

Key Performance Advantages

- Inhibits staining
- Emulsifies and lubricates
- Optimizes performance



Metalworking Fluids

CORRGUARD[®] SI CORROSION INHIBITOR

A Premier Staining Inhibitor for Metalworking Fluids for Use with Aluminum Alloys, Galvanized Steel and Galvaneal

Aluminum alloys are used as components in a variety of applications, in particular automobile and aircraft construction. The combination of high strength/weight ratio and corrosion resistance makes these alloys ideal for fuel-efficient vehicles. One known concern associated with the manufacturing of parts from aluminum alloys is their tendency to stain in contact with water-based metalworking fluids. Water itself stains aluminum, as do various additives such as amino alcohols. Staining can be undesirable because it adversely affects the appearance of finished parts. Staining can also be a problem with galvanized steel and galvaneal.

ANGUS has responded to the need for improved aluminum and galvanized steel staining control by developing an exceptional multi-functional, environmentally preferred staining inhibitor, CORRGUARD[®] SI. This material inhibits staining on common aluminum alloys, including cast Al 380, as well as galvanized steel and galvaneal.

CORRGUARD SI Corrosion Inhibitor is effective at concentrations as low as 0.05% (working dilution) in some formulations. This distinct building block is free of silicates and phosphorus. It is registered in the U.S., Canada, Western Europe, Japan, Korea, Australia and China.

Typical Uses

CORRGUARD SI Corrosion Inhibitor is designed primarily for use as an aluminum alloy, galvanized steel and galvanic staining inhibitor, but also provides emulsification and lubricity properties. This multi-functionality may allow other formulation ingredients to be reduced, allowing fluid cost and performance to be optimized.

Typical Properties

The following are selected physical characteristics of CORRGUARD SI. They are not to be considered product specifications.

Chemical type	Organic, anionic
Appearance	Yellow to brown liquid or gel-like solid
Solubility	Oil soluble, water dispersible
Color	Gardner 5
Viscosity at 25°C	1600 centipoise (cP)
Specific gravity at 25°C	0.9398
pH (0.1% aqueous)	7.9
Flash point (Setaflash closed cup)	210°F

CORRGUARD SI Corrosion Inhibitor can become a gel-like solid below 21°C (70°F). For ease of handling, it is recommended to store product at, or above, this temperature. Product that has solidified can be warmed to 40°C to return it to a uniform liquid. Product performance and formulating characteristics are unaffected by the physical appearance of CORRGUARD SI.

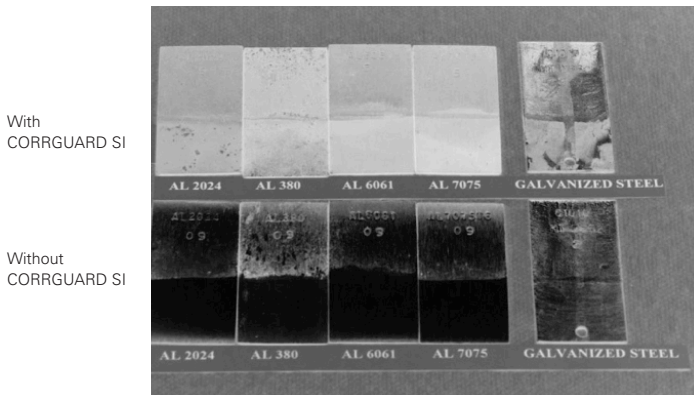


Figure 1. Effect of 0.1% CORRGUARD SI in Tap Water at pH 9.5

Aluminum and Galvanized Staining Control

CORRGUARD SI Corrosion Inhibitor effectively inhibits staining of aluminum (Al) alloys and galvanized steel in contact with water-based metalworking fluids (MWFs). Depending upon the alloy and MWF formulation, CORRGUARD SI is effective at 0.05–0.3% in the end use dilution. Staining control was evaluated by half-immersing Al alloy and galvanized steel coupons in pH controlled water with and without CORRGUARD SI. Figure 1 demonstrates the results when 0.1% CORRGUARD SI is added to Chicago, IL, USA tap water. Staining is completely eliminated in liquid phase contact areas on all alloys tested; the bottom half of the coupon was exposed to liquid while the top half was exposed to air. This is especially significant for the Al alloys because the pH was adjusted to 9.5 (using potassium hydroxide), a condition where staining can be more difficult to eliminate. Staining is not eliminated in the vapor phase because CORRGUARD SI is a non-volatile inhibitor.

