NLGI SPOKESMAN

Serving the Grease Industry Since 1933 - VOL. 86, NO. 5, NOV./DEC. 2022

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NLGI SPOKESMAN

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ON THE COVER

Happy Holidays!

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PRESIDENT'S PODIUM

Anoop Kumar, Ph. D
Chevron Products Company
NLGI President
2022-2024

As we are heading towards the tail end of the year, it's time to review the progress made so far on six strategic priorities, already laid down as our guiding principles.

- **Effective Governance and Leadership:** As we look towards the future, some changes to our governance structure are deemed necessary, without sacrificing our core values and principles. Based on feedback from a recent membership survey as well as guidance from an external consultant, the NLGI board of directors focused their March and November board meetings on this topic. The board engaged in a series of deep dive discussions, including how to engage members in leadership roles, including joining NLGI committees and board of directors. I am pleased to inform that we have made some great progress on this front and details will soon be communicated to the membership appropriately.

- **Membership Value, Engagement and Growth:** We have added new staff to our team who is focusing on working with individual members to understand the dynamics of their needs so that NLGI can align its efforts to meet the expectations of our members.

- **Global Outreach:** We are committed to maintain and grow our partnerships with other industry organizations like NLGI-India, ELGI, CLGI, ALMU, ILMA , STLE , ASTM , SAE etc. We have recently formed an international sub-committee to work on various aspects of outreach to grow awareness pertaining to our products and services in other parts of the world with initial focus on the Latin America region.

- **Industry Trends and Challenges:** We are committed to address the issues related to the grease industry, future trends, and challenges. We will continue to produce our annual global grease production survey, continue to develop specifications related to the grease industry such as NLGI's recently launched HPM specification and will continue to work on developing specifications required to serve grease industry needs. We are also closely monitoring and addressing challenges such as lithium, PFAS , EV greases, etc.

- **Education & Networking Opportunities:** We have recently launched a completely new revamped edition of the NLGI Lubricating Grease Guide which is available both in print as well as in digital forms https://www.nlgi.org/store/grease-guide/. We will continue to offer our education through our iconic basic and advanced lubricating grease courses as well as the hands-on training course. NLGI's editorial committee is diligently working to enhance the NLGI Spokesman. Beginning in 2023, the NLGI Spokesman will be provided to NLGI members only. Technical articles from the Spokesman may still be purchased for a nominal fee. Additionally, we are very pleased to announce NLGI's "Grease World," a quarterly e-newsletter circulated to members and non-members. The e-newsletter will contain a pertinent industry news article, as well as an update on NLGI's strategic priorities, new member highlights and more.

- **Sustainability:** A dedicated task force is working to lay out the modalities of sustainability aspects relevant to the grease industry. We spent quite some time during the November Board meeting discussing sustainability, including how to define sustainability as well as how to grow sustainability with respect to our industry, grow awareness and bring value to the industry. We are also working closely with other organizations to align and coordinate the efforts relevant to the grease industry.

We have very successfully conducted our 2nd Hands-On Training Course at Koehler Instrument Company Inc., Holtsville, NY, November 8-10, 2022. There were a total of 42 participants representing various member and non-member organizations that took advantage of this tailormade program. This year's training included 1/3 classroom and 2/3 hands-on training, including several new tests. On behalf of NLGI, I take this opportunity to express our gratitude and sincere thanks to Koehler Instruments Company Inc. for organizing this Hands-on-Training at their premises.

We wish you and your families a very Happy Holidays.
Anoop Kumar

Please Welcome our new NLGI Members!

Patech Fine Chemicals has joined the NLGI as a new **Supplier** member! They are located in **Dublin, OH** as well as Taiwan, and have multiple service points across the world to best accommodate their customers. Their focus and vision as an ester supplier make them a dynamic new member company to the NLGI. To read more about their mission, products, locations and services, click here!

The University of Twente is based in **The Netherlands** and has joined as a **Technical** member with the NLGI. Their affiliation with SKF University Technology Centre for Grease Lubrication, advances their extensive research and innovation in science and technology. Click here to read more about their research, programs, and specialties!

The NLGI is pleased to welcome our new Member Companies!

MEMBER VISIT - Chemicolloid Laboratories, Inc.

NLGI Executive Director, Crystal O'Halloran and Member Services Manager, Jen Foreman had the privileged opportunity to meet with NLGI legacy member, Chemicolloid Laboratories, Inc. Nov 9, 2022.

Anthony Pepe, President of Chemicolloid Laboratories, gave Crystal and Jen a tour of their facility and warehouse in Hauppauge, NY. Chemicolloid has been operating since 1924 when they began creating and manufacturing the world's first colloid mills, and continues to design, manufacture, and distribute them. It was incredible to learn all the history of their company and be on site with one of our valued manufacturer members.

To learn more about Chemicolloid, their products and services, click here!


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Industry Calendar of Events 2022

Please contact Denise if there are meetings/conventions you'd like to add to our Industry Calendar, denise@nlgi.org
(Your company does not have to be an NLGI member to post calendar items.)

Second Annual STLE Tribology and Lubrication for E-Mobility Conference	**Nov 30 – Dec 1, 2022**	San Antonio, TX, USA	STLE Tribology Conference
India Chapter Meeting	**March 3 – 5, 2023**	Hotel Hyatt Grand Gurgaon, India	India Chapter Meeting
STLE Chicago Chapter Education Event	**March 15 – 16, 2023**	Argonne National Laboratories, Chicago, IL	STLE Chicago Chapter Education Event
ILMA Engage	**April 20 – 22, 2023**	Loews Ventana Canyon Tucson, AZ	ILMA Engage
ELGI 33rd Annual General Meeting Meeting	**Apr 29 – May 2, 2023**	Amsterdam, Netherlands	ELGI 33rd Annual General
77th STLE Annual Meeting & Exhibition	**May 21 – 25, 2023**	Long Beach, CA, USA	77th STLE Annual Meeting
NLGI 90th Annual Meeting	**Jun 4 – 7, 2023**	San Diego, CA, USA	NLGI 90th Annual Meeting
ILMA 2023 Annual Meeting	**Oct 7 – 10, 2023**	Palm Desert, CA, USA	2023 ILMA Engage
STLE Tribology Frontiers Conference	**Nov 13 – 15, 2023**	Cleveland, OH, USA	STLE Tribology Frontiers

NLGI SPOKESMAN

Advertiser's Index

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India Chapter
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25th SILVER JUBILEE
NLGI-IC- Lubricating Grease Conference

25th Lubricating Grease Conference on "New Frontiers in Grease Industry"

Venue : Grand Hyatt Gurgaon

Golf Course Extension Road, Sector 58, Gurgaon, Haryana (India)

Date : March 3 – 5, 2023

A) Abstract Submission :

Receipt of Paper Abstract	Receipt of Paper Manuscript	Receipt of Paper Presentation
December 31, 2022	January 25, 2023	February 15, 2023

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B) Registration, Exhibition Stall and Business Talk :

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Covering the Bases:
A Study of the Influence of Synthetic Base Fluids on High Performance Greases

Luca Salvi, Product Development – Formulation Principal, ExxonMobil Technology and Engineering Company
Joseph Kaperick, Technical Advisor – Grease Technology, Afton Chemical Corp.

Abstract
As demand on equipment productivity and reliability continue to increase, it becomes more important to understand the impact of base fluid in improving the performance of lubricating greases under severe conditions, including higher loads and broader operating temperatures. The purpose of this study was to look at the performance of several different lithium complex greases produced with high viscosity metallocene polyalphaolefin (mPAO) base oils. The grease variations incorporated alkylated naphthalene (AN) and employed different additive combinations with the mPAO base fluid and were benchmarked against a mineral oil formulation. Performance of the base greases, as well as fully additized finished greases, were evaluated in a comprehensive study, including a wide range of testing to evaluate high and low temperature performance, elastomer compatibility, and ability to protect against oxidation, wear, extreme pressure, and corrosion.

Background Work
Use of synthetic fluids in greases has grown steadily, rising from the 3% reported in the 2010 grease industry survey (NLGI Grease Production Survey Report, 2011) (the first year in which this category was recorded) to over twice that in the most recent 2021 survey (NLGI Grease Production Survey Report, 2022) with a combined total of over 11% reporting the use of at least some synthetic fluid in their formulations. Although a more detailed breakdown of the types of synthetic fluids is not reported in the survey, it is likely that the majority of the synthetic fluids used are some type of PAO.

The use of PAO base fluid in greases are well documented in the literature beginning at least 40 years ago with a study of synthetic fluids including PAO in several different complex thickeners (Roberts, 1982). Recent work with synthetic base fluids was performed by Fish et al. and covered a range of PAOs and esters in various grease thickeners that were evaluated using standard bench tests (Fish, 2017).

A series of studies focused on metallocene-catalyzed PAO fluids (or mPAOs) were done to evaluate mPAO base fluids in polyurea greases and looked at the impact of including mPAO with PAO on low and high temperature stability (Bessette P. H., Synthetic Grease Formulated with PAO 6 and mPAO-65, 2017) (Bessette P. H., 2018). This work was expanded to aluminum complex greases the following year (Bessette P. H., 2019). Previous work looking at alkylated naphthalenes in grease was conducted by Kumbhar & Hunter and showed some thermal and oxidative stability benefits in lithium complex greases (Hunter, 2020). Polymers have been used extensively in the grease industry to improve mechanical stability of the thickener matrix (Willet, 2020).

Methods and Materials
The project was designed to answer two questions fundamentally: 1) what is the impact of the basestock selection in a high-performance grease and 2) is it possible to design an additive package that can deliver a finished product capable of meeting most of the requirements associated with the traditional GC-LB claim and those of the new HPM specification?

In order to answer these questions, a single additive package was selected to be used at the same treat rate of 3.5% for every candidate. The finished greases were manufactured targeting ISO VG 460 / NLGI #1 basic properties, considering that ISO VG 460 is a fairly utilized grade for heavy duty grease, although ISO 150 to ISO 220 may be more popular for multi-purpose greases, while the NLGI #1 thickness was selected to explore the properties of the candidates at the softer end of the manufacturing window. In this particular study, an initial comparison of NLGI #1 and NLGI #2 candidates was conducted in selected cases.

The candidates were manufactured to analyze the effect of the basestock selection, establishing the baseline utilizing a Group I paraffinic mineral oil, while the other candidates were manufactured with synthetic basestocks, and were named after the most significant feature of the formulation. For example, the grease named mPAO was prepared with both metallocene PAO and conventional PAO 6, but the naming convention in the paper was based on the interest of the authors to look at the effect of the mPAO presence as the determining factor in this product. The reasons that mPAO was selected for this comparison are to be found in its outstanding oxidation resistance, combined with excellent low temperature properties. The next candidate was prepared using the same platform of the mPAO-based grease, including ~20% alkylated naphthalene relative to the base oil mixture, and this candidate is referred to as mPAO + AN in the paper. Finally, the last candidate was defined to assess the potential benefits of utilizing an ethylene-propylene polymer, in order to improve the mechanical stability of the thickener matrix. This product was defined including 0.5% of the ethylene-propylene polymer in combination with mPAO and AN. The exact composition of the polymer is proprietary, but it can be described as a material with low crystallinity and medium viscosity. Additional information regarding the composition of each candidate is shown in Table 1.

Components, [wt%]	Mineral Oil	mPAO	mPAO + AN	mPAO + AN + 0.5% EP Polymer
Group I (32 cSt @ 100 °C)	84.4			
PAO (6 cSt @ 100 °C)		22.3	13.1	12.7
mPAO (150 cSt @ 100 °C)		57.3	52.5	50.8
Alkylate Naphthalene (12 cSt @ 100 °C) [AN]			16.4	15.9
LiX Thickener	12.1	16.8	14.4	16.5
Additive Package (Zn/S/P with AO/RI)	3.5	3.5	3.5	3.5
Anti-Oxidant (aminic)		0.1	0.1	0.1
Polymer (ethylene propylene) [Poly]				0.5
Key Manufacturing Tests				
Penetration (worked, 60x), 0.1 mm, ASTM D1403	334	320	326	318
Dropping Point, °C, ASTM D2265	216	266	249	266

Table 1 Grease Candidates

The candidates were all manufactured in two discrete steps, where the base grease was manufactured by ExxonMobil, and the finished grease was prepared by Afton using an available additive package of their choice, which will be described later. To avoid any base grease discoloration the aminic anti-oxidant was dosed in the base grease. The same precaution was not necessary in the case of the mineral oil base grease, because of the presence of small amount of naturally occurring anti-oxidants in the basestock.

The grease soap was manufactured in a 100 pound contactor which was charged with the basestocks, followed by LiOH, 12-hydroxystearic acid and commercially available di-acid complexing agent. The mixture was then heated to a top temperature of about 190 °C under pressure and held for approximately 2 hours. After dehydration, the grease was milled to ensure stable consistency results, then cut back with

additional base oil mixture as needed to meet penetration targets, which in this study, was NLGI #1. (Graham, 2012) It is worth noting that the dropping point of the mineral oil-based candidate was slightly lower than the other greases; therefore, when looking at some of the test results generated with this grease, this factor will have to be considered, particularly when looking at structural stability properties.

When the ethylene-propylene polymer was used, it was charged in the contactor at the same time as the basestocks.

The grease soap obtained was then finished utilizing the same additive package for every candidate, treating it at 3.5%. The additive package used was a commercial package based on ZDDP chemistry and included a primary antioxidant (Table 2). The additive package and required basestock/polymer combinations were added to the base greases, heated to 60 °C for an hour, and then thoroughly blended in a centrifugal mixer.

ID	Description	%Zn	%P	%S	%N	KV@100°C
Additive Package	ZDDP/Sulfur + AO/RI (rust inhibitor)	2	1.8	12.1	0.6	6.3

Table 2 Additive package detail

For the purposes of this study, it was decided to use the test performance profiles from the new NLGI High-Performance Multiuse (HPM) Core specification and Low Temperature (LT) enhanced specification along with the highest performance categories for chassis and wheel bearing greases (GC-LB) as outlined in NLGI's Specification for Automotive Service Grease (ASTM D4950). Each test line is color coded in green if it is listing a test needed for the HPM or HPM-LT specification, and it is shaded in blue if it is a test only needed for GC-LB. The tests required for both specifications are using a gradient of blue and green. The summary with all the tests that were run, and the limits required by the various specification are listed in Table 3 . The list of tests is further divided in 6 sub-categories to break down the specification according to the general physical properties being evaluated.

Some additional testing was carried out to highlight potential performance differences in low temperature and high temperature stability as well as energy efficiency:

- *ASTM D5483 "Standard Test Method for Oxidation Induction Time of Lubricating Greases by Pressure Differential Scanning Calorimetry"* - Samples were tested at 180 °C under 500 psi (3,447 kPa) oxygen atmosphere. The extrapolated onset time was measured and reported as the oxidation induction time (OIT) for each sample.
- FAG FE9, DIN 51821-T2 - This high temperature bearing rig test uses five separate angular contact ball bearings (ISO 7206) packed with the test grease. The test conditions employed were 1500 N axial load, 6000 rpm and both unshielded (mode A) and shielded (mode B) methods as indicated during discussion of the results. Failure of the bearing occurs when the bearing torque rises above the preset limit indicating that the lubricating grease is losing its ability to effectively lubricate the bearing. A 10% (L_{10}) and 50% (L_{50}) "grease life" is calculated using Weibull statistical analysis of the five bearing runs. This number is an indication of when 10% or 50%, respectively, of the bearings are expected to have failed under the conditions of the test. According to DIN 51825 and ISO 6743, guidance for the maximum operating temperature of the grease can be determined by the temperature at which an L_{50} of greater than 100 hours is obtained in the FE9 test.

- Low Temperature Flow, Kesternich, DIN 51805 – While the HPM + LT enhanced category only specifies performance targets at -30 °C, the low temperature limits of the grease formulations were further explored at both -40 °C and -50 °C using the same methodology.
- *ASTM D5707 "Standard Test Method for Measuring Friction and Wear Properties of Lubricating Grease Using a High-Frequency, Linear-Oscillation (SRV) Test Machine* – Samples were tested using the Optimol SRV ball-on-disk method to measure the coefficient of friction during the test run under 200 N load for 2 hours at 50 Hz and 80 °C.

