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Nye® Lubeletter

Synthetic Lubricant News from The SmartGrease *Company*™

Electrical Contact Grease Fills Industry Gap

Under development for 18 months, RheoTemp™ 761G is a new "high-temp" synthetic hydrocarbon grease that fills a price/performance gap in lubricants for separable electrical connectors. It performs at temperatures up to 175°C, a regime once confined to significantly more expensive silicone and fluorinated lubricants.

RheoTemp 761G prevents wear, environmental corrosion, fretting and resists water washout as well as NyoGel® 760G — a polyalphaolefin (PAO) connector grease developed by Nye in 1990, and now specified by Ford, GM, DaimlerChrysler and five of the world's Top 10 connector manufacturers. In addition, RheoTemp 761G withstands higher temperatures at a cost well below silicones and perfluoropolyethers (PFPEs). Plus, RheoTemp 761G significantly reduces insertion force, when compared to NyoGel 760G, which helps ensure a secure connection and lessens the likelihood of repetitive stress injuries among assembly workers.

Electrical connector manufacturers wanted a moderately priced grease to endure the hotter conditions of modern, compact engine compartments. To get there, Nye partnered with a Tier 1 connector manufacturer in early 2004. A wish list compiled for the next generation grease included: a high temperature target of 150ºC, insertion force reduction, and electrical resistance held to within 10 milliohms after 10 mating cycles. The cost of the new grease had to be lower than traditional high-temp greases. The "good qualities" of NyoGel 760G also had to be maintained: excellent wear protection, housing and seal compatibility, low water washout, low oil separation and protection against fretting corrosion.

Nye's R&D lab explored options. Synthetic esters can tolerate 150ºC to 175ºC, but esters are not compatible with some materials used for connector seals and housings. Silicones and PFPEs function at 200ºC and 250ºC respectively, but their cost exceeded development goals.

A unique blend of alkylated naphthalene (AN) and PAO base oils became the formula of choice. The AN fluid, also a synthetic hydrocarbon, boosts PAO's heat tolerance while maintaining its superior wear protection. The blended oils are also compatible with most connector materials.

To reduce insertion force, Nye focused on the grease thickener. Greases developed to lower insertion force often rely on polytetrafluoroethylene (PTFE), a slippery substance known as the "ball bearing" of lubricating molecules. But good PTFE isn't cheap. Focused on cost as well as performance, a proprietary blend of polyureas were chosen. The morphology of polyurea molecules allows them to easily slip and slide across each other — to increase the lubricity of RheoTemp 761G. Polyurea also does not burnish into contacts, a problem sometimes reported with PTFE that can increase electrical resistance.

Tests by Nye and its customer show RheoTemp 761G fulfills the wish list. It tolerates temperatures up to 175ºC, 25 degrees beyond the initial target of 150ºC. It reduces insertion force by up to 50%, depending on connector type, size and material. The new grease also meets USCAR-2, Rev.4 test criteria for electrical testing (5.3.2.4). After 10 mating cycles RheoTemp 761G maintains virtual parity with the resistance measured after just one mating. And its cost is significantly less than silicones and PFPEs, previously the only viable choice for most 150ºC to 175ºC connector applications.

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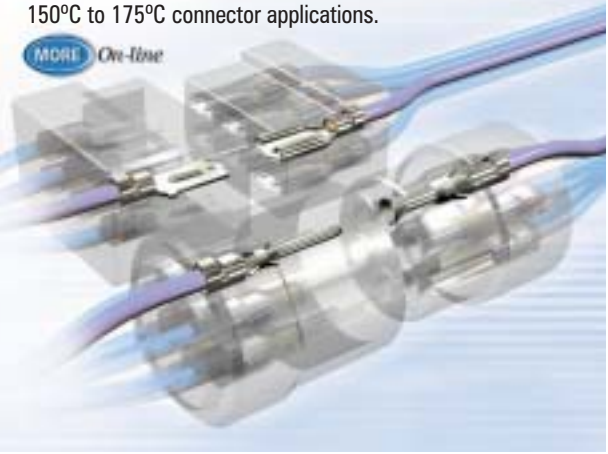

RheoTemp™ 761G tolerates temperatures up to 175ºC...reduces insertion force up to 50% and meets USCAR-2, Rev.4 criteria for electrical resistance.

NEWSClips

Silicone encapsulant technology was the subject of a pre-conference seminar by Joe Braza, Nye's Technical Director, at Intertech's LEDs 2005 in San Diego in October. Nearly 80 attended Dr. Braza's presentation.

Delphi's Technical Center laboratory staff in Mexico received Fourier Transform Infrared Spectroscopy training by Nye R&D Chemist Nicole St. Pierre, as part of the special services Nye offers to customers.

New product literature on SmartGel,® Nye's family of index-matching optical gels, is available at nyeoptical.com.

MIL-PRF 81322 vs. 32014 was the subject of a paper presented by Nye Product Services and Support Director Kevin Akin at the Tri-Services Corrosion Conference in Orlando in November. The paper is available at SmartGrease.com/techarticles.htm.

