Spring 2022

Dear No-Rosion Customer,

A question we are often asked is: **"What's the difference between No-Rosion and HyperKuhl?"**

The best way to answer this question is to begin by considering the similarities. Both are coolant additives that provide ASTM D3306 spec corrosion protection, and both contain wetting agents to aid heat transfer.

Additionally, both contain polymer dispersants that help prevent scales/deposits that rob cooling systems of efficient heat transfer, and both lubricate seals and working parts of water pumps to prevent premature failure.

Now to the differences…

No-Rosion is formulated to provide maximum benefit to engines having mostly cast iron components, and radiators made of copper/brass. It is therefore formulated with IAT chemistry.

HyperKuhl is formulated to provide maximum benefit to engines having mostly aluminum components, and radiators made of aluminum and its alloys. It is therefore formulated with OAT chemistry.

Let's break down each of these formula differences, and explore how/why they provide differential benefits.

One of the most important fundamentals to understand is that aluminum and its alloys have the unique ability to form non-reactive "***passive***" oxide surface films that are very resistant to corrosion. We refer to these types of protective aluminum oxide surface films as "*endogenous*," because they are formed from the metal itself.

Organic Acid Technology, referred to as "**OAT,**" chemically stimulates the surface of aluminum and alloy metals to form highly-protective endogenous surface films. It is these films' resiliency that allows extended service intervals to be achieved when properly applying OAT chemistry in engine coolants. This is the chemistry found in Extended Life antifreeze/coolant, for which a 5+ year service interval typically applies.

Inorganic Acid Technology, referred to as "**IAT,**" functions differently than OAT. Instead of converting the metal to its oxide form to establish a protective surface film, IAT forms surface films composed of, and sourced from, the chemistry of the IAT itself. Because these films are formed of materials sourced externally, or from the corrosion inhibitor component of engine coolant and not the metal itself, they are referred to as "*exogenous*." This is the chemistry found in conventional green antifreeze/coolant, for which a 1-2 year service interval typically applies.

Because iron, steel, copper, and brass don't self-form endogenous oxide surface films in quite the same way as aluminum and its alloys, IAT remains the most effective mechanism of corrosion protection for these metals.

Over time, exogenous surface films tend to slough off metal surfaces as coolant continually passes over them. This requires constant replenishment, and reforming, to occur in order to maintain corrosion protection. For this reason, IAT engine coolants have a shorter service interval, as corrosion inhibitor components are sourced via – and depleted from – the engine coolant.

The mechanism of metal passivation carries certain implications with regard to the amount of time an engine must run to achieve, and maintain, 100% corrosion protection. Key drivers are **heat** and **flow**. The more time the heated coolant flows over the metal surface, the quicker and more thoroughly passivation occurs. Meaning, infrequently-driven collector cars need an additive such as No-Rosion or HyperKuhl to prevent long-term issues.

The different underlying chemistries behind the OAT and IAT corrosion inhibitors in No-Rosion and Hyperkuhl, by default, result in correspondingly different physical properties, per the chart below.

Property	No-Rosion	HyperKuhl
Color	Red (pH-indicator)	Blue (dye)
Density (lbs/gal)	9.34	9.32
pH	11.0	9.8
Inhibitor type	Inorganic Acid (IAT)	Organic Acid (OAT)
# of Wetting Agents	1	3
Wetting Agent Cloud Point	Low	Low, Mid, and High
Nitrite	6%	0%
Oxygen Scavenger	Yes	No
Water Pump Lube	Yes	Yes
Freeze Point (^{o}F)	30	26

As the names themselves indicate, OAT chemistry derives from **organic** (carbon-containing) molecules, whereas IAT chemistry derives from **inorganic** (non-carbon containing) molecules. A typical OAT chemistry is *potassium 2-ethylhexanoate,* plus *azoles* for yellow metal protection. Comparatively, IAT chemistries include *sodium silicate, sodium nitrate*, *sodium nitrite*, and *sodium tetraborate*, plus *azoles* for yellow metal protection.