	Testing:	Unit	Method	HPM Core	HPM + LT	GC-LB
Structural Stability	Penetration, worked 60x	dmm	ASTM D1403	220-340	220-340	220-340
	Roll stability (2 hrs, room temperature), 1/2 scale only	dmm	ASTM D1831	+/-10%		
	Prolonged worked penetration (Δ100k)	dmm	ASTM D217	+/-30		
	Water washout, 2 bearings @ 79 °C, Avg	wt%	ASTM D1264	10 max		15 max
	Oil Separation (24 hrs @ 25°C), % loss	wt%	ASTM D1742	5.0 max		6 max
Wear and Corrosion	EMCOR rust, Deionized Water (DI)	rating	ASTM D6138	0,1 max		
	Copper Corrosion, 24 hrs 100 °C	rating	ASTM D4048	1b max		
	Four-Ball Weld	kgf	ASTM D2596	250 min		200 min
	Four-Ball LWI		ASTM D2596			30 min
	4 Balls Wear (40 kg, 75 °C, 1 hr, 1200 rpm)	mm	ASTM D2266	0.60 max		0.60 max
	Rust Prevention	Rating	ASTM D1743	Pass		Pass
	Fafnir Fretting, wt loss	mg	ASTM D4170			10 max
Elastomers	CR (3C) Volume Change (70 hrs, 100 °C)	Δ Vol %	ASTM D4289			0 to 40
	CR (3C) Hardness Change (70 hrs, 100 °C)	Δ Hard	ASTM D4289			-15 to 0
	NBR (2C) Volume Change (70 hrs, 150 °C)	Δ Vol %	ASTM D4289			-5 to 30
	NBR (2C) Hardness Change (70 hrs, 150 °C)	Δ Hard	ASTM D4289			-15 to 2
	NBR standard reference elastomer per ISO	Δ Hard	ASTM D4289	-15 to +2		
	13226, 168 hrs at 125 °C	Δ Vol %	ASTM D4289	-5 to +30		
High Temperature Stability	Dropping point	°C (F)	ASTM D2265			220(428) min
	Oxidation Stability at 100 °C (pressure drop, 100 hrs)	kPa (psi)	ASTM D942	35(5.1) max		
	High temp. screening PDSC (180 °C), OIT	min	ASTM D5483	Screening Value		
	Leakage, 20 hrs @ 160 °C, g	g loss	ASTM D4290			10 max
	Life Performance of Auto Wheel Bearing	hrs	ASTM D3527			80 min
	FE9, mode B (shielded), F50	Hours	DIN 51821-T2	100 according to DIN 51825		
	HT Bleed (30 hrs, 100 °C)	wt%	ASTM D6184	7.0 max		
Low Temperature Stability	Low Temp Torque @ -40 °C	N-m	ASTM D4693			15.5 max
	LT Torque at -20 °C, mNm (g-cm)		ASTM D1478			
	Starting torque	mNm	ASTM D1478	1,000 max		
	Running torque	mNm	ASTM D1478	100 max		
	LT Torque at -30 °C, mNm (g-cm)		ASTM D1478			
	Starting torque	mNm	ASTM D1478		1,000 max	
	Running torque	mNm	ASTM D1478		100 max	
	Grease Mobility @ -20 °C, g/min	g/min	US Steel LT-37		10 min	
	Flow Pressure, Kesternich @ -30 °C, mbar	mbar	DIN 51805		1400 max	
	Flow Pressure, Kesternich @ -40 °C, mbar	mbar	DIN 51805	Screening Value		
	Flow Pressure, Kesternich @ -50 °C, mbar	mbar	DIN 51805	Screening Value		
Energy Efficiency	SRV	COF	ASTM D5707	Energy Efficiency Screening Value		

Table 3 Product profiles and industry claims

The candidates that were prepared as part of this study were not optimized to meet all the requirements of the GC-LB and HPM Specifications. Where possible, when failing and/or borderline results were generated, an explanation for that behavior was offered and a potential solution suggested. Furthermore, since the candidates were designed with the same thickener system and with a fixed additive package, that did not allow for the optmization and/or improvements usually associated with the development of a package for a mineral oil-based grease. In fact, in a qualification program designed to utilize mineral basestocks, the additives are carefully tailored to compensate for some of the deficits associated with the basestock fundamental properties.

Results and Discussion

Structural Stability

The grease candidates were initially compared looking at the Roll Stability (D1831) and Prolonged Work Penetration (D217). All the candidates were capable of meeting the HPM limits, with the exception of the Mineral Oil-based grease which provided borderline performance in the prolonged worked penetration test. However, the result was just marginally above the limit of 30 mm/10 so it is reasonable to expect that with very minor adjustments this problem could be addressed. The one trend that is apparent looking at the results of these two tests, also summarized in Figure 1, is that all the synthetic-based greases have better structural stability compared to the mineral oil-based grease. The expectation is that greases with higher NLGI grade would also have better structural stability.

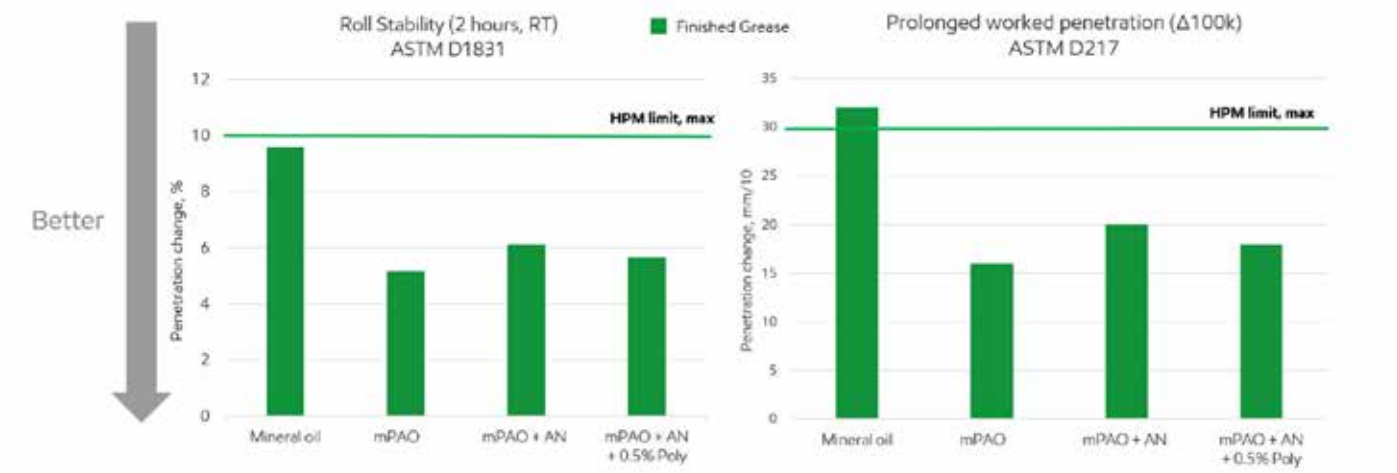

Figure 1 Roll Stability (ASTM D1831) and Prolonged Worked Penetration (ASTM D217)

Next, the grease candidates were evaluated to assess the water washout performance, which is a test that has different passing limits set for GC-LB and for HPM, where the latter is more stringent (see Figure 2). All candidates were able to meet the GC-LB limits, while the mineral oil-based grease and the one with mPAO/AN were borderline failing against the HPM limits. This may be explained by the higher polarity of these two candidates. The mineral oil-based grease is more polar due to the presence of the heteroatoms and the naphthenic rings, while the mPAO/AN candidate is more polar due to the presence of almost 20% alkylated naphthalene. The softer consistency of the mineral oil grease may also be a factor. It is also worth pointing out that the mPAO/AN candidate debit can be addressed in two ways:

1) Increasing the thickness going from NLGI #1 to NLGI #2
2) Increase structural stability by adding 0.5% of the ethylene-propylene polymer

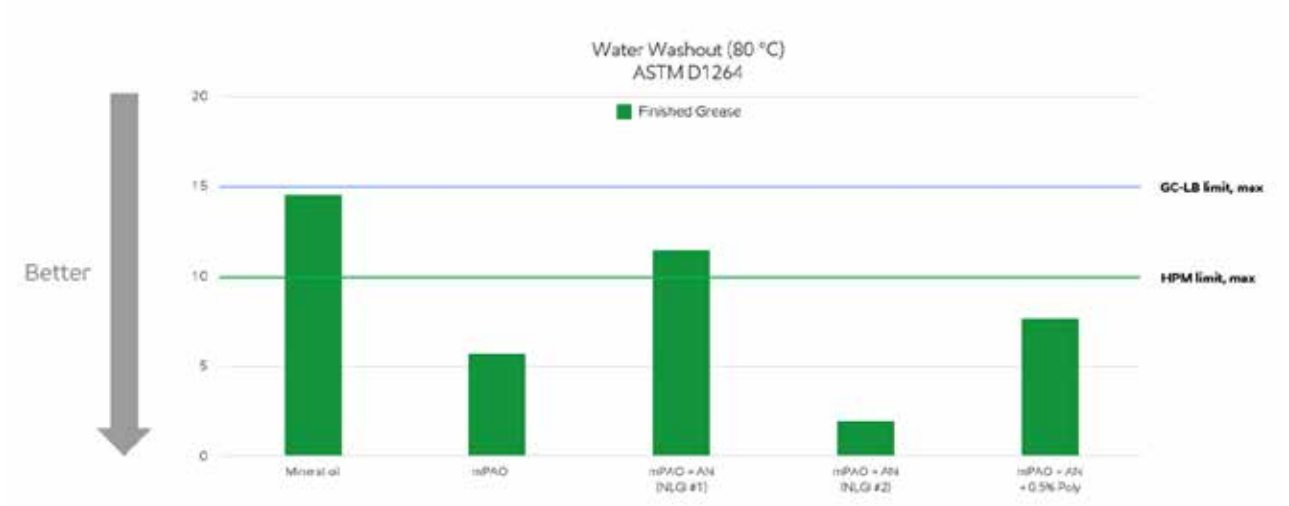

Figure 2 Water Washout (80 °C) ASTM D1264

The last test that was run in the initial structural stability assessment was the Oil Separation according to ASTM D1742. As it can be seen in Figure 3, all the candidates are performing quite well. In fact, all greases are able to meet the GC-LB requirements, while only the mPAO based grease sample is borderline failing to meet the HPM specification requirements. This can be likely explained by the less polar nature of this candidate that makes it more prone to separate the oil from the thickener matrix. However, since the result is so close to the limit, the oil separation performance could be tuned accordingly. In this case we did not observer a difference in performance between the same type of candidate mPAO + AN in two different NLGI Grades (1 vs. 2). This is not a surprise though, since the oil separation is associated with the ability of the basestock to separate from the grease matrix, and if the matrix and the basestocks are the same, we should expect very similar responses. Finally, looking at the effect of introducing the EP Polymer in the mPAO + AN matrix we can observe how the more mechanically stable thickener matrix is now increasing the amount of oil separation as compared to the same candidate without the EP Poly (mPAO + AN NLGI #1). The result is in line with what was expected, but still well within both GC-LB and HPM Limits. This learning could allow a formulator to define the amount of oil separation desired for a given application by titrating a certain amount of EP Polymer.

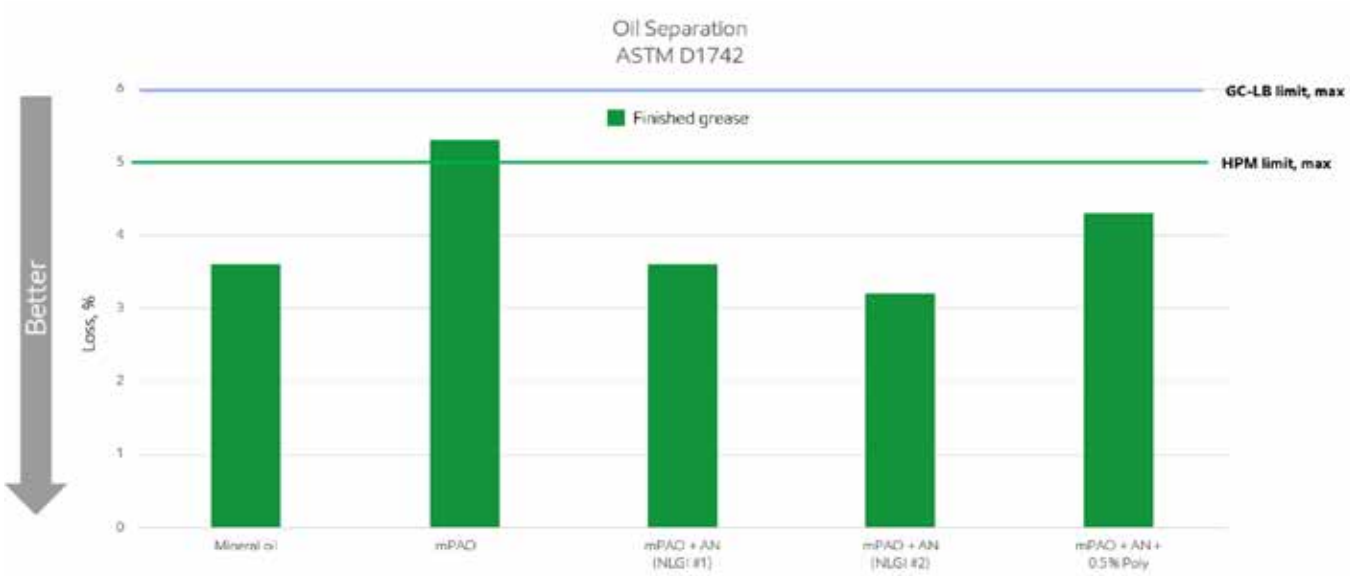

Figure 3 Oil Separation - ASTM D1742

The summary of all the Structural Stability tests that were run is shown in Table 4 including additional tests required by the specifications, but in interest of time, were not analyzed in this article. The color coding indicates whether the ~~test~~ grease met the specifications, being mindful that in some cases the limits may be different for GC-LB and HPM requirements. The green cell indicates that the candidates were capable of meeting each necessary requirement, while an orange shaded cell is used to indicate that some borderline results were obtained against one or more limits. Finally, the red cells are being used when the candidates generated results failing to meet the limits beyond the reproducibility or variation of that particular test.

This summary table will be provided at the end of each individual performance section as a graphical representation of the candidates' performance.

GC-LB HPM (High-Performance Multiuse)	Unit	Method	Mineral oil	mPAO	mPAO + AN	mPAO + AN + 0.5% Poly
Roll stability (2 hrs, RT), 1/2 scale only	dmm	D1831				
Prolonged worked penetration (Δ100k)	dmm	D217				
Water washout, 2 bearings @ 79 °C, Ave	wt%	D1264				
Oil Separation (24 hrs @ 25 °C), % loss	wt%	D1742				

Table 4 Structural Stability Tests - Summary

Wear/Corrosion

The results from the EMCOR corrosion test (Figure 4) indicate that the base grease made with only mPAO (blue columns) has a better corrosion resistance than the other base greases. This may be due to the nonpolar nature of the mPAO base fluid, as compared to the varying degrees of polarity brought with the alkylated naphthalene and mineral oil formulations. This polarity may lead to the incorporation of water into the grease and encourage more corrosion during the week-long test. The mPAO formulation may be more effective in repelling the water and keeping it off the bearing surface.

The additized greases all showed a marked improvement due to the rust inhibitors contained in the additive package. The only significantly different results are seen in the formulation containing alkylated naphthalene possibly due to competition with the polar corrosion inhibitors or incorporation of water as seen with the base grease. In either case, the addition of the polymer appears to negate that impact and would be a good formulation adjustment if using AN to meet the HPM specification in a finished grease.

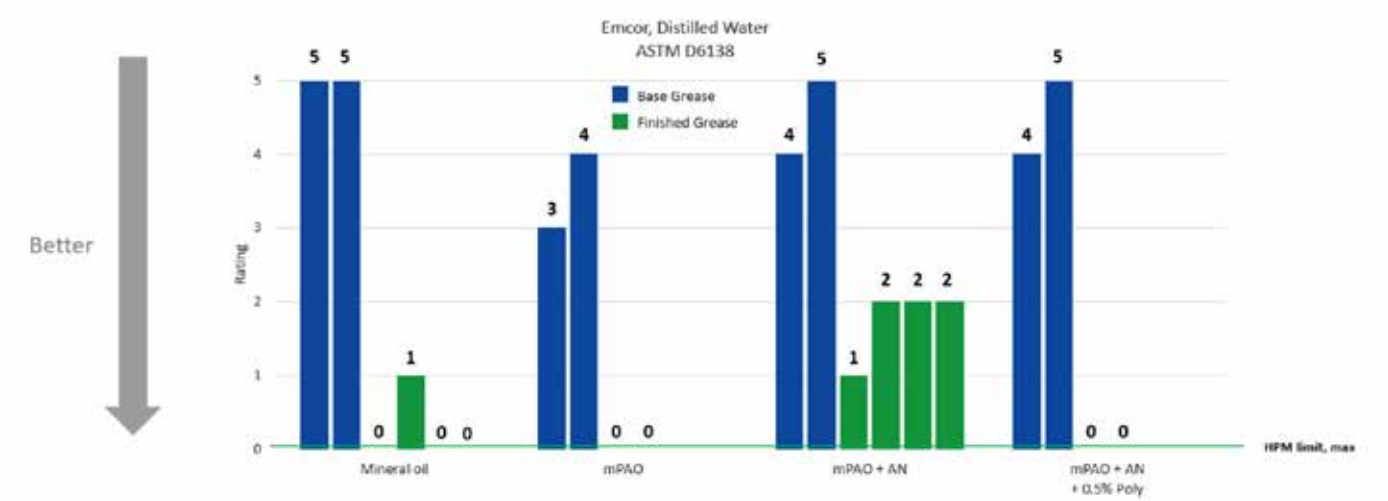

Figure 4 EMCOR corrosion test results

In the case of copper corrosion (Figure 5), there is a slight indication that the AN in the base grease could be detrimental to copper, but the additive package appears to overcome any negative impact from that base grease. Interestingly, the mineral oil-based grease showed no corrosion until it was additized. It is possible that the sulfur from the additive package, in combination with the sulfur from the mineral oil, are combining to have a negative effect which would need to be addressed with a copper corrosion inhibitor to meet the HPM specification if this approach was followed for a finished grease.

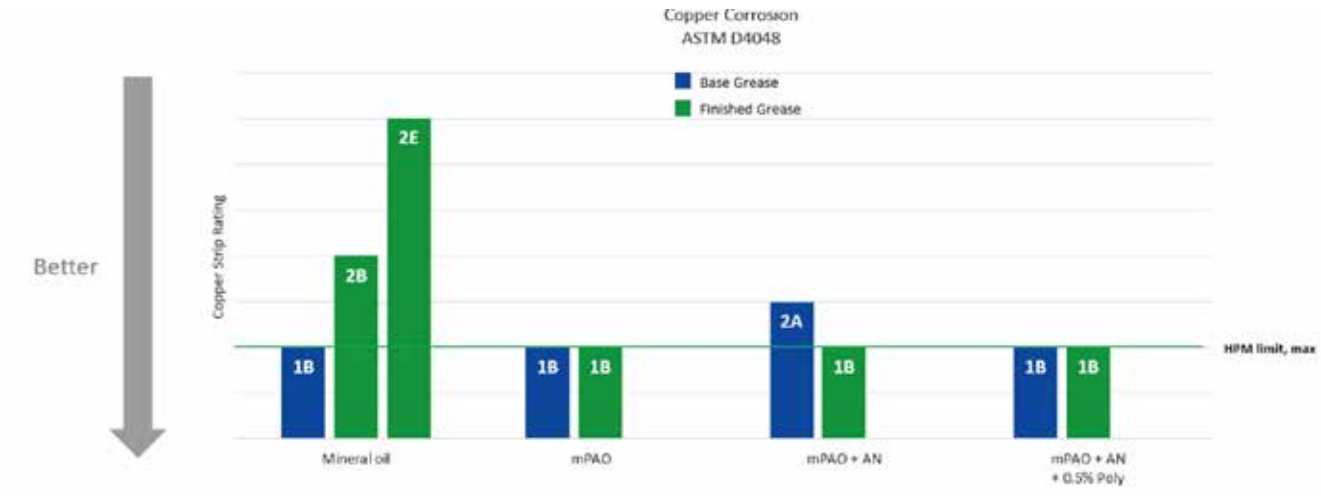

Figure 5 Copper corrosion test results

In terms of the ability to protect against extreme pressure, the impact of the sulfur EP componentry in the additive package is apparent (Figure 6). None of the base grease formulations are capable of meeting the bare minimum of 200 kg required by GC-LB; whereas all four additized formulations are able to meet or exceed the higher HPM specification of 250 kg. The higher weld point seen with the mineral oil formulation may well be due to the additional sulfur contributed by the base fluid.

