NYE® WILLIAM F. NYE, INC.
P.O. Box 8927, New Bedford, Mass.
AUTUMN 1991
LUBELETTER

A NEW FLAG TO FLY

Ford Q1 Preferred Quality Award

Quality Operating Systems are hardly new to us here at Nye. In supplying a total of perhaps 400 synthetic lubricants and compounds to industries such as automotive, aerospace, electronic, fiber optic and instrumentation, we have long been aware of the absolute necessity of minding our "P's and Q's". We are, however, proud of our latest automotive accomplishment - that of earning the elite *Ford Q1 Preferred Quality Award.*

The Q1 Award evaluation criteria entail a comprehensive review of plant quality practices and performance, including manufacturing processes, and the use of statistical methods to control manufacturing techniques. There is a significant focus on detecting defective raw materials and in generally increasing quality and productivity.

Additionally, the Ford "QOS" Program has now been initiated at our facility.

INTERPRETATION OF STRANGE NUMBERS

Reading the Lubricant Product Bulletin

On page 2 overleaf, we attempt to explain some of the mysteries of lubricant data sheets. Our apologies for the size of the type; we should properly provide a magnifying glass. However, there is so much to say, and we wanted to present both an oil and a grease in the same Lubeletter. We hope the eyestrain is worthwhile.

VOLATILITY AND ITS CONSEQUENCES

Low Vapor Pressure Oil and Grease for Aerospace and Computer Disk Drive Uses

Lubricant volatility can become a problem in two ways. Not only is evaporation one of the modes of lubricant depletion, leading to lube starvation in a bearing, but the reappearance of the lubricant as condensed vapor at some other sensitive point in a device can be equally troubling.

Lubricant starvation through evaporation does not crop up frequently in bearing failure analysis. Most synthetic oils are sufficiently low in volatility that lubricant migration or creep is a far more likely cause of lubricant loss. Only when one is intentionally stretching a very low viscosity fluid, chosen perhaps to achieve fluidity at a very cold temperature, will evaporation loss at elevated temperatures become a constraint.

Much more likely in very sensitive devices, however, are problems of contamination of optics or computer data storage media by condensed oil vapor which has volatilized from a nearby lubricated component. It takes very little such contamination to be troublesome, so little that lubricant loss from the lubricated component might never be detected.

Most highly-refined petroleum or modern synthetic oils have extremely low vapor pressures. It requires, however, exceptionally low vapor pressures to avoid the aforementioned contamination problems. One must separate the excellent from the very good.

Classifying synthetic or petroleum oils on the basis of vapor pressure requires test equipment not readily available. Traditional methods are not sufficiently precise. We have actually had to design and build our own device to permit measurement of the extremely low vapor pressures which most modern functional fluids display and to select among them those with truly special qualities.

We fabricated a vacuum test chamber capable of heating ten grams of candidate lubricant to 150°C or higher under 10^{-4} torr. The equipment consists of a thermocouple controlled stainless steel heating block, high capacity vacuum pumps, and the necessary instrumentation to monitor system vacuum, temperature and test duration. Vapor pressures are calculated based upon Langmuir's expression equating vapor pressure to weight loss, temperature and molecular weight.

One fluid which has shown exceptionally low vapor pressures and which has had a good reception among our aerospace customers is the newly-formulated Nye Synthetic Oil 2001. This oil is an alkylated cyclic hydrocarbon, actually a cyclopentane.

Vapor pressure data for Nye Synthetic Oil 2001, compared with data on other familiar lubricants, is shown in Table I below:

TABLE I

Lubricant	Type	Viscosity 40°C	Vapor Pressure, torr, 100°C
Mineral Oil	Naphthenic Petroleum	93	2.5×10^{-4}
Nye Oil 182	Poly-alpha-olefin	68	1.3×10^{-6}
Nye Oil 186	Poly-alpha-olefin	108	9.2×10^{-6}
Nye Oil 2001	Alkylated Cyclic	110	7.2×10^{-8}

A companion grease to Nye Synthetic Oil 2001 is Nye Rheolube 2000, gelled with a high molecular weight organic sodium soap.

