WATERWETTER®

SUPERCOOLANT

with

Rust & Corrosion Inhibitor

TECHNICAL MANUAL

Red Line WaterWetter® is designed to provide improved metal wetting and excellent corrosion inhibition when added to plain water or a glycol coolant. The most poorly maintained system in an automobile is usually the cooling system. Maintenance is quite simple and only required once each year, but most vehicle owners never routinely change the coolant or replenish the corrosion inhibitors which are required for trouble-free operation. Proper cooling system maintenance is very critical for most modern engines which utilize more aluminum. Aluminum has a very high corrosion potential, even higher than zinc, which is very widely used as a sacrificial anode. The only property which enables aluminum to be used in a cooling system is that it will form protective films under the proper conditions which will prevent the uncontrolled corrosive attack of acids or bases. Poor aluminum corrosion inhibition will cause the dissolution of aluminum at the heat rejection surfaces, weakening the cooling system walls and water pump casing and weakening the head gasket mating surfaces. These corrosion products will then form deposits on the lower temperature surfaces such as in radiator tubes which have very poor heat transfer properties, causing a significant reduction in the cooling ability of the entire system. Red Line WaterWetter® will provide the proper corrosion inhibition for all common cooling system metals, including aluminum, cast iron, steel, copper, brass, and lead.

Water has twice the heat transfer capability when compared to 50% glycol antifreeze/coolant in water. Most passenger automobiles have a cooling system designed to reject sufficient heat under normal operating conditions using a 50/50 glycol solution in water. However, in racing applications, the use of water and WaterWetter® will enable the use of smaller radiator systems, which means less frontal drag, and it will also reduce cylinder head temperatures, even when compared to water alone, which means more spark advance may be used to improve engine torque.

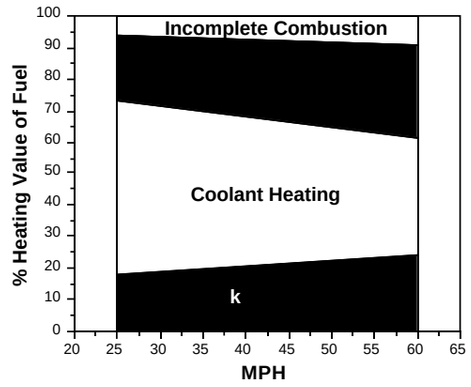
BENEFIT SUMMARY

- Doubles the wetting ability of water
- Improves heat transfer
- Reduces cylinder head temperatures
- May allow more spark advance for increased torque
- Reduces rust, corrosion and electrolysis
- Provides long term corrosion protection
- Cleans and lubricates water pump seals
- Prevents foaming
- Reduces cavitation corrosion
- Complexes with hard water to reduce scale

COOLING SYSTEM REQUIREMENTS

The conventional spark ignition gasoline engine is not a very efficient powerplant. A considerable amount of the available fuel energy must be rejected from the metal combustion chamber parts by the coolant and dispersed to the atmosphere through the radiator. This heat rejection is necessary in order to prevent thermal fatigue of the pistons, cylinder walls, and the cylinder head. Another problem is that the combustion chamber must be cooled enough to prevent preignition and detonation. The higher the combustion chamber temperatures, the higher the octane number required to prevent preignition and detonation. Since the octane of the available fuel is limited, increasing temperatures in the combustion chamber require retarding the spark timing which reduces the peak torque available. Higher inlet temperatures also reduce the density of the fuel/air mixture, reducing available torque further. For these reasons reducing the flow of heat to the coolant usually reduces the efficiency of the engine. Figure 1 shows a typical heat balance diagram for a spark ignition engine. This diagram demonstrates that the coolant in an automobile engine must absorb and reject through the radiator 2 to 3 times the amount of energy which is converted to brake power.

