Spring 2024

Dear No-Rosion Customer,

We have a couple of important announcements about which we think you'll be quite excited…

The first relates to **shipping charges**, which inflated extraordinarily during and after the Covid period, but we have now found a way to greatly reduce. The second relates to a **new product**, which is designed to provide a new type of protection for the special needs of engines in our older cars.

Since we began shipping product to you twenty-nine years ago, we have shifted back and forth between using **UPS** and **FedEX**. Factors that influenced which we used at various times related to costs, service dependability, and rate of lost/damaged shipments. Net, over the course of the last five years, and especially the last few years, costs of both have become exorbitant, while service has devolved into now being undependable. In fact, since Spring 2020 we've received a total of six price increases from UPS, and nine price increases from FedEX.

We tried negotiating better rates from both. As we're certain you noticed, our shipping prices rose horribly – to the point where, in some cases, it was actually costing more to ship a product than the cost of the product itself! In all regards, this was entirely unacceptable.

Last summer we began testing **USPS (United States Post Service) Priority Mail**. Fortunately, we've found the service to be better overall than UPS/FedEX, while costing lower than both. For these reasons, we now ship all orders via USPS Priority Mail, unless specifically requested by you to do otherwise.

As a result, we're happy to announce that we are now able to **REDUCE** shipping costs as follows: first 4-pk/6-pk ships for $20, with first additional pack costing $8, and all additional packs costing $6/ea. For example, if you order a 4-pk of HyperKuhl, a 6-pk of Combustion Optimizer, and a 6-pk of Octane Booster, your shipping cost is $20 + $8 + $6 = $34. Incidentally, this same shipment via UPS Ground would now cost $50-$80!

California is the exception. It is expensive to ship **ORM-D** chemicals (Other Regulated Materials Domestic) to CA. With apologies, for now, we must unfortunately add a 15-25% surcharge to shipments going into this state.

Having gotten this business item out of the way, let's proceed to the more interesting topic of our new product…

After several years of laboratory and in-field research, we are ready to launch a completely new technology in the form of our newest product, **No-Rosion Fuel System Friction Modifier**. You will find product details in the attached order form. But before we introduce you to this new chemistry, some background info is in order.

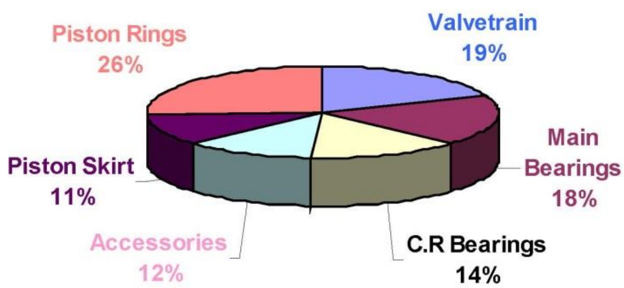
In several landmark studies, the **Society of Automotive Engineers (SAE)** identified that engine wear is highest during *cold startups*. This results from thin layers of corrosion on upper cylinder walls by condensed combustion byproducts. Long shutdown periods, low engine temperature, and high intake-air humidity exacerbate this effect. Secondarily, engine wear also results from *thermal breakdown* of oil, especially in upper rpm ranges.

As an example of the former, with short duration run times of less than 30 minutes, the engine does not reach high enough operating temperature to prevent condensation of combustion byproduct for long enough to get rid of them. Corrosion sets in, and grows worse as the engine cools after shutdown. In the next start of the engine, piston rings scraping away corroded metal films on cylinder walls causes wear.

SAE further investigated the contribution to corrosive wear of engine operating variables such as: length of shutdown period, temperature, and intake-air humidity. Not surprisingly, with longer shutdown periods, wear increases. That being said, most of the corrosion occurs in the first two hours of downtime. Thereafter, a small but persistent rate of increase indicates continuing corrosion over the duration of the shutdown period.

Furthermore, low engine temperatures were found to aggravate wear. Corrosive combustion byproducts such as H_2O (water), SO_2 (sulfur dioxide), SO_3 (sulfur trioxide), and HCl (hydrochloric acid) condense more readily at lower temperatures, and corrode piston ring surfaces and cylinder walls. In an interesting study, SAE compared startup wear after shutdown at room temperature with that after shutdown at 160°F, maintained by circulating hot water through the engine jacket. With the engine at 160°F, condensation of corrosive combustion gases is reduced, resulting in wear (after a 2-hour shutdown) being *reduced by 50%* in a hot engine versus room temp!

Lastly, the same studies found that, after 2-hour shutdown periods, wear is lower up to humidity levels of about 60%. However, above 60% humidity, wear increases sharply, and then levels off at levels greater than 80%.



In a related, but separate, study by **Ford Research and Advanced Engineering**, it was identified that piston rings account for the most frictional loss of any component in an engine, with 26% of loss occurring at the rings. An additional 11% occurs at piston skirts. Therefore, a full *37% of engine friction occurs in the upper cylinders.* Because of this, today OEM's utilize friction-reducing coatings, as well as redesigned, smaller skirts, for the purpose of efficiency improvement.

