



Halocarbon

PRODUCTS CORPORATION



Inert Lubricants
Oils – Greases – Waxes

Halocarbon Inert Lubricants

Halocarbon oils, greases and waxes are polychlorotrifluoroethylenes (PCTFE), which are chemically inert and nonflammable lubricants with high thermal stability, good lubricity, high dielectric strength and low compressibility. Halocarbon was the first to commercially produce PCTFE-based lubricants over 60 years ago.

We offer a wide range of oils, greases and waxes to meet industries' needs. The inertness of our lubricant is required for the safe handling of highly reactive and/or aggressive chemicals like oxygen, chlorine, hydrogen peroxide, sulfur trioxide and nitric acid. This unique chemistry can also provide advantage in many other applications from lab-scale to the production plant.

Have questions? Contact **David Antonuccio**, dantonuccio@halocarbon.com

Contents



<u>Chemical Composition</u>	3	<u>Thermal Stability</u>	12
<u>Chemical Inertness</u>	3	<u>Material Compatibility</u>	12
<u>Oxidizer Inertness Tests</u>	5	<u>Elastomers and Plastics</u>	12
<u>Oxygen Inertness Tests, Table 1</u>	5	<u>Metals</u>	13
<u>Shock Sensitivity, Table 2</u>	5	<u>Selecting a Halocarbon Oil Grade</u>	14
<u>Physical Properties</u>	6	<u>Industrial Lubricant</u>	
<u>Oils, Table 3</u>	7	<u>Viscosity Ratings, Table 6</u>	14
<u>Waxes, Table 4</u>	7	<u>Blending to a Custom Viscosity</u>	15
<u>Greases, Table 5</u>	8	<u>Oil Blending Chart, Figure 3</u>	15
<u>Vapor Pressures, Figure 1</u>	9	<u>Quality Assurance</u>	16
<u>Viscosity vs. Temperature, Figure 2</u>	10	<u>Toxicity</u>	16
<u>Solubilities</u>	6, 11	<u>Export Shipments</u>	17
<u>Bulk Modulus</u>	11	<u>Typical Applications</u>	17
<u>Lubricity</u>	11		
<u>Thermal Properties</u>	11		
<u>Surface Tension</u>	12		
<u>Electrical Properties</u>	12		

Chemical Composition

Halocarbon oils are saturated, hydrogen-free low molecular weight polymers of chlorotrifluoroethylene having the formula $-(CF_2CFCl)_n-$, where n ranges from 2 to approximately 10. They are made by controlled polymerization and then stabilized.

Halocarbon greases are made by incorporating gelling agents into Halocarbon oils to form two classes of grease. In one class, the thickening agent is an inert polymer, either PCTFE or PTFE. Therefore, the chemical properties of these greases are identical to the oils. The other class of grease is made from oils thickened with silica. Therefore, these greases have the chemical properties of silica (see [Chemical Inertness](#), below).

Both the oils and greases can be supplied with a conventional hydrocarbon rust inhibitor added to give extra protection to steel in high humidity and other corrosive environments. The presence of the inhibitor does not compromise the inertness of Halocarbon lubricants to oxygen (see [Oxidizer Inertness Tests](#), p. 5).

For applications where extra wear is anticipated, an anti-wear agent can be added to any oil grade. This agent does not compromise the inertness of the oils.

Chemical Inertness

The most outstanding property of Halocarbon oils, greases and waxes is their chemical inertness. This property, together with their nonflammability, long life, good lubricity and high dielectric strength, makes Halocarbon oils a safe and economically justifiable purchase for a wide number of applications. In addition, Halocarbon oils have no flash or fire points and are low in toxicity. They are among the safest lubricants you can buy.

Halocarbon oils and waxes are inert toward practically all compounds and solutions. This also applies to Halocarbon greases with the exception that the silica-thickened greases are prone to attack by chemicals active toward silica. Silica is attacked by alkalis, hydrofluoric acid and fluorinating agents so the silica-thickened greases should not be used in those applications (unless testing indicates otherwise).

Halocarbon lubricants are compatible with the following chemicals and many others not as widely used:

Aluminum chloride	Fluorine (gaseous)	Potassium perchlorate
Ammonium nitrate	Fuming nitric acid	Potassium persulfate
Ammonium perchlorate	Hydrogen	Propylene oxide
Antimony trichloride	Hydrogen bromide	Silane
Boron trichloride	Hydrogen fluoride	Silicon tetrachloride
Boron trifluoride	Hydrogen peroxide (all concentrations)	Sodium chlorate
Bromine	Hydrogen sulfide	Sodium hydroxide (all concentrations)
Bromine trifluoride (gaseous)	Hydroiodic acid	Sodium hypochlorite
Calcium hypochlorite	Iodine	Sodium perchlorate
Carbon dioxide	Muriatic acid	Sulfur dioxide
Chlorinated cyanurates	Nitrogen oxides (all)	Sulfur hexafluoride
Chlorine	Nitrogen trifluoride	Sulfur trioxide
Chlorine dioxide	Oleum	Sulfuric acid
Chlorosilanes	Oxygen (liquid and gaseous)	Thionyl chloride
Chlorosulfonic acid	Ozone	Titanium tetrachloride
Chromic acid	Phosphoric acid	Uranium hexafluoride
Chromyl nitrate	Phosphorus oxychloride	
Ethylene oxide		

Caution: Halocarbon lubricants should not be used in contact with sodium or potassium metal, amines, including amine additives (antioxidants, etc.), liquid fluorine or liquid bromine trifluoride. Caution should be used with aluminum and magnesium (and alloys of these metals) under conditions of large shear forces such as those found in threaded connections. See page 13 ([Metals](#)) for further details.

