NYE® WILLIAM F. NYE, INC.
P.O. Box G-927, New Bedford, Mass.
SPRING 1985
LUBELETTER

CLEAN GREASE

Ultrafiltration of Greases for Precision Ball Bearings

In the January 1985 issue of **Lubrication Engineering**, Hans-Karl Lorosch, of FAG Kugelfischer in Germany, reports, in his article entitled "Research on Longer Life for Rolling Element Bearings", on the mechanism by which solid contaminants in lubricants significantly shorten bearing life. Smaller precision bearings are the most vulnerable. If one asks how clean a grease for a precision bearing has to be, let him read the chilling scenario by which a 100 micron harddirt particle can brutalize a small bearing.

In many industrial applications where relatively large bearings are used, "clean" greases are not that critical. Most industrial greases are sufficiently free of solid particles, of whatever nature, that their cleanliness never arises as a factor in their usefulness. With delicate devices, such as computer disk drives, however, where precision ball bearings are involved, one is operating in a different universe. In some very small precision ball bearings, the balls riding in the raceway are only a few hundred microns (say 0.025 inches) in diameter. A dirt particle with a dimension in any direction of 100 microns would cause a pretty rough ride, even if it were not sufficiently hard to cause the metal damage described in the aforementioned article.

We have been doing a lot of grease filtration lately. Interestingly, the more we do, the more we are asked to do. There has been in past years a general concern within the bearing industry that "ultra-filtration" of greases, by which we mean filtration through filter elements of only a few microns nominal pore size, would destroy the grease structure. There was concern that the matrix by which the gellant holds the oil in suspension would be so disrupted by forced passage through fine pore structure that de-gellation would ensue. Our Laboratory Director, Paul Bessette, undertook to test this hypothesis and systematically subjected a comprehensive variety of greases, involving a broad spectrum of gellant types, to filtration through a 3 micron filter. The results were reported in a paper presented at the 1984 Annual Meeting of the National Lubricating Grease Institute in Phoenix. The conclusion stated that, with one principal exception, ultrafiltration is not a threat to grease structure. The exception was grease gelled with polytetrafluoroethylene polymer where, if polymer loading was too high, the discrete particle size of the gellant led to problems.

Filtering through a filter medium of 3 microns nominal pore size doesn't mean that all particles larger than 3 microns in any dimension are removed. Dirt particles come in all kinds of shapes and a rod 3 microns in diameter, but 100 microns long, could conceivably get through a 3 micron filter. As a practical matter, however, it wouldn't and the pattern of particle contamination in "ultra-filtered" greases usually ends up with no particle greater than 35 microns and some residual particulate contamination in the 10 to 34 micron range. Ultrafiltration thus doesn't mean zero particle content.

There is more to grease cleanliness than the filtration itself. Half the job is in preparing a clean container to receive the filtered lubricant. There is a practical limit on how large or small such containers should be; we have so far used only glass or plastic containers. The most popular containers have been 16-ounce amber glass jars with screw caps or various sizes of polyethylene dispensing cartridges. The latter are ready to use in popular grease dispenser designs used by many precision bearing manufacturers. Metal cans with friction tops are not appropriate.

Bearing users are finding that cleanliness counts. A bearing with limited life using a grease of standard commercial cleanliness can show significantly extended life if the grease is ultrafiltered.

We would like to offer to any interested parties at no charge a copy of Paul Bessette's report entitled "The Ultrafilterability of Various Grease Types Through Three Micrometer (Pore Size) Membrane Filters". Typical data from that paper is furnished below. We can also offer quotations on cleaning up your greases for you.

		Prior to Filtration			Following Filtration		
Grease	Gellant Type	Drop Pt.	Oil Separation*	Particles/ml. >35 microns	Drop Pt.	Oil Separation*	Particles/ml. >35 microns
A	Lithium Soap	206°C	2.3%	150	206°C	0.2%	None
B	Polyurea	245°C	None	300	245°C	None	None
C	Organic Clay	250°C	3.4%	200	250°C	3.7%	None
D	Sodium-Complex Soap	250°C	None	200	250°C	None	None

Oil separation measured for 24 hours at 100°C.

