THE PERFORMANCE CHARACTERISTICS OF ENGINE ICE – ICE WATER IN MOTORSPORTS & POWERSPORTS RACING APPLICATIONS

Water is frequently used in Motorsports and Powersports racing applications because it provides excellent heat transfer, improves cooling system efficiency, allows for smaller radiators, and is easier to clean off the track. However, water doesn't provide the corrosion protection needed for a cooling system: this is where Ice Water comes in. We started with a water base and added corrosion protection and other high-performance additives for maximum heat transfer for motorsports and powersports applications.

Benefit Summary:

- Superior heat transfer
- Protects all cooling system metals against corrosion
- Eliminates foam
- Improved wetting ability

Heat Transfer

To determine Ice Water's ability to transfer heat away from the engine, heat capacity and thermal conductivity testing were completed. The higher the heat capacity and the higher the thermal conductivity, the better the heat transfer. When compared to water and Water Wetter, Ice Water has better specific heat capacity (Figure 1) and better thermal conductivity (Figure 2) at typical engine temperatures (90-105˚C). See Charts 1 and 2 below for test data.

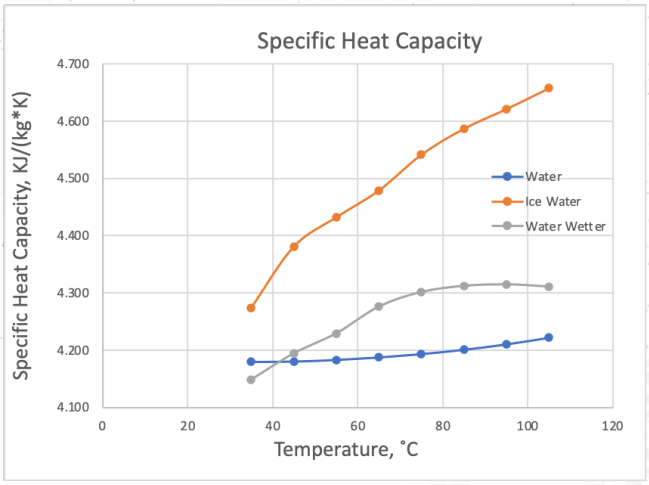


Figure 1: Specific Heat Capacity of Water, Water Wetter, and Ice Water.

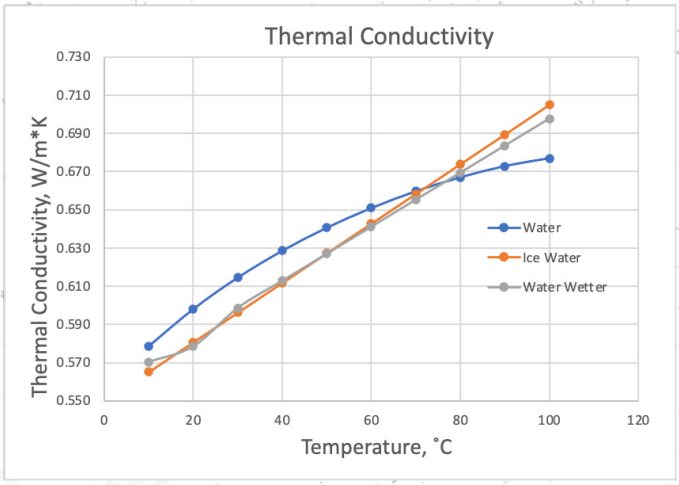


Figure 2: Thermal Conductivity of Water, Water Wetter, and Ice Water.

Better Corrosion Protection

Engine Ice sent samples of Ready-to-Use (diluted based on recommendations on label) Engine Ice - Ice Water and competitive product Red Line Water Wetter for comparative corrosion testing using on typical cooling system metals (ASTM D1384mod) at an external lab. D1384 testing (Figures 3 and 4) indicated significantly improved aluminum corrosion protection compared to water and Water Wetter.