Today, piston rings are coated with **PVD** (physical vapor deposition), **NiCr/Mo** (nickel-chromium/molybdenum), **DLC** (diamond-like carbon), and **nitrided case-hardening**. Piston friction is reduced by coating with ceramic or polymers (including graphite, carbon fiber, and molybdenum disulfide). Thinner, lower tension piston rings help as well, and currently exert about 50 percent less pressure against cylinder walls than did rings 10+ years ago.

That is the high-tech reality of reducing friction in modern engines. But engines in our older cars enjoy none of these "*tailwinds*." They have untreated, thicker, higher tension piston rings with no friction-reducing coatings, and thus are particularly vulnerable. Now add the fact that many of our older vehicles are not driven regularly, or for long enough durations, and you can easily understand how/why this is an issue. Therefore, in older engines, we rely on additives in oil and fuel as a means of controlling/reducing startup wear.

Until now, our only way of mitigating this issue was via use of **No-Rosion Lubrication System Passivator**. It is an oil additive that combines with engine oil to form tenacious, passive (non-reactive) surface films that prevent iron-oxide surface coatings (corrosion) from forming on cylinder walls, pistons, cams, bearings, crankshafts, and valve guides during idle periods. This protects each of these critical engine components against startup wear and related damage.

In conjunction with SAE, ongoing wear-reduction research has revealed that the most effective way to control upper cylinder wear comes by way of synergistic protection derived from BOTH fuel additives and oil additives. As piston rings come into direct contact with both fuel AND oil, as well as corrosive combustion byproducts, delivering a constant, steady, immediate replenishing source of protection via the fuel stream yields additional meaningful results for upper cylinders.

Thus the impetus for **No-Rosion Fuel System Friction Modifier**. It contains an advanced synthetic ester that is delivered directly to cylinder walls via the fuel stream, to continually replenish friction-reducing surface films. It contains dispersants that deter water absorption, which not only further protects cylinder walls, but also extends fuel pump life. And it contains corrosion inhibitors, for a ***multi-faceted*** approach to complete wear protection.

While developing this new formula, we studied other branded fuel additives in the automotive aftermarket to determine whether any similar product may already exist. We found that a few "**High Mileage Formulas**" do offer upper cylinder friction reduction. However, they utilize an old-school technique of petroleum-based mineral seal oil to deliver added lubricity. This is <u>NOT</u> the best approach. When delivered to upper cylinders via the fuel stream, it acts as deposit precursor that accelerates/exacerbates combustion chamber and intake valve deposit formation. This, in turn, results in longer-term lost performance and increased wear due to heat-insulating effects of said deposits. This is detailed and well-documented in a 1991 SAE study, under the title "*Engine Combustion Chamber Deposits: Fuel Effects and Mechanisms of Formation*."

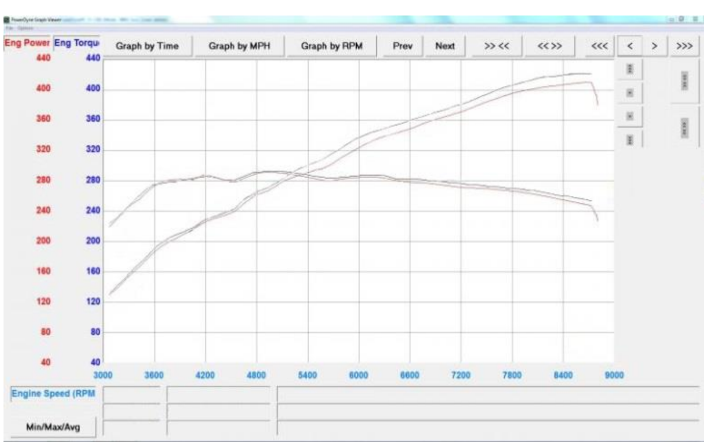
Comparatively, our advanced new proprietary ***alkyl amino ester*** friction modifier has <u>high thermal-stability</u>, and leaves behind no carbon footprint. It is more stable and less volatile than mineral seal oil lubricity additives. As a non-petroleum based ingredient, it won't form carbonaceous deposits or residues no matter how long it is used, or at what dose. Its greater thermal stability allows it to reside on hot metal surfaces longer than conventional petroleum-based friction modifiers, without thermal breakdown. It also better nebulizes in fuel than petroleum-based friction modifiers. Net, it is a far more advanced way of reducing engine wear/friction than old school techniques that use various petroleum-based oils

Through a multi-year, test-and-learn development process, we not only refined the formula's performance for its intended use, but also discovered some curiously beneficial side benefits that lend efficacy to other types of applications as well. What follows are some of the findings…

In the lab, test fuel was additized with **No-Rosion Friction Modifier** to quantify boundary friction coefficients <u>with</u> and <u>without</u> additive. A PCS Instruments HFRR (High Frequency Reciprocating Rig) was used to apply a 4N load between a 6 mm ANSI 52100 steel ball and an ANSI 52100 steel flat. The ball was oscillated over a 1 mm path at a frequency of 20 Hz. This was conducted at a number of different temperatures, and yielded net average friction reduction of <u>18%</u> as compared to non-additized base fuel.