A landing gear grease by Nye, Rheolube™ 374A, was featured in an article in the November 7 issue of *Machine Design* magazine. The grease was approved by the Air Force for the C-5 and is now being flight-tested by the Navy.

Tyco employees teed off with SmartGrease-logo golf balls and ball markers at their annual corporate golf outing.

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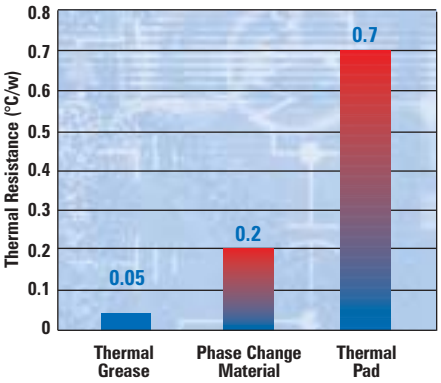
For articles ending with this icon, log on to nyelubricants.com/moreonline.

Thermal Greases: The Link from Source to Sink

As solid state and microelectronics get smaller and faster, they suffer a basic low tech problem: heat. Nye's answer: four new thermal coupling compounds designed to maximize heat dissipation from electronic devices.

Thermal Coupling Compound (TCC) 941, is a water-cleanable, silicone-based thermal grease that offers a thermal conductivity of 1.2 W/m-K at 36°C. It features virtually no bleed or evaporation over a temperature range of -55°C to 205°C. It does not harden, dry out or melt after 1,000 hours at 200°C. The fact that it can be cleaned with water eliminates the need for flammable or ozone-depleting solvents.

Typical Thermal Resistance



Compared to thermal pads and phase change materials, thermal grease offers the lowest possible thermal resistance.

TCC 942, 943, and 944 are non-silicone compounds. TCC 942 offers a high thermal conductivity of 2.2 W/m-K at 55°C. A thixotropic formulation, it was developed in response for a product that will flow initially when pressure is applied, but then adhere when pressure ceases. The material does not phase separate.

TCC 943 is a soft, pumpable gel that increases in viscosity when heated. Its viscosity can thicken from a thick-paint consistency to a non-flowing, tacky solid within one hour at 100°C to 110°C. In its cured state, it exhibits excellent thermal transfer properties – 1.4 W/m-K at 50°C.

TCC 944 is a water-cleanable, non-silicone thermal grease with a thermal conductivity of 1.3 W/m-K at 50°C. It delivers the flow characteristics of Dow Corning 340, with twice the thermal conductivity and the added benefit of water cleanup.

Incorporating a heat sink into a design is the first step in thermal management; creating an airtight connection between the heat sink and the electronics is the second. Even a tiny gap presents a barrier to effective system cooling. Nye's grease-like compounds offer good wettability, completely filling air gaps to optimize thermal conductivity. They are also dielectric, making them suitable for mounting transistors, diodes, rectifiers, resistors, and other devices where efficient cooling is desired.

Like all Nye products, the new thermal coupling compounds can be customized to match customers' designs. Viscosity, cure rate, temperature range and wettability can all be adjusted to address performance, dispensing and production requirements.

For data sheets and evaluation samples, log on to SmartGrease.com/heatsink or contact Nye's technical service department at 508-996-6721.

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Lubricants are a key design component. Ideally they should be selected and specified in conjunction with other design materials. In practice, however, lubricants are often added at the end of the design cycle. The result can be unexpected material incompatibility and premature failure.

Taking time upfront to specify a lubricant and ensure its compatibility with other materials pays off in the long run. Lubricant and material suppliers can offer compatibility guidance, but only component testing can provide real assurance. Why? A single category of elastomer, *Nitrile*, for example, can have as many as 100 possible formulations, each with different compatibility issues. So it is virtually impossible to make accurate, all-inclusive compatibility recommendations without actually testing a lubricant on a material.

When testing compatibility, materials should be exposed to lubricants under various temperatures, speeds and loads. For the most accurate evaluation of lubricant/material compatibility, test at the expected operating extremes. For further assurance, test materials of nearby components in case of oil migration or outgassing and condensation.

When the lubricant is set as a design priority, the need for re-lubrication can be limited or even eliminated. Wear can be greatly reduced, extending a product's lifetime, and material incompatibility can be avoided — all of which increase quality and end-user satisfaction.

Additive Study Aims For More Robust Synthetic Lubricants

A new antioxidant shows promise in extending the life of diester-based lubricants.

In studies conducted at Nye, a diester oil fortified with a traditional phenolic-aminic antioxidant package was compared to a diester formulation in which the phenolic antioxidant was replaced with an equal amount of the new antioxidant. Subjected to 175°C in a pressurized differential scanning calorimeter (PDSC), the oil with the new antioxidant remained functional for nearly two and a half times longer than the traditional formulation.

The manufacturer of the new antioxidant is currently seeking patents and expects to commercialize the product in 2006.

The antioxidant testing is part of a broader study in Nye's R&D department to identify new additives designed to extend the life of synthetic lubricants. Working closely with a synthesizer of perfluoropolyether fluids, Nye is also testing a series of not-yet-commercialized antirust and antiwear additives for fluorinated oils.

Nye® Synthetic Lubricants *The* SmartGrease *Company*®

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