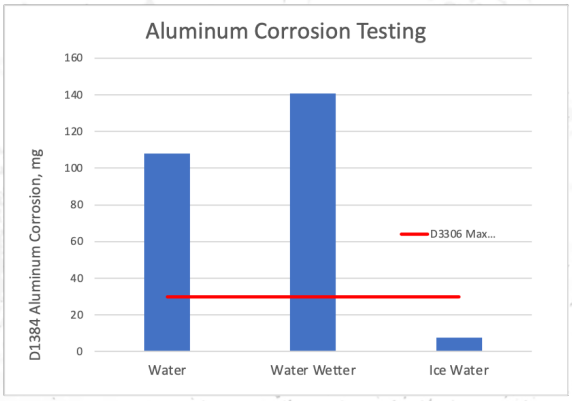


Figure 3: D1384 Aluminum Corrosion for Water, Water Wetter, and Ice Water

TEST DESCRIPTION	REPORT	D3306 SPECIFICATION	WATER	WATER WETTER			ICE WATER		
Copper	Weight Loss, mg	10 Max	1	0	0	1	1	0	0
Solder		30 Max	4	4	2	2	0	0	0
Brass		10 Max	1	1	0	1	1	1	1
Steel		10 Max	422	0	1	1	1	1	0
Iron		10 Max	534	1	1	4	1	0	0
Aluminum		30 Max	108	82	107	151	2	10	11

Figure 4: Data for all D1384 metals

Corrosion testing on aluminum heat transfer surfaces (D4340mod) was completed internally. See results below (Figure 5): with this test method, Ice Water eliminated 100% of aluminum corrosion.

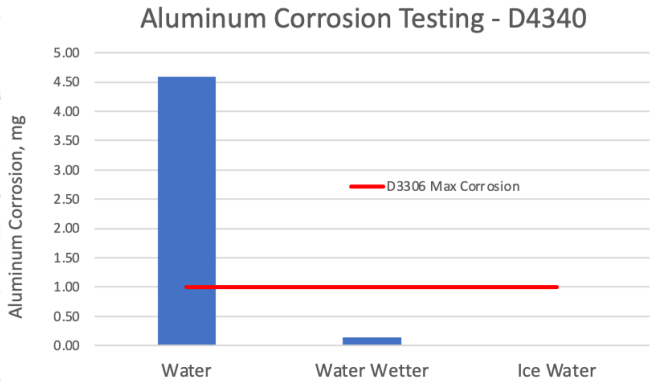


Figure 5: Aluminum corrosion of water, Water Wetter, and Ice Water as tested by D4340

Eliminates Foam

Ice Water contains a proprietary high-tech defoamer that eliminates foam before it can cause hot spots in the cooling system. When tested using ASTM D1881 (modified to test a water-based coolant), Ice Water exceeds the ASTM D3306 specification. With D1881, the coolant is heated to temperatures typical of a cooling system, and air is bubbled through the coolant. Once 5 minutes have passed, the air is cut off, and the following measurements are collected: the height of the foam is measured in mL and the break time –or time it takes for the foam to recess and "break" on the fluid surface—is measured in seconds. See below for our result compared to the ASTM D3306 specification: Ice Water exceeds the required performance.

ASTM D3306 SPECIFICATION (ML/S)	ICE WATER RESULT (ML/S)
150mL/5s Max	40mL/1s

Wetting Ability

Wetting ability is a liquid's ability to maintain contact with another surface and to spread easily and uniformly over the surface of another solid or fluid. A liquid with high wetting ability forms a thin, continuous film when it spreads over a surface. This wetting ability is important for heat transfer in a Motorsports or Powersports application.

When an interface exists between a liquid and a solid, the angle between the surface of the liquid and the outline of the contact surface is described as the contact angle θ (Figure 6). The contact angle (wetting angle) measures of the wettability of a solid by a liquid: the smaller the contact angle, the more "wetting ability" the fluid has because the liquid is more spread out on the surface. Another aspect of wettability is the surface tension. Lower surface tension and smaller contact angle will allow more efficient cooling and increased performance.

Testing showed that Water Wetter had both lower contact angle (Figure 7) and surface tension (Figure 8 - see next page), indicating that it has better wettability. However, Engine Ice – Ice Water improves wettability compared to water.