DRY-CLEANING AN OIL

Dielectric Quality in Functional Fluids

The ability of a functional fluid to act as an electrical insulator or dielectric is dependent upon the quantity of fluid, its molecular composition, and its cleanliness. For a number of years we have endeavored to convince customers that, within the regime of boundary lubrication, a lubricant does not generally interfere with current flow on an electrical contact. Under boundary conditions, no elastohydrodynamic (EHD) film is formed and the resultant metal asperity-to-metal asperity contact assures adequate electrical continuity. Used in bulk, however, many functional fluids that are routinely used as lubricants can be effective dielectrics.

The dielectric characteristic of a fluid is a function of its molecular composition. Non-polar fluids, such as silicones or hydrocarbons, are preferred to fluids containing polar groups such as esters. Under large potential voltage differences, non-polar fluids are better able to resist polarization or induced electrical charge separation within the molecules of the fluid.

Fluid cleanliness is a third characteristic required of an effective dielectric medium. Either water or particulate contamination (often involving metallic debris) can adversely affect a fluid's electrical properties, and the effectiveness of a fluid for high voltage electrical applications is dependent upon the extent to which both water and contamination have been removed from the fluid.

We have been upgrading various silicone fluids to electrical quality for several years, and we see the possibility of expanding our services within both the silicone and synthetic hydrocarbon fluid families. If you have an application requiring upgrading of a lubricant or functional fluid to a "dielectric quality", please call or write for details of our products and services.

AN AUTHORIZED REPACKAGER

Dow Corning® Silicone Lubricants

William F. Nye, Inc. is one of seven "Authorized Repackagers" for Dow Corning Corporation, Midland, Michigan. Dow Corning is a leading manufacturer of silicone oils and greases. To obtain their authorized repackager designation we have had to submit our plant and procedures to rigorous periodic inspection and evaluation by Dow Corning's technical service personnel. The basic service being rendered by this program is the quick shipment of silicone fluids in containers of one gallon or smaller or 8-pounds or smaller for greases and compounds. A comprehensive range of Dow Corning's lubricant products is maintained in stock for this purpose.

This basic repackaging program has elaborated into a series of more specialized services. The most frequent request is for a special viscosity of either the dimethyl or phenylmethyl silicone oils. The dimethyl fluids (Dow Corning® 200 Fluids) are available from Dow Corning in twenty "standard" viscosities ranging from 0.65 centistokes to 600,000 centistokes (at 77°F). There are four standard phenylmethyl viscosities (Dow Corning® 510 Fluids). We can supply viscosities in between the standards, usually controlled to a ±10% of the requested viscosity. Closer tolerances can be managed if needed. Pricing for non-standard viscosities is based on the price for the nearest standard viscosity plus a blending charge of 10% or $30.00 (whichever is higher).

With lubricating greases, also, we have been asked to modify standard products. Dow Corning's wide temperature silicone greases, Molykote® 33 and Molykote® 44, are both available in "light" and "medium" consistencies. At one time a "fluid" consistency of each was also available but had to be discontinued as a regular grade because of lack of demand. By adding additional silicone oil to the light grade and properly homogenizing, we have prepared (for a few residual users) fluid versions of each of these greases under our labels Nye NyoGel® 741B and Nye NyoGel® 761A respectively.

Other special requests have included dyeing of both oil and grease, filtration for special needs and, in a few situations, increasing the consistency of a standard grease or compound. Modifications always carry a Nye label and can no longer be labeled as a Dow Corning product.

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SOLVENT BLENDS

NyeBar® For Oil Creep Control

We see a continuing increase in the production line use of the NyeBar® fluorinated barrier films for control or prevention of migration of lubricants or other fluids. The formerly forbidding problem of high costs in using these products has been mitigated to some extent by the proven performance of very dilute concentrations of the active fluorinated polymer. In some cases concentrations as low as 0.1 weight percent are being used. Insofar as only a monomolecular layer of the polymer film is theoretically needed to provide an effective non-wettable barrier, the usefulness of such low concentrations should not be too surprising.

