreme pressure properties (4-ball method) weld load (kgf)	ASTM D2783	160	160
Scuffing capacity (FZG gear test)	ASTM D5182	7 - 8	12+
FZG double speed gear test (A/16.6/90)		-	12+
Micro-pitting performance- Micro-pitting load capacity	FVA test 54/IHV	-	High
Rust preventing characteristics - procedure A - procedure B	ASTM D665 (ISO 7120)	Fail Fail	Pass Pass
Copper corrosion- at 100°C /3 hours	ASTM D130 (ISO 2160)	1a	1a
Foaming characteristics (Seq I) - tendency/stability (cm3)	ASTM D892 (ISO 6247)	15 - 0	40 - 0
Water separation at 82oC - time to less than 3 cm3 of emulsion (min)	ASTM D1401 (ISO 6614)	25	20
Air release properties - at 50°C - at 75°C	ASTM D3427 (ISO 9120)	9.1 3.8	11.3 3.7



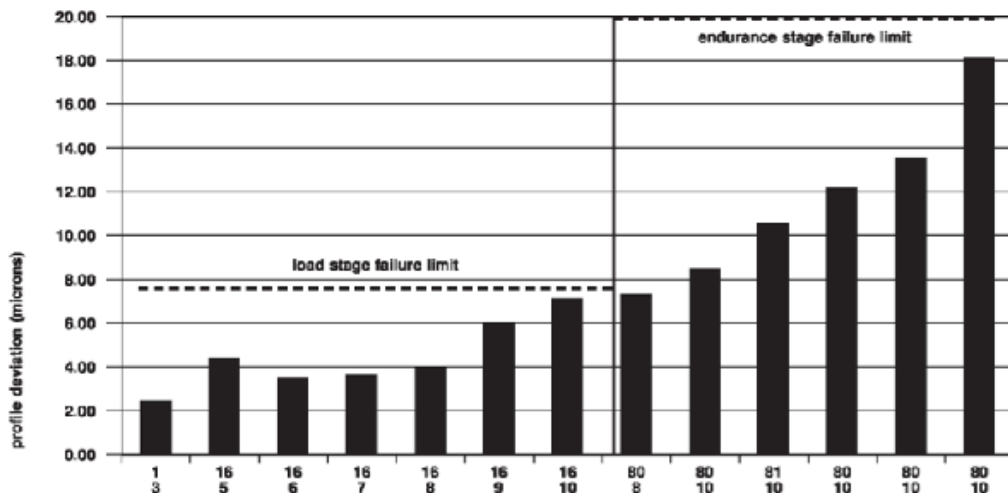
DURAD® 310M is an effective extreme pressure and antiwear additive for synthetic base stocks as demonstrated by the FZG gear test performance in esters and polyglycolethers.

BENCH TESTS

FZG – FAILURE LOAD STAGE DATA IN SYNTHETIC OILS: TEST METHOD: ASTM D 5182 (CEC-L-07-A-95)			
POLYOL ESTERS (ISO VG 32-EMKARATE 1800)			
	FORMULATION	SINGLE SPEED TEST (A/8.3/90)	DOUBLE SPEED TEST (A/16.6/90)
Ester Base	DURAD® 310M	9	-
Base + 1%		>12	-
POLYGLYCOLETHERS (ISO VG 46-EMKAROX DGLF 235)			
	FORMULATION	SINGLE SPEED TEST (A/8.3/90)	DOUBLE SPEED TEST (A/16.6/90)
Polyglycoether base	DURAD® 310M	-	7
Base + 0.5%		-	>12

FVA MICRO-PITTING CAPACITY TEST 54/I-IV: PROFILE DEVIATION

FZG MICRO-PITTING PROFILE DEVIATION: DURAD® 310M IN ISO VG 220 BASE STOCK.



In addition to gear oils, **DURAD® 310M** gives good performance in a broad range of industrial oils, both mineral and synthetic based, including hydraulic, turbine and circulatory oils. Performance data in an ISO VG 46 Group I base stock is shown.



SUMMARY OF INDUSTRIAL OIL PERFORMANCE

Additives at 1.0% w/w treatment in an ISO VG 46 Group I base stock.

TEST	METHOD BASE OIL	DURAD® 310M	1°ZDP	2°ZDP
Wear prevention (4-ball method) wear scar, mm - at 40 kgf	ASTM D4172 1.05	0.48	0.58	0.52
- at 80 kgf	1.78	50-56	22	158
- at 40 kgf (polyol ester)	0.76	40-45	18	158
- at 40 kgf (4 cSt PAO)	0.80	50-56	21	126
Extreme pressure properties (4-ball method) - highest non-seizure load	ASTM D2783 50	80	63	100
- weld load (kgf)	100	126	160	250
- load wear index	21.3	31.6	26.9	44.1
Scuffing capacity (FZG gear test) Failure load stage - at 1.0% loading	ASTM D5182 7-8	12+	10-11	10-11
- at 0.5% loading	-	10	-	-
Extreme pressure properties (falex pin and vee block test) Failure load (lbs)	ASTM D3233 <300	1000	660	550

EXTREME PRESSURE PROPERTIES FALEX PIN AND VEE-BLOCK TEST

TEST	METHOD BASE OIL	BASE OIL	DURAD® 310M
Failure load (lbs) in ISO VG 22 oil	ASTM D3233	<300 (fails break-in)	915
in ISO VG 46 oil	1.78	<300 (fails break-in)	1000

SAFETY & HANDLING

For more extensive information on the safe handling and use of these products, please refer to the appropriate Material Safety Data Sheet.

Please consult the material safety data sheet (MSDS) before handling

SHIPPING INFORMATION

These **DURAD®** products are available in 230kg drums.



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