From the wear testing (Figure 6), it can be seen that the mPAO/AN combination appears to be not as good at preventing wear in the base grease, but all additized formulations respond well to the ZDDP anti-wear componentry in the additive package with all four additized greases comfortably meeting the HPM specification limits.

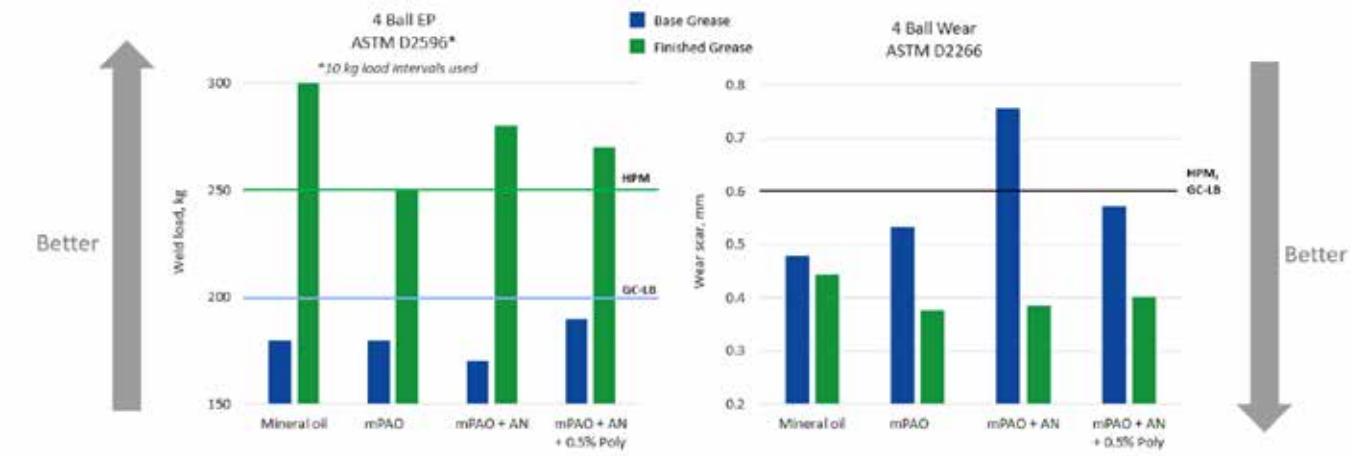

Figure 6 4 Ball weld and wear results

Although most of the additized greases met the wear and corrosion specification limits, the level of performance could be adjusted by optimizing the balance of additive componentry as needed. As seen in the mineral oil formulation, the presence of additional sulfur and other polar components may be causing problems with copper or steel corrosion. It can also be a benefit in protecting against extreme pressure. Likewise, the addition of AN may have a negative effect on steel or copper corrosion or wear protection, but the formulation targets can be met by additization or the use of the polymer in the base grease, according to need.

In summary, as it can be observed in Table 5, all the grease candidates that were analyzed in this study were capable of meeting most the requirements associated with wear and corrosion performance. This is a demonstration of the importance of the selection of the proper additive package, tailored to the targeted performance characteristics.

GC-LB HPM (High-Performance Multiuse)	Unit	Method	Mineral oil	mPAO	mPAO + AN	mPAO + AN + 0.5% Poly
EMCOR rust, DI	rating	D6138				
Copper Corrosion, 24 hrs 100 °C	rating	D4048				
Four-Ball Weld	kgf	D2596				
Four-Ball LWI	kgf	D2596				
4 Balls wear (40 kg, 75 °C, 1 hr, 1200 rpm)	mm	D2266				
Rust Prevention	Rating	D1743				
Fafnir Fretting, wt loss	mg	D4170	On Hold - Industry issues with test			

Table 5 Wear/Corrosion Tests - Summary

Elastomer compatibility

Elastomer compatibility is a key performance area to carefully assess in the development phase of a new grease candidate to verify the impact of the additive package and the base fluid composition. In this study, the grease formulations were tested against the more conventional chloroprene and nitrile materials from the GC-LB specification, as well as against the different nitrile elastomer specified in the new HPM specification.

All the grease candidates evaluated in this study met the GC-LB limits for volume and hardness change as can be seen in Figure 7. Not surprisingly, the mPAO-based candidate is the one that showed less swelling as can be seen from the lower volume change and higher level of hardness change. This is a known effect associated with the use of less polar basestocks. However, the addition of alkylated naphthalene brought the performance of these synthetic candidates to the same level of performance of the mineral oil-based candidate.

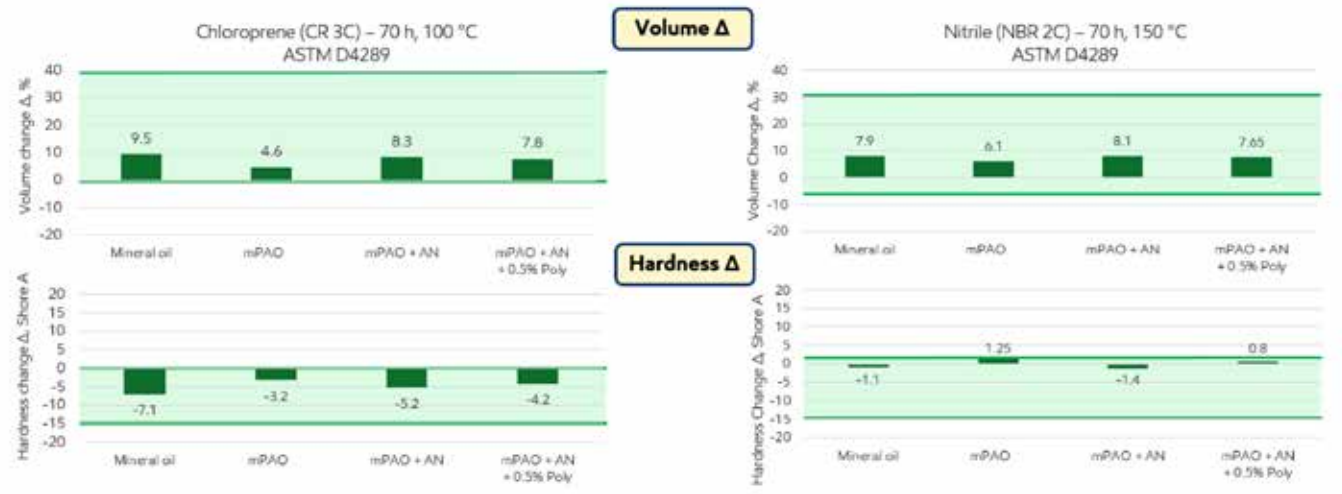

Figure 7 Seals Compatibility (CR 3C and NBR 2C)

Prompted by the positive results obtained with the conventional chloroprene and nitrile seals, the grease candidates were also tested against the new nitrile material as outlined in the HPM specification (See Figure 8), and again all the candidates met the stated limits. However, it was interesting to see that the mineral oil candidate displayed lower volume/hardness change compared to all the synthetic candidates, and particularly compared against the mPAO-based grease. This is a result that deserves further study to understand the root cause.

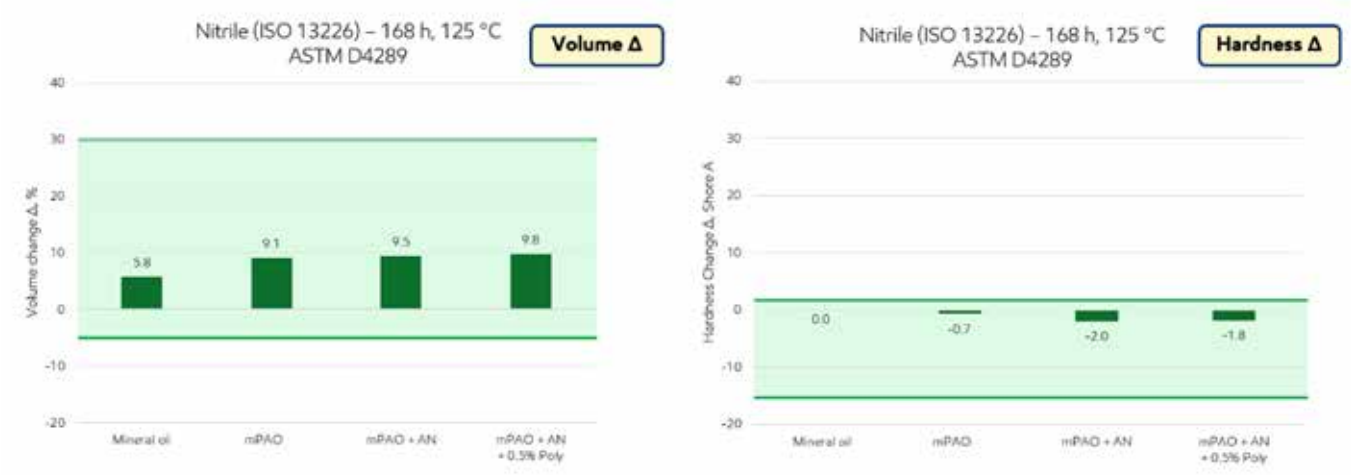

Figure 8 Seals Compatibility (Nitrile ISO13226)

The elastomer compatibility study did not highlight any significant concerns associated with either the base fluid or additive package composition, as is reflected in Table 6.

GC-LB HPM (High-Performance Multiuse)	Unit	Method	Mineral oil	mPAO	mPAO + AN	mPAO + AN + 0.5% Poly
CR (3C) Volume Change (70 hrs, 100 °C)	Δ Vol %	D4289				
CR (3C) Hardness Change (70 hrs, 100 °C)	Δ Hard	D4289				
NBR (2C) Volume Change (70 hrs, 150 °C)	Δ Vol %	D4289				
NBR (2C) Hardness Change (70 hrs, 150 °C)	Δ Hard	D4289				
NBR standard reference elastomer per ISO	Δ Hard	D4289				
13226, 168 hrs at 125 °C	Δ Vol %	D4289				

Table 6 Elastomer Compatibility Tests - Summary

High Temperature Stability

All 3 of the mPAO-containing base greases showed better oxidative stability in the PDSC testing (Figure 9) than the mineral oil formulation, but they also had oxidation induction times of less than 10 minutes, so it is difficult to attach too much significance to those results. They do mirror the trend of results seen for the additized greases based on the mineral oil giving a result that was roughly half of what was seen for the mPAO formulations. This test is not part of the HPM or GC-LB specifications but can be a good indicator of oxidative stability at higher temperatures and performance could be optimized by balancing the antioxidant levels in the formulations.

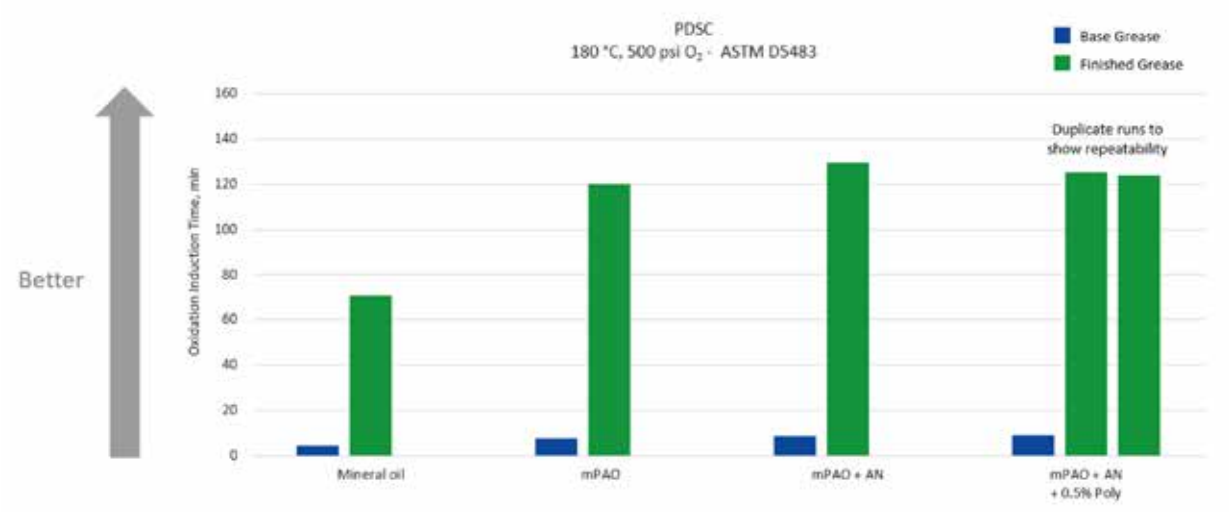

Figure 9 Pressurized Differential Scanning Calorimetry (PDSC) test results

A measure of high temperature structural stability is the ASTM D4290 Leakage Tendency test (Figure 10) and the mPAO formulations all respond better than the mineral oil-based grease under these conditions. The mineral oil-based grease did not meet the GC-LB specification limit, but this is also likely due in some part to the fact that this is a softer NLGI #1 grease which would not be expected to do as well in this test. Use of a stiffer, higher NLGI grade, or the mPAO formulations, would be indicated if improvement was needed in this category.

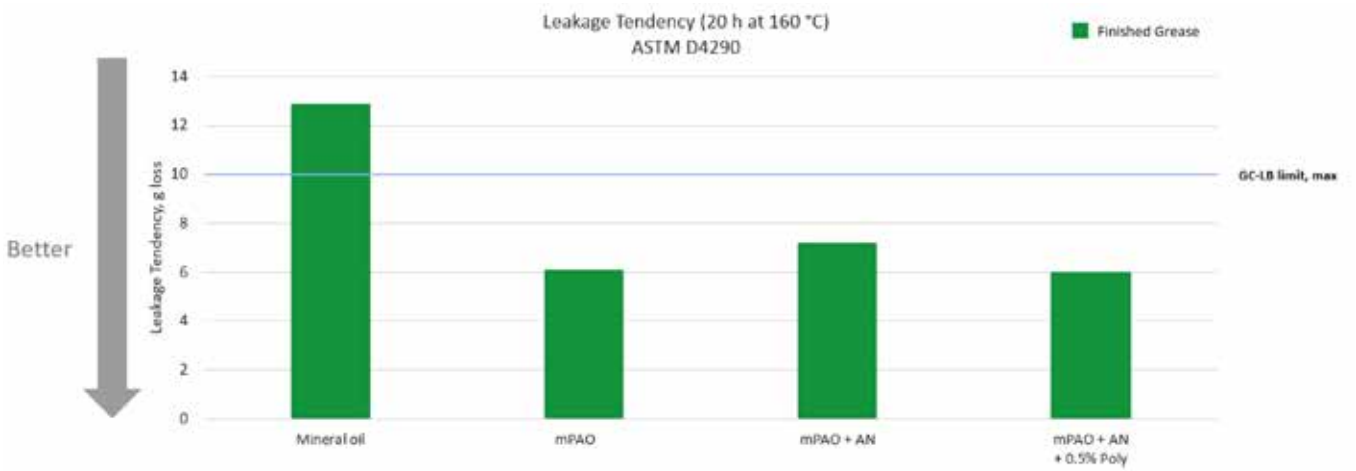

Figure 10 Leakage tendency test results

High temperature bearing tests are generally regarded as better indicators of a grease's high temperature capabilities since they simulate the action of a grease in an actual bearing under conditions that are closer to "real world" applications. The High Temperature Wheel Bearing test, or HTWB, (ASTM D3527) is one such bearing test and, although variability is problematic, it can still be a good differentiator of grease performance in high temperature applications. While not all the results (Figure 11) are significantly different, the general trend is clear with the mineral oil-based grease performing the worst and not meeting the GC-LB specification limit. All three of the mPAO formulations meet or exceed the specification limits with clear indications that the AN-containing greases have additional strength in this test.

