

NYE[®] WILLIAM F. NYE, INC. P.O. Box 8927, New Bedford, Mass.

LUBEletter

WINTER 1993

THIRD EDITION

New "Designer Lubricants" Catalog

For the first time in six years, we have completely revised and up-dated our "general" catalog. It is sub-titled "A Summary Catalog", since it would be impractical to include every product we sell; however, the listings are representative of the several specialty lubrication markets which Nye services.

The new edition includes an introductory discussion on the basic "theme and variations" of our product line, emphasizing the flexibility in our formulations. There is a new section on "Low Vapor Pressure Specialties" and on "Fluorinated Ether Lubricants for High Temperature and Chemical/Fuel Resistance". Our 1989 Lubeletter article on "Unit Costs for Application of Synthetic Lubricants" is reprinted in the new catalog, as is the pictorial summary of "Dispenser Containers" from the 1986 Lubeletter.

We have attempted to get a copy to everyone presently on our mailing list. If your Nye catalog doesn't have a forest green cover or if you need another for a colleague, please call or fax.

MARK C. BITELER

Our Man in Chicago

A hearty welcome to Mark Biteler, our new Midwest Marketing Manager, assigned to the five-state area of Illinois, Wisconsin, Minnesota, Iowa and Missouri. Mark is working out of our new Chicago-area office located in Elgin, Illinois. He will provide hands-on technical support for our many customers in his five-state area, and we are counting on expanding our customer base there through his efforts.

Mark is an industrial engineer, a 1984 graduate from the University of Illinois. He has had extensive experience in industrial sales in the greater Chicago area, where he has represented several manufacturers of high tech industrial equipment. He has detailed road maps to the Twin Cities, Sioux City and St. Louis and all points between, and if you're in that area, please extend him a welcome, as he is there to provide one-on-one engineering assistance.



For quick attention, you can call Mark at (708) 697-5446 or Fax (708) 697-5483.

A FLUOROETHER GEL FOR ELECTRICAL CONNECTORS

Advanced Electrical Connector Lubricant in an Ozone-Safe Solvent

Electrical connectors have traditionally been lubricated by dipping the connector into a dilute solution of an appropriate lubricant dispersed in some suitable volatile solvent.

The ozone depletion controversy will eliminate as options the most convenient volatile solvents, trichlorotrifluoroethane and 1,1,1-trichloroethane. Other fast-evaporating solvents are flammable; the alternatives, with flash points above the 100°F threshold regulated as combustible rather than flammable, evaporate slowly, creating frustrating application problems for production line situations. Fortunately, however, one family of very promising connector lubricants, the fluorinated polyethers, is soluble in an unusual fast-evaporating, non-flammable "ozone-safe" solvent type, the fluoroalkane. Virtually nothing else can be dissolved in these fluorinated solvents; but the fluoroethers are readily dissolved.

In his 1986 detailed surveys of connector lubricant alternatives (1) (2), Dr. Morton Antler of AT&T Bell Labs gave the fluorinated ethers high marks as connector lubricants with the qualification that, relative to the more favored polyphenyl ethers, the neat fluoroether liquids were more likely to migrate away from their application point. As lubricants they compared well with polyphenyl ethers or hydrocarbons, the favored alternatives.

This migration problem can be solved by a new Nye formulation. As an escape from the solvent choice dilemmas created by the ozone depletion issue, we are introducing as a new electrical connector lubricant NyeTact 570, based upon fluorinated poly-

ether oils, formulated as a gel to stay where it is applied, and dispersed in a safe, fast-evaporating, non-flammable fluoroalkane solvent. This product can be applied from the liquid dispersion by dipping or brushing; the solvent will evaporate quickly, leaving a thin, non-migrating, protective lubricating film on the contact surface.

We have carried out studies of contact resistance for extended periods at 100°C which indicate that NyeTact 570 performs fully as well as a polyphenyl ether contact lubricant displaying lower volatility than even the 6-ring polyphenyl ether.

