

DOVER PRODUCTS ADD PERFORMANCE TO LUBRICANT FORMULATIONS

- **PAROIL®/CHLOROWAX®/CHLOROFLO®**
LIQUID CHLORINATED ALKANES
- **CHLORINATED FATTY COMPOUNDS**

- **PAROIL® 300 SERIES CORROSION**
INHIBITING LIQUID CHLORINATED ALKANES

LIQUID CHLORINATED ALKANES

In boundary lubrication, pressure has reached a point where additives to the base oil are necessary to prevent metal-to-metal contact. Liquid chlorinated alkanes provide low cost, low odor extreme pressure (EP) performance through byproducts of a reaction between the chlorine in the molecule and the metal on which the lubricant is used. They are the most widely used additives in high stress metalworking applications such as broaching, grinding, cutting, stamping, and drawing to increase lubricant performance and equipment life.

Dover Chemical Corporation is the leading producer of liquid chlorinated alkanes, which are based on the chlorination of waxes, normal paraffins, and alpha olefins. We offer additives with chlorine contents from 40 to 70 percent and with viscosities from 2 to 1000 poise at 25°C through our Paroil, Chlorowax and Chloroflo product lines. A portion of our products is listed on pages 2 and 3. Dover also can custom formulate additives to meet your requirements.

Metalworking lubricant classifications include straight oils, soluble oils, and synthetic solutions. Straight oils include all the necessary additives, but no water. Soluble oils contain an EP additive package and an emulsifying agent, and are diluted with water to provide a cost effective heat sink. Synthetics are solutions of water-soluble salts. Liquid chlorinated alkanes may be used in both straight oils and soluble oils, but not in synthetic solutions. All grades of Paroil, Chlorowax and Chloroflo are compatible in varying degrees with both naphthenic and paraffinic base oils, but are generally more compatible with naphthenic base oils.

PAROIL 300 SERIES

The potential for rust on worked metal surfaces exists with both chlorine and sulfur compounds. Rust is more likely to occur in humid climates or where the lubricant is allowed to remain on the finished part for extended periods of time. It usually is associated with oil-based lubricants, since water-based lubricants typically contain water-soluble rust inhibitors.

Paroil 300 Series liquid chlorinated alkane products that have undergone Dover's unique inhibition process eliminate or significantly reduce stain and corrosion on a work piece exposed to high humidity and temperature for hours or even days. Corrosion inhibited grades of Paroil products exhibit physical and working properties in EP applications nearly identical to the uninhibited grades.

The following data demonstrate the superior qualities of Paroil 300 Series compared to standard materials. Activated steel panels were coated with 300 Series and uninhibited product. Treated faces of two panels were clamped to each other and were placed in an oven at 95°C for five hours. The panels were separated and subjected to 100 percent relative humidity at 100°F for four days.



Paroil 345



Uninhibited chlorinated alkane

SULFUR & PHOSPHORUS PRODUCTS

Chlorinated alkanes are often used in conjunction with sulfur or phosphorus-based compounds as EP additives in metalworking lubricants. Chlorine activates at approximately 150°F, while sulfur activates at 225-250°F. The reaction products, iron chloride and iron sulfide, melt at 1100°F and 2100°F, respectively. Iron chloride is softer than iron sulfide and consequently gives better lubricity. Sulfur products often have unpleasant odors and stain metals more than chlorine, while chlorinated alkanes have extremely low odor. Chlorine works better on hard metals, and sulfur works better on softer, more pliable materials.

Combinations of sulfur and phosphorus can approximate the performance of chlorinated additives. In addition, phosphorus additives offer enhanced performance in machining aluminum. In steel machining, phosphorus additives give a bright finish to the manufactured parts.

Depending on the severity of the extreme pressure operation, it may be necessary to combine chlorinated alkanes with sulfur and/or phosphorus compounds to obtain the benefits of each type of additive. Doverlube products meet such needs.

LIQUID CHLORINATED ALKANE PRODUCTS

(All are available in 300 Series corrosion-inhibited formulas)

LONG-CHAIN CHLORINATED ALKANES, C₂₀₊

Long-chain chlorinated alkanes are preferred for drawing and stamping applications, and offer excellent performance in aluminum machining. Their high viscosity gives additional lubricity, body and tenacity to lubricant films. They can be used in conjunction with mid-chain products.