Whereas organic chemistry is inherently soluble in water, inorganic chemistry is trickier to keep in solution. IAT inhibitors are a super-saturated mix of sodium-based salts that will drop out of solution unless the carrying fluid remains within a specific pH-range, and/or the carrying fluid is of reasonable purity.

This is why conventional IAT-based antifreeze requires annual draining, flushing, and refilling. (Unless No-Rosion is used.) Over time, the pH of coolant drops as a result of several influencing factors. Acidic gaseous combustion byproducts from the engine make their way into coolant, reducing pH. Also, glycol from antifreeze combines with water to form glycolic acid, which further reduces pH. Not only does reduced-pH engine coolant stimulate the corrosion process, it can also cause sodium-based salts in IAT inhibitor chemistries to drop out of solution.

When IAT inhibitors lose solubility, they form greenish/brown "***gels***." They adhere to hot surfaces in heat exchange areas, such as coolant passages in engine cylinder heads, and radiator tubes and headers, to form **scales and deposits**. They also combine with calcium/magnesium ions from hardness in water (if present) to exacerbate deposit thicknesses. **Scales/deposits only 1/16" thick reduce heat transfer by up to 40%!**

No-Rosion contains a **polymer dispersant** that keeps IAT inhibitors in solution. This prevents solubility drop-out, which protects against formation of insulative scales/deposits. It also contains "***reserve alkalinity***" that buffers pH to safe levels, preventing corrosive acidic buildup.

No-Rosion replenishes IAT inhibitor levels as a means of assuring that the exogenous surface film replacement process continues uninterrupted. The result is 100% protection against corrosion and scales/deposits.

No-Rosion can be dosed with pinpoint accuracy using our **Coolant Test Strips**. Because drive frequency, system metallurgy, operating temperature, water purity, and myriad other factors influence depletion rates, testing residuals after a year has passed is a good way to confirm it's time to add more – and if so, how much.

Because OAT chemistry is far more complex to test for, our Test Strips do not apply to use of HyperKuhl. Also, once established, endogenous surface films are less dose-sensitive, so there's less need for testing anyway.

As mentioned, the mechanism of forming passive/protective surface films inside cooling systems, whether of the exogenous or endogenous variety, is dependent on heat and flow. This carries with it important implications in terms of how often the engine is run, and for how long.

In many cases collector cars are operated sporadically, and stored for months at a time. Which of course means that formation, or preservation, of anti-corrosive protective surface films falls susceptible. This is all the more reason that addition of a corrosion inhibitor such as No-Rosion or HyperKuhl is in order.

These differences between No-Rosion and HyperKuhl chemistries result in differential user characteristics depending on your particular needs and application, per the chart below.

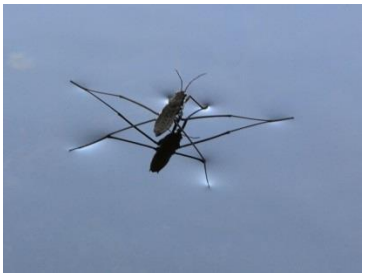
Characteristic	No-Rosion	HyperKuhl
Service Interval	1-2 yrs	2-3 yrs
Cost	$10.00/bottle	$12.50/bottle
Ideal Radiator Type	Copper/brass	Aluminum/alloy
Surface Film Type	Exogenous	Endogenous
Protects Diesel Cylinder Liners?	Yes	No
Dose w/Coolant Test Strips?	Yes	No
Surfactant Cloud Point	Mid-range	Mid-range to High-range

As indicated above, the easiest way to identify which of these two products is best for your application depends on the radiator type. But there are notable exceptions.

Let's say you've got a **diesel engine** with an aluminum/alloy radiator. Most diesel engines have wet sleeve cylinder liners requiring nitrite in coolant to prevent cavitation/erosion. No-Rosion contains nitrite and thus protects wet sleeve cylinder liners. Whereas HyperKuhl doesn't contain nitrite, and won't protect cylinder liners.

