



Spring 2016

Dear No-Rosion Customer,

If this year's early arrival of warm temperatures is a sign of what's to come, we'll have some serious heat to deal with this summer. Fortunately, we've got good news regarding how we can help your cars keep their cool...

We have completely reformulated our HyperKühl Super Coolant. But unlike most product reformulations, which are **evolutionary** in nature, this reformulation of HyperKühl is **revolutionary**! Let me tell you how/why....

Both of our coolant additives – No-Rosion and HyperKühl – contain a robust corrosion inhibitor package. In the past, they have shared the same package. The only difference has been that they contain different surfactants. No-Rosion contains a single surfactant. But HyperKühl contains multiple surfactants – a mix of **high cloud point surfactants** that reduce nucleate boiling at the cylinder heads, and **low cloud point surfactants** that reduce surface tension inside the radiator. The result is decreased engine temperatures.

With this reformulation, the new HyperKühl formula contains an entirely new corrosion inhibitor package.

The old formula is what we call a **hybrid** technology, because it contains a **mix** of both inorganic and organic chemical ingredients. They form **exogenous** surface films that reside on metal surfaces. In this context, the word “exogenous” means that the protective surface film comes from “outside” the metal. It is formed from adhesion of the chemical ingredients in the additive to the metal surface via electrochemical bonding.

As the ingredients in the coolant flow over the metal surface, they are constantly sloughed off and replaced. This continual replenishment process forms passive, non-reactive, protective surface films that prevent corrosion. But proper replenishment is contingent on maintaining the recommended dose of additive in the coolant at all times. That is why we always recommend that it be added every year, so it doesn't deplete.

The old formula is very “loaded”, and contains a complex mixture of borate, nitrite, silicate, alkali builders, azoles, and other ingredients. They function synergistically to provide protection to **all** metals found in automotive cooling systems. These metals include, but are not limited to: iron, steel, copper, brass, lead (solder), and various aluminum-containing alloys.

In order to maintain all these ingredients in solution, and provide the requisite reserve alkalinity, it's necessary to blend the product at a high pH. So the pH of our old formula is in the range of 10 to 11. This pH works very well for ferrous (iron-containing) and yellow (copper/brass) metals. But it can be less than ideal for aluminum, for which a slightly lower pH is more suitable. A well-formulated additive (such as No-Rosion) provides robust aluminum protection even at an elevated pH. But it makes things a bit more challenging.

As you know, copper/brass radiators are a thing of the past. Radiators in new cars and trucks are made of aluminum alloys – as are most engine blocks and cylinder heads. This was a key driver in the reformulation of HyperKühl Super Coolant. We needed to update/upgrade this product to provide a superlative level of aluminum alloy protection, while providing maximum temperature reduction for today's small-displacement, high-compression, high-revving, high-performance (often turbo-charged), high-heat-generating engines.

That's exactly what we have created with this reformulation.

Beauty lies in simplicity. The new formula is less complex than the old one. It relies on a proprietary, 100% organic acid technology (OAT) that allows us to blend it at a lower pH. But it's not just the lower pH that sets it apart. The mechanism of corrosion protection with this new chemistry is entirely different as well.

Whereas the old formula forms **exogenous** surface films, the new one forms **endogenous** surface films. In other words, the protective surface film is composed of the oxide form of the metal itself! In this way, the OAT ingredients in the new formula stimulate the metal to form its own passive, non-reactive oxide surface film – much like in-situ anodizing.

There are many advantages of endogenous surface films over exogenous surface films, mostly when they are used in aluminum alloy radiators. Once formed, they are highly resilient because they don't continually slough off and require replenishment, as do exogenous films. This makes them less dose sensitive, and longer-lasting.

And because they are composed of the metal itself, they penetrate deeper into the surface. This makes them more impenetrable to contaminants, such as tiny chloride and sulfide ions. This is important, as these two types of contaminants, in particular, are responsible for an increasing percentage of alloy radiator failures.