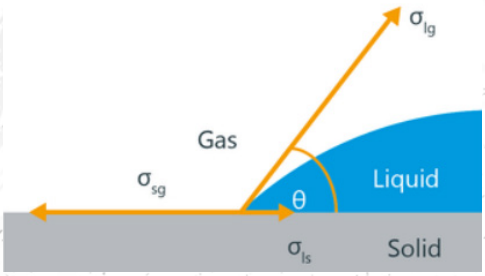


Figure 6: Contact angle

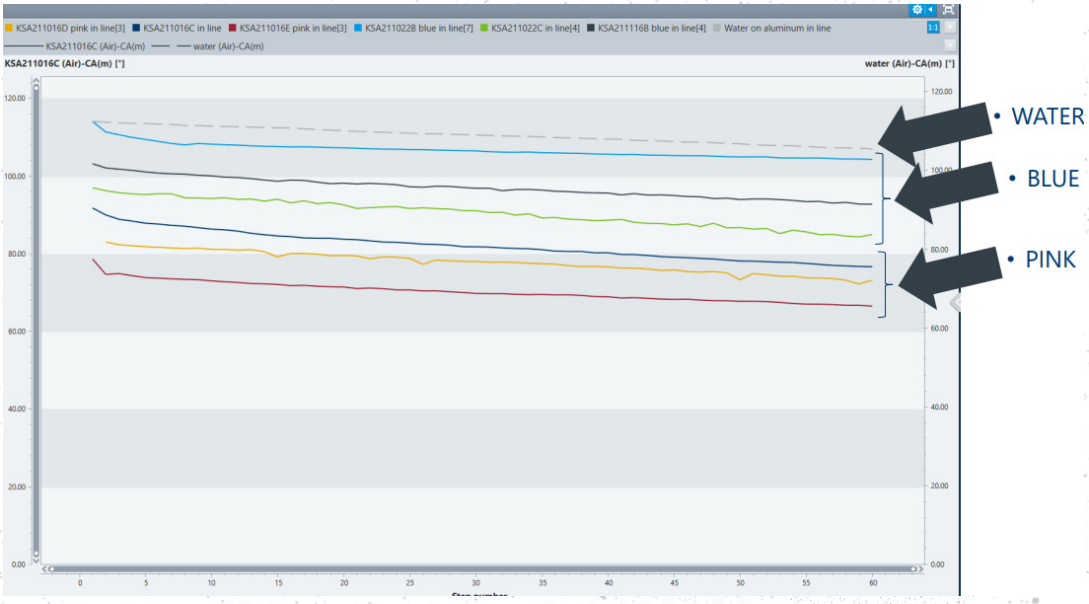


Figure 7: Contact Angle of water, Water Wetter (pink), and Ice Water (blue)