Problems have arisen, however, in the choice of solvent. These fluoropolymers are soluble only in fluorinated solvents. The standard solvent is trichlorotrifluoroethane. This is a very volatile fluid, however, and sometimes evaporates so fast that a brush dipped into a solution can dry before the hand can get it to the surface needing application.

This problem has been resolved by adding a second fluorinated solvent - a lower boiling, equally inert fluid, our Nye Fluorosolvent 506. Blends can be prepared to customer specifications on polymer concentration and mixed solvent content. Blends are designated by a code number identifying the blending solvent, the percent of that solvent, and the resulting percentage of active barrier film in the product. Thus, Code 506-30/0.2 means that the product contains, as the solvent vehicle, 30% of Nye Fluorosolvent 506 and 70% trichlorotrifluoroethane and that the active barrier film polymer is present at a concentration of 0.2 percent by weight. This blend would be considerably slower to evaporate than would a comparable 0.2% solution 100% in trichlorotrifluoroethane. We would be glad to send a small sample of each if you would like to make a comparison. We will also send our current four-page product bulletin describing the NyeBar® barrier films.

WHAT NEXT?

Flexibilities In Grease-Making

Grease is a very resilient material, considering the things we've been asked to do to it. That involves just about everything. We are speaking not only of our own greases but also of other manufacturers' greases being used by our customers. We've been asked to add things to them, take things from them, soften them, stiffen them, and change them in previously inconceivable ways. The flexibilities this gives the grease user are impressive and a list might suggest some interesting possibilities for your particular situation.

Things We've Been Asked to Add to Grease

- Solid lubricant fortifiers, such as molybdenum disulfide or polytetrafluoroethylene
- Film strength improvers, such as metal oxides
- Tackifiers and adherence modifiers
- Rust inhibitors, either organic or inorganic
- Load-carrying additives, including those categorized as "EP" (extreme pressure)
- Dyes of all colors, including ultraviolet
- Solvents, to make grease-plating dispersions
- Oil, to reduce grease consistency, even to the semifluid state
- Metal powders, as in certain gas valve sealants and antiseize compounds
- Dirt (grit), as in special crimping compounds for wiring connections
- Carbon, to make the grease electrically conductive
- Perfume (a rare request)

Things We've Been Asked to Take from Greases

- Dirt or other solid contaminants (see the article on page 1 on grease filtration)
- Air, using special de-aeration equipment
- Odor
- Volatile components, as when stabilizing a grease for vacuum system use

Raisins may be next.
(To put in or take out?
Stay tuned!)

Fluorinated Ether Greases

When we speak of "exotic" lubricants these days we are probably referring to the several varieties of fluorinated ethers, which display exceptional chemical resistance and outstanding thermal and oxidative stability, as well as good lubricating properties. Special customer needs have led to formulation of several new fluorinated ether greases, all using a fluorocarbon polymer as gellant. Evaluation samples and bulletins are available.

NYE® FLUOROETHER GREASE 833B

In several developing automotive underhood situations, electrical contacts must be lubricated in the presence of gasoline vapors, which tend to leach most lubricant types to dryness. Nye Fluoroether Grease 833B can serve both a lubricating and a sealing function in such a situation over a temperature range of -40°C to over 100°C with complete resistance to solvation or leaching by hydrocarbon fuel vapors.

NYE® FLUOROETHER GREASE 834RP

One of the toughest bearing lubricant problems we've ever encountered involves a small rotary vane blower on truck engine exhausts which enriches exhaust gases with air to extend catalytic converter life. This application involves bearing temperatures in excess of 350°F for extended periods. There is also a rust prevention requirement. A great array of greases have been tested, and only fluorinated ethers give decent life. Our approved grease for this application is Nye Fluoroether Grease 834RP.

NYE® FLUOROETHER GREASE 857

With a 20°C vapor pressure of 2×10^{-13} torr. (Knudsen method), this grease may be the ultimate in a chemically-resistant vacuum system sealant. It uses as base oil a rather viscous fluorinated ether oil with a 100°F viscosity of 1150 centistokes. It remains workable down to below 32°F and, of course, would have excellent high temperature stability to 400°F and higher. We must confess that we did not prepare this grease to any specific customer need; it just appeared to be a grease that ought to exist, like King Arthur and Camelot.