The basic oil component of these lubricants is currently made in very small lots, which means that they are quite costly. However, the benefits obtained from their extremely low vapor pressure are such that the investment required for ball bearing lubrication has readily been justified for several aerospace situations. Write for our new product bulletin.

NYE SYNTHETIC OIL 605

This polyol ester-based oil is an oxidation-stabilized synthetic fluid possessing low volatility and good film strength. Recommended service temperature is from -40°C to over 150°C.

TYPICAL PROPERTIES

Viscosity at:	100°C	9.0 cs
	40°C	57 cs
	-17.8°C	2,200 cs
	-40°C	37,000 cs
Flash Point		288°C
Pour Point		-57°C
Evaporation, 6-1/2 hrs at 204°C		Less than 2-1/2%
Neutralization Number		0.19 mg KOH/gr
Corrosion and Oxidation Stability		
a. Conditions		72 hrs at 175°C
b. Change in viscosity at 40°C		2.9% increase
c. Change in Neutralization Number		+0.33 mg KOH/gr
d. Evaporation during test		0.4%
e. Appearance after test		Reddish-dark Brown, No Precipitate
f. Change in weight of test metals, mg/cm^2		
(1) Brass		0.00, Bright Yellow
(2) Aluminum		0.00
(3) Nickel		0.00
(4) Copper		-0.10, Dark Tarnish, 3A
(5) Bronze		-0.07 Green and Blue
(6) Steel		0.00 Brown
Copper Corrosion, per FTM 5309		
a. Conditions		24 hrs at 100°C
b. Conditions of exposed copper strip		Slight Tarnish-1B
Shell 4-Ball Wear Test, Steel on Steel		
a. Conditions		40 kg, 1 hr, 600 rpm, 25°C
b. Wear Scar Diameter		0.38 mm
Specific Gravity at 25°C		1.00

1. Viscosity is the consistency of a fluid - is it light like water (1.0 centistoke) or heavy like molasses (10,000 centistokes)?

2. Flash Point - at what temperature will a flame induce a "flash" of fire from the fluid? This is the flash point. At a higher temperature the fluid won't just "flash", but will continue to burn with a flame. This would be the fire point.

3. Pour Point - when the fluid becomes too viscous to flow (under certain prescribed conditions), it has reached its pour point. It's not necessarily "frozen", like ice, but it is not mobile.

4. Evaporation under prescribed conditions is an indication of resistance to volatilization during extended use in thin film.

5. Neutralization Number is a signal of acidity in the fluid. A high reading, say above 3.0 mg. KOH/gram, would suggest a degree of fluid instability or breakdown.

6. Corrosion and Oxidation Stability - a widely used test procedure to determine the ability of an oil to resist oxidation at high temperatures and its tendency to corrode various metals. Air is bubbled through a heated test tube containing the oil in which the test metals are immersed. Note that changes in viscosity and acidity are monitored as well as evaporation and any evidence of sludging. Weight loss and appearance of the test metals are noted. Oil 605 performed exceptionally well in this 347°F test.

7. Copper Corrosion - since copper is a relatively reactive metal, this test is a good measure of the chemical reactivity of the oil.

8. The Shell 4-Ball Wear Test indicates the ability of the oil to prevent wear when a steel ball is rotated in a nest of 3 similar steel balls. A wear scar of less than 0.50 mm under a 40 kilogram load is quite good.

9. Specific Gravity is equal to the density of the oil divided by the density of water, which is 1.0 gm./ml. It is dimensionless, a relative measure of mass per unit volume. The 605 Oil has the same density as water. Some fluorinated oils would have a specific gravity of 2; hydrocarbon oils would have a specific gravity of less than 0.9.

NYE RHEOLUBE 723GR

A SYNTHETIC HYDROCARBON GREASE FOR TIMING MOTORS AND SMALL METAL OR PLASTIC GEAR TRAINS

This oxidation-stabilized, wide-temperature, lithium soap-gelled grease uses a polymer-fortified medium-viscosity synthetic hydrocarbon oil as the base oil. Polymer fortification permits enhanced film strength and an impressively high viscosity index for uses from -40°C to 120°C Excellent lubricating characteristics. Compatible with most ester-vulnerable plastics and rubbers. Rust Inhibited.