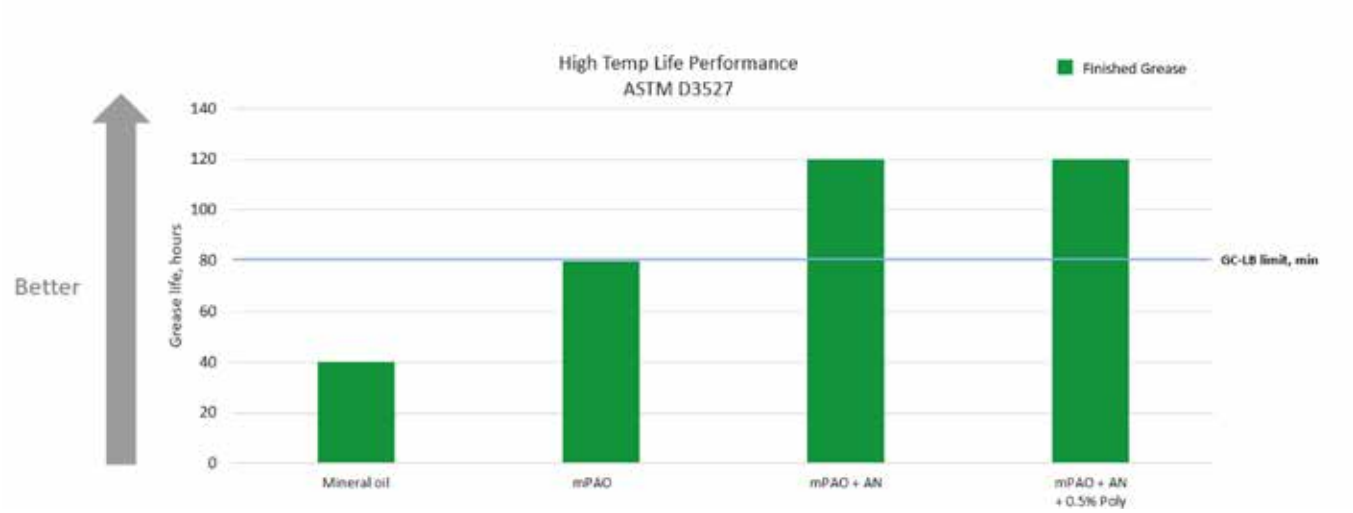

Figure 11 High Temp Life Performance (ASTM D3527) results

Another high temperature bearing test is the FAG FE9 test. The variability of this test is somewhat improved by the fact that each test uses 5 bearings, run to failure with Weibull statistics being used to determine the F_{50} for the test grease. The F_{50} is the time under test conditions that 50% of the bearings will be expected to fail. The test can be run at a variety of temperatures, depending on intended application with the target performance (according to DIN 51825) being 100 hours minimum at the target temperature. It can also be run without shields (mode A) or with shields (mode B). The shields are typically used in field applications that run at higher temperatures and help to keep the grease in the bearing. This can help extend the life of the grease in the FE9 test (as it would in the field) but they are not yet accepted under the DIN 51825 specification.

The FE9 test was run first at 140 °C in mode A and, in this case, an NLGI Grade 2 version of the mPAO/AN formulation was able to run as well (Figure 12). The results, while not statistically significant, do point toward better performance for the stiffer grade which would be expected due to the increased ability of the grease to stay in place. This same phenomenon can be seen in the mPAO/AN-based grease in which the addition of the EP polymer results in 50% longer life in this test.

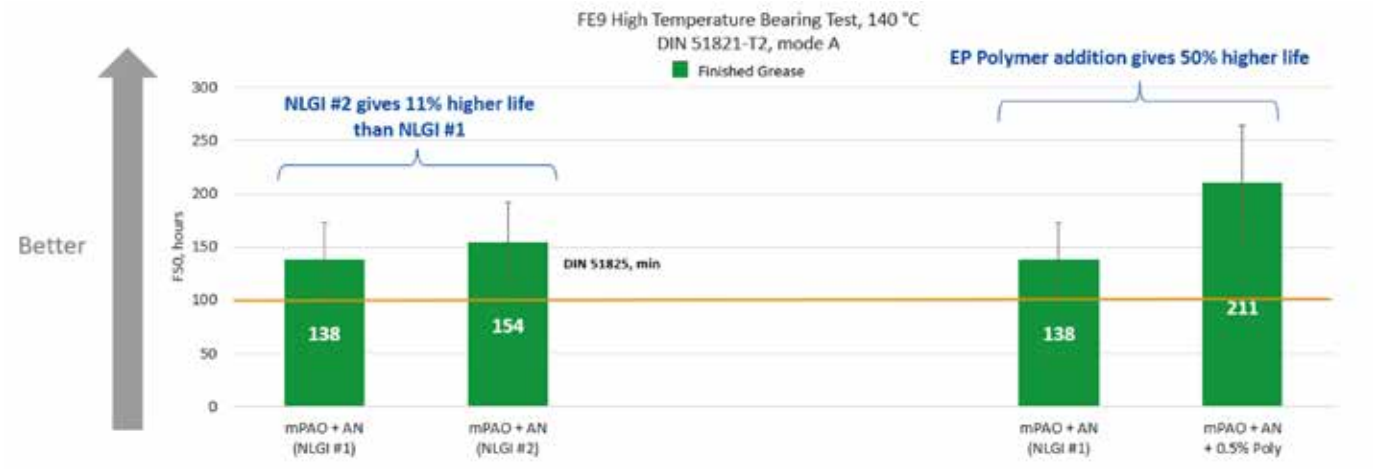

Figure 12 FE9 High Temperature Bearing test results, 140 °C

The test was repeated at 160 °C, although in this case, mode B was used due to the softer nature of the grease and the higher test temperature. Similar behavior can be seen in this set of results (Figure 13) with the NLGI

Grade 2 grease giving results that are 10% higher and the addition of EP polymer resulting in a 10% longer life as well. The mPAO containing formulations appeared to perform much better than mineral oil-based benchmark product. While in line with expectations from other thermal and oxidative stability testing, this testing would need to be repeated to confirm statistical significance.

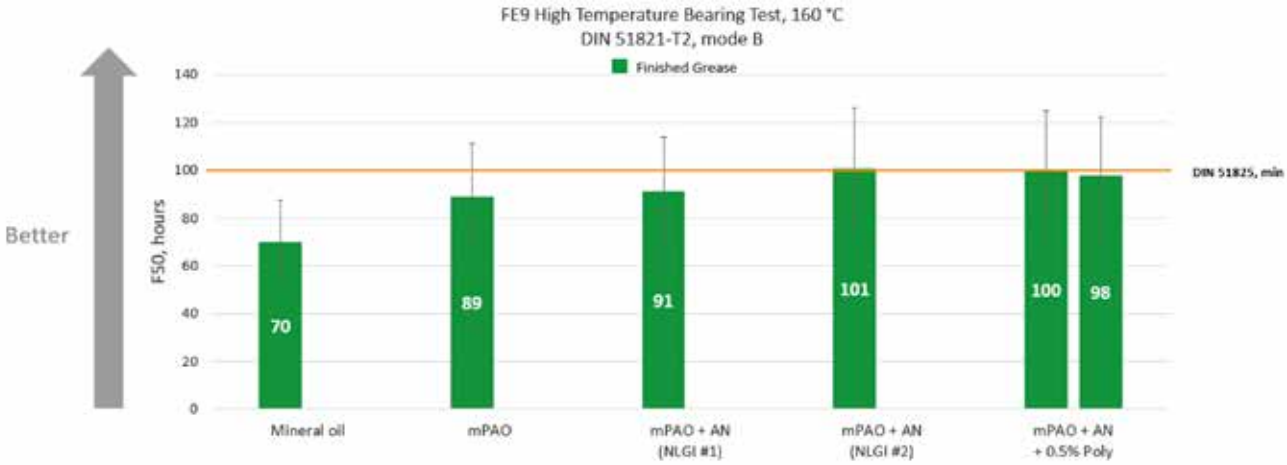

Figure 13 FE9 High Temperature Bearing test results, 160 °C

Overall, as seen in Table 7, the mPAO-based formulations appear to outperform the mineral oil-based formulation in most high temperature aspects. As expected, the oxidative stability of the mPAO formulations is better than mineral oil, but the addition of AN and the EP polymer appears to give it an extra boost in performance in the high temperature bearing tests. Additionally, there is some indication that the firmer NLGI Grade 2 grease gives longer life results than the softer NLGI Grade 1 in the FAG FE9 test. Additional testing would be needed to confirm this finding, but it would fit well with results showing that the addition of EP polymer seems to enhance the overall high temperature stability of the grease as seen in leakage tendency and the rig tests.

GC-LB HPM (High-Performance Multiuse)	Unit	Method	Mineral oil	mPAO	mPAO + AN	mPAO + AN + 0.5% Poly
Dropping point	°C (F)	D2265				
Oxidation Stability at 100 °C (pressure drop, 100 hrs)	kPa (psi)	D942				
High Temperature Screening PDSC (180 °C)	min	D5483				
Leakage, 20 hrs @ 160C, g	g loss	D4290				
Life Performance of Auto Wheel Bearing Grease	hrs	D3527				
FE9, Mode B (shielded, F50)	hrs	DIN 51821				
HT Bleed (30 hrs, 100°C)	wt%	D6184				

Table 7 High Temperature Stability - summary

Low Temperature Stability

The low temperature stability testing includes some more stringent requirements associated with the HPM + LT specification and not just with GC-LB and HPM core.

The first test that was considered in this section is the Grease Mobility at -20 °C (US Steel LT-37) which is only necessary when targeting HPM + LT performance (Figure 14). The only candidate that is capable of passing this test is the synthetic grease prepared with alkylated naphthalene. The excellent result of this candidate is likely due to the polarity provided by the AN in combination with a generally superior low temperature performance offered by the synthetic base oil mixture. Additionally, and not surprisingly, it's evident in this case that there is a deficit associated with the presence of the ethylene-propylene polymer in this performance area.

Finally, the known disadvantages of mineral oil products in low temperature performance come to the forefront, and in this instance, are likely due to the formation of waxy networks that severely affect the mobility of the grease.

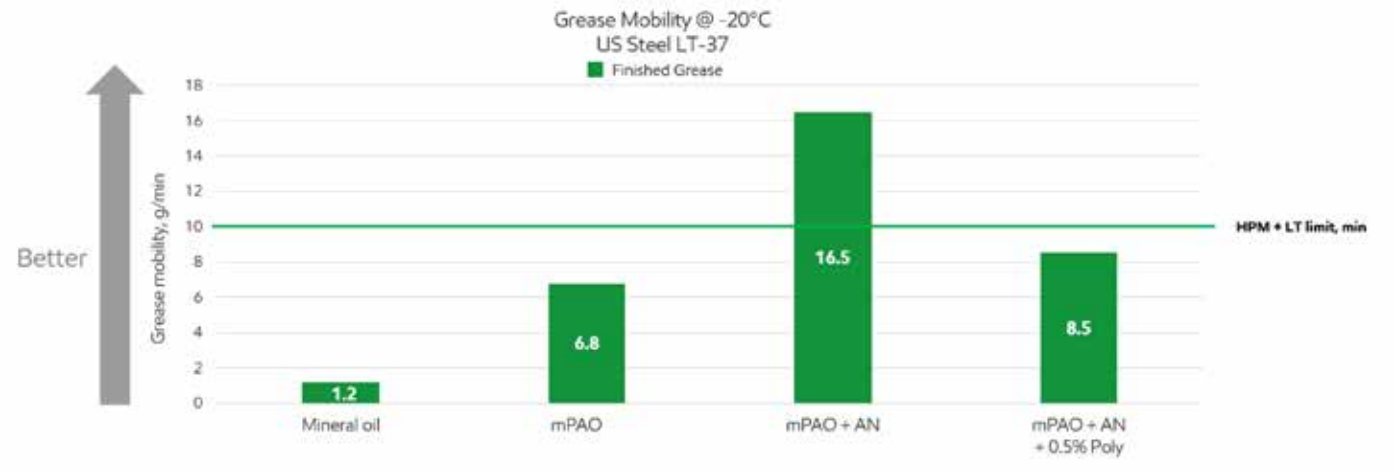

Figure 14 US Steel LT-37

The low temperature ball bearing torque test is required by both HPM Core and by HPM + LT. In Figure 14, the results are summarized showing the initial torque on the left, and the running torque on the right. All the candidates are capable of meeting the requirements at -20 °C (HPM core conditions), but it's apparent that the mineral oil offers lower performance compared to all the synthetic-based products. When the temperature is lowered to -30 °C (HPM + LT conditions), all the synthetic-based greases are still capable of meeting the HPM limits, while the mineral oil-based grease exceeds the limits significantly.

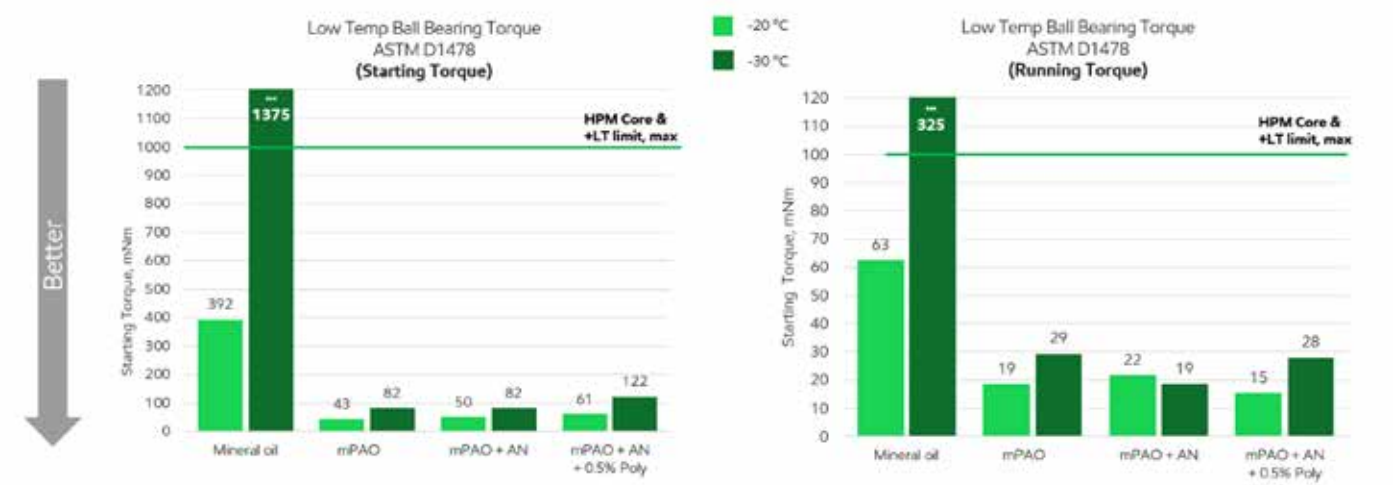

Figure 15 Low Temperature Ball Bearing Toque

Finally, the Flow Pressure Kesternich test was run at -30 °C, -40 °C and -50 °C, although the HPM + LT specification only requires the test to be run at -30 °C (Figure 16).

This test can predict the performance of the grease under very challenging low temperature conditions. The mineral oil-based grease is not capable of meeting the HPM limits at -30 °C, while the synthetic-based greases can meet the requirements both at the specified temperature of -30 °C, and also at -40 °C. To further demonstrate the difference amongst the synthetic based greases, a test was also run at -50 °C, and under those conditions

the mPAO-based grease is the only one that is still capable of meeting the HPM+LT limits (see Figure 16). It is clear from this experiment that balancing the formulation is the key challenge when formulating a new grease, particularly when targeting extreme conditions, such as low and high temperature performance. What can help to improve performance in one area, like the ethylene-propylene polymer in high temperature tests, can also have a negative impact in the low temperature tests such as the Flow Pressure Kesternich or the US Steel Mobility.

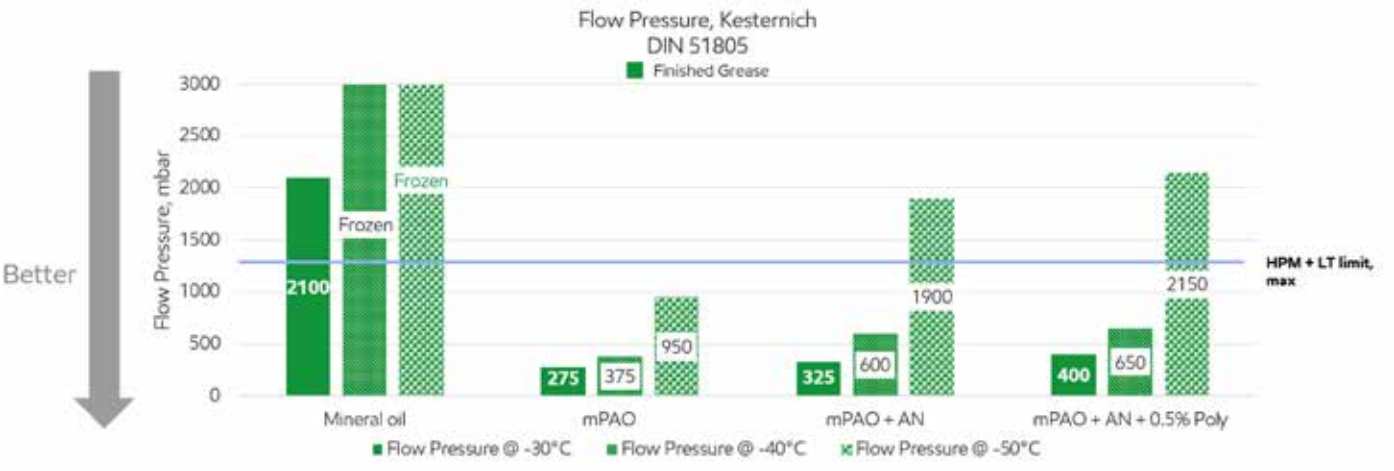

Figure 16 Flow Pressure Kesternich - DIN 51805

All the results generated in the Low Temperature section are summarized in Table 8. In this performance area, the benefits associated with the selection of a synthetic basestock become more apparent. Each of the synthetic candidates displayed some borderline performance, but the purpose of this study was not to develop a grease capable of meeting all the requirements of a given specification, but to demonstrate the effects of the basestock selection in a given performance category.

Particularly in this section, the performance deficit associated with the use of the ethylene-propylene polymer, which at low temperature can affect the matrix stiffness, becomes more apparent.

