Fleetguard®

OHIO SCHOOL BUS MECHANICS ASSOCIATION

Coolant Selection and Maintenance Best Practices

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Agenda

- Coolant Specifications
- HD Coolant Technologies and Types
- Common Coolant Related Maintenance Issues
- Nitrite Free Coolant Technology (OAT)
- Converting to Nitrite Free Coolant
- Coolant Testing
- Q & A

Function of Coolant

- The cooling system controls temperatures of all metallic and non-metallic material, along with other engine fluids.
- Cooling system responsible for 60% of engine heat transfer
- To properly transfer heat, must protect system components from corrosion, cavitation, and scale.
- **More than 40% of engine problems originate in the cooling system**
- Coolant selection and maintenance is key to the life of equipment.

Coolant Makeup

TYPICAL 50/50 PREMIX COMPOSITION

1-8% ADDITIVES

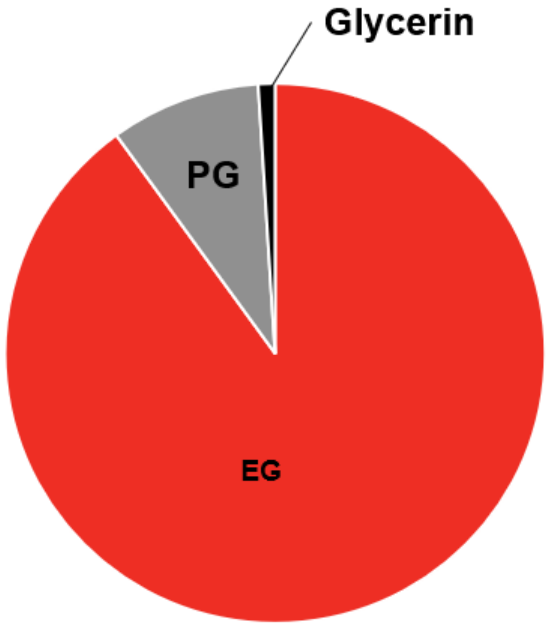
42-50% GLYCOL (Base)

45-50% DE-IONIZED WATER

- Poor quality water can cause scale, additive dropout, and corrosion
- To ensure good water quality, use deionized or reverse-osmosis water
- Premix coolant reduces water quality issues

Coolant Bases

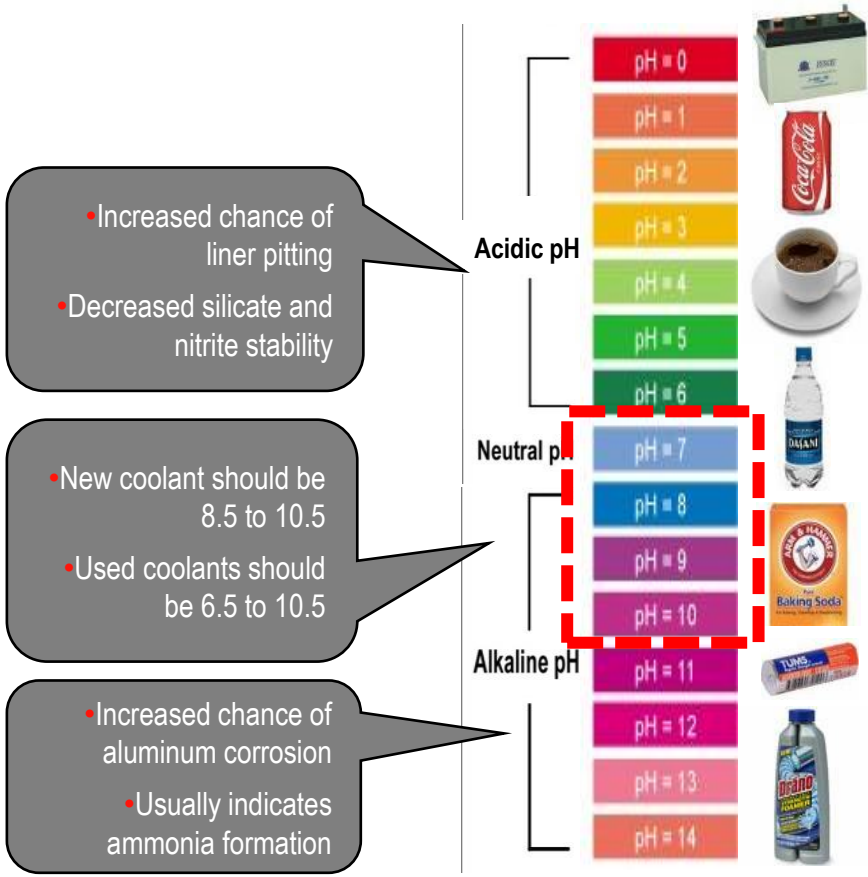
- **The most commonly used base is EG (Ethylene Glycol)**
  - Can be used in all climates
  - Toxic to humans and animals
- **PG (Propylene Glycol)**
  - Non-toxic
  - Not suitable for arctic climates
  - Higher cost
- **Glycerin**