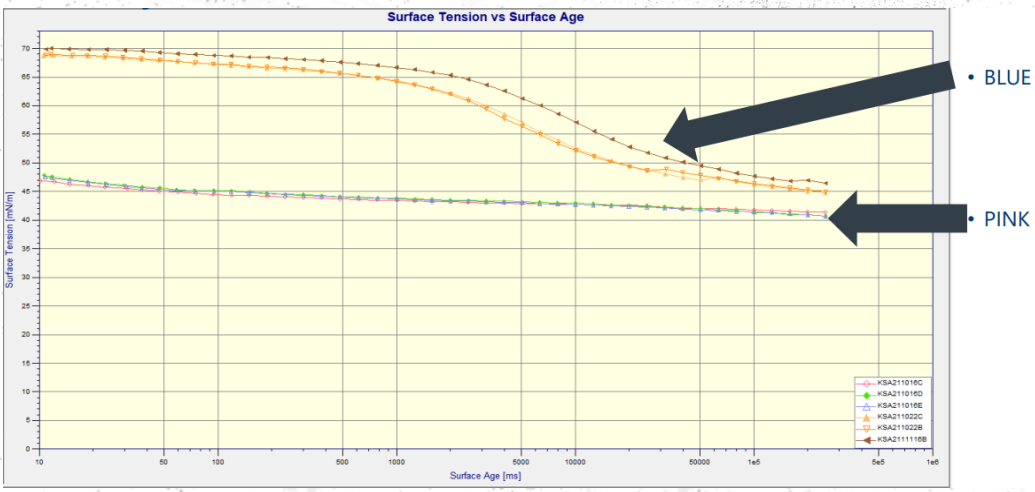


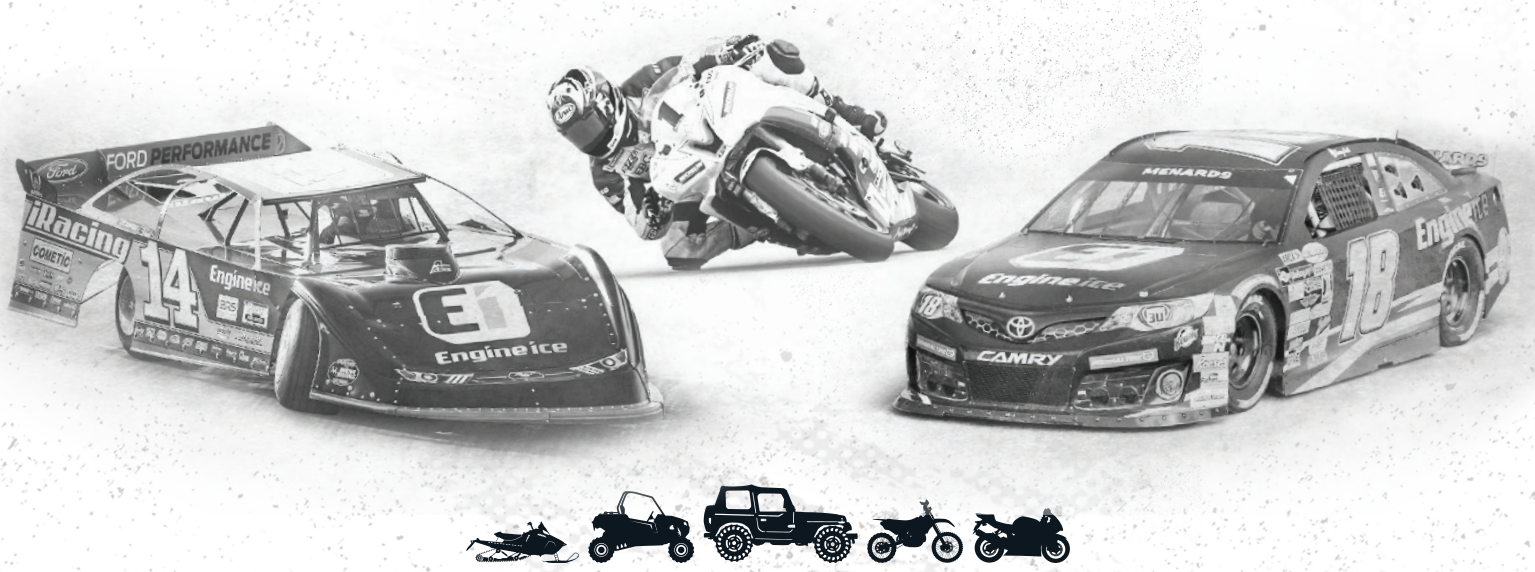
Figure 8: Surface Tension and Water Wetter (pink) and Ice Water (blue)

Boiling Point Elevation and Freeze Point Depression

The main components of most antifreeze/coolants are glycol (typically ethylene glycol) and water. Water is an excellent heat transfer medium; however, it does not provide adequate protection when temperatures drop below freezing. Ice Water utilizes the excellent heat transfer properties of water to improve cooling in high-performance applications where additional freeze protection is not needed.

Since Ice Water is a water-based coolant, it does not provide boiling point elevation beyond water. However, the boiling point of a fluid can be adjusted by changing the pressure. See the chart below for information on the effect of pressure on the boiling point of traditional coolant compared to water-based coolant.

FLUID	PRESSURE	BOILING POINT WITHOUT PRESSURE CAP	BOILING POINT WITH PRESSURE CAP
50/50 Water-Glycol Antifreeze/Coolant	15psi	226˚F	265˚F
Water-based Coolant	15psi	212˚F	250˚F
Water-based Coolant	23psi	236˚F	265˚F



KEEP IT COOL!