Halocarbon oils, greases and waxes also will not contribute fuel in fire-prone applications. For example, silane, a pyrophoric gas used by the semiconductor industry, would ignite hydrocarbon vacuum pump oils when the silane itself ignites. Therefore, a silane fire could be much less serious if Halocarbon oils were used instead of hydrocarbon oils.

Oxidizer Inertness Tests

Because of industry's ever expanding use of strong oxidizing agents, many test procedures have been developed to determine the safety of lubricants in contact with these agents. The results of one method, ASTM G72 "Standard Test Method for Autogenous Ignition Temperature of Liquids and Solids in a High-Pressure Oxygen-Enriched Environment," are given for several Halocarbon oils and greases in Table 1 (below). None of Halocarbon's lubricants, including those with rust inhibitor, ignite throughout the entire testing range, exceeding 400°C (752°F) and 2,000 psig (13.9 MPa).

Also in Table 1 are the results of a test similar to ASTM D2512 "Test for Compatibility of Materials with Liquid Oxygen (Impact Sensitivity Threshold Technique)." The apparatus used has upper limits in excess of the ASTM method. Again, none of Halocarbon's products showed any sensitivity at the highest impact loading.

Table 2 (below) shows how insensitive Halocarbon oils are to shock in the presence of 90% hydrogen peroxide and liquid oxygen. No sensitivity was detected with any treatment.

Halocarbon lubricants have also been evaluated by the German Federal Institute for Materials Research and Testing (BAM) for lack of reactivity with gaseous oxygen under pressure.

Table 1. Oxygen Inertness Tests

	Autogenous Ignition Temp. ¹ (°C)	Impact Sensitivity ² (foot-pounds)
Halocarbon Oils		
4.2	>400 (752°F) ³	>114 ³
4.25	>400	>114
56	>400	>114
56S	>400	>114
700	>400	>114
700S	>400	>114
HaloVac® Oils⁴		
100	>400	>114
190	>400	>114
Halocarbon Greases		
25-5S	>400	>114
25-5SI	>400	>114
25-10M	>400	>114
25-10MS	>400	>114

1. ASTM G72 "Standard Test Method for Autogenous Ignition Temperature of Liquids and Solids in a High-Pressure Oxygen-Enriched Environment".

2. Similar to ASTM D2512 "Test for Compatibility of Materials with Liquid Oxygen (Impact Sensitivity Threshold Technique)". See Text.

3. Upper limit of text.

4. See [Vacuum Pump Fluids](#), p. 22.

Table 2. Shock Sensitivity¹

Oxidizer/Oil	Oxidizer		
	H ₂ O ₂ (90%)	H ₂ O ₂ (90%)	LOX
8/1	None	None	—
4/1	None	None	—
2/1	None	None	—
1/1	—	—	None
Pretreatment Temp.²			
°F	160	70	-300
°C	71.1	21	-184
Test Temp.			
°F	70	70	-300
°C	21	21	-184

1. Tests run on a Picatinny Arsenal type impact tester (see Picatinny Technical Report 1401, Revision 1, 1950).

2. Mixtures of Halocarbon oil and 90% H₂O₂ held at constant temperature for 24 hours prior to test.

Physical Properties

As the viscosity of the *Halocarbon oils* increase, so does the density, pour point and cloud point. Table 3 (p. 7) lists these and other physical properties. The *vapor pressure* is inversely related to viscosity of the oil, as shown in Figure 1 (p. 9). The *viscosity* of an oil decreases with temperature as shown in Figure 2 (p. 10). These data will help choose the appropriate oil for a particular application.

The polymers change from oils to waxes as the viscosity increases. The waxes are all white solids at room temperature that melt upon heating. They have initial boiling points above 260°C (500°F) and densities of about 1.89 g/mL at 99°C (210°F). *Drop melting point and viscosity* data are given in Table 4 (p. 7).

The properties of *Halocarbon greases* depend upon how heavily they are gelled. Table 5 (p. 8) gives penetration, service temperature range and drop melting point data.

Solubility of Halocarbon Fluids in Other Solvents

The lower viscosity Halocarbon oils are soluble in most organic liquids but solubility decreases as viscosity increases. All Halocarbon fluids are insoluble in aqueous solutions however stable emulsions are possible with fluorinated surfactants.

Solubility of Other Substances in Halocarbon Fluids

Halocarbon fluids will dissolve halogens and volatile anhydrous inorganic salts (such as titanium tetrachloride). Typical organic materials with which various Halocarbon oils are miscible are:

Acetone	Ethanol	Methyl ethyl ketone
Amyl acetate	Ether	Methyl isobutyl ketone
Benzene	Glacial acetic acid	Methylene chloride
n-Butyl alcohol	Hexane	Mineral oils
Carbon disulfide	Isopropyl alcohol	Silicone oils
Diethyl phthalate	Kerosene	Tetrachloroethylene
Diethyl sebacate	Methanol	Trichloroethylene