Another exception may be if you've got a copper/brass radiator, but experience **overheating**. As HyperKuhl contains three surfactant ingredients that provide wetting performance across a wider range of temperatures, you'll better achieve optimal heat transfer, and better cooling, by using HyperKuhl with straight water. Consider our new **HyperKuhl Pre-Mix** blended with ultra-pure RO water. It's easy to use and doesn't require dosing.

How does HyperKuhl provide enhanced heat transfer, and therefore better protection against overheating?



Coolant absorbs heat inside cylinder heads, and disperses it via the radiator. Critical to efficient transfer of heat in both these areas is close contact of coolant with metal surfaces. Water has a property called *surface tension*, which is caused by the cohesive nature of water molecules. You've seen it first-hand when observing a Water Strider walking on water. While beneficial for this insect, it has the opposite effect in a cooling system, as it prevents coolant from making close enough contact with metal surfaces for optimal heat transfer.

Wetting agents, known chemically as "***surfactants***," are surface active agents that disrupt this cohesive property of water molecules. In a cooling system, this allows closer contact of coolant with the metal surface, resulting in enhanced heat transfer. Or, in the aforementioned example of the Water Strider, a single tiny drop of surfactant placed in the water near him would break the surface tension and cause him to drown!

Every surfactant has what is known as a "***cloud point***." This is the temperature above which it loses solubility and thus its surface tension reduction performance.

No-Rosion is blended with a **single surfactant** having a cloud point designed to provide wetting performance in a normal range of engine operating temperatures. Comparatively, HyperKuhl is blended with **three different surfactants**, each having a different cloud point and thus unique temperature range in which it provides optimal wetting performance. Of these three, the surfactant with the highest cloud point provides wetting performance in a high range of engine operating temperatures, making it suitable for higher-temperature, high-compression engines in performance and racing applications.

This "***tiering***" of different cloud point surfactants in the HyperKuhl formula is similar to the way formulators of motor oils deliver variable viscosity via **multi-weight oils**, for example. And with HyperKuhl, is what allows it to provide optimal heat transfer across a wider range of engine coolant temperatures, including very high ones.

Here's the bottom line: **Preventing iron corrosion is markedly different than preventing aluminum corrosion.**

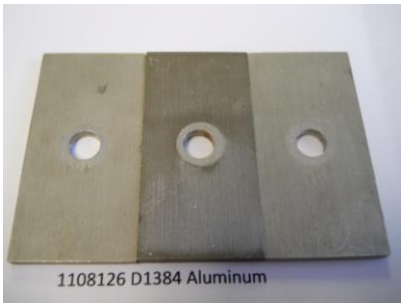
Higher pH environments devoid of oxygen suit iron well. This is why No-Rosion is blended with an ***oxygen scavenger*** – and is why its formula includes a built-in pH indicator that visually turns from pink to clear when pH falls below 8.5. As oxygen doesn't act as a catalyst for aluminum corrosion, and aluminum actually does better in slightly lower pH ranges, HyperKuhl's formula does not include an oxygen scavenger or pH-indicator.

Importantly, when used as directed, No-Rosion and HyperKuhl both provide corrosion protection sufficient to surpass specifications as established by **ASTM D3306**. This is the standard engine coolant spec used by all OEM auto manufacturers. As case in point, below are photos of aluminum test specimens from the **ASTM D1384 Standard Test Method for Corrosion Test for Engine Coolants**, one of the tests included in ASTM D3306.

As you'll note, samples tested with a 50/50 mix of IAT antifreeze suffered corrosion, whereas samples tested with No-Rosion and HyperKuhl both formed nicely passivated surface films that protected against corrosion.

Conventional 50/50 IAT antifreeze

RO water with No-Rosion



RO water with HyperKuhl

Be sure to watch for our Fall 2022 newsletter, in which we'll review test results of fuel economy improvements from using **No-Rosion Fuel System Combustion Optimizer**, and see that at gas prices of $4.00+/gallon, it actually pays for itself after only a few tanks…

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.

Applied Chemical Specialties, Inc.