The standard NyeTact 570 product contains 2% by weight of the active lubricant in the fluoroalkane solvent; thinner or thicker films, as may be needed for special applications, are readily prepared. We would be pleased to supply an evaluation sample on request. If your operation can utilize hydrochlorofluorocarbons (HCFC's, or Class II solvents), such a solvent could be incorporated in NyeTact 570 instead of a fluoroalkane, providing a more economical product.

(1) M. Antler, "Electronic Connector Contact Lubricants: The Polyether Fluids", Proc. IEEE Holm Conference on Electrical Contacts, Boston, MA, October 27-29, 1986.

(2) M. Antler, "Sliding Studies of New Connector Contact Lubricants", Proc. Connectors and Interconnection Technology Symposium, Electronic Connector Study Group, Inc., Anaheim, CA, October 7-9, 1986.

New Vapor Pressure Data on Synthetic Oils

Most often when a lubricant is accused of evaporating, the real culprit is migration; the oil has simply crept away rather than having volatilized. Volatility can be a very real factor, however, with very low viscosity fluids or with any oil in thin film for long periods at temperatures over 100°C.

In our 1991 Lubeletter we described a new test apparatus which we had put together to fill a gap in available equipment. The aerospace and computer industries are most interested in volatilities of candidate lubricants; and there were no standard useable tests with which we could obtain helpful data on vapor pressure at varying temperatures.

Our apparatus is based on controlled heating of the test oil on a metal heating block with a large surface area at 10^{-4} torr. Based on weight loss, Langmuir's expression permits calculation of vapor pressure. Data obtained at 50°C, 75°C and 100°C can be used to extrapolate vapor pressure at 25°C.

We have recently completed testing of twelve oils representing different families of petroleum and synthetic fluids. Summary data at two temperatures is listed below:

Fluid	Viscosity 40°C	Mol. Wt.	Vapor Pressure in torr	
			25°C	100°C
Naphthenic petroleum oil	101	335	4.2×10^{-6}	4.2×10^{-5}
Polyphenyl Ether (5-Ring)	350	446	1.7×10^{-8}	1.5×10^{-6}
Medium viscosity polyol ester	57	528	1.4×10^{-8}	2.6×10^{-6}
Light sebacate di-ester	13	370	4.6×10^{-8}	7.2×10^{-5}
Medium viscosity polyglycol	80	1220	3.1×10^{-8}	1.3×10^{-6}
Branched-chain fluoroether	50	3000	5.2×10^{-7}	2.6×10^{-5}
Linear fluoroether	154	16000	9.1×10^{-10}	7.3×10^{-8}
Methyl silicone, 100 cs. grade	80	5000	1.9×10^{-13}	4.0×10^{-8}
Methylphenyl silicone, 100 cs. grade	77	9000	9.2×10^{-11}	4.3×10^{-8}
Poly-alpha-olefin high viscosity	400	1400	1.6×10^{-8}	8.3×10^{-7}
Poly-alpha-olefin low viscosity	32	525	2.8×10^{-8}	1.4×10^{-5}
Cyclic hydrocarbon	110	910	3.5×10^{-11}	5.3×10^{-8}

Several observations on this data are in order.

(1) Molecular weight and viscosity influence vapor pressure, but the data shows they are far from the only factors. Differences in polarity and molecular architecture appear to be equally important when comparing one fluid family with another.

(2) It is impressive to see the superior performance of silicone oils, whether of the dimethyl or methylphenyl variety, which may be a function of intensive fractionation in their manufacture.

(3) The lower vapor pressure of all synthetics relative to the natural petroleum entry should be noted. Keep in mind, however, that all of the fluids were tested in the absence of oxygen. At 100°C, there could easily be volatility effects of incipient oxidation, especially with hydrocarbons.

(4) Temperature is an important factor in ranking volatilities. As temperature is increased, witness the sharper drop of the light sebacate di-ester compared with the less dramatic vapor pressure reduction of the high molecular weight, high viscosity poly-alpha-olefin.

(5) Volatility of the lower viscosity branched-chain fluorinated ethers should be watched carefully in demanding applications.