Combustion Heat Distribution



THERMAL PROPERTIES

Water has amazingly superior heat transfer properties compared to virtually any other liquid cooling medium - far superior to glycol-based coolants. As shown in Table 1, water has almost 2.5 times greater thermal conductivity compared to glycol coolants. Mixtures of glycol and water have nearly proportional improvement due to the addition of water. Most heat is transferred in a cooling system by convection from hot metal to a cooler liquid as in the engine block or from a hot liquid to cooler metal surfaces, as in the radiator. The convection coefficient of liquids in a tube is a complicated relationship between the thermal conductivity, viscosity of the liquid, and the tube

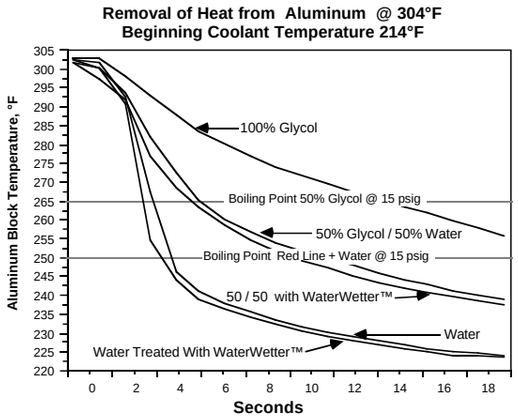
Table 1
Thermal Properties of Cooling System Materials

Material	Density g/cm^3	Thermal Conductivity Watt/m•℃	Thermal Convec ion Watt/m^2•℃	Heat Capacity cal/g•℃	Heat of Vaporization cal/g
Water	1.000	0.60	1829	1.000	539
Glycol	1.114	0.25	-----	0.573	226
50/50	1.059	0.41	897	0.836	374
Aluminum	2.70	155		0.225	
Cast Iron	7.25	58		0.119	
Copper	8.93	384		0.093	
Brass	8.40	113		0.091	
Ceramics		1-10			
Air	.0013	.026		0.240	

diameter which determines the amount of turbulent flow. Since 50/50 glycol solution has about 4 times the viscosity and only 70% of the thermal conductivity of water, the thermal convection coefficient for a 50/50 glycol solution is approximately 50% of the coefficient for water. Water in the cooling system is capable of transferring twice as much heat out of the same system as compared to a 50/50 glycol coolant and water solution. In order for a 50/50 glycol mixture to reject as much heat as water (amount of heat rejected is independent of the coolant), the temperature differentials at the heat transfer surface must be twice as great, which means higher cylinder head temperatures.

HEAT TRANSFER

Red Line WaterWetter® can reduce cooling system temperatures compared to glycol solutions and even plain water. Water has excellent heat transfer properties in its liquid state, but very high surface tension makes it difficult to release water vapor from the metal surface. Under heavy load conditions, much of the heat in the cylinder head is transferred by localized boiling at hot spots, even though the bulk of the cooling solution is below the boiling point. Red Line's unique WaterWetter® reduces the surface tension of water by a factor of two, which means that much smaller vapor bubbles will be formed. Vapor bubbles on the metal surface create an insulating layer which impedes heat transfer. Releasing these vapor bubbles from the metal surface can improve the heat transfer properties in this localized boiling region by as much as 15% as shown in Figure 2. This figure demonstrates the removal of heat from an aluminum bar at 304°F by quenching the bar in different coolants at 214°F under 15 psi pressure. Compare the time required to reduce the temperature of the aluminum to 250°F, or the boiling point of water at 15 psi. Red Line with WaterWetter® required 3.2 seconds, water alone 3.7 sec, 50/50 glycol in water required 10.2 sec, and 100% glycol required 21 sec. Water alone required 15% longer, 50/50 glycol 220% longer, and 100% glycol required 550% longer.



DYNO TEST RESULTS

Dynomometer tests performed by Malcolm Garrett Racing Engines showed significant improvements in coolant temperatures using WaterWetter®. These tests were performed with a Chevrolet 350 V-8 with a cast iron block and aluminum cylinder heads. The thermostat temperature was 160°F. The engine operated at 7200 rpm for three hours and the stabilized cooling system temperature was recorded and tabulated below:

Cooling System Fluid	Stabilized Temperature
50% Glycol/ 50% Water	228°F
50/50 with WaterWetter®	220°F
Water	220°F
Water with WaterWetter®	202°F

These numbers are similar to the temperatures recorded in track use and heavy-duty street use.