Table 3. Halocarbon Oils¹

Oil	0.8	1.8	4.2	6.3	27	56	95	200	400	700	1000N	
Flash and Fire Points							None					
Pour Point² °F (±10°F)	-200	-135	-100	-95	-40	-30	-15	10	15	40	50	
°C (±5°C)	-129	-93	-73	-71	-40	-34	-26	-12	-9	5	10	
Cloud Point³ °F (±10°F)	<-200	<-135	<-125	<-125	<-95	-30	-5	35	50	55	65	
°C (±5°C)	<-129	<-93	<-87	<-87	<-71	-34	-21	2	10	13	18	
Viscosity⁴ (±10%)												
@-65°F (-54°C)												
Centistokes	5.7	143	—	—	—	—	—	—	—	—	—	
Centipoises	10	271	—	—	—	—	—	—	—	—	—	
@100°F (37.8°C)												
Centistokes	0.8	1.8	4.2	6.3	27	56	95	200	400	700	1000	
Centipoises	1.3	3.5	7.8	12	51	108	182	390	780	1365	1950	
@160°F (71.1°C)												
Centistokes	0.54	1.1	1.9	2.6	6.8	11	16	26	40	62	83	
Centipoises	0.89	1.9	3.4	4.7	13	21	30	49	75	118	158	
@210°F (99°C)												
Centistokes	—	0.8	1.2	1.6	3.1	4.9	6.3	9	12	17	22	
Centipoises	—	1.4	2.1	2.8	5.6	8.9	12	16	22	32	41	
Density⁵ (±0.01 g/mL)												
100°F (37.8°C)	1.71	1.82	1.85	1.87	1.90	1.92	1.92	1.95	1.95	1.95	1.95	
160°F (71.1°C)	1.65	1.76	1.80	1.82	1.85	1.87	1.87	1.89	1.89	1.90	1.90	
210°F (99°C)	1.60	1.71	1.75	1.77	1.81	1.82	1.82	1.85	1.85	1.86	1.86	
Refractive Index												
n _D ²⁰ (typical)	1.383	1.395	1.401	1.403	1.407	1.409	1.411	1.412	1.412	1.414	1.415	

1. Same oil grades followed by "S" indicated rust inhibitor has been added. Oil is still oxygen compatible.

2. ASTM D97

3. ASTM D2500

4. ASTM D445

5. Gay-Lussac pycnometers or equivalent

Table 4. Halocarbon Waxes

Wax		40	600	1200	1500
Minimum Drop Melting Point¹	°F	—	135	230	270
	°C	—	57	110	132
Viscosity², Centistokes (±10%) @160°F (71.1°C)		190	1000	—	—

1. ASTM D127

2. ASTM D445

* These tables give typical properties (not specifications) based on historical production performance. Halocarbon Products Corporation does not make any express or implied warranty that these products will continue to have these typical properties.

Table 5. Halocarbon Greases

Grease	Consistency		Service Temperature	Minimum Drop Melting Point	Description
	NLGI	ASTM Penetration			
PCTFE/Silica Thickened Greases					
28I	2	265-295	0 to 250°F -20 to 120°C	None	This product contains a rust inhibitor.
28LTI	2	265-295	-50 to 200°F -45 to 95°C	None	For low temperature use. This product contains a rust inhibitor.
25-5S	3	220-250	0 to 350°F -20 to 175°C	None	Lowest vapor pressure. Also available with rust inhibitor (25-5SI), which has a recommended service temperature of 0 to 250°F (-20 to 120°C).
PCTFE/PTFE Thickened Grease					
MT-3I	3	220-250	0 to 350°F -20 to 175°C	None	Ideal as a thread sealant to prevent galling. This product contains a rust inhibitor.
PCTFE/PCTFE Polymer Thickened Greases*					
25-10M	1	310-340	30 to 275°F 0 to 135°C	300°F 150°C	Softest grease for wide temperature range. Also available with a rust inhibitor (25-10MS).
X90-10M	1	310-340	-40 to 200°F -40 to 95°C	300°F 150°C	For low temperature use.
25-20M	4	175-205	20 to 300°F -5 to 150°C	320°F 160°C	Hardest grease with broad temperature range.

* This table gives typical properties (not specifications) based on historical production performance. Halocarbon Products Corporation does not make any express or implied warranty that these products will continue to have these typical properties.