(6) The exceptionally low vapor pressure of the cyclic hydrocarbons, the basis for Nye Synthetic Oil 2001 and Nye Rheolube 2000, continues to stand out.

The principal value of this testing, however, is in making available some numbers that one can hang a hat on. Data from the traditional ASTM-D972 evaporation test never permitted fine distinctions, especially at temperatures below about 150°C. It remains for further application testing to determine how well this new comparative test method separates the excellent from the merely very good.

UNHAPPY OPTIONS OR NEW OPPORTUNITIES

Alternatives to Use of Chlorinated Solvents

It looks like "curtains" for chlorinated solvents. The traditional products, trichlorotrifluoroethane (DuPont's Freon 113) or 1,1,1-trichloroethane (also called methyl chloroform) are either being phased out of production or will soon be subject to crippling labeling restrictions on any product on which they might be utilized.

There are unfortunately no easy "drop-in" substitutes for these solvents. They had singular qualities of non-flammability, relatively low toxicity and fast evaporation. They have been widely used as carriers for "lubricant-plating" solutions, where it is necessary to apply a thin film of an oil or grease to multiple parts in a speedy manner.

To obtain comparable speed in evaporation for a non-chlorinated solvent, one must resort to solvents which all have low flash points; i.e., they are flammable. Their collected vapors can be explosive. Their use would require installation of expensive explosion-proof motors along with an array of difficult precautions for ventilation and spark prevention. This is true whether one uses simple hydrocarbons, like petroleum ether, or low-boiling alcohols, like isopropanol. All have flash points below 100°F.

A flash point above 100°F renders a solvent combustible rather than flammable and mitigates some of the precautions required. However, strict care must still be used in ventilation and other protections, and, from a toxicity standpoint, all hydrocarbon solvents have lower TLV's (threshold limit values) for sustained employee exposure than did the aforementioned chlorinated solvents.

Even if combustible solvents prove more practical to handle from a safety standpoint, their higher molecular weight reduces their speed of evaporation such that the whole nature of the application

process may have to be changed. The applied solvent solution may take so long to dry that it may migrate by fluid creep to unwanted areas. Blowing with warm air may be required to achieve complete evaporation of the carrier solvent from a lubricant film. Mineral spirits with a flash point of 105°F takes about five minutes to completely evaporate when heated to 140°F.

We are looking for other options in newly available chemicals, such as HCFC's (hydrochlorofluorocarbons), or more recently HFC's (hydrofluorocarbons). Certain of the former materials have shown unexpected toxicity or are listed by the EPA as Class II substances in their new labeling regulations; therefore, we are hesitant to suggest them as options. Newer hydrofluorocarbons are not yet commercial and have uncertain solvating capabilities; but we are studying their suitability as we can get information.

The frustrations of this solvent search have led us more than once to suggest the option of doing without the solvent altogether. Equipment developed for the semiconductor industry for precise deposition of minute quantities of epoxies, adhesives and related compounds can be adopted to dispensation of either oils or greases, even on multiple numbers of miniature components (1). The problem here, or course, is expense, since these deposition machines are themselves highly engineered precision devices.

From the standpoint of efficiency of lubricant utilization, especially for minimizing quantity required of very costly lubricants, we happen to favor the non-solvent option. If anyone would like the name of a manufacturer of the special deposition equipment referred to above, give us a call.

(1) See R. Currence, "Selective Area Chemical Deprocessing By Use of Micro-Application, Surface Tension and Surface Wetting", Proc. ISTFA Symposium, Los Angeles, CA, October 19-23, 1992.

UV Signal for Deposited NyeBar-K Films

In our 1990 Lubeletter we introduced NyeBar-Type K, an oil creep barrier film in an "ozone-safe" fluoroalkane solvent. The NyeBar films, as applied, are so thin that they cannot usually be seen visually; and many customers have requested the addition of an optical or UV dye to the solution so that the presence of the film on a component may be confirmed.