Functions Of The Additive Package

Additives provide protection against:

- Liner pitting
- Scale
- Foaming
- Corrosion
- Cavitation and Erosion
- **Changes in pH**



Color Confusion

Is color a reliable indicator of coolant technology?

Brand	Heavy Duty OAT		Heavy Duty NOAT	Heavy Duty Hybrid		Heavy Duty Conventional	
Fleetguard	ES Compleat OAT		ES Compleat NOAT	ES Compleat	Fleetcool EX	Fleetcool	
Shell	Rotella ELC NF	Rotella Ultra ELC	Rotella ELC	Not offered		Rotella Fully Formulated	
Old World	Final Charge Global		Final Charge NOAT	Fleetcharge Hybrid Blue (new)		Fleetcharge	
Chevron	Delo XLC		Delo ELC	Not offered		Not offered	
Valvoline	Zerex HD Extended Life Nitrite Free		Not offered	Zerex G-05	Zerex HD Extended Life	Zerex Pre-charged Fully Formulated HD	Zerex Pre-charged Heavy Duty Formula

Selecting A Coolant

Coolants are classified based on **performance** and **type.**

PERFORMANCE

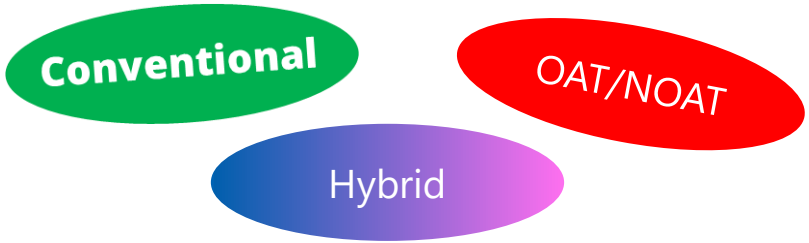
Industry or OEM specifications

ASTM INTERNATIONAL

Cummins®

TYPE

Generic terms used to group coolants based on base type and additive chemistry



Coolant Performance Specifications

ASTM D3306

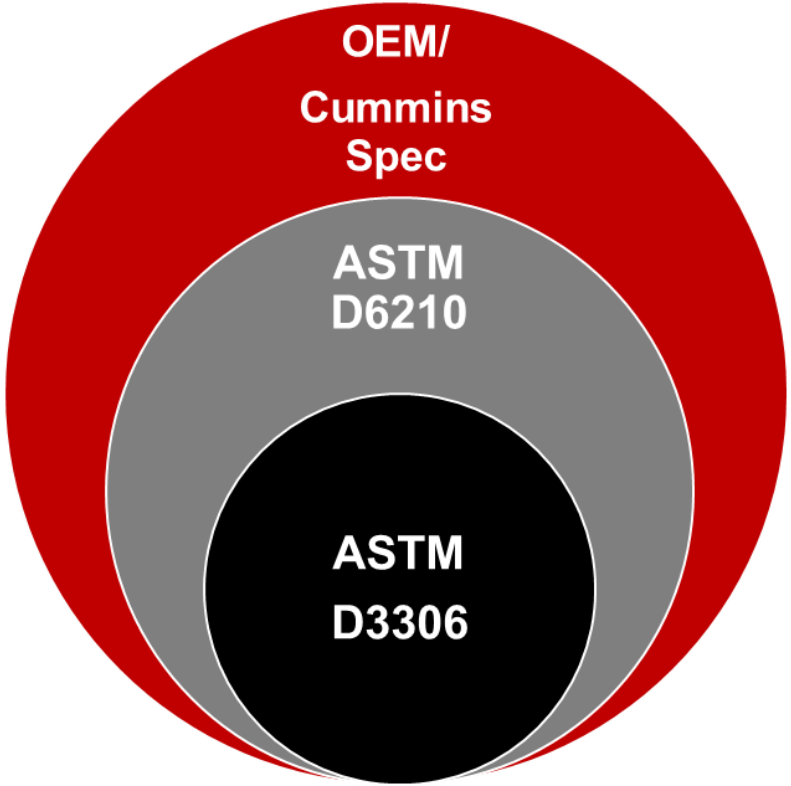
- Light-Duty requirements

ASTM D6210

- Heavy-Duty requirements
- Requires protection against liner pitting and hot surface scaling