Figure 1. Typical Vapor Pressures for Halocarbon Oils

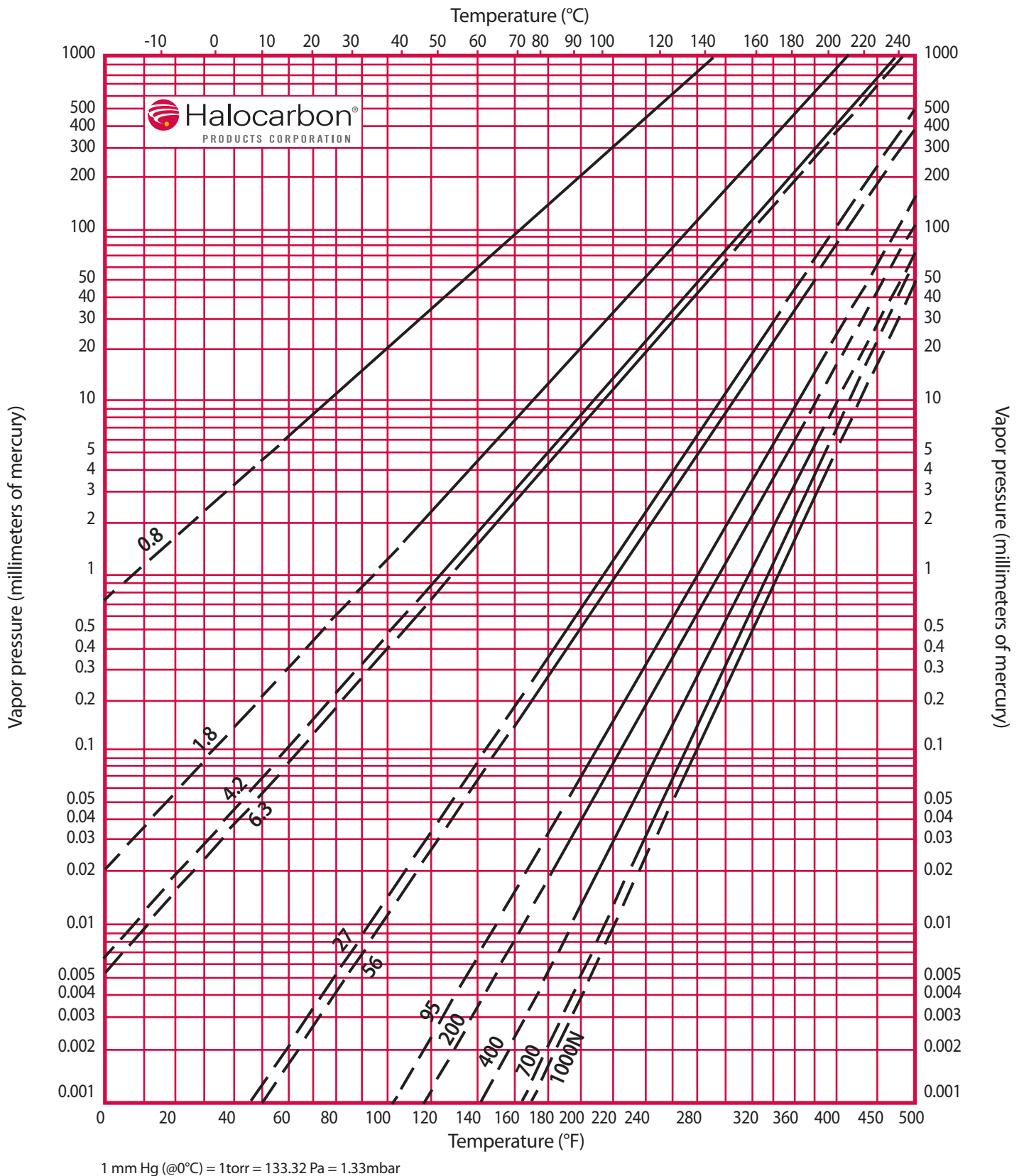
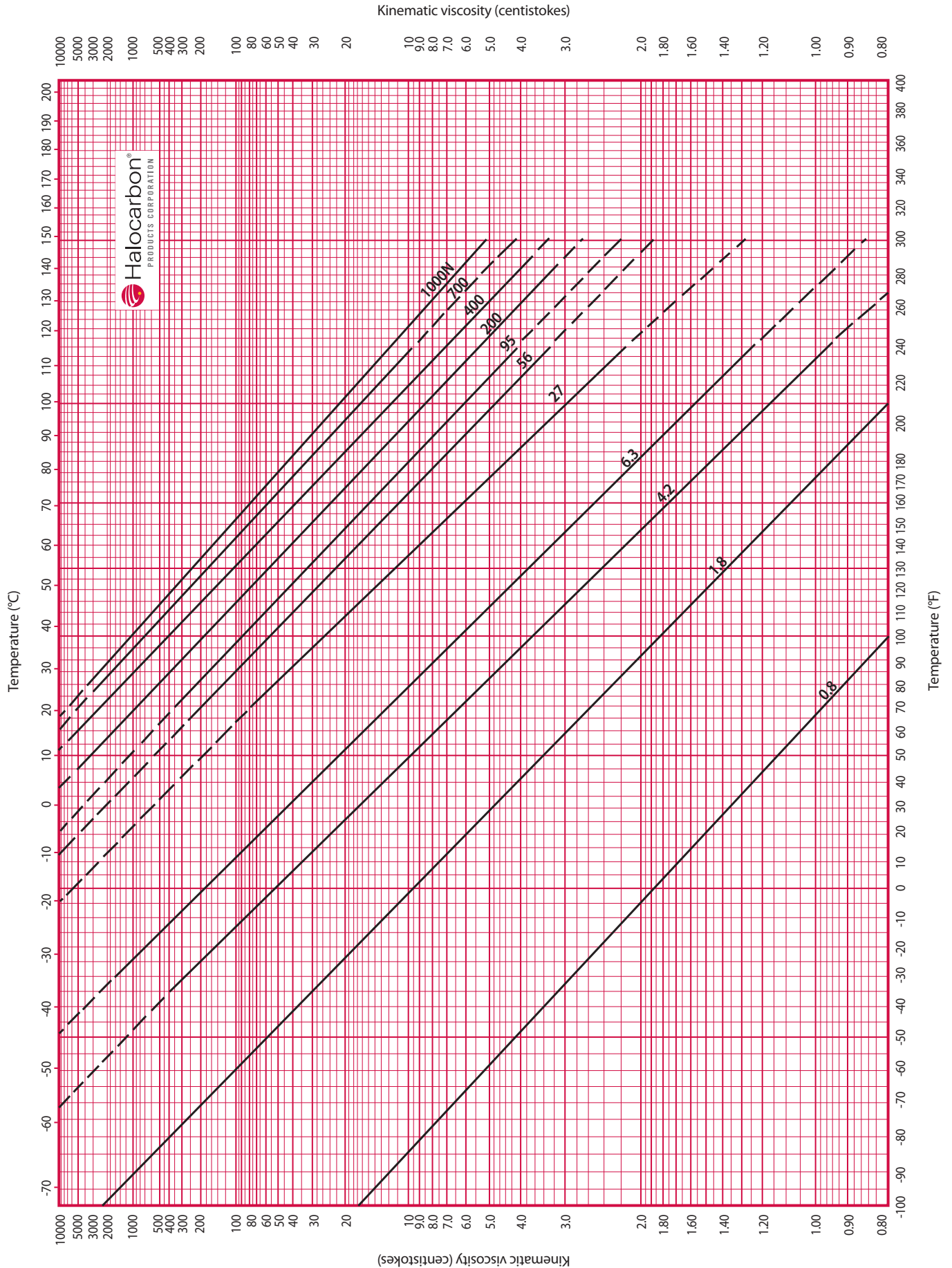


Figure 2. Viscosity vs. Temperature of Halocarbon Oils

Modified ASTM D341



Solubility of Gases in Halocarbon Fluids

Halocarbon fluids dissolve gases readily. Chlorine, for example, is soluble to the extent of several weight percent at ambient conditions. Oxygen, nitrogen and carbon dioxide dissolve to the extent of 0.15, 0.26 and 1.3 mL of gas per mL of Halocarbon 27 oil at 25°C (77°F) and atmospheric pressure, respectively. Gas solubility increases with an increase in pressure. Halocarbon 27 oil dissolves 10.2 mL of nitrogen gas per mL of oil at 1,000 psig (7.0 MPa) and 37.8°C (100°F) but Halocarbon 6.3 oil dissolves only 5.4 mL of gas per mL of oil under the same conditions.

