NYE® WILLIAM F. NYE, INC.
P.O. Box G-927, New Bedford, Mass.
WINTER 1986
LUBELETTER

Connections

The use of lubricants for electrical connectors has parallels in transmission of other forms of energy. This issue of the Nye Lubeletter treats with new developments in several "non-lube" disciplines involving **coupling media** specifically designed for transmission of

- **heat,** as in thermal conductivity compounds for a variety of electronic devices
- **sound,** as in sonic coupling fluids for ultrasonic medical instrumentation
- **light,** as in optical coupling gels for fiber optic connectors

LET US MAKE THIS PERFECTLY CLEAR

Optical Fiber Coupling Gels

The fast transmission of data in digital form can be accomplished using light waves. A glass or plastic fiber serves as the transmission medium and has led to the development of the new technology of fiber optics.

Where fiber optic connections are made, special considerations must be given to the quality of the connection to avoid "attenuation" or light losses through reflection, absorption or scattering. The small optical fibers must be precisely aligned in any connection or junction, and the end finish of the fiber is also critical. In separable optical connectors, a short gap is designed into the connection to prevent the end of one fiber from rubbing against the end of th e other. If this gap is left unfilled, meaning that the fibers are separated by air, a reflection loss is created. If this gap could be filled by a medium with a refractive index matching that of the fiber, the loss can be reduced to a minimum. "Index matching fluids" have been utilized to accomplish this and have evolved into an even newer product for William F. Nye, Inc., an optical coupling gel. A gel structure enhances needed stay-in place capability without sacrificing the void-filling capacity afforded by a fluid's plasticity. Our first commercial product of this nature is Nye Optical Coupling Gel OC-430.

One of the tests we have passed in formulating this product is that of clarity — and from two rather different perspectives. One issue to be addressed is that of color; a clear transparent, "waterwhite" gel is one which is not absorbing or scattering light of any specific frequency. Were the gel colored, it would be absorbing light frequencies other than those represented by the color displayed. If it were not transparent, it could be scattering light. Nye Optical Coupling Gel OC-430 is a crystal clear grease. This crystal clarity should not change on aging or on exposure to light. Ultraviolet light can energize molecular orientations which, over time, can result in absorption of certain light frequencies; a vulnerable gel will sooner or later display a color. We have exposed the OC-430 gel to ultraviolet light of 365 nanometers for almost two months with no evidence of discoloration.

The other issue involving clarity is that of cleanliness. Impurities in glass cause absorption and loss of light energy. Likewise, the presence of solid particles in a coupling gel can cause attenuation and minute distortion of the light signal being transmitted. Special processing techniques are used to minimize particle size and content in the OC-430 gel.

This is an oxidatively stable material with plasticity and stability over the usual optical cable operating temperature range of -25°C to 80°C. We recommend its evaluation in optical fiber connectors, and we have packaged evaluation samples in small 5 ml syringes for ease of application.

(See page 2 for additional information on compounds for optical fibers.)

THERMAL CONDUCTIVITY

A Non-Silicone Heat Sink Compound

Heat sink compounds are grease-like materials which serve as a flexible medium to conduct thermal energy from heat-producing elements in electronic equipment either to larger ventilated components or to heat measuring or controlling instruments. The plasticity of the grease form permits ready filling of gaps or voids between conducting surfaces. A heat sink compound must naturally be stable to high temperatures and must maintain its condition without bleeding, evaporating or hardening. Such compounds normally consist of a large proportion of inert metal oxides dispersed in a stable gel. Silicone oils have traditionally provided an excellent vehicle for these gels.

We have recently been working with a new non-silicone heat sink compound, our Nye Heat Sink Compound 920, which uses as its base oil a wide-temperature stable polyol ester fluid. This heavy oxide-filled grease displays exceptional stability, exhibiting virtually zero bleed or evaporation over its projected operating temperature range of -40°C to +175°C. Excursions to 200°C are sustainable for short periods. The most interesting property of this compound is its heat conducting capability, which we have measured at over 2 x 10^{-3} gm.-cal./sec./cm²/°C/cm.

Nye Heat Sink Compound 920 could further afford a capable alternative in any situations where, for whatever reason, silicone-based products cannot be used. This may occur in certain telecommunications applications, or where solderability or paintability might be affected by low surface tension silicones.

We recommend evaluation of Nye Heat Sink Compound 920 for any electronic device where efficient coupling is required. Evaluation samples are available at no charge along with a preliminary product data sheet.