OEM/Cummins Spec

- Cummins CES14603
- Coolant compatibility with silicone
- hoses, seals, elastomer materials, etc

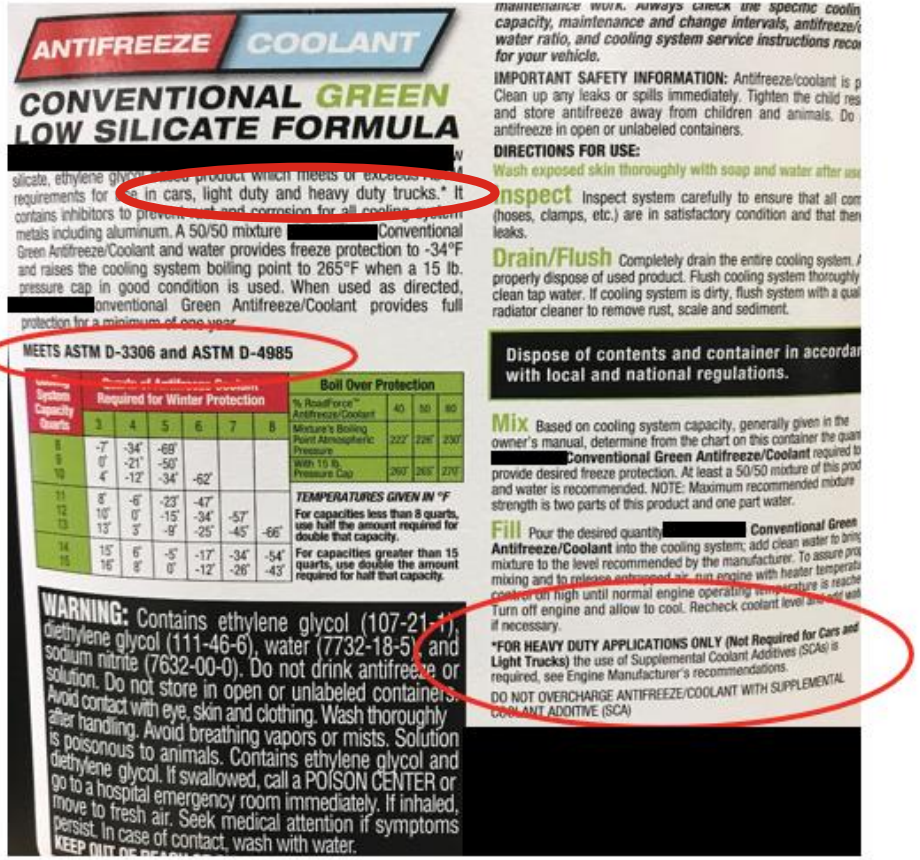


Universal Conventional Coolants

ASTM D4985

Standard Specification for Low Silicate Ethylene Glycol Base Engine Coolant for Heavy Duty Engines **Requiring a Pre-Charge of Supplemental Coolant Additive (SCA)**

Always check the label



Technologies of Coolant

CONVENTIONAL

Lower cost, Highest TCO
Shortest Service Interval
Most Maintenance
Nitrite, Borate and/or Phosphate

NOAT

Extended Service Interval
Moderate Maintenance
Phosphate, Borate, Silicate Free
EC-1 Compatible

HYBRID

Extended Service Interval
Moderate Maintenance
Nitrite, Borate and/or Phosphate
Supplementary organic acids

OAT

Longest Service Interval
Most Robust to Contamination
Preferred by many OEMs
NAP or NAPS-free, Borate-free