Product	Color, Typical Gardner (1933 Std.)	Chlorine Content % by Wt.	Specific Gravity @ 25°C	Viscosity, Poise @ 25°C	Viscosity, SUS @ 210°F	Density, Pounds Per Gallon	Volatility % Loss, 24 hrs. @ 100° C	Stability JQD % HCl, 4hrs @ 175°C	Flash Point ° F (Cleveland Open Cup)
Chloroflo 42	2	40.0	1.120	8	83	9.3	0.5	0.3	>450
Paroil 140	1	42.0	1.170	29	150	9.6	0.8	0.3	>450
Paroil 140 LV	2	43.5	1.185	30	140	9.9	N/A	0.2	>450
Paroil 140 LVXS	1	42.0	1.171	23	127	9.8	N/A	N/A	>450
Paroil 142	2	45.5	1.215	70	200	9.9	0.8	0.4	>450
Paroil 142 LV	2	43.2	1.200	49	167	10.0	N/A	0.2	>450
Paroil 145	2	46.5	1.220	95	230	10.0	0.8	0.5	>450
Paroil 150	2	50.0	1.260	375	450	10.3	1.0	0.5	>450
Paroil 150 LV	2	49.0	1.259	150	251	10.5	N/A	0.3	>450
Paroil 500	4	53.2	1.309	N/A	649	10.9	N/A	0.3	>450
Chlorowax 40	2	43.0	1.170	27	140	9.7	0.8	N/A	>450
Chlorowax 41SW	2	42.5	1.172	24	130	9.8	N/A	N/A	>450
Chlorowax 50	3	48.0	1.230	117	210	10.3	0.8	0.3	>450

VERY LONG-CHAIN CHLORINATED ALKANES, C₂₁₊

Product	Color, Typical Gardner (1933 Std.)	Chlorine Content % by Wt.	Specific Gravity @ 25°C	Viscosity, Poise @ 25°C	Viscosity, SUS @ 210°F	Density, Pounds Per Gallon	Volatility % Loss, 24 hrs. @ 100° C	Stability JDG % HCl, 4hrs @ 175°C	Flash Point ° F (Cleveland Open Cup)
Paroil CW 40-AO	1	43.3	1.169	27.5	161	9.7	N/A	N/A	392
Paroil CW 50-AO	1	46.6	1.22	110	N/A	10.2	N/A	0.27	392

MEDIUM-CHAIN CHLORINATED ALKANES, C₁₄-C₁₇

Mid-chain chlorinated alkanes are best for multipurpose or general purpose metalworking fluids. They have good solubility in all oils, and are easiest to emulsify into water-based metalworking fluids.

Product	Color, Typical Gardner (1933 Std.)	Chlorine Content % by Wt.	Specific Gravity @ 25°C	Viscosity, Poise @ 25°C	Viscosity, SUS @ 210°F	Density, Pounds Per Gallon	Volatility % Loss, 24 hrs. @ 100° C	Stability JQD % HCl, 4hrs @ 175°C	Flash Point ° F (Cleveland Open Cup)
DO 8110	1	52	1.246	6	61	10.3	0.8	0.25	>450
Paroil DO-152	1	50.7	1.269	9.8	63	10.6	N/A	N/A	>392
Paroil 10-NR	1	40.8	1.113	0.37	35	9.3	8	0.2	>350
Paroil 45	1	45.0	1.180	2.5	48	9.6	15	0.2	>400
Paroil 152	1	51.0	1.270	15	70	10.3	0.9	0.2	>450
Paroil 51-NR	1	50.1	1.228	5.8	57	10.2	N/A	0.2	>450
Paroil 53-NR	1	53.7	1.292	14	71	10.8	1.0	0.2	>450
Paroil 54-NR	1	55.3	1.294	17.8	75	10.8	N/A	0.2	>450
Paroil 56-NR	1	56.9	1.327	119	119	11.1	N/A	0.3	>450
Paroil 58-NR	1	59.0	1.390	271	172	11.6	0.5	0.2	>450
Paroil 63-NR	1	63.6	1.439	N/A	317	12.0	N/A	N/A	>450

CHLORINATED FATTY COMPOUNDS

Chlorinated fatty compounds offer improved EP properties over standard chlorinated products, and function at much lower total chlorine level. They offer excellent lubricity and function as EP agents in a wide range of temperatures for different types of ferrous and non-ferrous lubricants, including those for synthetic coolants, cutting, drawing, and gear oils. They also can be used in conjunction with chlorinated alkanes, phosphate esters, and sulfurized additives.

Benefits include:

- Good adherence to metallic surfaces
- Excellent EP properties:
 - DA-8506 at 3% by weight in 100 SUS naphthenic oil carries 4500 lbs. Falex loads.
 - DA-8527 at 1% in 100 SUS naphthenic oil carries 4500 lbs.
- Thermal and hydrolytic stability. The latter is significant if the additives are designed for synthetic coolants or soluble oils.
- Water solubility:
 - DA-8527 can become water soluble when neutralized with slight excess of alkanolamine.

Product	Material	Color, Typical Gardner	Color, ASTM	Chlorine Content % by Wt.	Acid Number (mgKOH/g)	Specific Gravity @ 50°C	Viscosity, SUS @ 100°F	Viscosity, SUS @ 210°F	Viscosity, Poise @ 25°C	JDG % HCl, 4hrs @ 175°C
DA-8506	Chlorinated Methyl Ester	3	(1)	35	0.5	1.14	950	752	6	0.5
DA-8527	Chlorinated Fatty Acid	3	(1)	29	140	1.09	1800	110	12	4.0



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