GC-LB HPM (High-Performance Multiuse)	Unit	Method	Mineral oil	mPAO	mPAO + AN	mPAO + AN + 0.5% Poly
LT Torque at -20 °C, mNm (g-cm)	mNm(g·cm)	D1478				
Starting torque						
Running torque						
LT Torque at -30 °C, mNm (g-cm)	mNm(g·cm)	D1478				
Starting torque						
Running torque						
Low Temp Torque @ -40 °C	N-m	D4693				
Grease Mobility @ -20 °C, g/min	g/min	US Steel				
Flow Pressure, Kesternich @ -30 °C, mbar	mbar	DIN 51805				
Flow Pressure, Kesternich @ -40 °C, mbar	mbar	DIN 51805				
Flow Pressure, Kesternich @ -50 °C, mbar	mbar	DIN 51805				

Table 8 Low Temperature Tests - Summary

Energy Efficiency

Energy efficiency of grease formulations are of great interest when discussing sustainability of grease formulations. Although there are no readily available test rigs for comparing energy efficiency of different finished greases, comparison of coefficient of friction (COF) can be an initial proxy indicating potential differences that could be realized in applications.

The SRV friction test (ASTM D5707) showed significant differences between the greases studied (Figure 17). The mineral oil formulation gave a significantly higher COF for the duration of the 2-hour tests. The COF for the mineral oil formulation was over 10% higher than the mPAO and mPAO/AN-based formulations. The EP polymer may have slightly raised the COF of the mPAO-based formulation, but it still ended up over 5% lower than the mineral oil formulation.

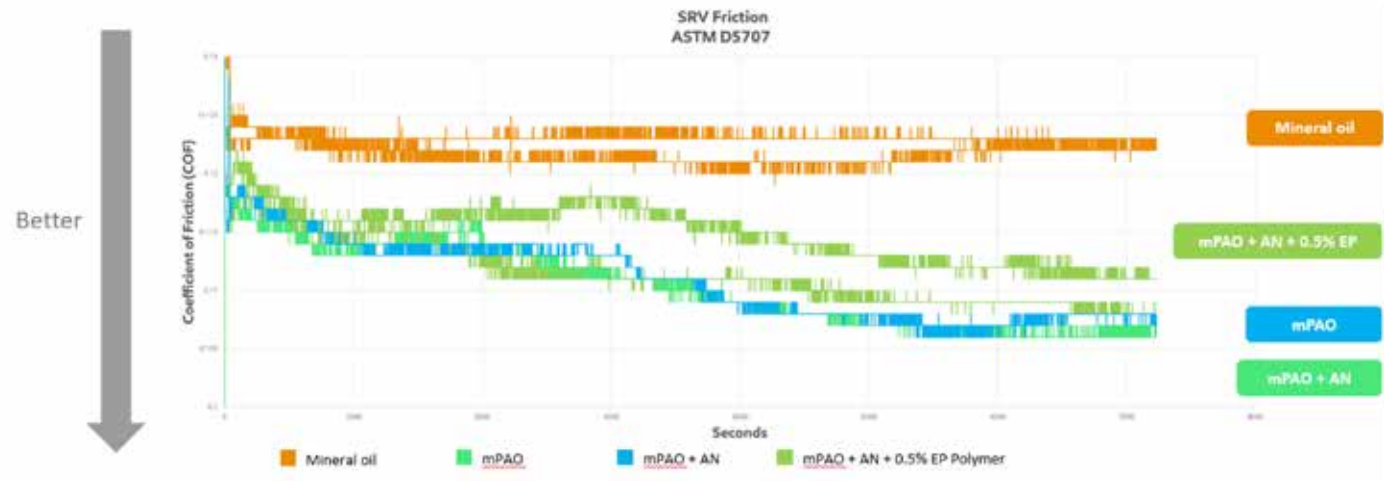

Figure 17 SRV Friction test results – mineral oil vs mPAO

Additional testing compared the NLGI Grade 2 and NLGI Grade 1 greases (Figure 18). This comparison shows that the change in grades results in a COF that is about 13% higher for the thicker NLGI Grade 2 grease. This is unsurprising given the increased amount of thickener present in the NLGI Grade 2 grease, but the comparison also shows that the use of mPAO with AN in the grease formulation gives a drop in COF which is equivalent to the incremental change in grade from NLGI Grade 2 to NLGI Grade 1.

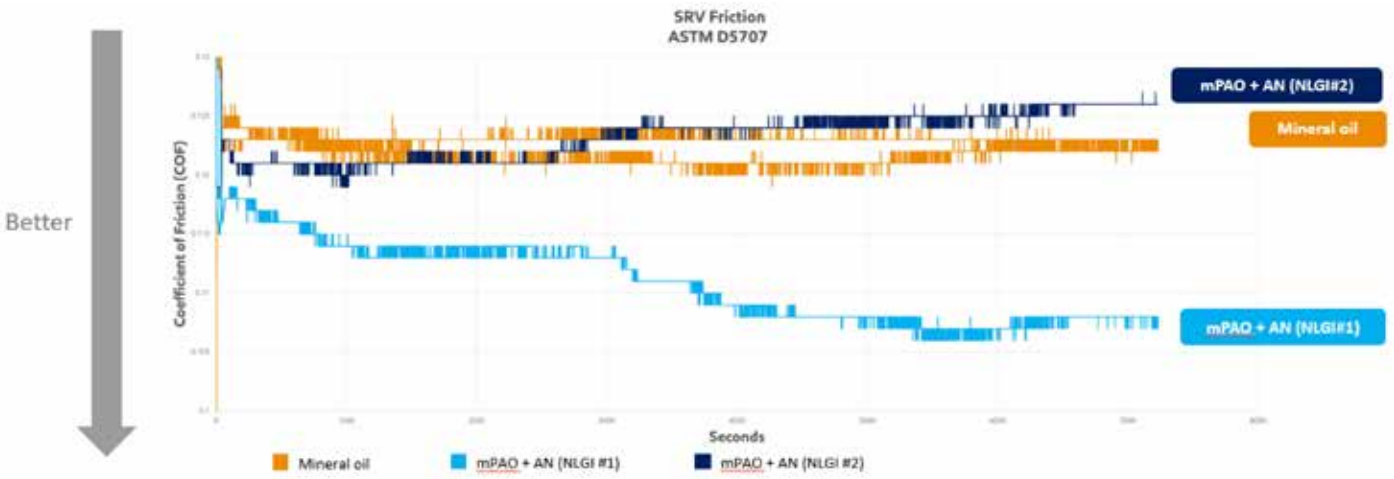

Figure 18 SRV Friction test results – NLGI Grade 2 vs NLGI Grade 1

Summary and Conclusions

In summary, this study systematically examined different basestocks which were selected with regard to how they might affect the properties of a finished grease. These were primarily chosen to compare mineral oil with mPAO-based formulations. Additionally, the impact of the additive package on those different base greases was evaluated using the GC-LB and HPM specifications [Table 9] as a benchmark.

Structural stability was clearly superior within the group of greases manufactured with a synthetic basestock. The mineral oil-based greases can meet the necessary requirements easily as well, even if in this study they were technically failing to meet certain parameters. The authors believe that those concerns could be addressed simply by optimizing the manufacturing process and/or formulations. There are indications that the NLGI Grade is more important in this area than in some others with one data point indicating a large improvement in water washout with an NLGI Grade #2 formulation. The presence of alkylated naphthalene did negatively impact the water washout performance, likely due to the increased polarity of this base oil mixture. The addition of an ethylene-propylene polymer was beneficial to water washout performance even in the presence of alkylated naphthalene.

In the area of wear/corrosion, the effect of mineral oil may be positive in some respects such as extreme pressure, but could be offset by negative impacts on copper corrosion or wear. Alkylated naphthalene may lead to some deterioration of corrosion protection, but the EP polymer seems to eliminate this negative effect. Overall, the need for balanced additive formulation to meet the desired performance targets is key.

Elastomer compatibility was excellent across the board, but further study would be necessary to understand why the conventional seals and the new HPM nitrile seals had an opposite response when tested with greases containing mPAO. In fact, the new HPM nitrile seals displayed more volume/hardness variation when tested with the synthetic-based grease as compared to the mineral oil-based grease.

The expected benefits of synthetic fluids were especially visible in high temperature attributes. The oxidative and thermal stability detriments of mineral oil formulations were obvious and translated into poor performance in the high temperature bearing tests. While mPAO-based formulations were better in these aspects, the inclusion of alkylated naphthalene and/or EP polymer seemed to give benefits, especially in the HTWB and FE9 testing.

The well-known low temperature properties of PAOs were also apparent in the grease formulations incorporating the mPAO fluid combinations, although some attention should be paid to the possible impact of EP polymer and AN balance in a finished formulation depending on the properties desired. The US Steel mobility test may need AN to pass the HPM + LT specification, but the EP polymer (which helps high temperature performance) may be detrimental.

Energy efficiency benefits may be indicated by the significantly lower coefficient of friction seen with the mPAO formulations, although as in the low temperature performance, the EP polymer may negate some of those advantages.

Overall, the findings here should be a guide for the positive and negative impacts of different styles of formulation with great care being needed to meet desired performance targets. The data shown here indicates that with the proper choice of base fluid and additive combinations, high performing finished greases can be formulated that meet the performance levels of NLGI's new HPM core specification and its enhanced performance categories.

	Mineral oil	mPAO	mPAO + AN	mPAO + AN + 0.5% Poly	Comments
Struct. Stability					mPAO better stability; AN negative impact on water washout; higher consistency gives better stability
Wear/Corrosion					Mineral oil helps EP, hurts wear/copper (sulfur); additive response good but need balance
Elastomers					mPAO can cause hardening/lower vol change; AN helps (solvency); new HPM seals - different response
High Temp					Mineral oil generally poor response at high temp; mPAO + EP Polymer best response in bearing rigs
Low Temp					Mineral oil doesn't meet most LT targets; AN helps LT mobility; EP Polymer generally hurts LT (need balance)
Efficiency					mPAO grease show decrease in COF even with higher treat of EP Polymer; higher grade raises COF to mineral level

Table 9 Overall Performance Summary

Future work

Additional work will focus on the comparison of the performance of the same set of greases analyzed in this study, looking at candidates manufactured in the NLGI Grade 2 class. Such a systematic comparison could help to understand how to move the needle further in all the critical tests, where the thickness of the grease may play a more substantial role.

Further studies could be focused specifically to understand the FE9 high temperature performance utilizing the same NLGI Grade 2 grease, diluting it to the corresponding NLGI Grade 1 candidate. This, in turn, will remove some of the variability associated with the manufacturing process.

Additional study is also planned to evaluate the balance needed to optimize specific performance areas with different combinations of base fluid, polymer and additive and, perhaps, in different thickener types. Evaluation of the differences in response to additive systems seen between mPAO and mineral based grease formulations is also of interest.

Finally, further exploration of potential differences in energy efficiency and better ways to measure these differences could be very beneficial in real-world applications.

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NLGI Interviews Dr. Deepak Saxena
Executive Director, Indian Oil Corporation Limited
Vice President, NLGI-India Chapter

By Mary Moon and Raj Shah

Dr. Deepak Saxena
Executive Director, IOCL
Vice President, NLGI-India Chapter

Dr. Deepak Saxena considers himself a formulator, first and foremost, while he holds a doctorate and an MBA. He is an executive director at IOCL, "the Energy of India", which accounts for nearly half of India's petroleum products market share, with sales of 81.027 million metric tonnes (MMT) in the year 2020-21. And he sits on the Boards of NLGI-IC and Lubrizol India Private Limited. In this interview, Dr. Saxena explains how his boyhood hobby of taking things apart to find out how they worked led him to his career in research and development and management. To learn about his career, his perspectives on the grease industry, present and future, and managing a manufacturing company through the COVID-19 pandemic – read on!

Education

NLGI: Please tell us a little bit about where you grew up.

DR. DS: I was born in the city of New Delhi, the capital of India. My Father worked for the Indian Railways, and he was transferred several times. Subsequently, we moved to the Northern Railway Zonal Training Campus at Chandausi, Uttar Pradesh (UP) where my Father taught the new employees various skills. Overall my childhood was pretty good. Things went effortlessly during my teens. It was just me, Mom, my two younger Brothers and Dad, and we had great times together.

My initial schooling was in the Railway School. Later on, we moved to Saharanpur, UP. My Father represented Indian Railways in badminton and chess tournaments. I learnt both games from him. I had lots of opportunities for enhancing my sports skills in Railway clubs and at college where I represented my college in various district-level tournaments.

NLGI: How did you develop your interest in engineering, science, or business?

DR. DS: I became interested in engineering as a young boy. Around the age of six I developed a knack for figuring out how to take things apart and put them back together. I was curious to check and understand the working of toys, radios, televisions, cycles, electric appliances, etc. This was fuelled by my Father's encouragement and patience. My Dad always helped me to learn new things and made me to understand the mechanisms of how things worked. That left imprints on me and it became my habit to get answers to "Why?", "When?", "Where?", "What?" and "How?" for getting complete understanding of a thing/object.

Physics and chemistry were my favourite subjects. I topped the entire University in M.Sc. Chemistry and was admitted to IIT (Indian Institute of Technology), Roorkee (formerly known as the University of Roorkee), a renown educational institution in India. My Professor, Dr M K Maheswari, saw my interests and guided me to pursue a Master's and a Ph.D. in Chemistry. He also encouraged me to take research as a career and use my inquisitiveness as a tool for better understanding problems and searching for new solutions. All these factors pushed me to take a job at the IndianOil R&D Centre and

Dr Saxena with Dr Peter Jost, "Father of Tribology", at the 5th World Tribology Congress, Torino, Italy (2013)

take up research in the area of machinery lubrication, friction and wear.

NLGI: Did you study lubrication or tribology?

DR. DS: Tribology is the study of the science of friction, wear, and lubrication of two rubbing surfaces in relative motion. The management of lubrication alters the friction and wear of rubbing components. I started understanding and practicing Tribology concepts at the IndianOil R&D Centre just after I joined in the year 1988. I was given a challenging project to develop energy efficient industrial gear oils using a variety of chemical additives. I took two different approaches to reduce friction without compromising other properties of gear oil, i.e., by optimising viscous drag and reducing friction with friction modifiers. Subsequently, these concepts were used for developing innovative lubricant/grease formulations and providing tailor-made solutions to customers.

NLGI: Have you continued your education?

DR. DS: I loved studying since I was a kid. I am fortunate enough to have chosen research and development as my career and continued my passion for learning new things and implementing my experience for the benefit of my country, organization, and society as well as my own enjoyment. I got the opportunity to do an MBA in general management in the years 2000-01, and my degree was awarded by the University of Ljubljana, Slovenia, in Europe. My MBA gave me a new way of looking at things and methods to assess projects on both technical and commercial merits.

Dr Saxena presenting during the Opening Session of the 22nd Lubricating NLGI-IC Grease Conference, Indore (2020)

Career

NLGI: How did you begin your career?

DR. DS: I always enjoyed formulating new, innovative concept-based products for solving real life lubrication issues. I've always been interested to understand how additives interact and develop a synergistic combination to prevent wear, reduce friction and provide adequate lubrication. I have utilized all these concepts in grease and lubricant formulations since the beginning of my career. I always look for the power of possibilities and use them for solving a given lubrication problem. Basic research in the area of additive-additive and additive-base stock interactions helped me to quickly come out with new formulation recipes. I am still using these concepts for guiding my team members.

I always look for the power of possibilities and use them for solving a given lubrication problem. Basic concepts in the areas of additive-additive and additive-base stock interactions helped me quickly come out with new formulation recipes.

NLGI: Please tell us a little bit about the Company where you work.

DR. DS: As the commercial enterprise with the largest customer interface in India, IndianOil provides precious petroleum fuels to every nook and corner of the country

through its network of over 56,000 customer touch-points, surmounting the challenges of tough terrain, climate and accessibility. As our logo, the Energy of India, shows IndianOil accounts for nearly half of India's petroleum products market share, with sales of 81.027 million metric tonnes (MMT) in the year 2020-21.

IndianOil is far more than being the highest-ranked Indian Energy Public Sector Undertaking (Rank 212) in Fortune's Global 500 listing with the vision to become A Globally Admired Company. I am working in the R&D Centre of this great organization at Faridabad. IndianOil R&D anchors the Organization's vision of being the energy provider of choice. Apart from maintaining research leadership in core areas of fuel and lubricant technology, R&D has forayed into eco-friendly fuel research domains such as second and third generation (2G/3G) biofuels, H-CNG (a mixture of compressed natural gas and hydrogen), and hydrogen. IndianOil R&D is an emerging global technology provider of cutting edge refinery processes and catalysts. IndianOil R&D also pursuing advanced research in energy storage devices, hydrogen based fuel cells and scalable carbon capture and utilization techniques in line with the energy transition objectives of India.

Dr Saxena with the Grease Development Team at IndianOil R&D, Faridabad (2022)

NLGI: What are your current responsibilities?

DR. DS: I'm responsible for leading and motivating teams in the Fuels and Lubricants, Pipelines and Corrosion, Solar and Nano Technology divisions. My other responsibilities are identifying the needs for future products, leading the development of innovative products, and providing solutions to sister divisions and networking with them. Additionally, I'm engaged in encouraging team members to do work differently and innovate at each step to achieve their targets.

NLGI: Please tell us a little about your management philosophy.

Dr DS: My management philosophy revolves around motivating and encouraging my team. I always work to push myself out of my comfort level, and I expect the same from my team members. I use my transformational management style to guide my team members through challenging tasks, when

Dr Saxena with the scientists of the Tribology Group at IndianOil R&D, Faridabad (2022)

required. I use listening and effective communication skills for communicating the objectives to team members and keeping their focus and priorities in the right direction. This helps the team utilize its full potential. I continually reward my team members with positive reinforcement when they complete a project. I also listen to their concerns and guide them when they tackle difficult phases of each product development project and experiment to solve a lubrication problem.

NLGI: Can you please tell us about your key areas of interest?

DR. DS: My passion is developing new, state-of-the-art formulations of greases and lubricants with unique selling points. I am involved in the development of new formulations with the working team from day one. I always focus on doing Smart research for achieving set targets in a short time using our knowledge base. I love to interact with grease/lubricant users and understand their lubrication related issues from their point of view. It helps me in setting targets for a particular lubricant property and solving lubrication issues. I enjoy taking on challenging development projects and using my experience of working in different areas of lubrication.