*NAP= Nitrite, Amine, Phosphate
*NAPS = Nitrite, Amine, Phosphate, Silicate

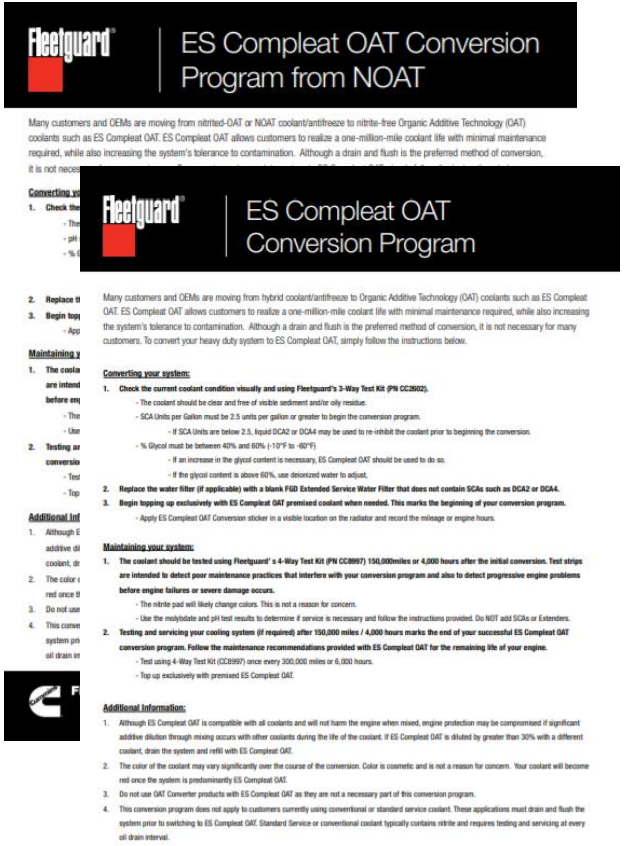
Benefits of a Nitrite Free Coolant

- Lower total cost of ownership, especially in high mileage vehicles and equipment that is kept longer.
- No need for liquid SCA's or SCA filters….saves money.
- Robust against contamination and superior protection against solder flux contamination, potentially prolonging the life of radiators and EGR coolers.
- Consolidates coolant inventory for mixed fleets, even natural gas engines.
- **OAT takes the confusion out of coolant!**

Converting To Nitrite Free OAT

- **Conventional technology coolants, both light duty and heavy duty must be drained, flushed and refilled.**
- **Light duty OAT coolants (i.e. Dex-cool) should be drained, flushed and refilled.**
- Hybrid / ELC / NOAT Heavy Duty coolants can be converted to Nitrite Free OAT by top off.
- No dosing of SCA's (DCA2 or DCA4) after the conversion.
- Chemical water filters must be replaced with blank water filter.
- Use CC8997 to test ES Compleat OAT.
- Top off by using ES Compleat OAT 50/50.
- Procedure (MB10468) can be found at:

  www.cumminsfiltration.com/literature/cooling



Fleetguard | ES Compleat OAT Conversion Program from NOAT

Many customers and OEMs are moving from nitrited-OAT or NOAT coolant/antifreeze to nitrite-free Organic Additive Technology (OAT) coolants such as ES Compleat OAT. ES Compleat OAT allows customers to realize a one-million-mile coolant life with minimal maintenance required, while also increasing the system's tolerance to contamination. Although a drain and flush is the preferred method of conversion, it is not nece

Fleetguard | ES Compleat OAT Conversion Program

Many customers and OEMs are moving from hybrid coolant/antifreeze to Organic Additive Technology (OAT) coolants such as ES Compleat OAT. ES Compleat OAT allows customers to realize a one-million-mile coolant life with minimal maintenance required, while also increasing the system's tolerance to contamination. Although a drain and flush is the preferred method of conversion, it is not necessary for many customers. To convert your heavy duty system to ES Compleat OAT, simply follow the instructions below.

Converting your system:

1. **Check the current coolant condition visually and using Fleetguard's 3-Way Test Kit (PN CC2602).**
   - The coolant should be clear and free of visible sediment and/or oily residue.
   - SCA Units per Gallon must be 2.5 units per gallon or greater to begin the conversion program.
     - If SCA Units are below 2.5, liquid DCA2 or DCA4 may be used to re-inhibit the coolant prior to beginning the conversion.
   - % Glycol must be between 40% and 60% (-10°F to -60°F)
     - If an increase in the glycol content is necessary, ES Compleat OAT should be used to do so.
     - If the glycol content is above 60%, use deionized water to adjust.
2. **Replace the water filter (if applicable) with a blank FGD Extended Service Water Filter that does not contain SCAs such as DCA2 or DCA4.**
3. **Begin topping up exclusively with ES Compleat OAT premixed coolant when needed. This marks the beginning of your conversion program.**
   - Apply ES Compleat OAT Conversion sticker in a visible location on the radiator and record the mileage or engine hours.