Additionally, endogenous films are 20%-30% thinner than exogenous films. This allows greater transfer of heat to take place at metal surfaces inside aluminum alloy radiator tubes. Though minor on a per-unit surface area basis, this effect is magnified when applied to the significant amount of surface area inside an entire radiator. When combined with the surfactant chemistry in our HyperKühl formula, the result is a net increase in heat transfer, and a cooler-running engine. How much cooler?

We performed temperature reduction testing in copper/brass and aluminum radiators. Both formulas were tested in a 50/50 mix, as well as straight water coolant. Below is a breakdown of results that shows: (a) reductions in stabilized coolant temperatures, and (b) reductions in cylinder head temperatures.

Coolant Type	Copper/Brass Radiator	Aluminum Alloy Radiator
50/50	(Baseline)	(Baseline)
50/50 + old formula	-5° to -7° F (coolant) -10° to -18° F (heads)	-5° to -7° F (coolant) -10° to -18° F (heads)
50/50 + new formula	-5° to -7° F (coolant) -10° to -18° F (heads)	-5° to -9° F (coolant) -10° to -29° F (heads)
Water	(Baseline)	(Baseline)
Water + old formula	-12° to -16° F (coolant) -22° to -36° F (heads)	-15° to -20° F (coolant) -26° to -47° F (heads)
Water + new formula	-12° to -16° F (coolant) -22° to -36° F (heads)	-16° to -25° F (coolant) -32° to -66° F (heads)

IMPORTANT NOTE: The new formula only provides incremental temperature reduction in aluminum alloy radiators. It does NOT provide incremental temperature reduction when used in copper/brass radiators.

SEPARATELY: In recent years, there has been a significant shift in the way OEM and aftermarket aluminum alloy radiators are being manufactured. This trend is being driven largely by the initiative to build lighter vehicle components. Lighter components (such as radiators) will help OEMs to meet the upcoming federally-mandated strict fuel economy standards. Lighter radiators also benefit high-performance applications in the aftermarket, of course, as weight is always the enemy in racing.

HERE'S THE CHALLENGE: Aluminum is highly malleable. That's why, historically, less complex 1000, 3000, and 4000 series alloys have been used to build radiators. Their high aluminum content yields excellent weldability, brazeability, and solderability. But as aluminum radiator tubes get thinner and lighter, they lose tensile strength. To compensate, it's become necessary for manufacturers to switch to complex alloys that contain less aluminum. That's why today's alloy radiators are built of more complex alloys in the 2000, 5000, 6000, 7000, and 8000 series. These alloys' lower aluminum content yields higher tensile strength.

Alloy Series	Metals in Composition	Tensile Strength (MPa)	Complexity
1000	Aluminum	70-175	Low
2000	Aluminum-Copper-Magnesium	380-520	High
3000	Aluminum-Manganese-Magnesium	140-220	Low
4000	Aluminum-Silicon	205-330	Medium
5000	Aluminum-Magnesium-Manganese (3-6% Mg)	280-380	High
6000	Aluminum-Magnesium-Silicon	250-380	High
7000	Aluminum-Zinc-Magnesium-Copper	620-620	High
8000	Aluminum-Lithium-Copper-Magnesium	280-560	High

