

ASTM Report OPTISHIELD® Corrosion Inhibitor Water Additive

OPTISHIELD® and OPTISHIELD® II are water based coolant additives specially formulated to effectively control corrosion of dissimilar metals commonly used in laser systems, optic systems, semiconductor processing equipment, and other laboratory and industrial heat transfer equipment.

OPTISHIELD® passivates the surface of metals, reacting with the surface to prevent acids from attacking the materials. Other products such as automotive anti-freeze often contain silicates that coat heat transfer surfaces with a silicate gel that reduces heat transfer. Silicates have also been known to damage pump seals.

Because OPTISHIELD® is water based it has excellent heat transfer characteristics. Specific heat, thermal conductivity, and viscosity are similar to that of water. Because the viscosity of glycol based products is higher than water, higher fluid velocities are needed to attain the fully developed turbulent flow desired to obtain optimal heat transfer. Higher velocities translate into increased back pressure. For some applications the increase in ΔP can be substantial and problematic.

Because OPTISHIELD® is a water based product it does not provide freeze protection. It is however compatible with uninhibited ethylene glycols.

In fact OPTISHIELD® also buffers acids formed as a result of glycol oxidation. All glycols produce organic acids as degradation products. This degradation is accelerated in the presence of oxygen and/or heat. Left in solution, such acids lower pH and contribute to corrosion.

The standard ASTM D1384 corrosion test is a screening test that measures the relative corrosion protection provided by different solutions on standard metals under standard test conditions.

The data in Table 1 show relative corrosion rated for OPTISHIELD® compared to uninhibited ethylene glycol and distilled water. The data indicates that solutions of OPTISHIELD® and water fall well within the generally accepted corrosion limits. Rates below 0.5 mg/year (2.5 mg/year for aluminum) are generally considered adequate corrosion protection.

Table 1 – Corrosion Test Results:

Mils Penetration per Year (Weight Loss in Milligrams) rates in Excess of 0.5 mg/y [2.5 mg/y for Aluminum] is generally an indication of inadequate corrosion protection.

	Water	Ethylene Glycol	OPTISHIELD® ⁽¹⁾
Copper	0.08 (2)	0.16 (4)	0 (0)
Solder	3.14 (99)	56.5 (1780)	0.03 (1)
Brass	0.23 (5)	0.46 (11)	0 (0)
Steel	9.69 (212)	44.5 (974)	0 (0)
Cast Iron	21.2 (450)	55.7 (1190)	+0.05 (+1)
Aluminum	13.2 (110)	19.8 (165)	0.48 (+4)

⁽¹⁾ Note: Solution is 10% OPTISHIELD® and 90% Distilled Water, ASTM D1384, 160°F (71 °C) for 2 weeks. Samples with a “+” indicate weight gain.

The presence of excessive amounts (>25 ppm) of contaminants such as chlorides, sulfates, and/or ammonia can contribute to corrosion. For example, excessive concentrations of chloride ions will result in the formation of iron chloride. With any available oxygen, iron chloride will react to form iron oxide, which is insoluble.