Maintaining your system:

1. **The coolant should be tested using Fleetguard' s 4-Way Test Kit (PN CC8997) 150,000miles or 4,000 hours after the initial conversion. Test strips are intended to detect poor maintenance practices that interfere with your conversion program and also to detect progressive engine problems before engine failures or severe damage occurs.**
   - The nitrite pad will likely change colors. This is not a reason for concern.
   - Use the molybdate and pH test results to determine if service is necessary and follow the instructions provided. Do NOT add SCAs or Extenders.
2. **Testing and servicing your cooling system (if required) after 150,000 miles / 4,000 hours marks the end of your successful ES Compleat OAT conversion program. Follow the maintenance recommendations provided with ES Compleat OAT for the remaining life of your engine.**
   - Test using 4-Way Test Kit (CC8997) once every 300,000 miles or 6,000 hours.
   - Top up exclusively with premixed ES Compleat OAT.

Additional Information:

1. Although ES Compleat OAT is compatible with all coolants and will not harm the engine when mixed, engine protection may be compromised if significant additive dilution through mixing occurs with other coolants during the life of the coolant. If ES Compleat OAT is diluted by greater than 30% with a different coolant, drain the system and refill with ES Compleat OAT.
2. The color of the coolant may vary significantly over the course of the conversion. Color is cosmetic and is not a reason for concern. Your coolant will become red once the system is predominantly ES Compleat OAT.
3. Do not use OAT Converter products with ES Compleat OAT as they are not a necessary part of this conversion program.
4. This conversion program does not apply to customers currently using conventional or standard service coolant. These applications must drain and flush the system prior to switching to ES Compleat OAT. Standard Service or conventional coolant typically contains nitrite and requires testing and servicing at every oil drain interval.

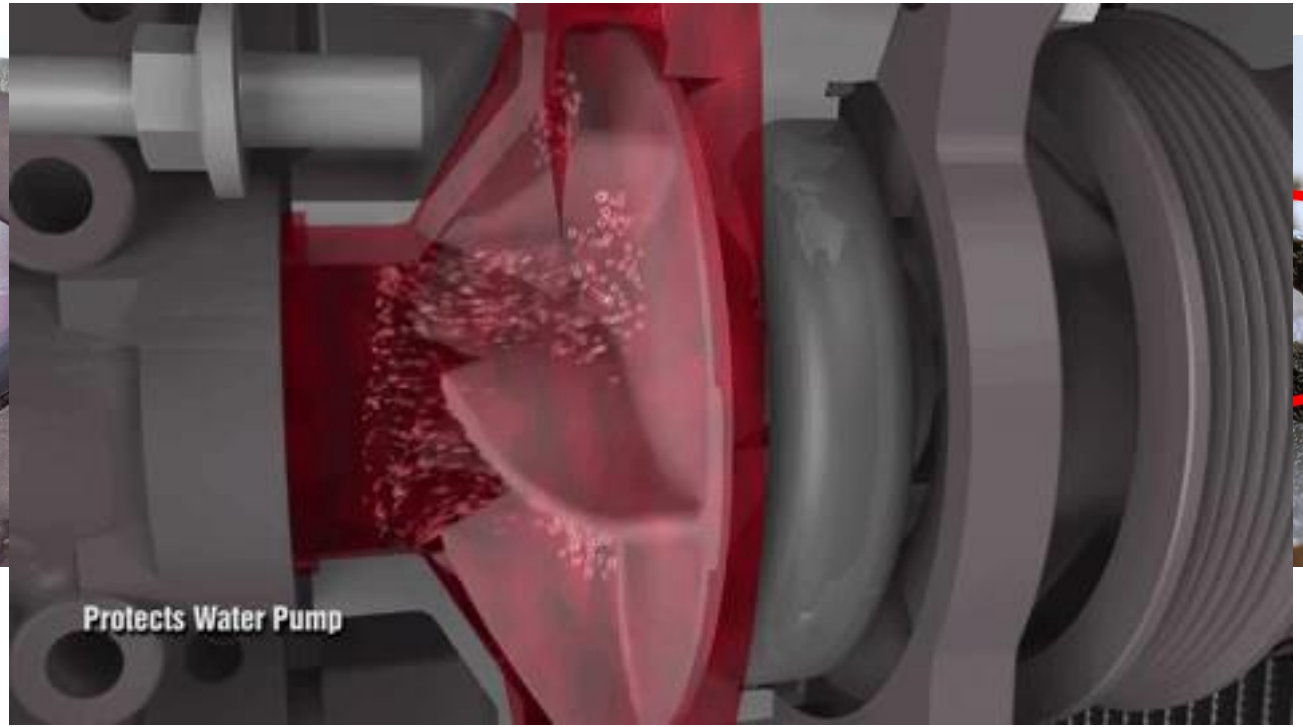
Functions of Additives

Additives provide protection against: **Scale**

*Did you know? 1.6 mm of scale has the **same** heat stopping power as 75 mm of cast iron!*