Oil viscosity and density are reduced appreciably by dissolved gas.

Bulk Modulus

Bulk modulus measurements for Halocarbon oils are well over 200,000 psi (1,379 MPa) at 37.8°C (100°F) with applied pressures up to 10,000 psig (69.1 MPa). Halocarbon oils have compressibilities similar to mineral oils and are much less compressible than perfluoropolyethers.

Lubricity

Halocarbon oils can be used interchangeably with hydrocarbon oils to lubricate a wide range of equipment such as bearings, compressors, gear boxes and oil pumps. Occasionally, some equipment modification may be required because of density, viscosity or vapor pressure differences from hydrocarbon lubricants.

Extreme-pressure tests using the four-ball method show that Halocarbon oils and greases are very good lubricants. The oils exhibit no seizure even at a final applied load of 800 Kg. These greases and oils have load wear indexes that are appreciably better than hydrocarbon oils. Scar diameters increasing uniformly with increasing applied load.

Halocarbon oils have been used successfully in all types of equipment for over 50 years. However, if there is any question of suitability or interchangeability, a monitored test in the equipment is advised.

Thermal Properties

Heats of vaporization of Halocarbon oils vary from 36 to 54 BTU/lb (84 to 126 KJ/Kg). Their specific heats range from 0.2 to 0.25 BTU/(lb)(°F) [837 to 1,047 J/(Kg)(°C)] as the molecular weight increases. Thermal conductivities also increase with molecular weight, but they are all close to 0.1 BTU/(hr)(ft²)(°F/ft) [0.17 W/(°K)(m)].

Surface Tension

Halocarbon oils have low surface tensions because of their chemical composition. The low values (23 to 30 dynes/cm) result in easy wetting of most materials, which is helpful for lubricity and other properties.

Electrical Properties

The typical volume resistivity of Halocarbon oil is in the range of 10^{13} to 10^{14} ohm-cm. The dielectric constant varies from 2.25 to 4.0 depending on frequency and temperature.



Thermal Stability

The thermal stability of Halocarbon oils extends up to the decomposition temperature of the carbon chain. The decomposition to toxic, nonsludge-forming volatiles occurs rapidly at 327°C (620°F), noticeably at 304°C (580°F) and to a lesser degree at lower temperatures. The maximum safe operating temperature recommended, therefore, is 204°C (400°F) and maximum short-term temperature recommended is 260°C (500°F) in scrupulously clean systems. Oils containing rust inhibitor discolor after some exposure to temperatures of approximately 121°C (250°F) due to decomposition of the inhibitor. The oil is unchanged.



Material Compatibility

Elastomers and Plastics

The major portion of any elastomer is a specific cross-linked polymer, but its properties depend in large part upon fillers, plasticizers and other additives. In fact, the composition of the final item such as an O-ring or gasket is usually proprietary. Therefore, predictions about compatibility for any elastomer must be viewed with caution. A prudent approach would involve bench tests with the specific elastomer at operating conditions. Keeping these cautions in mind, Halocarbon oils have been found compatible with specific recipes of the following elastomers:

Ethylene propylene rubber	Viton [®] , Fluorel [®]	Cured epoxies
Polyvinyl alcohol	Kalrez [®]	Urethanes
Neoprene	Polyimides	PNF (phosphonitrilic fluoroelastomer)
Polytetrafluoroethylene (PTFE) and other fluorinated plastics	Polycarbonates	EPDM (ethylene propylene diene rubber)
Chlorinated polyethylene	Fluorosilicone	

Most solvent-resistant elastomers and plastics are unaffected by Halocarbon fluids. Within certain temperature ranges, the fluids may dissolve in and seriously weaken the following materials:

Buna-N (butadiene/
acrylonitrile)

Silicon rubbers

Polymers or copolymers
of chlorotrifluoroethylene

Buna-S (butadiene/
styrene) rubber

Natural rubber

PVC (polyvinyl chloride)

Metals

Halocarbon lubricants wet metallic surfaces readily and form lubricating films similar to the more common lubricants.

Steel parts that have been lubricated with Halocarbon oils and then cleaned for disassembly may rust on exposure to air. Rusting can be inhibited by keeping a thin film of oil on the part or using a Halocarbon oil supplied with a rust inhibitor.

Halocarbon oils and greases are noncorrosive toward metals at temperatures up to about 177°C (350°F), with the exception of copper and some of its alloys, which will discolor at temperatures over 49°C (120°F). Prior testing should be done on all metals for applications above 177°C (350°F) and on copper for applications above 49°C (120°F).

Halocarbon oils, greases and waxes, may react with aluminum or magnesium under conditions of large shear forces such as those found in threaded connections. For example, a reaction may occur from the tightening of a bolt where aluminum or magnesium is one of the components and Halocarbon oil or grease is applied to the threads. Such reactions have been found to be extremely localized and nonpropagating, even though they may be accompanied by a sharp noise. Such reactions do not always occur, even under large shear forces. No reaction was observed when ¾" (19.1 mm) flared aluminum hydraulic tubing lubricated with Halocarbon grease was deliberately tightened on an aluminum coupling until the threads failed. The torque exerted (over 200 ft-lbs or 271 N-m) destroyed the threads, but the Halocarbon grease was not affected. Halocarbon oils and greases have been used routinely in aluminum and magnesium housings, tubing, containers and other parts without incident. The user should conduct tests to determine the suitability of these materials in this type of application.