COOLANT EFFECTS ON PERFORMANCE

Under moderate load conditions, each percent glycol raises cylinder head temperatures by 1°F. 50% glycol raises head temperatures by 45°F. This increase in temperature will raise the octane required for trace knock levels by typically 3.5 octane numbers. A car equipped with a knock sensor will retard the timing to compensate for the increase in octane requirement by approximately 5°, which will reduce the maximum brake torque by about 2.1%. Racing vehicles not equipped with knock sensors can advance timing for increased torque.

Performance Properties of Coolants

SAE 880266	Water	50% Glycol	70% Glycol
Increase in Cylinder Head Temperature	Baseline	+45°F	+65°F
Increase in Octane (RON) Requirement	Baseline	+3.5	+5.0
Change in Spark Timing for Trace Knock	Baseline	-5.2°	-7.5°
Change in Torque	Baseline	-2.1%	-3.1%

BOILING POINT ELEVATION

Red Line WaterWetter® does not significantly increase the boiling point of water; however, increasing pressure will raise the boiling point. The boiling point of water treated with Red Line using a 15 psi cap is 250°F compared to 265°F at 15 psi for 50% glycol. Increasing the pressure by 50% to 23 psi will increase the boiling point of water to 265°F. Because of the doubling of the ability of the radiator to transfer heat, boilover using Red Line treated water is not a problem as long as the engine is circulating coolant through the head and the fan is circulating air. Sudden shutdown after very hard driving may cause boilover.

FREEZING POINT DEPRESSION

Red Line WaterWetter® does not significantly reduce the freezing point of water. If the vehicle will see freezing temperatures, an antifreeze must be used. Water expands approximately 9% upon freezing which can cause severe engine damage. Even in summertime, the use of air-conditioning can blow freezing air through the heater and cause freezing of the heater core unless approximately 20% antifreeze is used.

CORROSION PROTECTION

Modern automotive engines now use aluminum for heads, radiators, water pump housings, and nearly all hose fittings. These engines require significantly greater corrosion protection than their cast iron counterparts of the past. Aluminum is such an electroactive metal that it requires an impenetrable corrosion inhibitor film to prevent rapid corrosion. Acid neutralization capability is very important. Coolant which has been left in a cooling system for several years has probably become acidic from the oxidation of the glycol to acids. Also, keeping the glycol concentration in the cooling system below 50% will help stability.

Red Line also provides excellent protection from cavitation erosion in the water pump and cylinder head. Localized boiling in the cylinder head forms vapor bubbles which collapse when they come in contact with cooler liquids. This collapse creates tremendous shock waves which removes the inhibitor film from the aluminum surface and can cause catastrophic erosion of the aluminum if the inhibitor does not reform the film quickly. Another problem created by cavitation erosion is the deposition of the removed aluminum as a salt with poor heat transfer properties in the lower temperature radiator tubes. Red Line prevents this corrosion through effective film formation and smaller vapor bubble formation, which has a less violent collapse. Foam control is equally important since entrained air will cause cavitation erosion due to the collapse of foam bubbles. Red Line provides excellent control of foam with water alone and glycol solutions.

Most coolants additives on the market provide only protection for iron and perhaps moderate protection for aluminum. The milky soluble oil types can actually impede heat transfer by wetting the metal surface with oil and this oil can swell and soften rubber coolant hoses. Table 3 shows the many tests which the Red Line formula will satisfy and how it compares to a standard antifreeze.