The traditional chlorofluorocarbon solvents for the NyeBar films were not great solvents for dyes, but they would permit addition of the minor concentrations needed. However, NyeBar-Type K's solvent, being completely fluorinated, dissolved little other than fluorinated chemicals. The usual dyes were totally insoluble, and for many months we have been on a merry search for a dye of any type which could be introduced into these very selective solvents.

When adding a dye to a barrier film solution, several questions must be successfully answered in addition to its basic solubility. Will the dye be visible on a treated part? Will the dye affect the surface energy of the NyeBar film in such a way as to compromise its non-wettability? Will the addition of the dye affect the adhesion or durability of the applied film? Is a prohibitive cost involved?

For some months, we experimented with a particular blue dye, the only candidate visual color which seemed to be even a possibility for meeting all the criteria. Even at high concentrations, however, we could never achieve reasonable visibility with it.

With great relief we can now report that a new ultraviolet dye, visible under black light, has been found which, present at approximately 1.0% by weight of the applied NyeBar polymer, seems to provide satisfactory answers to all of the above questions. Samples of UV-dyed NyeBar-Type K are available on request.

ISO 9002 Certification a Target for 1993

We still consider ourselves a small business. But we've also been warned that only two things can really ruin a small business - failure or success. The key to surviving success is a total commitment to quality.

1992 was another year of strong growth in all of the Nye lubricant market areas. New products for automotive instrumentation and components, precision bearings and electrical controls have added to the sales increases coming from the appliance, small motor, computer, fiber optic, medical equipment and other oftentimes rather exotic market areas. The Nye engineering staff has now increased to eight professionals, twice what it was just three years ago.

Our current plant expansion (the 4th in 7 years) will accommodate expanded capability in ultrafiltration of lubricants as well as increased flexibility for small packaging to supply synthetic oils and greases, our own and those of others, in convenient dispenser containers for field service as well as production line requirements.

Our principal challenge for 1993 is to complete certification for ISO 9002 Quality Status during the year. Most of our customers will need no introduction to ISO 9000. These are quality technical standards established by the International Organization for Standardization (ISO) and are increasingly an essential requirement for marketing in Europe. They involve a series of analytic steps defining a manufacturer's implementation and documentation of sound, basic quality procedures in all phases of his operation from procurement through production to packaging and shipping.

It is our hope that our commitment to ISO 9002 certification will serve as a clear signal of William F. Nye, Inc.'s total commitment to quality and individual customer service.

Response Coupon

Cut along the above line and mail in your company envelope to:

WILLIAM F. NYE, INC.
P.O. Box 8927, New Bedford, MA 02742
Telephone (508) 996-6721

Special Requests or Comments:

Fill in your name company and mailing address on the reverse of this form.

Send at no charge or obligation a lubricant sample especially selected to meet the following needs:

Type of Mechanism _____

Components to be Lubed _____

Materials of Construction _____

Ball or Sleeve Bearing (if either)? _____ Sintered Metal? _____

Preference for Oil _____ Grease _____ Dry-Film _____

Is Oil Creep a Problem? _____

Will Lube Touch Plastics? _____ Type: _____

Elastomers? _____ Type: _____

Lowest Operating Temperature _____ °C/°F. If an electric contact, is arcing expected? _____

Highest Operating Temperature _____ °C/°F.

Desired Life at High Temperature _____

Present Lube _____

If unsatisfactory, in what way? _____

The Apparent Viscosity of Greases — Chapter 2

In our 1990 Lubeletter we discussed the "apparent viscosity" of greases. Grease viscosity depends on the rate at which the grease is being sheared as well as on the temperature. At that time we promised further elaboration on the effect of different gellants on grease viscosity. Some interesting data have now been produced on new viscometry equipment, displaying unexpected relationships of gellant type and temperature on apparent viscosities.

The accompanying graph plots apparent viscosity change over a wide temperature range, from -40°C to 100°C, for several synthetic hydrocarbon greases. All of these greases are based on a single oil, a light polyalphaolefin of 4 cs. viscosity at 100°C. All measurements were taken at a relatively slow 3 rpm spindle speed. Higher shear rates would shift everything down on the graph.