INAUDIBLE IMAGES

Ultrasonic Coupling Fluids

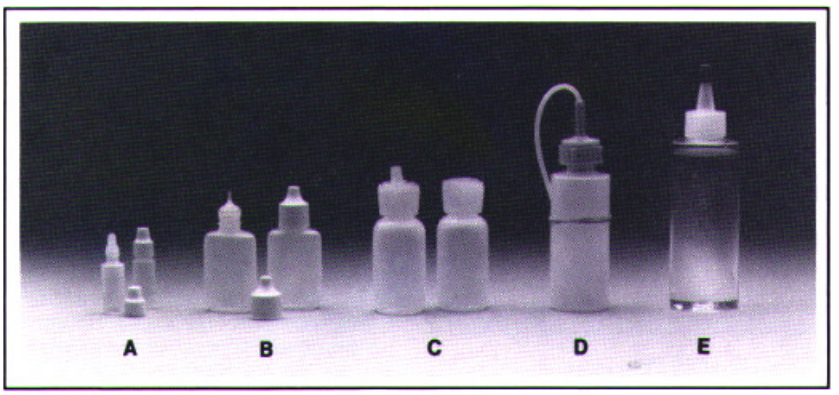
Humans are generally unable to detect sound waves vibrating at frequencies greater than 20,000 Hertz; however, ultrahigh frequency sound waves are useful for a number of industrial applications including fracture analysis, ultrasonic cleaning and ultrasonic imaging. Ultrasonic scanners allow medical personnel to monitor fetal development and provide a means for physicians to determine the status of internal organs prior to surgery. These systems consist of an acoustical generator feeding sound waves into an acoustical coupling medium (a functional fluid) connecting to a probe that contacts the patient, plus the necessary electronics to convert reflected soundwaves into images.

Ultrasound waves are governed by the same physical laws common to all wave phenomena; they can be reflected and refracted (bent) to various degrees upon contact with various materials and substances. Reflected waves from the target produce the necessary signal for imaging, while the refracted (bent away from the normal) waves must be minimized to prevent unnecessary beam attentuation. Careful selection of an acoustical coupling fluid to match closely the acoustical properties of a particular scanning system can reduce incident beam attenuation and maximize the reflected signal resulting in a strong image. We have developed several promising fluids for acoustical coupling applications and would welcome the opportunity to discuss your particular application and requirements.

DISPENSER CONTAINERS

Flexibility in Packaging

Whether for field service use or for direct utilization on the production line, dispenser containers are a basic element in a specialty lubricant service. On this page we display a range of such containers for both oils and greases. The items displayed are selections from a wider range of options and are only suggestive of the possible patterns we can supply in dispenser containers. Final choices may sometimes be affected by the compatibility of certain synthetic oils with certain types of plastics.



OILS

From left to right, above, are pictured

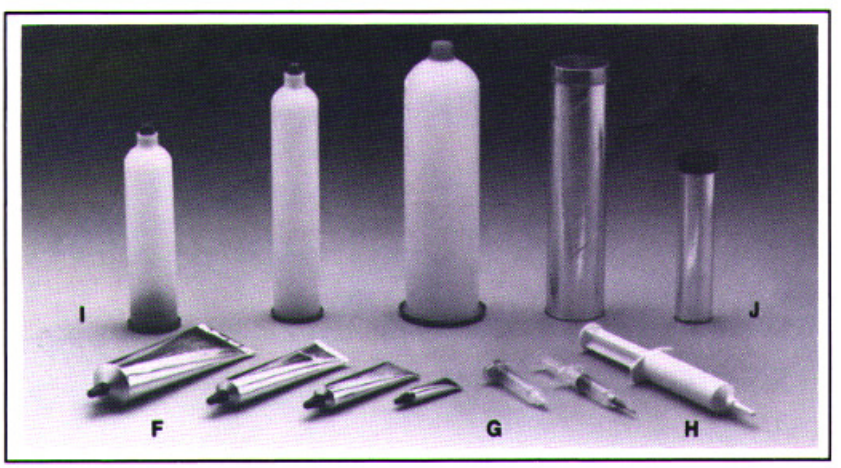
A. A 3 ml polyethylene dropper vial for point application of single drops of fluid. Screw cap.

B. A 1/2-fluid ounce polyethylene vial with a 1/4" long dispensing tip (0.5 mm orifice) and a screw cap.

C. A 1-fluid ounce polyethylene vial with a screw cap fitted with a 3/8" long pop-up dispensing tube (1.0 mm orifice).

D. A 2-fluid ounce polyethylene vial with a special 6-inch long dispensing tube (0.5 mm orifice). The cap contains a valve closure actuated by pushing the tube base in or pulling it out.

E. A 4-fluid ounce polyvinyl chloride cylinder with a "Yorker" style cap. The plastic cover on the dispensing tip is removeable and reattachable. The tip can be cut to afford the orifice size desired.