NLGI: What have been your experiences in the area of lubricating grease?

DR. DS: Development of new products and establishing their performance credentials in the machines at customer sites are part of my job. This has given me the opportunity to walk through various plants in India. I have visited steel, cement, fertilizer, power, rubber, food processing, and chemical plants and other manufacturing facilities. During these trips, I have discovered several

Dr Saxena with tribology engineers and equipment at Faridabad (2022)

recurring lubrication issues that seem to be widespread throughout industry. In most manufacturing plants, lubrication does not receive the attention it merits given its great importance.

Lubrication generally has direct bearing on machine health and impacts proactive maintenance schedules. In addition, not following SOPs, not using the right quantity of grease/ lubricant of the right quality at the right time, improper sample collection procedures and over greasing are some of the important shortcomings I observed in plants. I always focus on relating the grease properties with the application requirements and observing conditions in and around the machine so that I can provide the right solution to each customer.

Grease Industry

NLGI: What is your perspective on the lubricating grease industry worldwide? What are some challenges and opportunities?

DR. DS: Global grease production has remained stable in the range of 1.0–1.2 MMT for the past decade. The 2020 NLGI Production Survey reported that there was an 8.5% decrease in world grease production in 2020 as compared to 2019. This clearly shows that the COVID-19 pandemic has had a significant impact on worldwide grease production. Currently our biggest challenges include sustaining business, alternates for lithium hydroxide and development of environmentally benign products.

First, many of the raw materials, especially the lithium compounds, required for manufacturing a variety of greases are being sourced from countries other than India that hold these mineral deposits. Pandemic restrictions have affected global movement of raw material, leading to between a twofold and tenfold increase in cost. Second, strict COVID norms, low mobility, lockdowns, containment zones, limits on working in manufacturing plants, unavailable/limited availability of staff, and working from home have affected production and sales alike. Therefore, manufacturing of greases and lubricants has become a challenge since the COVID outbreak.

Globally 80% of grease production is based on lithium soap, and availability of lithium hydroxide has always been a concern.

Sourcing of lithium hydroxide, (the key ingredient for making of lithium soap based greases) is restricted to a few geographical locations such as Chile, China, Australia, the USA, and Bolivia. Globally, 80% of grease production is based on lithium soap, and availability of lithium hydroxide has always been a concern. Cost of this material has been on the rise due to the skewed supply-to-demand ratio. Another factor that has made supply and pricing of lithium hydroxide critical is the "surge" in the number of EVs and digital devices where lithium is being consumed in large quantities for production of lithium-ion batteries.

With global supply chains of lubricants and greases in place, the onus is on grease manufacturers to develop environmentally safe products in order to meet local as well as global regulations. Thus, grease

manufacturers are increasingly using low polycyclic aromatic hydrocarbon (PAH) oils and excluding heavy metals additives to meet REACH or other guidelines for products.

New opportunities are constantly cropping up in sync with changing industrial and environmental scenarios including the customization of greases for electric vehicles (EVs), wind turbines and machinery for renewable energy applications. From the grease technology point of view, we are constantly looking at ways to reduce the carbon footprint in grease manufacturing by using alternate grease cooking processes and developing alternate chemistries to replace lithium hydroxide.

Dr Saxena with colleague Ms D. Padma at the Platts Global Energy Awards, New York, USA (2016)

NLGI: Looking forward, what trends do you see influencing the grease industry?

DR. DS: Some of the trends in the global grease industry are as follows:

- Manufacturing raw materials – Use of multifunctional soaps and additives;
- Manufacturing process – Use of alternate ways of cooking, such as microwaves, in grease manufacturing;
- Finished products – High performance and long life;
- Condition monitoring – Artificial Intelligence and web-based remote monitoring;
- After sales – Circular economy to reduce/reuse/recycle.

NLGI: What may be some effects of global warming on the grease industry, and on what time frame?

DR. DS: Global warming is related to the use of fossil fuel based products and other chemicals leading to generation of greenhouse gases, particularly CO2 and methane. Grease production methods (burning of fuel oil, use of coal, use of conventional refrigerants, etc.) also add to the carbon footprint of the grease industry. It is now possible to estimate the amount of CO2 produced while manufacturing a 10 MT batch of lithium grease using conventional methods. Mitigation of the release of CO2 by the use of alternate heating methods such as microwave radiation could reduce the overall carbon footprint.

Lubricants may decrease power consumption by up to 5% and contribute to reduction in carbon footprint. To improve efficiency, it is important to use the right quantity of the right grease in the machine components to be lubricated.

One of the key benefits of lubrication is the reduced demand in power by applications. Studies indicate that use of appropriate quality greases reduces friction and wear of machine components. Lubricants may decrease power consumption by up to 5% and contribute to reduction in carbon footprint. To improve efficiency, it is important to use the right quantity of the right grease in the machine components to be lubricated.

Using lubricants more effectively also leads to a reduction in the current demand on resources. Reducing the consumption of lubricant is imperative to protect the environment, since severely degraded lubricants may contain harmful components resulting from excessive oxidation and heavy metal contaminants from the wear of components. Reduction in the volume of grease for disposal can be achieved by use of high performance lubricating greases that last longer and reduce wear effectively.

Dr Saxena with Dr Sarita Garg, Nimkar and the Lubrizol team at Kinura Lab, Japan (2017)

NLGI: How have your Company, your suppliers, and your customers responded to the COVID pandemic? How is this affecting your planning?

DR. DS: The COVID pandemic has affected activities of every business entity in one way or another. The day that the national lockdown was announced in India (24 March 2020), everything nearly came to a standstill. However, some the services of our organisation such as fuels and cooking gas were categorized as essential services, so plants and related supply chains were allowed to operate. Our management planned for virtual work schedules/work from home strategies to continue projects while focusing on learning and preparatory work that could be used on resumption of normal operations. Virtual monitoring with Internet of things (IoT) infrastructure was augmented to run equipment (engines/ pilot plants/machines) with limited staff. We arranged for constant communication with our customers, suppliers and service providers through virtual meetings.

With the gradual reopening of India, several strategies such as working on alternate days and working with flexible hours were adopted to keep the business operating. With the onus on us as a leading organisation of the country, we took it upon ourselves as our social responsibility and worked on quickly developing our own brand of surface sanitiser and a safe tool for contactless operation of manual devices such as handles. A COVID safety kit was distributed to every employee. Through the several waves of COVID-19 since 2020, we worked towards minimising risks faced by our employees as well as their families in their work and life in general. Additionally, we joined with government agencies and hospitals to provide opportunities for our employees, their families, and the various others connected to us, such as contract workers and canteen staff, to receive vaccinations. And we found ways to control increases in expenses, especially logistics, owing to COVID.

Besides this, COVID has affected future planning of the projects requiring travel and visits to customers. For example, some of the field trials with Indian railways or state transport agencies could not be initiated due to COVID restrictions or lockdowns. Many such trials were delayed owing to restrictions at customer sites. Now, the situation is improving, and business activities are going smoothly.

Dr Saxena in the lab working with scientists at IndianOil R&D, Faridabad (2022)

NLGI: What are your thoughts about the lubricating grease industry in India? What do you think about its future?

DR. DS: According to the 2020 NLGI Global Grease Production Survey, India produced 86,181 MT of lubricating greases. The COVID pandemic effect was quite severe on grease production during the year, as India reported a major decrease of over 15% compared to 2019 production, of which approximately 4% could be attributed to participant drop-out from the survey.

Neverthless, grease production in India has been fluctuating between 0.09 and 0.14 MMT for the past decade. The Indian grease industry is a mix of organisations, from PSUs (public sector undertakings) and private companies to toll blenders and small-scale manufacturers. Even though India is a major supplier of castor oil (approximately 50% of global production), a key fatty acid source, the Indian grease industry heavily depends on lithium hydroxide, a resource nearly non-existent in India.

Despite continuous efforts for nearly two decades to find a suitable alternate to lithium soap, the future of the Indian grease industry is still tied to the availability and price of lithium hydroxide. To decrease the dependence of the Indian grease industry on lithium as well as to encourage grease formulators to find alternatives, the Bureau of Indian Standards (BIS) has omitted the mandatory requirement for "Lithium Soap" from industrial grease specifications. Mixed soap thickeners such as calcium-lithium are slowly emerging as cost competitive alternates to lithium soap thickeners, and mixed soap greases can reduce the use of lithium by almost 50% in grease making. Polyurea greases are now being manufactured in India and show great promise for the future. There is also increased emphasis on "sulphonate complex" greases with lower sulfonate content.

Dr Saxena with members of the Board of AVI-Oil Pvt Ltd, Budapest, Hungry (2018)

NLGI: Are there new or future applications of greases?

DR. DS: The Indian automotive industry has become increasingly focussed on EVs in response to the environmental concerns raised with use of conventional ICE vehicles. The sales of EVs are on the rise with incentives being offered to the end user for purchase of the same. This has given an opportunity to grease manufacturers to develop suitable greases for such vehicles. However, concern about the range of EVs and charging infrastructure development are the key barriers that must be overcome to enhance the usage of EVs.

Use of alternate energy sources (wind, solar) is on the rise in India. Large numbers of wind and solar farms are being established in India, and they require the use of specialised greases. Another growth area is high speed trains and metro rails. These require both long life (axle greases) and specialised (railway track and wheel flange) greases. Energy efficient greases are on the verge of a boom. I will not be surprised to see greases lasting up to 5–6 Lakh (100,000) km in axle grease applications in the near future.

I will not be surprised to see greases lasting up to 5–6 Lakh (100,000) km in axle grease applications in the near future.

NLGI: Are there new chemistries for greases?

DR. DS: Grease formulators are constantly experimenting with a variety of metals as bases for soap making. From the lessons of lithium scarcity, the preferred metal bases are the alkaline or alkaline earth metals found in abundance in India. Mixed soap thickeners for greases such as lithium-calcium have already proved their superior water resistance and mechanical stability. Polyurea grease technology is being adopted with new technology for making it from a selection of a large number of amine and isocyanate derivatives to form polyurea thickener. However, every combination of amine and isocyanate will have its own advantages and disadvantages. Another emerging area is use of polymer based greases for automotive and food grade applications.

Dr. Saxena (left) chairing a session with Dr. Anoop Kumar, R.T. Vanderbilt Company and Vice President, NLGI (right), NLGI-IC Meeting, Amritsar (2018)

NLGI: Are there new tests and specifications for greases?

DR. DS: Framing of specifications for energy efficient greases is in a nascent stage. The Bureau of Indian Standards (BIS) is working on several futuristic specifications including EV greases, environmentally benign greases, and greases made from reclaimed oil.

NLGI: Do you have a favourite grease chemistry or grease test?

DR. DS: I have two specific favourite grease tests. First, one of my favourites is a screening test for grease friction and wear, viz. the SRV test. We use it to screen the frictional properties of a grease and quantify wear in terms of the scar diameter after the test is completed. I have been using this test for most of my career for a quick screening of the frictional properties of various lubricating oils and greases. It is very effective and offers a repeatable method to measure additive response in film formation on the contact surface in the boundary

lubrication regime. However, I observed that the results are not as repeatable and straightforward for screening grease as was the case with oil testing primarily due to the "starvation effects" that depend on the grease type and quantity put in the contact zone. Specialized sample cups may solve this issue.

Another favourite test of mine is the failure life analysis using the FAG FE9 test. We have used this test for quantification of the life of a grease in rolling element bearings in various industrial and automotive applications. The degree of variation in failure life testing is fascinating from the perspective of understanding the influence of various parameters of bearing design and fabrication on the qualitative and quantitative filling of the grease in the test bearing. The statistical analysis of the data generated on this test using Weibull charts to take into consideration the uncertainties in life testing and arrive at a meaningful conclusion that could be used to correlate with field life was very interesting for me.

Fond memories of the 1st NLGI-IC Lubricating Grease Conference, Nainital (1997)

NLGI-India Chapter

NLGI: Please tell us a little bit about your role in the NLGI-India Chapter.

DR. DS: I was one of the founding members of the organizing committee of the 1st NLGI-IC conference held in 1997 at Nainital. I looked after the organization of various technical sessions and interactions with presenting authors. Subsequently, I was involved in the organization of various conferences and education courses for NLGI-IC at different places. I was later inducted as Secretary of the NLGI-IC Board in February 2017. Gradually I moved up to the ladder and was elected Vice President by the Board in the year 2019. My role encompasses the work related to the organisational activities (conferences, education courses, meetings and AGM) and coordination with NLGI and other organizations. This has been a good learning experience for me, as working in this role that involves interacting with almost everyone in NLGI-IC as well as many members and the staff of NLGI.

NLGI: How many members belong to NLGI-IC? What is on the calendar for NLGI-IC? What is the topic of the 2022 Grease Education Course?

DR. DS: Presently, 19 companies are members of NLGI-IC. These include grease manufacturing/marketing companies in the public sector, private companies, equipment manufacturers, and additive suppliers. The NLGI-IC Board comprises currently 22 members. Activities of NLGI-IC in 2022 began with the Annual General Meeting (AGM) and Board meeting in January 2022.

Dr. Saxena with NLGI-IC Board members, Guwahati (2019)

A lubricating grease education course in the virtual online mode was jointly organised by IOCL and NLGI-IC on the theme "Wind Mill Lubrication" (February 25-26, 2022).

To promote grease research in India, NLGI-IC has decided to sponsor two candidates for a doctoral programme. We expect to formally sign an agreement with the Council Of Scientific and Industrial Research–Indian Institute Of Petroleum (CSIR)-Indian Institute of Petroleum (IIP) Dehradun in April 2022 for sponsoring two students in the Ph.D. Program through NLGI-IC research fellowships in the coming summer semester.

NLGI-IC has plans to conduct its 24th Lubricating Grease conference as an in-person event during the 3rd/4th weeks of August 2022. An inter-laboratory correlation program to improve the quality of multipurpose grease is being conducted by NLGI-IC.

NLGI: How did you become involved in the NLGI India Chapter?

DR. DS: First, I was involved in organizing various conferences of NLGI-IC. During early 2014, I was entrusted by IOCL to look after Grease Department activities at the IOCL R&D Centre. Since, the IOC R&D

Dr Saxena with Dr SSV Ramakumar and Dr T Singh (from left to right) during Sponsor recognition at the NLGI-IC 22nd Lubricating Grease Conference, Indore (2020)

Centre Grease Department is HQ of NLGI-IC, I became responsible and involved in every activity through the year.

NLGI: How have you benefitted by attending NLGI India meetings?

DR. DS: I have been attending NLGI-IC meetings in different capacities over the last few years. I was introduced to global grease industry perspectives through interactions with leaders in the national and global grease industry. This has given me access to the technical publications from NLGI such as the Global Grease Production Survey, which is really helpful in charting our grease business strategy. The AGMs of NLGI-IC were very enriching experience because of exposure to topics related to not only the grease industry but also the general lubricant industry. This has given me the chance to network with additive suppliers, equipment manufacturers, other raw material traders and grease manufacturers.

Dr. Saxena (center) chairing a session with Mr. Joe Kaperick, Afton Chemical and NLGI (left) and Dr T Singh, BPCL and NLGI-IC (right), Guwahati (2019)

NLGI: Why are NLGI and NLGI-IC important?

DR. DS: NLGI and NLGI-IC offer platforms to its members for discussion on research and development as well as proposed best practices in grease manufacture, application and condition monitoring in order to encourage their general use. NLGI-IC is a nonprofit scientific organisation that promotes research in the area of lubricating greases and provides a place where all grease manufacturers and companies in related industries share their knowledge and experience for the benefit of the Indian grease industry.

Dr Saxena with colleagues from IndianOil at CERAWEEK, Houston, USA (2018)

NLGI: What are your affiliations other than NLGI-IC? Have you been active in areas other than Grease Industry?

DR. DS: I have been fortunate enough to participate in global energy events such as CERAWEEK, the World Petroleum Congress, SAE WCX™ (Society of Automotive Engineers World Congress Experience), the World Tribology Congress, and Global Energy Outlook Forums. I am also on the board of Lubrizol India Private Limited as the IndianOil nominee director and previously worked on the Board of AVI-Oil India Limited, looking after the aviation business in India.

Dr Saxena presenting a paper at the Society of Automotive Engineers World Congress Experience (SAE WCX™),

Besides working with the premier grease industry body NLGI-IC, I have contributed by being actively involved with various professional societies such as Infrastructure Financial & Financial Services Leasing Ltd (IL&SF), the Tribology Society of India, the Indian Society for Analytical scientists (ISAS), the International Council of Combustion Engineers (CIMAC) India chapter, and the Society of Automotive Engineers (SAE) India.

NLGI: Please tell us about your family and home.

DR. DS: Well, first of all, the main thing to know is that I come from a small family with five members. They are my Mother, Wife, Son and Daughter-in-law. In fact, my small family always makes me feel relaxed and comfortable in the moment. Something else that I need to comment on is that my Family is a very happy one.

NLGI: Where is your favorite place to travel?

DR. DS: I love to travel. The excitement of planning and visiting different places brings me enormous joy. My family also loves to travel to different places. My favorite place to visit is Kashmir. It is Heaven on Earth. Kashmir has many picturesque locations, viz. Dal Lake with sparkling water, Gulmarg, Sonmarg, Pahalgam, and Betab Valley. Kashmir is full of natural beauty. The hospitality of the Kashmiri people, particularly those who live in house boats, is extremely pleasing. I love their traditions and food very much. Travelling in Kashmir also offers enthralling experiences ranging from shikara (wooden boat) rides, river rafting, mountain biking, and horseback riding to jeep safaris.

Dr Saxena with Dr SSV Ramakumar, Dr R K Malhotra, R. Suesh and spouses at the Golden Temple, Amritsar during the 20th NLGI-IC Lubricating Grease Conference (2018)

NLGI: If NLGI members travel to India, do you recommend special things to do and places to visit?