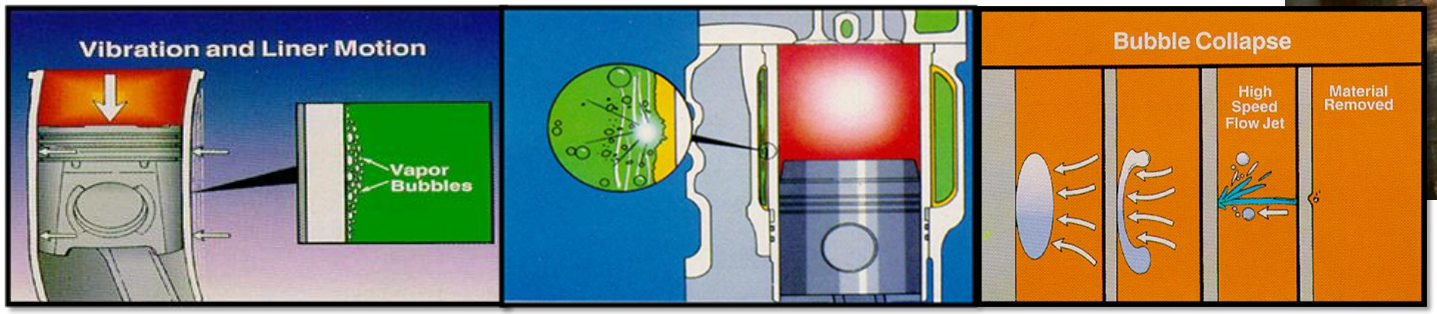
Functions of Additives

Additives provide protection against: **Cavitation & Erosion**



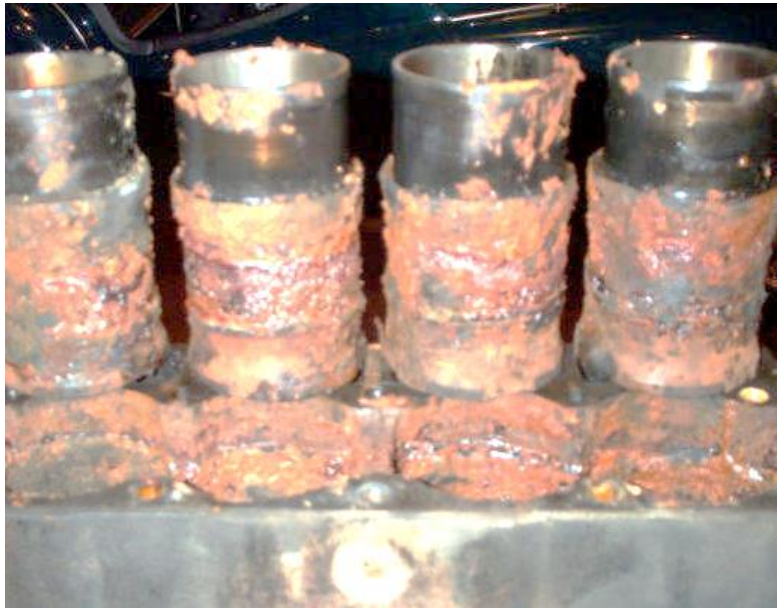
Wet Sleeve Liner Pitting

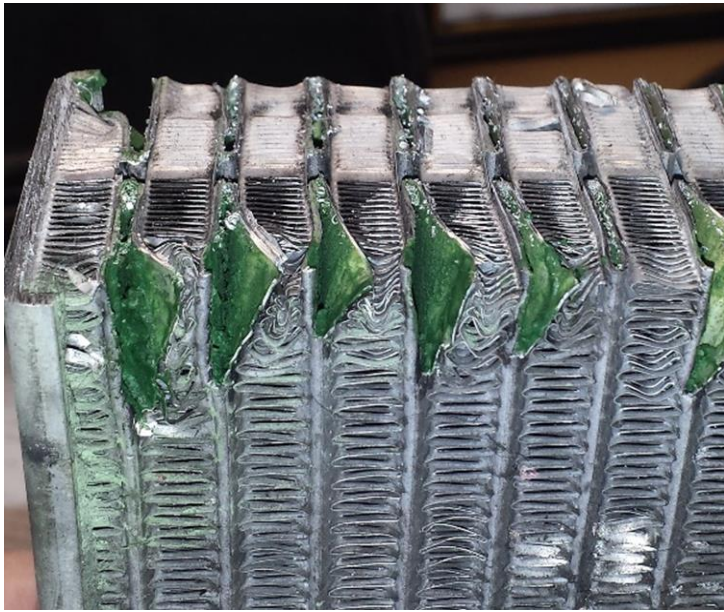
- Coolants that are not properly formulated may not protect liners from cavitation in heavy-duty applications.
  - Lack of protection can lead to liner pitting
  - This failure mode will result in costly system rebuild