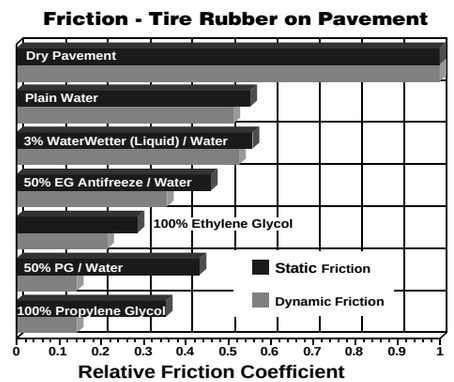
Table 3

Comparison of Corrosion Inhibition Properties

PROPERTY	RED LINE	SPEC	COOLANT A
pH	8.6	7.5 - 11	9.8
Boiling Point @ 15 psig	250°F		265°F (50%)
Freezing Point	31°F	-35°F(50%)	-35°F
Foaming Height, ml	75	150	50
Color	Pink	green/blue	green
Ash, %	0.5	5, max	1
Surface Tension @ 100°C, Dynes/cm2	28.3	58.9 (water)	
ASTM D4340 Heat Transfer Corrosion Test, Aluminum Weight loss, mg/cm^2/wk	0.21	1 max	0.45
ASTM D1384 Corrosion, Weight loss, mg/specimen			
Copper	1	10 max	5
Solder	6	30	7
Brass	2	10	5
Steel	1	10	6
Cast Iron	0	10	3
Aluminum	16	30	30

SLIPPERINESS OF COOLANTS

Red Line WaterWetter® does not alter the frictional property of tire rubber and water on a pavement surface. The chart below shows the static and dynamic friction of pavement wetted with different coolant types. Higher friction indicates less slipperiness. The dynamic friction indicates the increase in slipping which occurs after the tire begins to break loose. Water and water with Waterwetter® reduce the friction relative to dry pavement about 50%, but it is much less than the reduction in friction caused by ethylene glycol and even more slippery is propylene glycol.



USE DIRECTIONS

One 12 ounce bottle treats 12-16 quarts of water or a 50% ethylene or propylene glycol solution. In smaller cooling systems, use 4-5 caps per quart. Add directly through the cooling system fill cap into the radiator or into the overflow tank. Do not open a cooling system while hot. For best protection for aluminum, replenish or replace every 15,000 miles. The anti-scaling ingredients in Red Line WaterWetter® allow its use with ordinary tap water. However, using with distilled or deionized water will accomplish some scale removal in the cylinder head area. Plain water with or without WaterWetter® should not be used in cooling systems containing magnesium - antifreeze should be used - with WaterWetter®. For maximum temperature reductions use the most water and the least antifreeze possible to prevent freezing in your climate. Even in summertime the use of air-conditioning can blow freezing air through the heater and cause freezing of the heater core unless approximately 20% antifreeze is used. Red Line WaterWetter® is available in 12 ounce containers.

DESIGNED FOR PERFORMANCE

Red Line Synthetic Oil Corporation is the leader in lubricant and fuel system chemistry. Red Line manufactures a full line of automotive products which are designed to provide noticeable improvements in performance. Other Red Line products are:

Diesel Fuel Catalyst - with Fuel Lubricant
85 Plus Diesel Fuel Additive - with Fuel Lubricant
Diesel Fuel Biostat - Antimicrobial Agent
SI-1 Fuel Injector & Intake Valve Cleaner
Lead Substitute
Motor Oils - 5W30, 10W30, 10W40, 15W50, 20W50
Diesel Engine Oil - 15W40
Race Oils - SAE 5, 10, 20, 30, 40, 50, 60, 70
High-Performance Two-cycle Lubricants
Gear Oils - Lightweight, 75W90, 75W90NS, 80W140
ShockProof™ Gear Oils
MTL- Manual Transmission/Manual Transaxle Lube
ATF - Synthetic Dexron II, High-Temp ATF, D4 ATF, and Racing ATF
CV-2 CV-Joint and Wheel Bearing Grease
Assembly Lubricant
Synthetic Compressor Lubricants
Synthetic Suspension Fluids

For further information please contact:

Check out an excellent selection of oils, fluids, lubricants we offer on our website.