CORRGUARD SI was tested in generic semi-synthetic and synthetic metalworking fluids known to stain Al alloys; the fluid formulations are shown in the Appendix. Two percent CORRGUARD SI was added to the fluid concentrates which were then diluted 20:1 in Chicago tap water, giving 0.1% CORRGUARD SI at dilution. Pictures comparing the staining properties of fluids with and without CORRGUARD SI are shown in Figures 2 and 3.

CORRGUARD SI at higher dosages emulsifies hydrocarbon oils. This is demonstrated in Figure 4, where one part severely hydrotreated naphthenic oil with varying amounts of CORRGUARD SI was mixed with 20 parts of Chicago tap water (125 ppm hardness). A reasonable emulsion is formed with 10–12% CORRGUARD SI in the base oil.

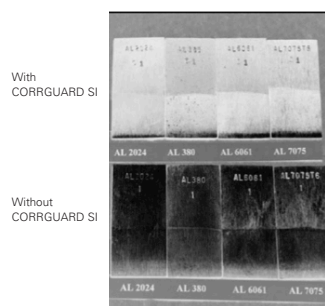


Figure 2. Effect of CORRGUARD SI in Semi-Synthetic Fluid

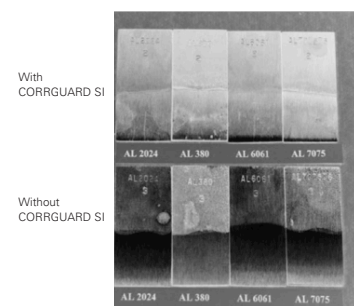


Figure 3. Effect of CORRGUARD SI in Synthetic Fluid

Lubricity Properties

CORRGUARD SI Corrosion Inhibitor provides lubricity at higher dosages. This is demonstrated using a simple Falex Pin and Vee test (ASTM D 3233), where failure load and torque using tap water with and without 0.3% CORRGUARD SI were measured.

Test Fluid	Pin/Vee Materials	Failure Load (lbs)	Torque at Failure (lb-in)	Temperature at Failure (°C)
Water	Steel/Aluminum*	1000	91	94
Water +0.3% CORRGUARD SI	Steel/Aluminum*	1000	22	57
Water	Steel/steel**	300	26	51
Water +0.3% CORRGUARD SI	Steel/steel**	1500	32	63

* Pin = M2 steel; Vee = 356-T6 aluminum

** Pin = AISI 3135 (#8) steel; Vee = AISI C-1137 steel

CORRGUARD SI increases the failure load significantly with steel on steel. With steel on aluminum the failure load relative to water alone is unchanged, however torque and temperature at failure are significantly reduced. These results confirm that CORRGUARD SI provides a mild level of lubricity.

Other Advantages

As a silicate-free material, CORRGUARD SI Corrosion Inhibitor will not blind ultrafiltration membranes. CORRGUARD SI is relatively non-volatile and will not contribute significantly to volatile organic compound (VOC) emissions from metalworking fluid manufacturing facilities or plants using these fluids. CORRGUARD SI can be easily removed from wastewater using traditional methods such as acid-alum split, as well as more recent techniques like ultrafiltration. Additionally, CORRGUARD SI is not likely to persist in the environment.

Amino alcohols are known to contribute to aluminum staining, and staining severity is often related to amine concentration. Fluid pH is important, and the lowest pH allowing overall fluid performance requirements to be met is recommended.

The oil solubility of CORRGUARD SI Corrosion Inhibitor makes it easy to formulate into soluble oil and semi-synthetic concentrates; addition with oil and oil-soluble components is advised. CORRGUARD SI is easily dispersed in synthetic fluid concentrates, however production of clear concentrates is more challenging and requires the addition of coupling agents; inversely soluble esters are useful.