The gellant types run the gamut from lithium soap and clay to silica and two types of polytetrafluoroethylene polymer.

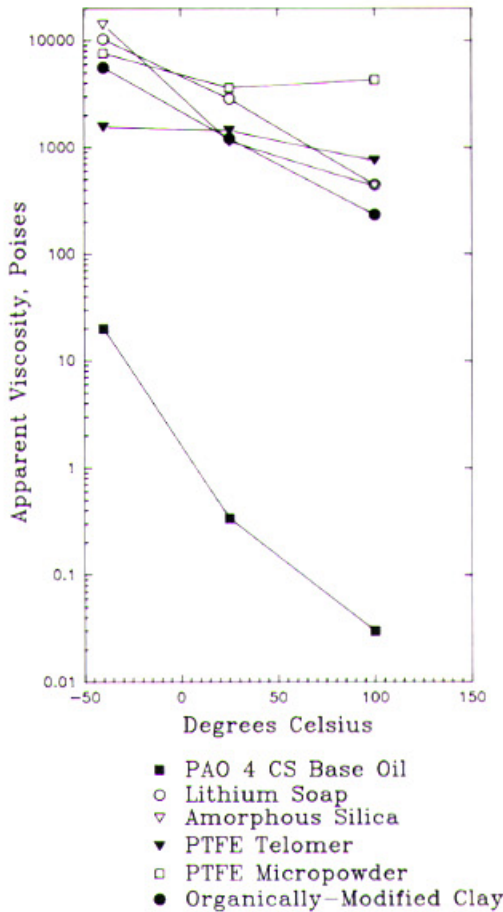
First, we should note the great difference between the viscosities of these greases and those of the base oil.

Second, we are not surprised by the fluorocarbon telomer ranking as the lowest apparent viscosity at below room temperature. The higher apparent viscosity at 25°C when PTFE micropowder is used was a little surprising, but perhaps better understood when related to the high gelling agent percentage in such greases (40%+).

More interesting, however, were the changes with temperature. The fluorocarbon polymers give greases with surprisingly high "v.i.'s", if the term viscosity index can indeed be applied to the apparent viscosity of greases. Apparent viscosity at 100°C is little different from that at 25°C.

The other gellant types show considerably more softening with temperature, the silica-gelled grease showing the greatest change. However, these changes with temperature are nowhere near as profound as the change of viscosity of the base oil over the same temperature range. The latter changes by a factor of more than 600 from 100°C to -40°C. The factor for the companion greases is in no case more than 24.

We hope this data provides some useful insights to customers dealing with greases in applications with varying temperature exposure.



Cut along this line and mail sample or literature request to: **William F. Nye Inc., P.O. Box 8927, New Bedford, MA 02742**

LITERATURE SECTION

Check below for special catalogs and other literature:

- Designer Lubricants, a Summary Catalog
- Lubricants for Electric Contacts and Connectors, a special catalog.
- The Nye Lubeletter for Autumn, 1991, containing a guide to understanding product bulletins on oils and greases.
- Fluid-Central Catalog, a descriptive summary of the grades and physical properties of the principal synthetic functional fluids.
- Flexibility in Packaging, a pictorial guide to small oil and grease dispenser containers presently available.
- Precision Dispensing Equipment, a list of references to manufacturers of precision dispensing apparatus.
- Nye Lubricant Kit H, a two-page brochure on a special kit of oils and greases in dispenser containers for instrument servicemen.
- Precision Bearing Greases: Ultrafiltered Packaging, a small volume price list for super-cleaned commercial bearing greases.

Send Lubricant Sample (from reverse) or literature (as checked to the left) to:

Name: _____

Title/Position: _____

Company: _____

UPS or Mailing Address: _____

WILLIAM F. NYE, INC.
P.O. Box 8927
New Bedford, MA 02742-8927
Tel: (508) 996-6721
Fax: (508) 997-5285