Selecting a Halocarbon Oil Grade

When replacing a conventional lubricant with a Halocarbon oil, we have found through experience that a good choice is a Halocarbon grade numerically similar to the ISO grade. Table 6 (below) shows the alignment of Halocarbon oil grades with the commonly used viscosity systems.

Alternately, the fluid being replaced and the Halocarbon oil should have similar absolute viscosities, expressed in centipoises. Absolute viscosity is the kinematic viscosity (expressed in centistokes) multiplied by fluid density (expressed in g/mL). The high density of Halocarbon oils (about twice that of water) means that the absolute viscosity is about twice the kinematic viscosity. Hydrocarbon-based fluids, which have densities below 1 g/mL, have similar centipoises and centistokes values.

Table 6. Industrial Lubricant Viscosity Ratings

PCTFE Oil Viscosity (Cs @ 100°F)	ISO Grade	AGMA ¹ Grade No. (Approx.)	S.A.E. Viscosity No. (Approx.)	S.A.E. GEAR Lubricant No. (Approx.)	Viscosity SUS at 100°F (Approx.)
0.8					
1.8	2	—	—	—	29-35
4.2	5	—	—	—	36-44
6.3	10	—	—	—	54-66
	15	—	—	—	68-82
	22	—	—	—	95-115
27	32	—	10W	75W	135-165
	46	1	10	—	194-236
56	68	2	20	80W	284-346
95	100	3	30	—	419-511
	150	4	40	85W	630-770
	220	5	50	90	900-1100
400	320	6	60	—	1350-1650
	460	7	70	140	1935-2365
700	680	8	—	—	2835-3465
1000					

1. American Gear Manufacturers Association.

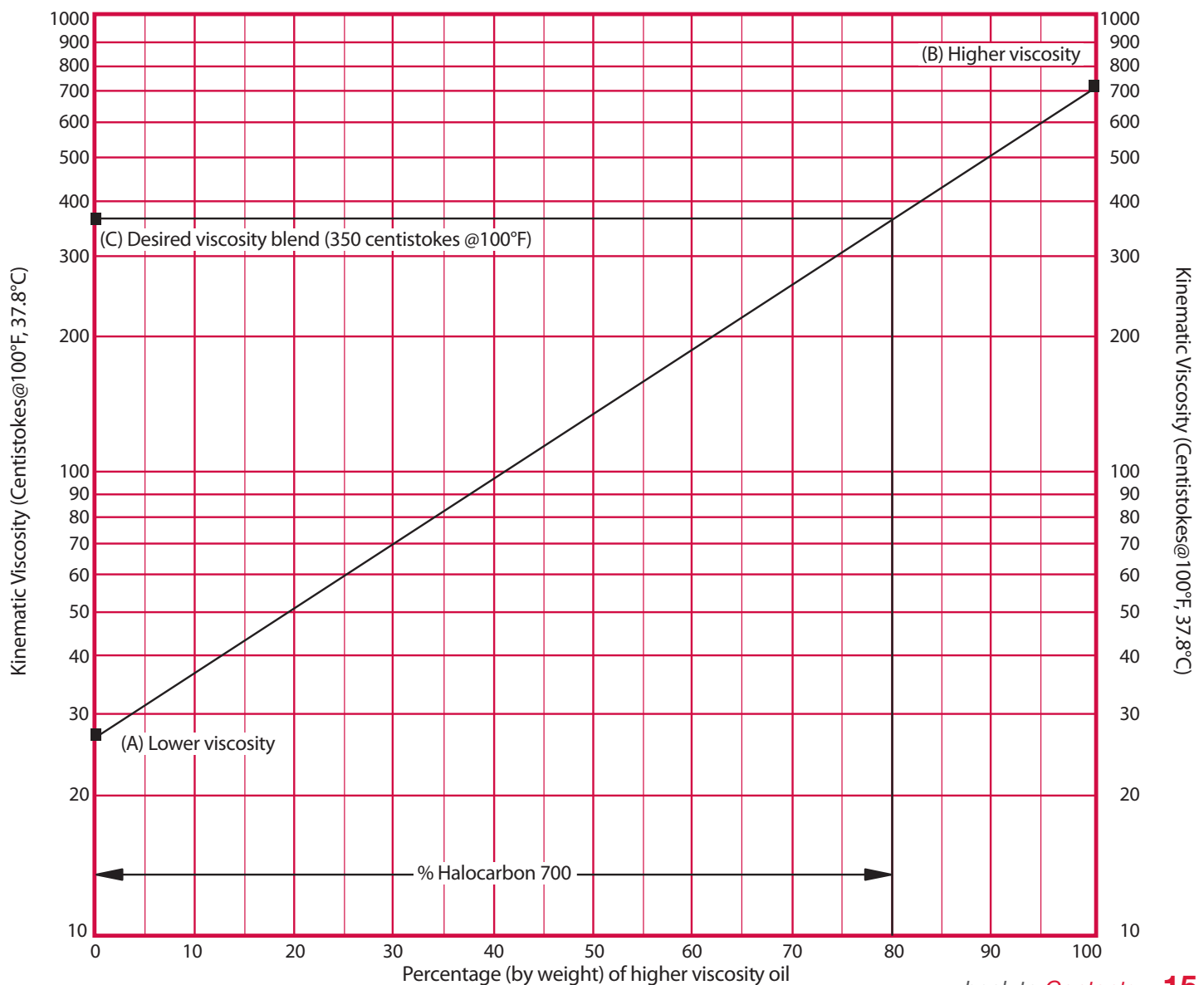


Blending to a Custom Viscosity

Oils with viscosities between our standard grades can be easily obtained by blending two standard grades. For example, to obtain a 350 centistoke oil from Halocarbon 27 and Halocarbon 700 oils, use the following procedure in Figure 3 below:

1. Draw a line from 27 (A) on the left viscosity scale to 700 (B) on the right viscosity scale.
2. Locate the desired viscosity (C) on left scale.
3. Draw a horizontal line from this point to where it intersects the drawn line.
4. Draw a vertical line from the intersect to the bottom of the blending chart and read the required weight percent of 700 oil (i.e. 80 percent).
5. The required weight percent of 27 oil equals 100 percent minus 80 percent or 20 percent.

Figure 3. Oil Blending Chart



Quality Assurance

Halocarbon oils are inert because they are fully halogenated. Halocarbon rigorously excludes any hydrogen in its processing and then tests for its absence in the finished products. To be sure there is essentially no hydrogen in our oils, we use an infrared analysis that can detect to less than 10 ppm. Depending on the shipping container, there could be a slight increase in hydrocarbon content. This increase will not compromise inertness.

An exception is the rust inhibited oils. The rust inhibitor contains hydrogen. However, testing has shown that our oils containing the rust inhibitor have the same oxygen compatibility as uninhibited oils (see [Oxidizer Inertness Tests](#), p. 5).

Another possible reactive site is what chemists call “unsaturation.” If unsaturation is present, it will react over time with air and moisture to form acids, which are corrosive to metals. The oil processing is carefully controlled to eliminate any unsaturation. Our specification involves a very sensitive permanganate oxidation test, which rules out all but traces of unsaturation in our oils.

Acidity, for obvious reasons, is undesirable in lubricating fluids. Halocarbon specifies that our oils contain less acidity than would be titrated with 0.0002 mg KOH/g of oil; that is essentially no acidity.

Halocarbon maintains very strict standards for quality both in our processing steps and in our finished products.

Toxicity

There have been several toxicity studies on various grades of Halocarbon oils. The most significant of these studies was performed on a 3 centistoke oil, using the inhalation route of exposure for both rodents and primates. Based on all the available data in three species of animals, limited exposure to Halocarbon oil should not be harmful. Studies conducted by the US Air Force have demonstrated liver toxicity in rodents, but not in primates. The observed liver toxicity is believed to be specific for rodents and not relevant to humans. All mutagenicity studies were negative.

Halocarbon oil is not irritating to skin but simple skin protection should be used to prevent exposure and the possibility of sensitization.

Oral toxicity studies were performed with Halocarbon 27 oil. This oil caused no deaths in rats dosed daily for 21 days with 2.5 g oil/Kg body weight. Symptoms attributed to fluoride poisoning by metabolism in the liver were noted. Enlargement of the livers and kidneys in the treated animal support this conclusion.

Please read the appropriate MSDS before use of any product.

Toxicity at Temperatures above 260°C (500°F)

As mentioned in the Thermal Stability section, these compounds are subject to thermal cracking above 304°C (580°F) with rapid breakdown occurring above 327°C (620°F). This breakdown may occur from heating in a vessel or operating equipment, from the vapors coming in contact with an open flame or passing through a lighted cigarette. Breakdown products in air form acidic substances that have harmful physiological effects. When these oils or greases are heated above 260°C (500°F), exposure to the vapors should be avoided and adequate ventilation provided.

Export Shipments

The export of these materials from the US, when used in certain activities related to nuclear, chemical or biological weapons or missiles, is regulated by the U.S. Department of Commerce, Bureau of Export Administration, Office of Export Licensing, Washington, DC, 20044.

If an export license is required, please contact Halocarbon Products for current information.

Typical Applications

Halocarbon lubricants are excellent inert lubricants with many uses across many industries. These versatile compounds also have uses beyond lubrication. Take a look at some of their typical uses and see how they can help with your application!

Additives

Halocarbon lubricants have good extreme pressure properties and are added to specialty engine oils, compressor oils and greases. They can also be formulated into anti-seize compounds and function as an impregnant for gaskets and packings.

Aerospace

Halocarbon oils are used extensively as lubricants in the oxidizer section of rockets and oxygen handling systems.

Analytical Labs

Halocarbon oils can be used as a fluid for suspension of mulls in infrared analysis and as a viscous, proton-free solvent for NMR analysis.

Biological

With their high oxygen solubility, more viscous Halocarbon oils are used as a staging oil for living microscopic biological specimens.

Chemical Manufacturing

Halocarbon lubricants are essential for the safe handling of aggressive chemicals. They have proven to be safe and cost-effective in many applications where hydrocarbons, silicones and other fluids are unsafe because of the danger of rapid reaction, ignition or explosion. Companies producing chlorine, bromine, sodium chlorate, sulfur trioxide, pulp and paper and swimming pool chemicals have relied on Halocarbon oils for years. Some typical applications:

- Valves for hydrogen peroxide service
- Sodium chlorate pump oil
- Ammonium perchlorate service
- Lubrication of equipment used for fluorination of for blow-molded plastic bottles
- Fill fluid for mechanical seals
- Fill fluid for gauges
- Lubricant for swimming pool chemical equipment
- Hydrogen sulfide service
- Water treatment systems
- All facets of chlorine processing

Halocarbon oils are also ideal as an inert process solvent or heat transfer fluid.

Coal Industry

Halocarbon oils are commonly used as a fluid for coal density testing.