DR. DS: The variety of travel themes that India offers to any visitor is just amazing. One can experience the ancient heritage across India with monuments like those at Agra, Hampi, Jaipur, Jodhpur, Amritsar, Srinagar, and Ooty as well as explore natural beauty from the beautiful beaches of Goa and Kerala on the long coastline, the desert of Rajasthan, the undulating peninsular plateau and mountains of the Western Ghats and the magnificient peaks of the Himalayas in a single trip to India. So, I would advise NLGI members to take a good amount of time off their work schedules and explore these diverse destinations across India. NLGI-IC has held meetings at many of these fascinating destinations. Dr. Raj Shah has been a regular at many of our conferences, and he would be happy to share his experiences at several NLGI-IC conferences with NLGI members. We would be happy to offer assistance to NLGI members visiting our country.

This interview series, started in 2019 by Dr. Moon and Dr. Shah, gives NLGI members a bit of insight into the professional and personal lives of their colleagues, developments in the grease industry, and the role of NLGI worldwide. If you would like to suggest the name of a colleague for an interview (or volunteer to be considered as a candidate), please kindly email Mary at mmmoon@ix.netcom.com or Raj at rshah@koehlerinstrument.com.

Dr. Mary Moon is Technical Editor of The NLGI Spokesman. She consults, edits, and writes scientific and marketing features published in Lubes'n'Greases and Tribology & Lubrication Technology magazines,

book chapters, specifications, and other technical literature specific to lubrication and condition monitoring. Her R&D and project management experience in the lubricant, polymer, and specialty chemicals industries includes inventions, formulation, product development, marketing, and applications of tribology, electrochemistry, rheology and spectroscopy. She served as Section Chair of the Philadelphia Section of STLE. She is a member of the National Association of Science Writers.

Dr. Raj Shah is currently a Director at Koehler Instrument Company, Long Island, NY where he has lived for the last 25 years. An active NLGI member and he served on the NLGI board of directors from 2000 to 2017. A Ph.D in Chemical Engineering from Penn State University and a Fellow from the Chartered Management Institute, London, Dr. Shah is a recipient of the Bellanti Sr. memorial award from NLGI. He is an elected fellow by his peers at NLGI, IChemE, STLE, INSTMC, AIC, MKI, Energy Institute and the Royal Society of Chemistry. He has over 300 publications and is currently an Adjunct Professor at the Dept. of Material Science and Chemical engineering, State University of New York, Stony Brook. Currently active on the board of directors of STLE he volunteers on the advisory boards of several universities. More information on Raj can be found at https://www.nlgi.org/nlgi-veteran-member-raj-shah-presented-with-numerous-honors-in-2020/

NLGI COMMITTEE UPDATE

Editorial Committee

Josh Sheffield, Livent Corporation, Chair

The Editorial Committee collaborates on content circulated to NLGI members and non-members including *The NLGI Spokesman*, and Ask the Expert Q&A.*Consists of three sub-groups

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Improve content and readership for The NLGI Spokesman.

Editorial Review –
Peer review process for technical papers submitted in The NLGI Spokesman.

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NLGI SPOKESMAN

***If interested in serving on a committee/sub-group, complete the volunteer form on the NLGI website. Please don't hesitate to contact NLGI HQ with any questions: 816.524.2500 or nlgi@nlgi.org.**

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The NLGI SPOKESMAN is pleased to announce the launch of a new section within its publication titled "VALUE -ADD." The theme of this new section is to highlight changes, advancements, best practices in lubrication and maintenance, as well as challenges in the grease industry as they relate to customer centricity, general grease issues, suppliers, supply chain, education and other non-traditional technical related topics that are current to the grease industry. NLGI leadership is excited to provide additional value to *The NLGI Spokesman* readers and welcome future articles that bring insight into our industry.

Contact nlgi@nlgi.org for more information on how to submit.

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Select your ad plan before 2023 and save on your Spokesman and NLGI advertising.

- 10% off with 1 year *Spokesman* or Web advertising plan.
- 5% off with 3 *Spokesman* advertising plan.
- 5% off with 6 month web advertising plan.

Select Ad Options

Retrospective
NLGI Decades
70's & 80's

1970
NLGI Personnel received medical coverage as an employee benefit

Recommendation to increase board of directors size to 22 by nominating committee

1971
Board approved waiving registration fees for any honorary members wanting to attend the Annual Meeting

Closely following the developments from the Clean Air Act of 1970 and how it could affect the grease industry

1972
Held a mine tour for invited members showing how the operations yielded eight different minerals

1973
The Grease Education Course was considered a success with approximately 115 enrolled

Proposed adding Consumer as a new membership category

1974
42nd Annual Meeting was held at the Drake Hotel in Chicago, IL

Proposed Constitutional changes to all new Consumer membership category

1975
Membership reaches 146 members

1976
Awarded the Clarence E. Earle Memorial Award for 1st time since 1968

Board authorized $800 expenditure for the development of an EP grease

1977
Removed Fluid Gear Lubricants' section from Grease Production Survey due to lack of quality information

Submitted necessary paperwork to obtain copyright of Grease Service Classification

1978
Sweetheart roses were provided for each lady present at the Annual Banquet

Membership reaches 164 members

With increasing numbers in the Marketing and Technical membership categories, suggested having the content of the Annual Meeting reflect this shift

1979
Annual meeting attendance at The Park Hotel in Toronto, Canada was a record high with 502 attendees

Name changed from "Ladies Activities" to "Spouses Activities" at the Annual Meeting

Offered $25,000 term life insurance policy for each NLGI employee

1980
Registration of the NLGI Spokesman with the Copyright Clearance Center (CCC) was finalized

Eighth consecutive year that NLGI has shown net gain in revenue

1981
Board approved including a list of participating companies in the Grease Production Survey

Decided that NLGI should be involved with the International Standardization Organization (ISO) and possibly create a committee to keep pace of ISO activities and report back to the Board

1982
Record breaking attendance at Annual Meeting reaching 515 attendees

Membership reaches 209 members

1983
Celebrated the 50th Golden Anniversary Annual Meeting at the Westin Crown Center Hotel in Kansas City, MO

NLGI received a proclamation from the Governor of Missouri declaring the week of October 23 – 29, 1983 as the National Lubricating Grease Week

Membership reaches 216 members

1984
Annual Meeting was at The Point in Phoenix, AZ

1985
The first Fun Run event was held at the Homestead Resort in Hot Springs, VA

1986
The annual meeting was held at the Hotel del Coronado in San Diego, CA

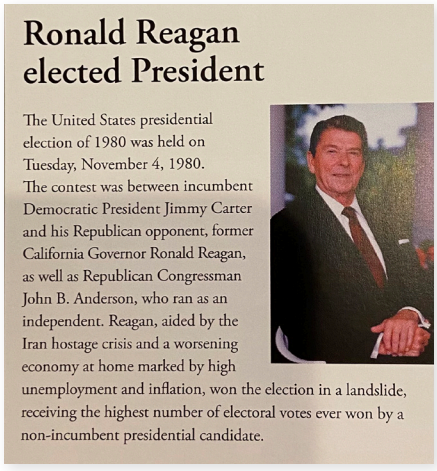
80 attendees registered for the Grease Education Course

1987
The Four Seasons in Toronto, Canada, was the site for the Annual Meeting

3,000 Lubricating Grease Guides (2nd Edition) were printed

1988
The General Session was opened by Representative Michael Bilirakis, U.S. Congress, of Florida

1989
ELGI was formed to primarily focus on the needs of the European grease community



NLGI: 2023 Call For Papers

Submissions for 2023 are now open

Grease is a critical and often overlooked lubricant used in many applications. Our membership and conference attendees are interested in papers related to the advancement of grease technology and grease knowledge in general. For our upcoming conference, we are interested in grease-related papers from a range of topics, including:

- Thickener development or improvement
- Raw material selection and evaluation
- Base oil / fluid selection and evaluation
- Evaluation and use of performance additives
- Tribology
- Grease testing
- Test method development
- Manufacturing processes and improvements
- Environmental, regulatory and safety issues
- Applications and problem solving
- Condition monitoring

Papers covering any other success stories of superior application or improvement of technology are also welcomed. Technical papers approved for presentation at the Annual Meeting may be published in The NLGI Spokesman, after evaluation by the NLGI Editorial Review Committee. Presentation timeslots are 40 minutes each, including 30 minutes for presentation and 10 minutes for Q&A.

NLGI is now accepting Papers for the 2023 Annual Meeting on June 4-7 at the Hotel del Coronado in San Diego, CA, USA. Two types of Papers are eligible:

Industry Related to Substantive Issues

- If submitting an Industry Paper, it cannot be deemed too commercial. If so, it may be rejected.
- Papers are considered for publication in The NLGI Spokesman and will be copyrighted by NLGI.
- All papers must be original to the extent that they have not been published in any other magazine nor presented identically before any society, unless permission has been granted by NLGI.
- All papers and presentations will be reviewed by the NLGI Technical Committee (see deadlines below).
- Technical presentations must comply with NLGI standards that limit their commercial content (see Author Guidelines for details) with two exceptions:
  - The first (title) and last slides may contain company name, logo or other information
  - Company name and/or logo (small size) may appear in one corner of all other slides
- Avoid use of specific brand names except instruments, reagents, etc. used to perform the work.
- Use chemical, scientific, or generic terms to refer to lubricant-specific products.

Commercial

- If submitting a Commercial Paper, you will be subject to pay a commercial fee ($1,000 USD for members and $2,000 USD for non-members).
- Commercial (or marketing) presentations are not restricted by NLGI standards for commercial content.
- Commercial papers are not eligible for publication in *The NLGI Spokesman*.

If submitting an Industry Paper, it cannot be deemed too commercial (see Author Guidelines below). If so, it may be rejected. If submitting a Commercial Paper, you will be subject to pay a commercial fee ($1,000 USD for members and $2,000 USD for non-members). Papers are considered for publication in the *NLGI Spokesman* and will be copyrighted by NLGI, all papers must be original to the extent that they have not been published in any other magazine nor presented identically before any society, unless permission has been granted by NLGI.

2023 DEADLINES

JANUARY 13, 2023
The following items must be submitted **in full** for consideration:
- Abstract (250 Word Maximum)
- Author Form (one abstract per form)
- Bio (for all authors)
- Photo (for all authors)

FEBRUARY 17, 2023
NLGI will notify all authors of acceptance

APRIL 21, 2023
Draft paper is due to NLGI

MAY 5, 2023
Final presentation / paper is due to NLGI for committee review

HOW TO APPLY

STEP 1:
Review the Author Guidelines

• 2023 AUTHOR GUIDELINES •

STEP 2:
Complete the Author Information Form and submit along with your Abstract, Bio and Photo to nlgi@nlgi.org by January 13, 2023

• 2023 AUTHOR INFORMATION FORM •

For questions, please contact NLGI HQ at 816-524-2500 or nlgi@nlgi.org

Announcing the NLGI E-newsletter!

NLGI

GREASE WORLD

Serving the Grease Industry Since 1933
VOL. 1 NO. 1 JANUARY 2023.

NLGI Grease World, coming to your email on January 2023. Complete with industry news, NLGI strategic priority updates, member introductions, and highlights of people and places!

Enjoy the NLGI E-newsletter with your morning cup of coffee.

ELGI Technical Sustainability Consortium

The ELGI established a Technical Sustainability Consortium, with the intention of providing guidance to define, develop and measure sustainability in the European Lubricants Industry, to address misconceptions on the industry's sustainability capacities, and to take part in the ongoing discussions on sustainability at EU and international level.

With a clearer strategy on sustainability, the ELGI could be more proactive in defending the reputation of the sector on this matter, showcase the value it brings to the environment, society and governance, and lead the whole lubricants value chain to become more sustainable.

ELGISTC Objectives

1. Understanding the uniqueness of grease compared to other lubricants with regard to sustainability particularly CO2 footprint in the production and use phase as well as end of life aspects
2. Providing a sound and robust united industry voice to the European Commission – as a frontrunner in sustainability legislation - and regulators worldwide.
3. Established to have a positive impact on climate over the whole value chain.
4. Combine the pool of knowledge and experience between the ELGI and NLGI.
5. Working with other organisations UEIL, ATIEL, VSI and ATC to avoid duplication of work.
6. A shared vision. From an essential industry with world-wide membership from the one-man business to the global oil giants.
7. Take advantage of a broad spectrum of members. Grease producers, Raw Material suppliers, End Users, Equipment manufacturers with a worldwide wealth of knowledge and experience.
8. Access to relevant and updated legislation and regulatory procedures.
9. Utilising ELGI's experience of running and administering consortia. e.g. ERGTC (REACh consortium)
10. To provide Companies with the knowledge and tools to ensure accountability for all aspects of their industry, and to avoid environmental damage or harmful emissions which could be limited or removed from productive processes and use of their products.

SUMMARY COMMITTEES AND TASK FORCE(S)

Executive Committee

Responsibilities

- Governance of the TFs
- Master record of all input (Regulatory)

Regulation & Communication Task Force

Participants

2 Probity ..... Sofia Oberg
Cargill ..... Gemma Stephenson
RS Clare ..... Gavin Porter
Total Energies ..... Severine Jubault
Carl Bechem ..... Jürgen Groenen
Fuchs ..... Sabine Hausmann
VSI ..... Inga Herrmann

Responsibilities

- Review current regulations
- Feed-back on new regulations (EGD, Global sustainability regulations)
- Risk and impact assessment
- Point of contact with regulators
- Communicate at the Annual meetings
- Communicating to the stakeholders on what the industry is doing.
- Alignment to the SDGs (Regulator bodies, Industry partners)
- Development of terminology / glossary
- Communicating the benefits of the lubricant industry to the end users.
- Societal responsibilities: Investigate the different paths of the ELGISTC members

Carbon Footprint Task Force

Participants

Cargill .....Antony Harris
RS Clare ..... Elaine Littlewood
Eldon's..... George Dodos
Total Energies..... Olaf Kurtz
Castrol*.....Melissa Quinn
Lanxess ..... Wayne Mackwood
LPC..... Archontoula Chatzaki
Axel Christiernsson..... Mark Wheeler
Nynas .....Mehdi Fathi

Responsibilities

- Develop Case studies and test the methodology based on the UEIL model
- Cradle to Gate
- Gate to Gate
- Investigate the way data is shared
- What are the vital parameters for our process(es)
- Develop user manual for model and data collection

End user Task Force

Participants

Total Energies.....Pierre Belot
Castrol .....Melissa Quinn
Afton Chemical .....Joe Kaperick
Lanxess ..... Wayne Mackwood
Falex.....Mike Anderson
Quaker Houghton .....Josef Barreto-Pohlen
DuPont..... Alexandra Nevskaya
Shell..... Olaf Hoeger
OEMS***
VDMA?

Responsibilities

- Identify OEM requirements
- Identify End user requirements
- Carbon offsetting
- Defining the benefit of the grease to the end user.
- Define benchmarks
- Grease handling (packaging / delivery systems)
- Best practices (re lubrication intervals, storage)
- Condition monitoring….

Life Cycle Analysis

Participants

Castrol .....Melissa Quinn
Lanxess ..... Wayne Mackwood
Clariant ..... Eric Nehls
Afton Chemical ..... Chris Pether
DuPont..... Alexandra Nevskaya
RS Care..... Elaine Littlewood
Quaker Houghton .....Josef Barreto-Pohlen
Vickers Oils..... Paul Vickers
Total Energies.....Celine Verrat
Axel Christiernsson..... Mark Wheeler
OEMS…..

Responsibilities

- Case Study / Particular application evaluation
- End of Life
- Define specific use categories
- (Third) party verification

End of Life

Participants
Eldon's..... George Dodos
Afton Chemical ..... Chris Pether

Responsibilities

- Possible reuse
- Industrial symbiosis
- Investigate what happens to grease after use
- Fate of grease
- Criteria for loss levels
- Define how end of life is defined

REGISTER ONLINE

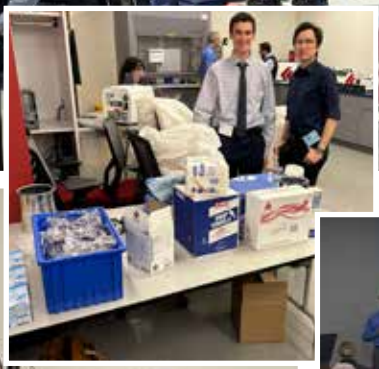
For questions, contact Carol Koopman at carol@elgi.demon.nl.

elgi sustainability technical consortium

NLGI Hands-On Training Recap

November 8-10, 2022 | Koehler Instrument Company, Holtsville, NY

Thank you to our instructors! From L-R
Constantin Madius, AXEL Americas, LLC
Michael Lennon, Afton Chemical Corporation
Brandi Ford, Afton Chemical Corporation
Amanda Harris, King Industries, Inc.
Teresa Makuvek, FedChem
Vincent Colantuoni, Koehler Instrument Company, Inc.
Joe Kaperick, Afton Chemical Corporation
**Not pictured: George Dodos, ELDON'S S.A.*



Thank you to Koehler Instrument Company for hosting the NLGI 2022 Hands-On Training"

SUSTAINABILITY SERIES

At the 2022 Annual Meeting, NLGI held a Sustainability Panel Discussion involving industry experts, Dr. Piet Lugt, SKF, Dr. Ryan Evans, The Timken Company and Andreas Dodos, Eldon's. The discussion was moderated by Joe Kaperick, Afton Chemical Corporation.

As NLGI continues to explore resources to help members with their sustainability efforts, please enjoy this "Sustainability Series" including additional insights on grease from cradle to grave. This sustainability series will run through the March/ April 2023 Spokesman issue.

Dr. Piet Lugt
SKF

Dr. Ryan Evans
The Timken Company

Andreas Dodos
ELDON's S.A.

If we think of the "footprint" in our industry as being the negative impacts of obtaining the raw materials and producing the grease and bearings, what are your thoughts about the positive impacts of these products and how we might quantify these?