TYPICAL PROPERTIES OF THE BASE OIL

Viscosity:	100°C	15.5 centistokes
	40°C	73 centistokes
	25°C	133 centistokes
Flash Point		over 200°C
Pour Point		Below -40°C
Viscosity Index		220

TYPICAL PROPERTIES OF THE GREASE

Dropping Point	205°C
Unworked Penetration	330
Worked Penetration, 60 strokes	356
Oil Separation, 16 hours at 100°C	4.2%
Evaporation, 16 hours at 100°C	0.2%
Copper Strip Corrosion, per FTM 5309, 24 hours at 100°C	Light tarnish, 1B
Neutralization Number	0.1 mg. KOH/gm.
After 16 hours at 100°C	0.13 mg. KOH/gm.
Norma Hoffman Bomb Oxidation Test	100 hours at 100°C
Conditions	Less than 10 psi
Pressure Drop During Test	Less than 1.0 mg. KOH/gm.
Increase in Neutralization Number	
Shell Four Ball Wear Test, Steel on Steel	1 hour,40 kg., 600 rpm., 25°C
Conditions	0.65 mm.
Wear Scar Diameter	0.86
Specific Gravity, 25°C	

1. Important properties of the oil used as the base fluid for the grease are listed here; their significance is explained above.

2. Viscosity Index - a dimensionless number reflecting the relative change of viscosity with temperature. Less than 100 is not so good; an index in the mid one hundreds is expected for good synthetic oils; silicones are exceptional with indices above 400. This oil contains a "viscosity index improver".

3. Dropping Point is the temperature at which the grease begins to melt and exudes a drop of oil. Some types of grease never melt; however, due to oil separation, oil may eventually drop, and a dropping point defined (see 5. below). Dropping point should not be confused with "high temperature operating limit". A grease can easily begin to oxidize or otherwise degrade at temperatures well below any dropping point.

4. Unworked and Worked Penetration - the numbers are in tenths of a millimeter and express the distance a metal cone of prescribed dimensions will penetrate into the grease when dropped from a prescribed height. The "worked" number, often higher, would display the softening achieved by 60 strokes of "working" the grease through a perforated plate.

5. Oil Separation defines the tendency of the grease to bleed over time and at high temperature. Some degree of oil separation is inevitable in most bearing greases; levels above 10% can be expected with extremely soft greases. Separation is usually self-limiting and should not be extrapolated for extended time periods.

6. Neutralization Number - on this bulletin the neutralization number, as explained in par. 5 above, is recorded both before and after exposure at a high temperature.

7. The Norma-Hoffman Bomb Oxidation Test exposes the grease to pure oxygen under pressure for a prescribed time at high temperature. The pressure drop displays the tendency of the grease to absorb oxygen and reflects its relative oxidation resistance. Its change in acidity is also recorded for this exposure.

Aluminum Complex Grease Based on Synthetic Hydrocarbons

As new applications for specialty greases are presented to us in the future, we expect to have sharply enhanced formulating flexibility for difficult situations. We are preparing a new series of synthetic grease products using as gellants complex aluminum and lithium soaps and also polyureas.

These are advanced gellants using chemistries and processing techniques not easily established for the smaller batch quantities in which we specialize. Dropping points on these types of greases are all above 500°F; thus, for practical purposes, they all afford a "non-melting" quality. Compared with other non-melting greases in our present product line, however, they will more readily accept rust inhibitors and other additives.

Water resistance is one of the attractive qualities of the non-melting aluminum complex greases. The first formulation to be introduced in this new grease program uses an aluminum complex soap to gel a 6 cs. (at 100°C) synthetic hydrocarbon oil. The formulation was especially prepared to meet a ball bearing problem in air conditioners where water condensing within the apparatus was flooding the bearing and destroying the traditionally-used grease.

This new grease will be labeled Nye Rheolube 390 and can be targeted for wide-temperature ball bearing applications, from -50°C to over 120°C, where rust inhibition and water resistance are critical to successful performance. A new product bulletin and evaluation samples can be provided on request. As the months go on, we expect to add novel lithium complex and polyurea formulations.