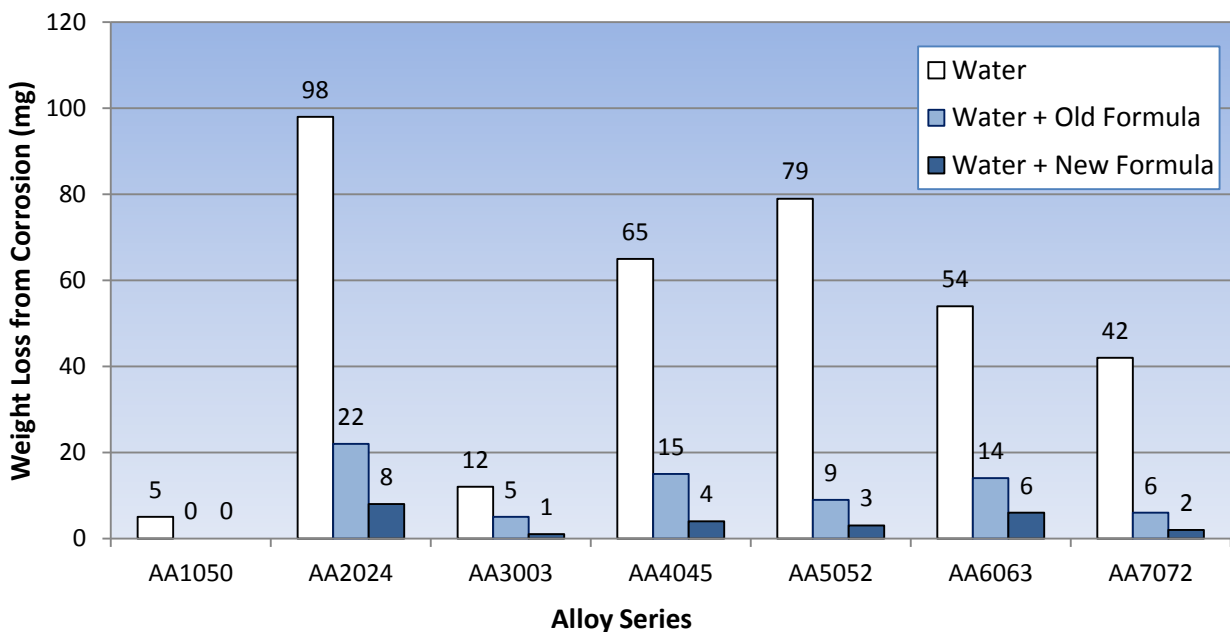
HERE'S THE PROBLEM: Complex alloys exhibit different corrosion behavior than less complex ones. They are vulnerable to what is called *intergranular corrosion*. We call it **IGC** for short.

IGC occurs when the different metal constituents in an alloy react electrochemically with one another. In complex alloy radiators, coolant contaminants act as electrolyte catalysts that stimulate and support IGC. Chloride is the most common culprit. And because chloride is being found more and more in municipal water sources (especially in coastal cities), this type of corrosion will become even more of a problem in the future.

IGC is *autocatalytic*. This means that, once it begins, it continues until the entire thickness of the alloy is penetrated, and a leak occurs. Usually leaks as a result of IGC in alloy radiators appear as pinhole leaks.