Cryogenic Gases

The cryogenic gas industry has been using Halocarbon oils since the 1950s in their oxygen manufacturing plants. Typical applications are compressors and LOX pumps with 10,000 psi (69 MPa) output and air compressors with 15,000 psi (103 MPa) output. Other applications in this field are:

- Lubricants for oxy-acetylene welding equipment
- Lubricants for swivel joints in oxygen delivery systems to basic oxygen furnaces and space shuttle oxidizer tanks
- Lubricants for diving gear and self-contained breathing apparatus
- Thread and rotary meter lubricant

Caution: Special cleaning procedures must be used for components being put into oxygen and LOX service. Special procedures are also required with oxygen enriched gases and other oxidizers. These procedures should be discussed with the supplier.

Electronics Industry

Halocarbon oils are used in vacuum pumps for plasma etching and chemical vapor deposition. The greases are used in semiconductor processing equipment.

The oils have low dielectric constants and high resistivity. These properties, along with their inertness, make the oils useful for many electrical applications such as dielectric fluids and as potting and sealing waxes.

Hydraulic Fluids

Halocarbon oils, with their low compressibility, are used in many hydraulic applications where nonflammable fluids are a necessity.

The US Air Force has done extensive testing and found that Halocarbon oils are nonflammable, exhibiting no flash or fire point under severe test conditions. In one test, Halocarbon oil was sprayed on a red hot manifold at a temperature in excess of 927°C (1,700°F) with no ignition.

Index Matching Fluids

Halocarbon oils have refractive indexes around 1.4. This is close to matching silica in refractive index and can be used in fiber optic joints and interfaces to avoid Fresnel reflection effects. An added feature is that these fluids are transparent to light in many wavelength regions.

Instrument Fill Fluids

Halocarbon oils are used in fluid-filled instruments where nonflammability, inertness and low compressibility are required. Strong oxidizing agents, such as oxygen, chlorine, fluorine (gaseous), nitric acid and hydrogen peroxide, preclude the use of commonly used glycerine or silicone fill fluids. Halocarbon 4.2 and 6.3 oils are frequently used in this application.

Laboratory Apparatus

Substantial quantities of Halocarbon greases are used in laboratory apparatus as a stopcock and ground joint lubricant and seal. Unlike many other synthetic lubricants, Halocarbon greases can be readily removed from glassware, ceramics and metal with common organic solvents.

Life Support Systems

Halocarbon oils and greases are used to safely lubricate life support systems where an oxygen-enriched atmosphere (>25%) or high-pressure air is required. Examples are:

- Diving gear
- Hyperbaric oxygen chambers
- Hospital oxygen and nitrous oxide systems
- Home oxygen units
- Liquid oxygen respiratory equipment
- Anesthesia machines
- Portable oxygen generating plants
- Systems for evacuating and refilling oxygen bottles

Low-Temperature Bath Fluids

Constant-temperature baths used for calibrating instruments over a wide temperature range use Halocarbon 0.8 oil, particularly at low temperatures. It is nonflammable, has a low pour point (-129°C/-200°F), is easily pumped at low-temperatures and is not miscible with water. Any ice formed in the bath will float on the oil and is easily removed.

Mechanical Seals

Mechanical seals filled with Halocarbon oils are installed on equipment handling aggressive chemicals where the reaction between conventional barrier fluids and aggressive chemicals could be explosive.

Metalworking Fluids

Halocarbon lubricants should be considered wherever precision machining or forming of high-tech metals is required. For many years, Halocarbon oil has been used in the machining of molybdenum, tungsten and niobium. The use of Halocarbon oil dramatically increases tool life. Halocarbon oils have also been found to be very useful in the forming of tantalum and tungsten parts and the drawing of tantalum wire.

Nuclear Industry

Halocarbon oils were originally developed for use in gaseous diffusion plants where isotopes of uranium were separated as uranium hexafluoride, an extremely reactive compound. Halocarbon oils and greases are also being used by the nuclear industry where inert and proton-free lubricants are required.

Plastics Processing

Halocarbon oils are used as mold release agents for rubber and plastics and as a plasticizer for fluorinated plastics.

Pulp and Paper Industry

Many highly reactive chemicals such as chlorine, chlorine dioxide/sodium chlorate, calcium hypochlorite, sodium hypochlorite, oxygen, hydrogen peroxide, ozone and caustic soda are used in the pulping and bleaching processes. Halocarbon oils and greases are safe with these chemicals and are commonly used in this industry.

Steel Industry

Halocarbon greases and oils are widely used in lances and swivel joints in systems feeding oxygen to steel making furnaces.

Vacuum Pump Fluids

Halocarbon oils are used in applications where the reactivity of conventional oils presents severe safety and maintenance problems. For example, if conventional vacuum pump oil is used in a pump evacuating a chlorine-containing system, the oil will sludge so badly that even one effective evacuation may not be possible. Explosive reactions can also occur.

Halocarbon developed the HaloVac® line of oils to meet the need for inert, nonflammable, hydrogen-free and reliable vacuum pump oils. HaloVac® oils are especially useful for aluminum etching processes where the aluminum chloride produced decomposes perfluoropolyether oils.

Typical vacuum pump applications include:

- Plasma etching of semiconductors, printed wiring boards and photovoltaic devices
- Plasma etching of aluminum with chlorine producing aluminum chloride
- Chemical vapor deposition and low temperature oxidation processes
- Sampling of effluent gases for EPA testing
- Laser systems
- Plasma cleaning of electronic and medical devices
- Vacuum metalizing
- Surface treatment of plastics
- High purity graphite production
- Fluorination process used for blow-molded plastic bottles

We believe the information given here to be correct. However, we cannot guarantee its accuracy or be responsible for loss or damage that results from the use of such information. Nothing in this bulletin is intended or should be construed as a recommendation to infringe on any existing patents.

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