Novel Applications for NyeBar Barrier Films

For the last twenty years our product bulletins for the NyeBar oil creep barrier films have highlighted their use in preventing oil loss from ball and sleeve bearings. For a ball bearing, the face of the bearing is coated with the low surface energy NyeBar polymer. For sleeve bearings a ring of NyeBar around the shaft as it exits the bearing can control oil bleed.

Many of our NyeBar customers use the product in just these two ways, but there have also been some unusual and imaginative applications which deserve mentioning.

1. Creep of epoxy during curing.

The creep of two-component epoxy systems in their fluid mode before they are completely cured can create headaches of various types including contamination of adjacent components. Judicious treatment of threatened areas with a NyeBar film can control this phenomenon.

2. Fouling of sliding electric contact in timer mechanism.

The proximity of a soft, semi-fluid grease, used to lubricate timer gears, to a relay contact, which operates an alarm signal from the timer, created serious fouling problems for the contact until it was coated with a NyeBar film. The film from a dilute (0.1% concentration) NyeBar solution is too thin to affect current flow but does create a non-wettable surface on the contact which keeps the lubricant from adhering and creating problems.

3. Rendering a porous medium hydrophobic.

For several very different end uses, there has developed a need to prevent water absorption or wetting on porous filter media or other membranous surface or matrix. The NyeBar film will prevent wetting by water just as well as it will with most functional fluids and lubricants. The extremely thin film thickness required makes it ideal for rendering such media harmlessly hydrophobic.

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.

Highest Operating Temperature _____ °C/°F.

If an electric contact, is arcing expected? _____

Desired Life at High Temperature _____

Present Lube _____

If unsatisfactory, in what way? _____

Nye Lubricants Meet Automotive Market Specifications

Over thirty Nye synthetic oils and greases have been written into formal specifications of the three major U.S. automobile manufacturers and their principal component suppliers.

Through our Detroit office, our company has maintained close relationships with the many engineering staffs who are designing the automobiles of the 1990's, and we have been in a position to recommend lubricants customized for the special demands presented by evolving design concepts.

A listing matching products and their successful applications displays the great flexibility of quality synthetic lubricants, and we present the following for cross-linking with our readers' application possibilities.

Nye Fluorocarbon Gel 880	parking brake cable systems light truck calipers stabilizer bar boots
Nye Fluorocarbon Gel 885	light duty control cables
Nye NyoGel 759G	wire harness connectors fuel tank sender connectors submergible connector seals headlamp switch connectors strut sealant
Nye Synthetic Oil 605	supercharger oil
Nye NyoGel 783H	water pump O-ring assembly aid
Nye NyoGel 759T	seat track slide mechanisms
Nye NyoGel 795LT	windshield washer control knob
Nye Fluoroether Grease 842	automatic brake leadscrew automatic brake piston/bore
Nye Fluoroether Grease 828RP	automatic brake ball bearing
Nye Rheolube 373	automatic brake clutch spring
Nye NyoGel 779	rotary temperature control linear temperature control
Nye Rheolube 362F	window lift motor shaft
Nye Rheolube 375	advanced brake bearings
Nye Synthetic Oil 634B	high temp. sintered bearing
Nye Rheolube 363F	seat motors
Nye Fluorocarbon Gel 813	crankshaft sensor terminals
Nye NyoGel 782G	headlamp switches
Nye Fluorocarbon Gel 855D	rotary ignition switches linear ignition switches trunk/fuel switches
Nye Rheolube 362HT	visor light switch rear lamp switch
Nye Fluoroether Grease 834RP	heat pump bearing
Nye Rheolube 362	brake trans. select. indicator
Nye NyoGel 793	steering wheel horn rings
Nye Fluorocarbon Gel 885ST	air bag clocksprings

Nye lubricants are also used in many additional automotive applications where, rather than lubricants being defined by specifications, they are part of a purchased "black box" component. If the above applications suggest any potential prospects for your own situation, automotive-related or not, we would be happy to send data and evaluation samples.

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 Lubeletter Digest, a compendium of over twenty articles from Nye Lubeletters for the years 1972 to 1987.
- ☐ 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