Next, using a BMW 335i having 3.0L I6 DOHC 24V turbo engine, a series of twenty sequential cold starts was performed with and without additive. After each twenty start series, engine oil was drained and analyzed in the lab for iron contaminants as a result of piston ring wear. Baseline wear, without additive, resulted in 9 ppm iron. With additive, wear was reduced to 5 ppm iron. This equates to <u>44%</u> wear reduction!

As a means of gaining insight into thermal stability of our formula's proprietary alkyl amino ester, numerous dyno runs were performed in different test vehicles/engines. The goal was to run rpm as high as possible, as it is in this upper rpm range where more significant friction-related heat develops in upper cylinders, resulting in temporary <u>thermal breakdown</u> of engine oil and thus, related wear. For this reason, a substantial amount of this work was performed using a 2015 Porsche GT3 3.8L engine, with a rev range that extends to 9,000 rpm.

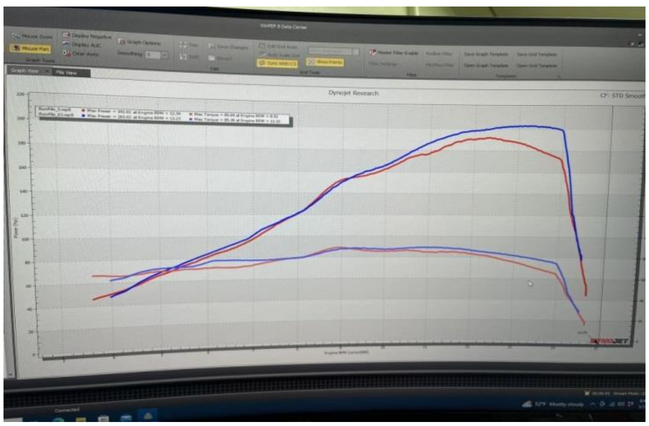


Results were: Baseline, without additive: 410.7 hp. With friction modifier: 426.3 hp. Therefore, a gain of 3.8%.

As you will note in the dyno graph at the bottom of the previous page, most horsepower gain occurred over 4500 rpm. It is in this upper range where more significant friction-related heat develops in upper cylinders, resulting in temporary thermal breakdown of engine oil. Our synthetic ester friction modifier compensates for this effect, as it is delivered *directly* to cylinder walls via fuel injectors.

In separate tests, we evaluated a "**High Mileage Formula**" branded fuel additive obtained from a local auto parts store for its ability to reduce wear and increase horsepower. It contains mineral seal oil for upper cylinder friction reduction. The results were: HFRR net average friction reduction of 12.8%. BMW startup wear baseline, without additive: 9 ppm iron. With additive, 8 ppm. Therefore, wear reduction of 11%. Dyno baseline, without additive: 410.7 hp. With additive: 413.5 hp at the rear wheels. Therefore, a gain of only 0.7%.

So, even though the competitor product does provide friction reduction, it does not seem to correlate to as high a degree of cold-start wear reduction, nor does it provide as significant of hp gain. We believe this relates to the lack of sufficient film strength of its lubricity ingredient (mineral seal oil) to reside/remain on cylinder walls during idle times, or during highest-heat, high-rpm operation. And as already mentioned, when introduced to upper cylinders via fuel, mineral seal oil's petroleum footprint accelerates longer-term, performance-robbing carbonaceous combustion chamber/intake valve deposits that cause further heat build-up.



With this learning in place, we pushed the limits further upward by running a 2023 Ducati Panigale V4 motorcycle on the dyno. Its engine is the amazing 998cc Desmosedici Stradale R that can reach an incredible 16,500 rpm, and makes 207 hp at 13,500 rpm. Results were: baseline without additive, 192.4 hp. With additive, 203.1 hp. So, a whopping 5.6% gain! But like the GT3, said gains came primarily in the upper rpm range, beginning at 9500 rpm and carrying all the way to 14,000 rpm. Again, this is due to temporary thermal degradation of engine oil in these very high heat-producing upper rpm ranges.

As a result of these secondary, but very important, performance-enhancing findings, we have introduced our synthetic friction modifier to a US-based, world-leading branded race fuel provider on an exclusive basis. They now blend it into certain of their racing gasolines as a *power-enhancement*, *wear-reduction* technology.

But it is in older engines with thicker, non-treated piston rings where this technology really shines – and is most needed. For this reason, we're very excited to introduce you to **No-Rosion Fuel System Friction Modifier**.

Please find the enclosed order form that you can use to place your next order. Or for quicker service, visit our web site and order online at: www.NoRosion.com.

We thank you very much for your support, and look forward to continuing to be of service to you and your cars.

Sincerely,

Applied Chemical Specialties, Inc.