Functions of Additives

Additives provide protection against: **Corrosion**





Corrosion, which can appear as rust, can be the result of diesel fuel contaminating in the cooling system.

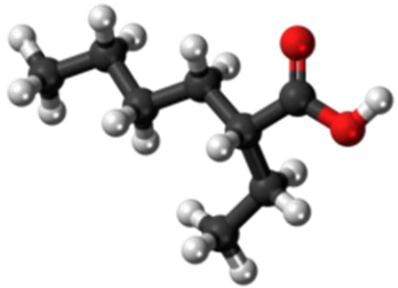
Additive dropout can cause copper corrosion and eventually plug the radiator.

Additive Drop Out

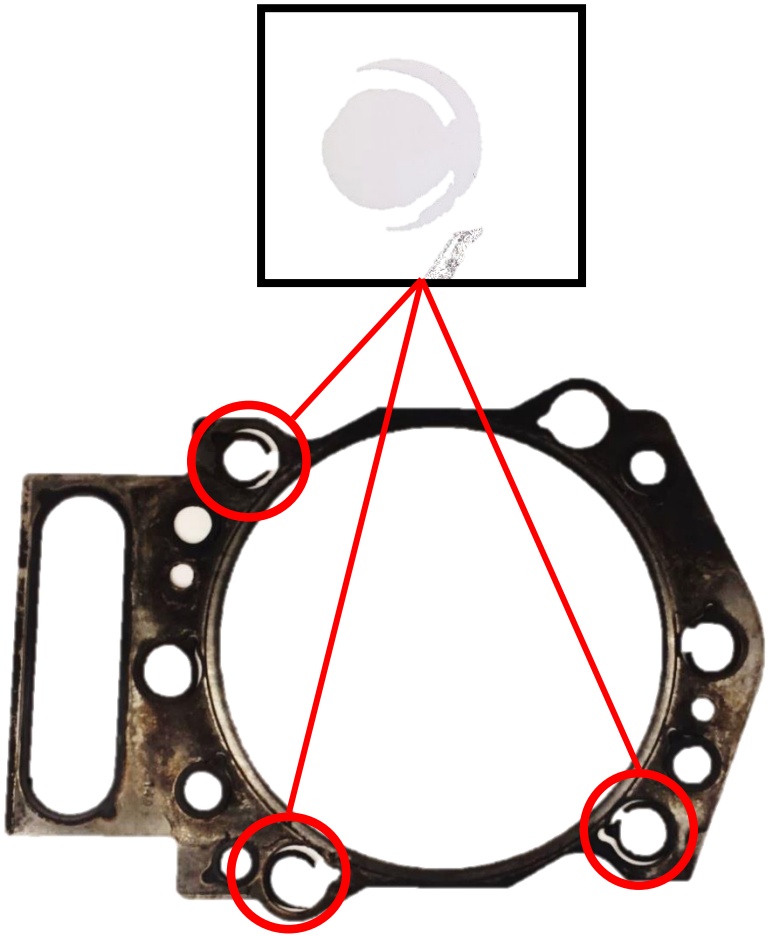
- Additive instability may be caused by:
  - Poor formulation
  - Rapid pH fluctuations
  - Hard Water
  - Corrosion Products
  - Over addition of SCAs
- Phosphate and silicate are the most common additives to drop out
- NAPS-free OAT coolants are the least likely to experience additive dropout
- Drop-out can lead to system overheating

What Can Go Wrong?