NYE® FLUOROETHER GREASE 899

This grease is the ultimate in several things, not the least of which is its price ($520.00 per pound). It uses a linear fluoroether as base oil and thus can serve an extremely wide temperature range from -100°F or below to 400°F and above. At the same time, the base oil displays far lower volatilities than do alternative fluids of comparable viscosity. It is resistant to aggressive chemicals and is an excellent lubricant. We are suggesting it for evaluation in several oil-field downhole instrumentation applications.

Response Coupon

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

WILLIAM F. NYE, INC.
P.O. Box G-927, New Bedford, MA 02742
Telephone (617) 996-6721

Send Literature on the Following:

Special Requests or Comments:

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

Desired Life at High Temperature _____

Present Lube _____

If unsatisfactory, in what way? _____

THIN FILMS

A Screening Test For Greases

In previous editions of this newsletter, we have several times emphasized the importance of the "thin-film" aspects of lubricant exposure in delicate machinery. Oxidation and evaporation of oils or greases can be accelerated by several orders of magnitude when spread out in a very thin as opposed to thicker films. When a customer is faced with selecting among a variety of lubricants for a demanding application involving higher temperature, a thin-film exposure test can be an extremely useful tool.

A screening test of this type has been described and the results compared with more traditional test procedures in a paper presented at the 50th Annual Meeting of the National Lubricating Grease Institute in Kansas City in October, 1983. The paper was titled "Volatility of Lubricating Greases in Thin Film" and was based on work done here at William F. Nye, Inc., by Paul Bessette, our Laboratory Director. The numbers he obtained (which are set forth in his paper) proved that a thin-film test is a far more critical measure than the traditional ASTM-D972 test for assessing the volatility of lubricating greases.

This test can be elaborated to provide information on relative oxidation stability, as well as volatility, principally by extending test duration or increasing test temperature. Grease hardening and evidence of gum or varnish on the test panels can permit comparative ranking of greases on the basis of their thin-film oxidative stability.

Please let us know if you would like to receive a copy of this paper. The copy sent will identify the specific greases compared in Paul's tests.

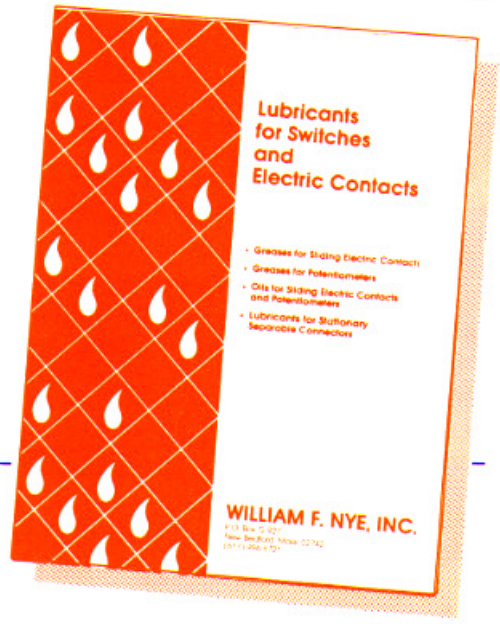
CATALOG/GUIDE

Lubricants For Electric Contacts

For several years Nye has had available a special catalog titled **Lubricants for Switches and Electric Contacts**. We have recently re-written this catalog, increased the number and variety of products included, up-dated all product data sheets, and generally tried to make it a more useful document.

This catalog has four sections:

- greases for sliding electrical contacts
- potentiometer greases



- oils for potentiometers and sliding contacts
- lubricants for stationary separable connectors

A final section notes possibilities for use in electrical controls or electronic devices of oil creep barrier films, damping greases and fuel/solvent resistant specialty greases.

We would be pleased to send you a copy of this new catalog at no charge on request.

from:
WILLIAM F. NYE, INC.
P.O. Box G-927
New Bedford,
Massachusetts 02742-0927

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A New

NYE® LUBELETTER

New Developments in Specialty Lubricants