GREASES

Above, are pictured

F. Metal squeeze tubes of varying sizes, including 1/4 fluid ounce (tin-metal), 1, 2 and 4 fluid ounces (all aluminum).

G. A 5.0 ml plastic syringe which can be supplied with or without plunger or needle. Dispensing needles of various orifice sizes can be specified.

H. A 30.0 ml (1 ounce) plastic syringe with a "stopperless" plunger and a 1" long plastic dispensing needle (with 1 mm orifice) molded into the syringe cylinder.

I. Plastic cartridges of varying sizes for use with automatic air-operated dispensing equipment. Sizes shown are 6 ounce, 8 ounce, and 20 ounce. Smaller and intermediate sizes are also available.

J. Two sizes of fibreboard grease cartridges, the "mini-cartridge" of 3 ounces and the standard 14.5 ounce cartridge.

"WATER BLOCKING"

Optical Fiber Cable Fill Compound

Elsewhere in this newsletter we have described the use of special greases for optical fiber connections. Many designs of optical fiber cable also use a water-resistant gel or grease for a very different but equally important purpose, which is to cushion and protect the optical fiber from stress and moisture, while allowing for environmentally-induced expansion and contraction. These special gels actually surround the fiber bundle and are encapsulated within the cable tubing.

The qualities needed for such a water-blocking filling compound are:

(1) wide temperature plasticity, from -30°F to 200°F

(2) oxidative stability and non-volatility within this temperature range

(3) low oil bleed and high melting point

(4) water wash resistance

Our water-resistant synthetic hydrocarbon grease, Nye NyoGel® 759G, widely used as an electrical connector lubricant and sealant, has proved to be an excellent product for optical cable fill. We have expanded our production capabilities for this product.

LOW-SHEAR IN HIGH VACUUM

Linear Fluoroether Grease For Ball Bearings In Vacuum Systems

Lubricants for use in vacuum have traditionally been high molecular weight polymers, often gelled into greases. This is fine for sealant needs, but where one wants to lubricate a ball bearing, with limited torque available, within an evacuated chamber, traditional vacuum greases could be so viscous and present sufficient internal shear as to prove less than useful. Available bearing torques could be overwhelmed.

The linear fluoroether oils display singularly low volatility in fluids with relatively low viscosities, and we can propose consideration of Nye Fluoroether Grease 899 for bearing use under vacuum conditions. Although the price is sufficiently high, unfortunately, as to permanently damage our relations with your purchasing people, nevertheless a little goes a long way.

Vapor pressure data available to us on the base oil in the 899 grease is summarized below:

20°C	5×10^{-12} torr
100°C	5×10^{-9} torr

A bonus from use of this particular type of grease would be its resistance to most aggressive chemicals as might be used in semiconductor manufacture.

We can supply without charge on letterhead request a 5 gram sample tube of Nye Fluoroether Grease 899 for checking volatility in your particular system.

Grease Plating

How is a grease to be applied? This is easy enough if there are only a few components needing a few spots of lubricant. The metal squeeze tube fills this need. On a production line, however, where there may be thousands of assemblies produced in a day, each needing a spot of grease in a specific location, more efficient application techniques are necessary.

Air-operated grease pumps, operating out of a five-gallon or larger grease container, can be fitted with controls and meters to deliver relatively precise quantities of grease to specific points in a mechanical assembly. This dispensing approach can also be used with plastic grease cartridges, ranging in size from 3 to 20 ounces.

Where a very large number of components need coating with a lubricant, an alternative and possibly more efficient method of applying a grease film is available. It is called "grease plating" and involves the dispersion of the grease in a solvent, dipping the components needing lubrication into the resulting liquid (or "slurry"), then removing the components from the liquid and allowing them to drain and dry. As the solvent evaporates, a lubricant film is effectively "plated" onto the parts.

Concern is sometimes expressed regarding grease plating that the dispersion of the gellant into the solvent might destroy or distort the gel structure of the grease. We have not seen this happen. The grease film deposited from the solvent dispersion appears to be no different from the grease prior to dispersion. The gellants in most greases do not actually dissolve in the solvent but merely disperse, and care should be taken that grease components do not settle to a high concentration in the lower portion of a dip tank, leaving a low concentration higher up. Mild, frequent agitation of the slurry during use should prevent any such problem.