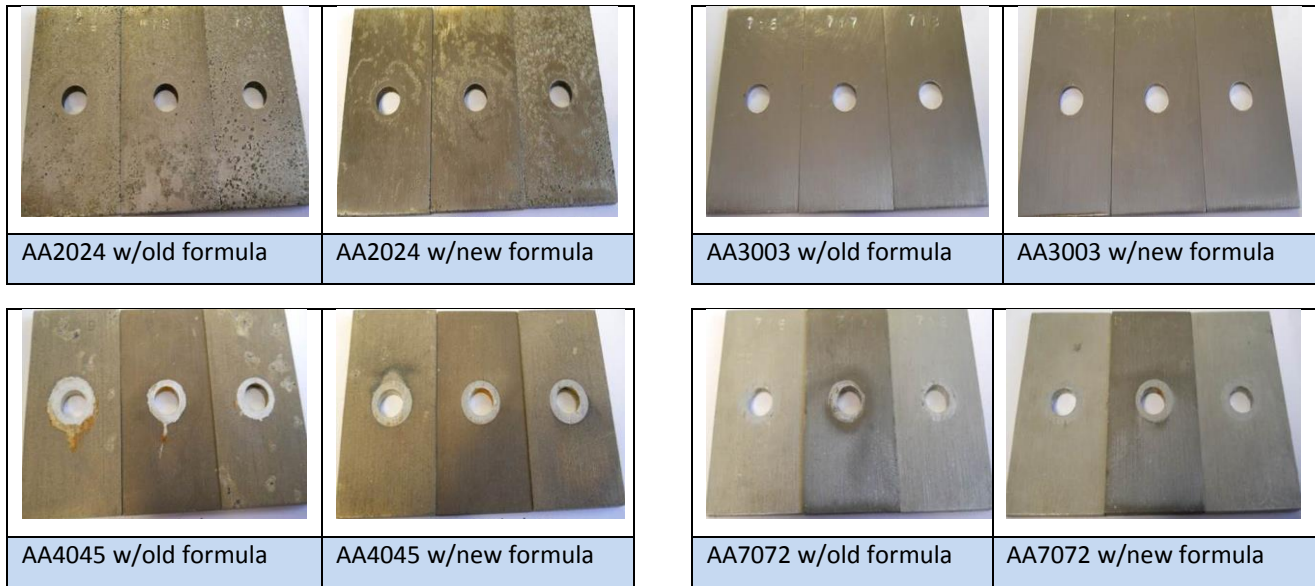
The increased resiliency of endogenous oxide surface films in our new HyperKühl formula are more effective at preventing IGC in complex alloy radiators – even in the presence of chloride. How do we know?

We ran a modified **ASTM D2570 Simulated Service** test. We compared our old and new formulas' ability to protect alloys from corrosion in an artificially extreme corrosive environment. Simulated corrosive coolant containing 265 ppm chloride was circulated at a flow rate of 84 L/min for 1,064 hours at 190°F in a loop consisting of a metal reservoir, a coolant pump, a radiator, and connecting rubber hoses. Alloy test specimens were mounted inside the reservoir. At the end of the test period, the corrosion-inhibiting properties of the coolant were determined by measuring the weight losses of the test specimens, and by visual examination of the interior surfaces of the alloy test specimens. The results are presented below.



As the data in this graph shows, both our old and new HyperKühl formulas are effective in protecting alloys from IGC – even in the harshest, most corrosive conditions. But our new formula is **MORE** effective, by a factor of about three.

Here are some photos of the alloy test specimens after the test was completed:



SO HERE'S THE BOTTOM LINE: Our new HyperKühl formula provides better protection of today's complex aluminum alloy radiators, and even slightly enhanced engine temperature reduction for some applications. But it's not the most suitable product for all applications. That's why we recommend the following...

For copper/brass radiators: Use No-Rosion Corrosion Inhibitor. It is ideally suited for cooling systems that contain copper/brass radiators, and engine blocks/heads composed of iron and/or aluminum. It contains a robust mixture of inhibitor ingredients that function synergistically to provide complete multi-metal corrosion protection. And it contains a basic wetting agent that helps to enhance heat transfer. Add it once per year.

For aluminum alloy radiators: Use HyperKühl Super Coolant. It is formulated for higher aluminum content systems, and/or sensitive alloy radiators. It contains endogenous surface film technology that protects aluminum alloys from IGC, even in the presence of contaminants. And it contains multiple surfactants that provide maximum heat transfer, for high-performance, high-heat applications. Add it once every two years.

To run as cool as possible this summer, remember: High octane gasoline prevents detonation and helps your engine to run cooler as well. Our No-Rosion Octane Booster is one of very few products that contains the metallic boost ingredient MMT – the closest thing you can get to real tetraethyl lead. Use it along with HyperKühl Super Coolant to keep your engine cool and free of detonation!

Enclosed is a form you can use to place your next order for high-quality No-Rosion and HyperKühl products. Or, for faster service, please place your secure, encrypted order online at our web site: www.NoRosion.com.

Thank you, as always, for your continued patronage and support.

Sincerely,

Applied Chemical Specialties, Inc.