Higher Dosages

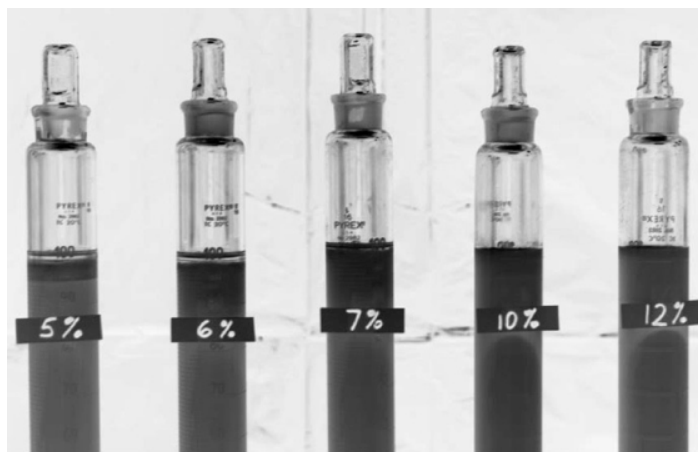


Figure 4. Higher Dosages of CORRGUARD SI Emulsify Hydrocarbon Oils (Percentages shown represent CORRGUARD SI in undiluted base oil.)

CORRGUARD SI Corrosion Inhibitor is a surface active material, and can generate foam at higher use levels. Optimizing the formulation dosage is important to minimize foaming. Since CORRGUARD SI provides emulsification, other surface-active materials may be reduced in an effort to meet low foaming requirements.

Application Guidelines

The following application guidelines may be helpful as you consider CORRGUARD SI for your application.

Prevention of Aluminum Staining

CORRGUARD SI is effective in preventing staining of aluminum alloys in liquid contact areas. It has been tested successfully on alloys 356, 380, 2024, 3003, 6061 and 7075. The typical use level (at dilution) is 0.05 to 0.3%.

Prevention of Staining on Galvanized Steel

CORRGUARD SI can be effective on standard galvanized steel, as well as annealed galvanized (galvaneal). The typical use level is 0.05 to 0.3% at dilution.

Magnesium

CORRGUARD SI will not prevent staining of magnesium or its alloys.

Water Hardness

CORRGUARD SI is typically effective up to a water hardness level of 300 ppm.

Cation Compatibility

Because CORRGUARD SI is anionic, it is generally incompatible with cationics such as certain biocides and surfactants. Reactions between these materials will adversely affect the performance of each.

Depletion

CORRGUARD SI can be depleted during use through reaction with metal surfaces (as well as cations and water hardness mentioned previously). In most cases, tankside addition will be required at regular intervals. CORRGUARD SI should be added at a point of good agitation. Please consult ANGUS if you require an analytical method for monitoring CORRGUARD SI.

Galvanic Corrosion

CORRGUARD SI will not prevent galvanic corrosion. Galvanic corrosion can occur wherever multiple metals are machined with the same fluid. Where galvanic corrosion is possible, ANGUS recommends using triazole chemistries, such as tolyltriazole in combination with CORRGUARD SI. Replenishment of both chemistries will be required to maintain good control.

pH Effect

CORRGUARD SI is effective in fluids formulated above pH 8. It is not recommended for use below this pH level.

Handling Precautions

Before using this product, consult the Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS) for details on product hazards, recommended handling precautions and product storage.

CAUTION! Keep combustible and/or flammable products and their vapors away from heat, sparks, flames and other sources of ignition including static discharge. Processing or operating at temperatures near or above product flashpoint may pose a fire hazard. Use appropriate grounding and bonding techniques to manage static discharge hazards.

Storage

Store product in tightly closed original containers at temperatures recommended on the product label.

CORRGUARD SI Corrosion Inhibitor may be stored in carbon steel or stainless steel equipment. Copper and copper-containing alloys should not be used as they are incompatible with the product. Schedule 40 steel pipe should be used. Gaskets made of materials suitable for mildly basic conditions are acceptable.

Disposal Considerations

Dispose in accordance with all local, state (provincial) and federal regulations. Empty containers may contain hazardous residues. This material and its container must be disposed in a safe and legal manner.

It is the customer's responsibility to verify that treatment and disposal procedures comply with local, state (provincial) and federal regulations.

Product Stewardship

ANGUS encourages its customers to review their applications of ANGUS products from the standpoint of human health and environmental quality. To help ensure that ANGUS products are not used in ways for which they are not intended, ANGUS personnel will assist customers in dealing with environmental and product safety considerations. For assistance, product Safety Data Sheets, or other information, please contact your ANGUS representative at the numbers provided in this document. When considering the use of any ANGUS product in a particular application, review the latest Safety Data Sheet to ensure that the intended use is within the scope of approved uses and can be accomplished safely. Before handling any of the products, obtain available product safety information including the Safety Data Sheet(s) and take the necessary steps to ensure safety of use.

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