Greater concern should perhaps be devoted to proper ventilation of solvent vapors. The range of solvents normally used in grease plating is not wide. The safest, from a flammability and toxicity point of view, is trichlorotrifluoroethane, a fast-evaporating, non-flammable solvent with a TLV (threshold limit value) of 1000 parts per million. (This is the recommended permissible air concentration averaged for an eight-hour working period.) Trichlorotrifluoroethane, however, is relatively expensive. Less costly options are (1) 1,1,1-trichloroethane (sometimes called methyl chloroform) which is non-flammable but is somewhat more toxic, with a TLV of 350 ppm; and (2) mineral spirits, which is combustible (flash point of 105°F), evaporates relatively slowly and has a TLV of 120 ppm. Whatever solvent is used, it should be remembered that, for every gram of lubricant applied, several (perhaps many) times as many grams of solvent are being volatilized. All of this solvent in vapor form must be properly ventilated and not allowed to accumulate in the workplace. OSHA and various state regulations apply to control of solvent vapors.

The thickness of the applied grease film is a function of the concentration of the grease in the solvent dispersion. The higher the concentration, the thicker the film. We have seen customers use concentrations ranging from 1 percent to 30 percent (by weight), depending on the particular use for the lubricant. Concentration of grease in a working slurry must be checked regularly by gravimetric analysis, since solvent can evaporate from open containers over a period of time. Grease concentrations would slowly increase, and fresh solvent would have to be added to correct for the evaporation.

Efficient use of grease plating requires accommodation to the specific requirements and problems of the individual production line. We can prepare grease dispersions in varying concentrations and solvents and stand ready to work with any interested grease customers.

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? _____

CLOSING THE WINDOW (GREASEWISE)

Ester-Based Greases For 300°F Exposure

We are still trying to close a window of vulnerability. When operating temperatures for a lubricant, especially in thin film, approach and exceed 300°F, some very difficult choices, even compromises, are required. Lower-cost options, such as petroleum or hydrocarbon-based oils or greases, are beyond their oxidation threshold when temperature exceeds 300°F for any length of time.

Somewhat more expensive silicone lubricants can readily tolerate such high temperatures but either afford limited load-carrying capability or, as in electrical contact situations, pose other limitations. To assure both good lubrication and long life at high temperature, one has to look to fluorinated lubricants. Costs here, however, can approach or exceed $100 per pound, prohibitively high for many needs.

There remains one lower-priced alternative which, depending on the application, holds potential for reasonable life at or beyond 300°F. The hindered polyol esters, even in thin film, if properly stabilized with antioxidants, can afford extended life to 350°F. Success depends on the application. Continuous 350°F exposure on a catalytically-active metal such as copper could lead to disappointment; whereas multiple shorter-term excursions to this temperature level may be tolerated satisfactorily. The polyol esters are good lubricants with excellent low temperature as well as high temperature properties.

We can presently put forward two new polyol ester-based greases for evaluation in difficult ball bearing, gear train or switch contact applications where the potential for 300°F or higher temperatures has been causing difficulties. Nye Rheolube 789D uses a non-melting organically-modified clay as gelling agent. Nye Rheolube 798 utilizes a lithium soap. Both greases would be suitable for use to -40°F and thus could be considered for a wide range of automotive underhood devices, which must operate over a -40°F to 300°F temperature cycle. As with any ester, care must be used with certain plastics or elastomers. Product bulletins and evaluation samples are available at no charge upon request.

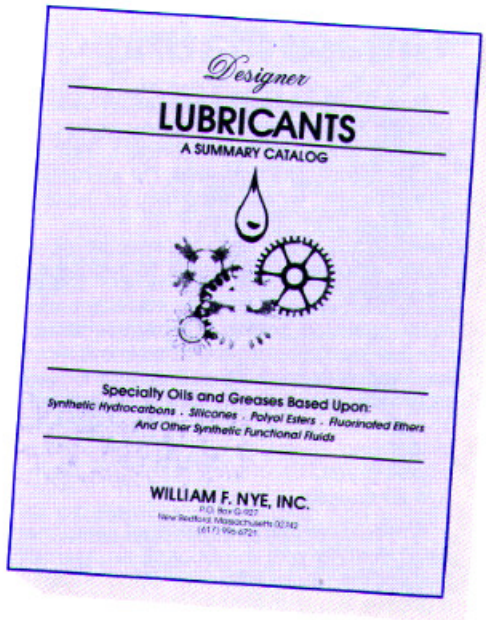
SECOND EDITION

Designer Lubricants

Our "general" catalog has been re-written and retitled. We hesitate a bit to call it "general", since it is far from comprehensive and is really quite selective in the products listed. It does, however, give a reasonable overview of the product possibilities within the several realms of specialty lubrication which Nye services.

The new edition is titled **Designer Lubricants, A Summary Catalog**. Just as there are "designer jeans" and "designer sunglasses", the phrase "designer lubricants" emphasizes our effort to promote specialty lubricants as legitimate design materials to be considered at the earliest practicable point in new product development.

A free copy of the new **Designer Lubricants Catalog** is available for the asking.



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