The positive impact of lubricating grease is that it reduces friction and therefore helps in reducing energy consumption. The global bearing market is 140 million bearings . The total energy loss in these bearings is about 500 TWh/year. The equivalent of this is 66 million tons of oil equivalent (!) corresponding to about 1% of the total energy consumption (Bakolas, V.,Roedel, P., Oliver Koch and Pausch, M., A first approximation of the global energy consumption of ball bearings, Tribology Transactions, 2021). It is therefore significant to develop bearing solutions with reduced friction. By far most bearings are grease lubricated. Semi-dry friction typically gives a coefficient of friction of 0.6. By using (grease) lubrication this is reduced to say 0.04. one may argue that if there would be no lubricating greases the total energy consumption would be a factor 15 higher. So the word cannot do without lubrication. It is up to our community to reduce friction (performance of lubricants) and reduce the impact on the environment.
- Piet Lugt; SKF

Highly engineered bearings and greases improve machine efficiency and reduce friction throughout the lifetime of equipment – ultimately reducing the power loss experienced by their end users as compared to using less-engineered or standard bearings and greases for the same purposes. In addition, bearings that are optimized for durability and reliability can have longer service times in applications and require less maintenance and shorter replacement intervals. This can save the energy and materials required to produce replacement parts.
- Ryan Evans, The Timken Company

Do you think it is possible to ultimately come up with a single number that combines these "footprint" and "handprint" measurements?

It remains to be seen whether a single number can be agreed upon to illustrate the balance between carbon that is expended going into producing tribological components and lubricants and carbon use that is avoided in end-use equipment utilizing these technologies. We believe it is possible but will require many simplifying assumptions and agreements on definitions of inputs and outputs into that balance.
- Ryan Evans, The Timken Company

Are there other industry organizations that you are either working with or aware of that are doing work in the area of sustainability that you feel we should either model some aspect of within NLGI or that we could "piggyback" on to avoid duplication of effort?

Sustainability is high on the agenda of every company. SKF is working with Environdec (www.environdec.com) to create PCR (Product Category Rules = standardized LCA recipe) as well as EPD (Environmental Product Declarations = Type III / ISO 14025)..
- Piet Lugt; SKF

ELGI is launching a sustainability consortium. Individual companies are working create their own sustainability calculations at the request of their customers and stakeholders, usually within the context of a Corporate Social Responsibility (CSR) report. For example, The Timken Company published its Sustainable Engineering Process within its 2021 CSR (www.timken.com).
- Ryan Evans, The Timken Company

What specific actions do you think NLGI could or should take to help its member companies in relation to sustainability efforts?

- Create an agreed and standardized LCA recipe; a Product Category rule for greases
- Work on Grease recyclability
- Develop standardized test methods for bearing friction and degradability.
- Provide a platform for joint research for
  - Reducing friction
  - Reducing the carbon footprint due to grease consumption
  - Zero Carbon cradle to cradle grease
- Provide support/recommendation for non-hazardous greases ("white SDS")

- Piet Lugt; SKF

NLGI should continue the sustainability dialogue and create networking opportunities to help companies, government agencies, and universities transparently share their progress on these topics and adopt best practices. NLGI should also encourage participation from all points in the value stream, from raw material suppliers to component manufacturers to equipment builders to end users. This may require engaging different functional area experts within organizations than typically associate with NLGI.
- Ryan Evans, The Timken Company

What is a "green grease"?

Green grease
= 1) grease that has a very low friction
= 2) grease that has a very low C02 footprint (cradle to cradle).
= 3) grease without hazardous ingredients
= 4) grease with as less as possible depletion of natural resources (eg. water,…)
- Piet Lugt; SKF

"Green grease" is a vague term. It may refer to a grease that was manufactured from renewable source materials. It may refer to a high-performance grease that has very high life and requires many fewer re-greasing maintenance intervals over the life of a bearing in an application. It may refer to a grease that is biodegradable, food safe, and non-toxic and thereby is easily and safely disintegrated at the end of its life as a lubricant.
- Ryan Evans, The Timken Company

High-Performance Multiuse (HPM) Grease Column

THE BENEFITS

Benefits for Equipment Owners / Grease Users

- **Easily understand your product has passed testing**
  The new HPM certification and enhanced performance tags (improved water resistance, corrosion resistance, etc.) allow grease users to easily identify and understand that your product has passed the proven performance testing required by the program.

- **Enhanced marketing benefits**
  Because this is a new performance standard and program, early adopters will enjoy the enhanced marketing benefits from initial consumer awareness planned for in the coming months.

- **Awareness campaigns in order to create interest**
  The HPM program will be promoted to equipment manufacturers, grease specifiers and maintenance personnel through awareness campaigns in order to create interest and demand for products certified in the HPM Grease Program.

Benefits for Equipment Owners / Grease Users

- **Eliminate downtime and reduce operating costs**
  HPM provides a means to eliminate downtime and reduce operating costs by ensuring that you use a grease certified to a high-performance multiuse HPM grease certification.

- **Ensures products meet performance standards**
  The HPM Grease Program ensures availability of high-performance grease products for the grease user and the program's auditing process ensures that the products can meet the performance standards.

- **Instills confidence in your selection of a grease**
  The HPM performance specification instills confidence in your selection of a grease for your maintenance needs.

- **Streamline your options**
  HPM can streamline your options by standardizing, simplifying and consolidating your inventory.

- **Reduced overall cost of ownership**
  Selecting the right grease and performing preventative maintenance reduces overall cost of ownership and extends equipment life.

- **Helps weed through false marketing claims**
  The additional HPM classification tags such as Water Resistance (+WR), Improved Corrosion Resistance (+CR), High-Load carrying (+HL) and Low Temperature (+LT) help you weed through the marketing claims to make your selections easier when a grease is required to perform beyond normal operating conditions.

Benefits for OEMs And Grease Specifiers

- **Help customers select the right grease**
  Helping your customers select the right grease to perform preventative maintenance reduces your customers' overall cost of ownership and extends equipment life. OEMs and those specifying greases for applications can reference the HPM grease specification and ask suppliers to have their grease products certified for use.

- **Identify where high-performance grease is required**
  For specialized applications (e.g., steel mills), the HPM grease specification may not be the right specification for your application. However, OEMs can utilize the HPM specification for applications where high-performance grease is required. OEMs and grease specifiers can use the HPM grease specification as a foundation on which to build.

HPM APPROVED PRODUCTS

As of November, 2022

Registered Branded Product	Supplier	CORE	Corrosion Resistance	Water Resistance	High Load	Low Temperature
Acinol 152 HQS (US) – All Colors	Axel Americas	CORE+		+WR		+LT
Axellence 652 HQ (US) – All Colors	Axel Americas	CORE+				+LT
Castrol Molub-Alloy 860/460-1 ES	BP Lubricants USA, Inc.	CORE				
Castrol Tribol™ GR SW 460-1	BP Lubricants USA, Inc.	CORE+	+CR		+HL	+LT
Gadus® S3 V220C 2	Shell	CORE+			+HL	
GLEITMO 680 XT	FUCHS Lubricants Co.	CORE				
LML Lithium Complex Grease	Loadmaster Lubricants, LLC	CORE+		+WR		
Mobilgrease XHP™ 222	ExxonMobil Oil Corporation	CORE+		+WR		
MOLYKOTE® Multilub Synthetic High Performance Grease	Molykote Specialty Lubricants	CORE+				+LT
Peerless™ LLG	Petro-Canada Lubricants, an HF Sinclair Brand	CORE				
Peerless™ OG2 Red	Petro-Canada Lubricants, an HF Sinclair Brand	CORE				
RENOLIT CXS BGR	FUCHS Lubricants Co.	CORE+			+HL	+LT
RENOLIT CXS CRM 1	FUCHS Lubricants Co.	CORE				
RENOLIT LX 2	FUCHS Lubricants Co.	CORE				
STABYL LX 460 SYN	FUCHS Lubricants Co.	CORE+			+HL	
Valvoline™ Cerulean Plus #2	Valvoline, Inc.	CORE		+WR	+HL	
Valvoline™ Extreme Red	Valvoline, Inc.	CORE				

FAQ's for Grease Users

FAQ's for Grease Manufacturers

Learn More

Goodbye from 2022 Retired NLGI Member

As we say goodbye to the wonderful members that have been a part of NLGI, let's hear from 2022 retirees on what NLGI has meant to them over the years.

Andy Waynick*, NCH Corporation*

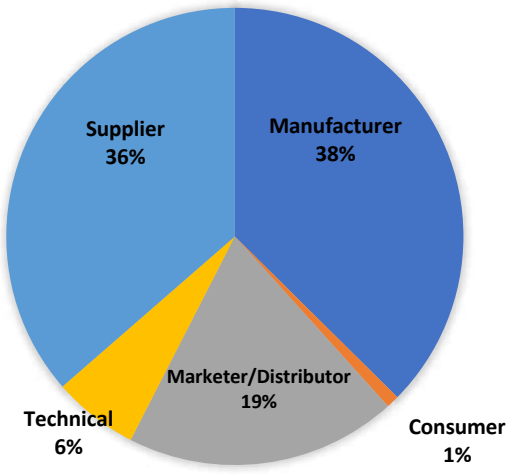
On October 1, 2022, I retired from full-time employment. What a ride it has been! After receiving my Master's in Physical Chemistry from Purdue University in 1977, I began my professional career as a research chemist. It began with two years as a food chemist at Land O' Lakes. Then on to International Harvester, 17 years at Amoco Oil Company, and over 7 years at Southwest Research Institute. For more than 45 years I have had the privilege to work with wonderful scientists from which I learned so much, especially during my early years. Most of those who read this will know me for my work in fluid lubricants and lubricating greases. Over the years, I have been fortunate to be placed in a position to develop new technology in polyurea, simple calcium soap, simple lithium soap, lithium complex, aluminum complex, and calcium sulfonate-based greases. But I also have been able to work in fuel chemistry, especially distillate fuels and biodiesel. In fact, most of my over 40 published research papers have been in those areas rather than in lubricants. Being able to work equally in fuels and lubricants has been an objective from very early in my career for the very simple reason that virtually no one else has done it. Somehow, I have been able to achieve that objective. I have also been very fortunate to have received 42 U.S. patents with several others ready to issue in the coming months. It was never a goal of mine to receive so many patents, but it just seemed to happen.

And I continue to work. I am currently fulfilling a contractual obligation as a technical consultant. My work on the NLGI Membership Committee will also continue. As of January 1, 2023, I will assume responsibility as the Technical Editor of the Spokesman, an opportunity that has me very excited. I also plan to continue to present papers at the NLGI annual meetings.

Those new to the lubricating grease industry may think such accomplishments are the centerpiece of my career. But those who have been around for a while will know better! My personal interactions with friends and colleagues, especially within the NLGI, are the things that matter most to me. And that will not end anytime soon. On another personal front, my wife and I plan to spend more time with our five grand-daughters and my first grandson (due to be born near the end of this November). And then there is my other great love: the trombone. I plan to spend more time playing it at special events at church and other occasions. So, although technically speaking, I am retired, please do not think of me as being put out to pasture. I plan to wear out, not rust out.

NLGI Year End Recap 2022

2022 NEW MEMBERS



- **Barentz North America**
- **Dynamic Green Products Inc.**
- **Pilot Thomas Logistics**
- **SMART PETROLEUM TECH, LLC**
- **Rexol FZC**
- **RILCO Lubricants and Services**
- **LubTechnology**
- **Patech Fine Chemicals Co Ltd**
- **The University of Twente**

95% member retention rate

RESEARCH GRANT

University of California, Merced for their research proposal titled "Novel Ionic Liquids as Grease Lubricant Additives". The grant will take place over a one-year period with expected completion in August 2023.

2022 DEVELOPMENTS

Women in Grease
INTEREST NETWORK
Connecting, Sustaining and Educating Industry Experts Around the Globe

Women in Grease Interest Network

NLGI Women in Grease Interest Network is committed to educating, promoting, advancing, and sustaining industry experts in the lubricating grease industry while emphasizing the need for diversity in management and leadership. This is accomplished by connecting professionals within the industry through networking events, educational workshops and philanthropic endeavors.

Additional Groups Formed in 2022

- **Sustainability Committee**
- **International Committee**
- **EV Ad Hoc**

Additional Developments

- **NLGI joins ELGISTC**

FINANCIAL

NLGI remains financially healthy and on track to produce over budgeted revenue in 2022.

2021-2022 BOARD MEMBERS

President
Anoop Kumar
Chevron Products Company, a division of Chevron U.S.A. Inc.

Vice President
Wayne Mackwood
LANXESS Corporation

Secretary
Tom Schroeder
AXEL Americas, LLC

Treasurer
Chad Chichester
Molykote by DuPont

Immediate Past President
Jim Hunt
Tiarco Chemical

Technical Committee Co-Chair
David Turner
CITGO Petroleum Corporation

Martin Birze
The Lubrizol Corporation

Muibat Gbadamosi
Calumet Branded Products, LLC

Matthew McGinnis
Daubert Chemical Company

Joshua Sheffield
Livent Corporation

David Cardy
Italmatch Chemicals

Maureen Hunter
King Industries, Inc.

Dwaine (Greg) Morris
Shell Global Solutions (US) Inc.

Jeff St. Aubin
Axel Royal, LLC

Chuck Coe
Grease Technology Solutions LLC

Tyler Jark
AOCUSA

John Sander
Lubrication Engineers, Inc.

Pat Walsh
Texas Refinery Corp

Jay Coleman
ERGON, Inc.

Joe Kaperick
Afton Chemical Corporation

Simona Shafto
Koehler Instrument Company, Inc.

Ruiming "Ray" Zhang
Vanderbilt Chemicals, LLC

2022 ANNUAL MEETING

NLGI 89TH ANNUAL MEETING
Finding The Green In Grease

Total Attendees: 321	Basic Course Participants: 29	Advanced Course Participants: 18	CLGS Exam Participants 4
Number of Technical Presentations: 18	Number of Exhibitors: 22	Golf Tournament Participants: 58	Fun Run Participants: 61

The NLGI 89th Annual Meeting was held at the Westin Harbour Castle in Toronto, Canada, June 12 – 15, 2022.

- Industry Speaker Panel discussion regarding sustainability featuring Dr. Piet Lugt, SKF Research and Technology Development, Dr. Ryan Evans, The Timken Company and Andreas Dodos, ELDON's SA.
- Various networking opportunities
- Sustainability Town Hall
- General session
- Awards ceremony

RALPH BEARD MEMORIAL SCHOLARSHIP RECIPIENTS

Jack Janik

Jeff Dreschler

Robert Jackson

NLGI COMMITTEES

Marketing Committee

The Marketing Committee creates awareness of NLGI, events, education, certifications, and other offerings by creating marketing campaigns, promoting events, creating advertising, and posting on social media platforms.

This committee is currently being formed.

Membership Committee

The Membership Committee focuses on membership growth by recruiting new member companies including international expansion. Additional focuses of the Membership Committee include member benefits, membership value and retaining current member companies. The membership committee also offers ambassadors for volunteers who are not able to commit as a full-time committee member. Contact NLGI HQ for more details.

Annual Meeting Committee

The Annual Meeting Committee serves as the advisory group for the Annual Meeting including selecting speakers, award recipients, solidifying technical sessions and direction on the site selection process.

Education Committee

The Education Committee focuses on the overall education strategy for NLGI education including education courses and the certified lubricating grease specialist certification.
*Consists of four sub-groups

✓ **Basic Lubricating Grease Course** – Basic Course focuses on fine-tuning the Basic Grease Courses.

✓ **Advanced Lubricating Grease Course** – Advanced Courses focuses on fine-tuning Advanced Lubricating Grease Courses.

✓ **Hands-On Training** – Hands-On Training focuses on planning and execution of the training.

✓ **Certified Lubricating Grease Specialist (CLGS)** – Must be CLGS certified to participate on this committee. Focuses on the test given at the Annual Meeting.

Editorial Committee

The Editorial Committee collaborates on content circulated to NLGI members and non-members including The NLGI Spokesman, and Ask the Expert Q&A.*Consists of three sub-groups

✓ **The NLGI Spokesman** – Improve content and readership for The NLGI Spokesman.

✓ **Editorial Review** – Peer review process for technical papers submitted in The NLGI Spokesman.

✓ **Ask-the-Expert** – Answer inquiries submitted to NLGI HQ.

Technical Committee

The Technical Committee focuses on technical aspects within the industry and organization. The technical committee is comprised of two main areas – technical and research. The technical group focuses on NLGI's certification marks, working groups, HPM Steering committee and the Annual Grease Production Survey. The research group focuses on annual research grants and academic outreach. *Consists of five sub-groups

✓ **Certification Marks** – HPM, GC-LB, GC & LB certification marks

✓ **Working Groups** – Bio-Based, Food Grade, Grease Specification and Grease Particle working groups

✓ **Production Survey** – Annual survey provided complimentary to NLGI members containing an array of industry information, including global grease production.

✓ **HPM Steering Committee** – Plan and execute on marketing efforts toward HPM.

✓ **Research Grants/Academic Outreach** – Seeks to strengthen the grease industry by fostering relationships with universities containing tribology programs and evolving the organization's research grant program.

***If interested in serving on a committee/sub-group, complete the volunteer form on the NLGI website. Please don't hesitate to contact NLGI HQ with any questions: 816.524.2500 or nlgi@nlgi.org.**

2022-2024 STRATEGIC PRIORITIES

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Women in Grease

INTERNET NETWORK

Connecting, Sustaining and Educating
Industry Experts Around the Globe

First virtual networking event coming early 2023.

Stay tuned for more details.

NLGI Women in Grease Interest Network is committed to **educating, promoting, advancing, and sustaining industry experts in the lubricating grease industry** while emphasizing the need for diversity in management and leadership. This is accomplished by connecting professionals within the industry through networking events, educational workshops and philanthropic endeavors.

EQUALITY | LEADERSHIP | PROFESSIONAL BRANDING | SELF-CARE | ENTREPRENEURSHIP
NETWORKING | MENTORING | PHILANTHROPY

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