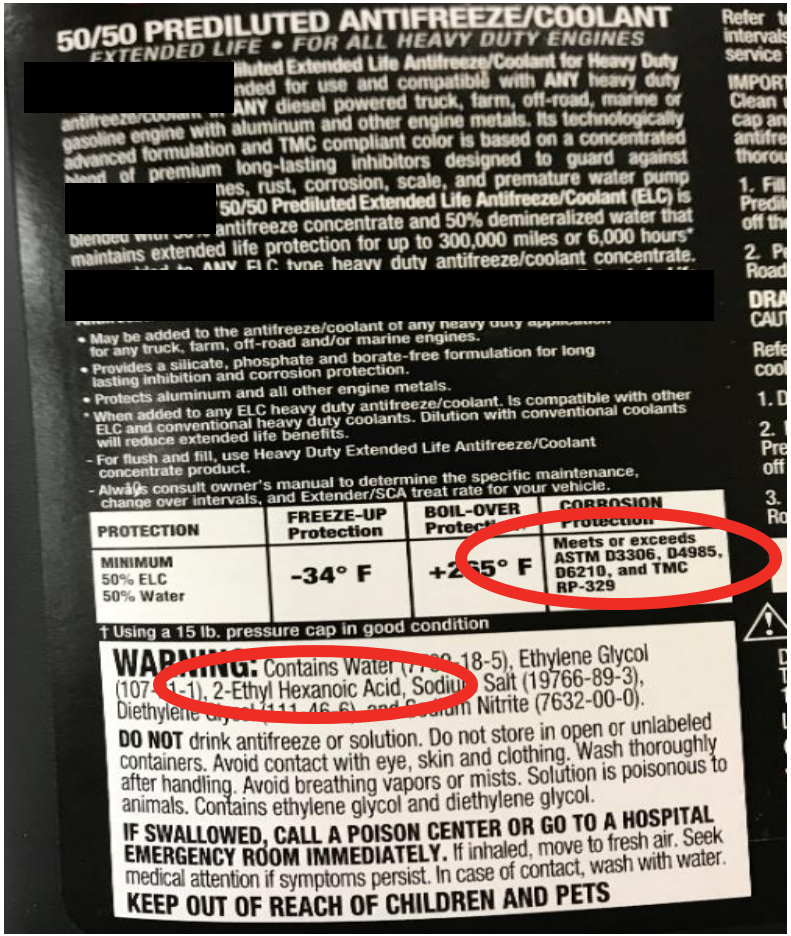
Many OAT or NOAT coolants available on the market today contain the additive called **2-Ethylhexanoic Acid** (**2-EH**).



2-EH is **extremely aggressive** to silicone seals, which are often used as head gaskets and hoses.

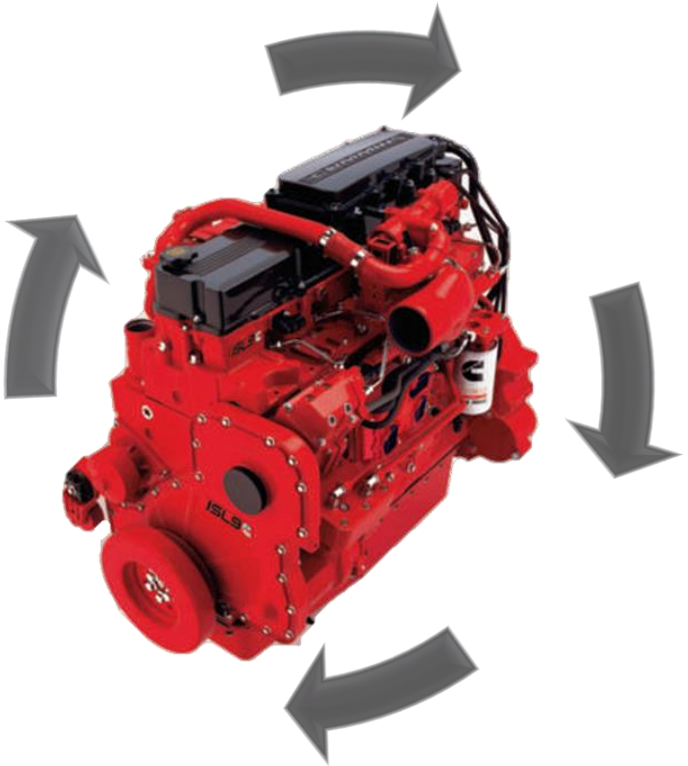


2-EH Presence In Coolant



Ammonia Formation

- As cooling systems evolve, more and more aluminum components are used in the cooling system.
- If any of the aluminum is un-passivated (typically due to residual flux or fluoride) nitrite from the coolant can convert to ammonia.



Functions Of The Additive Package

Additives provide protection against:

- Liner pitting
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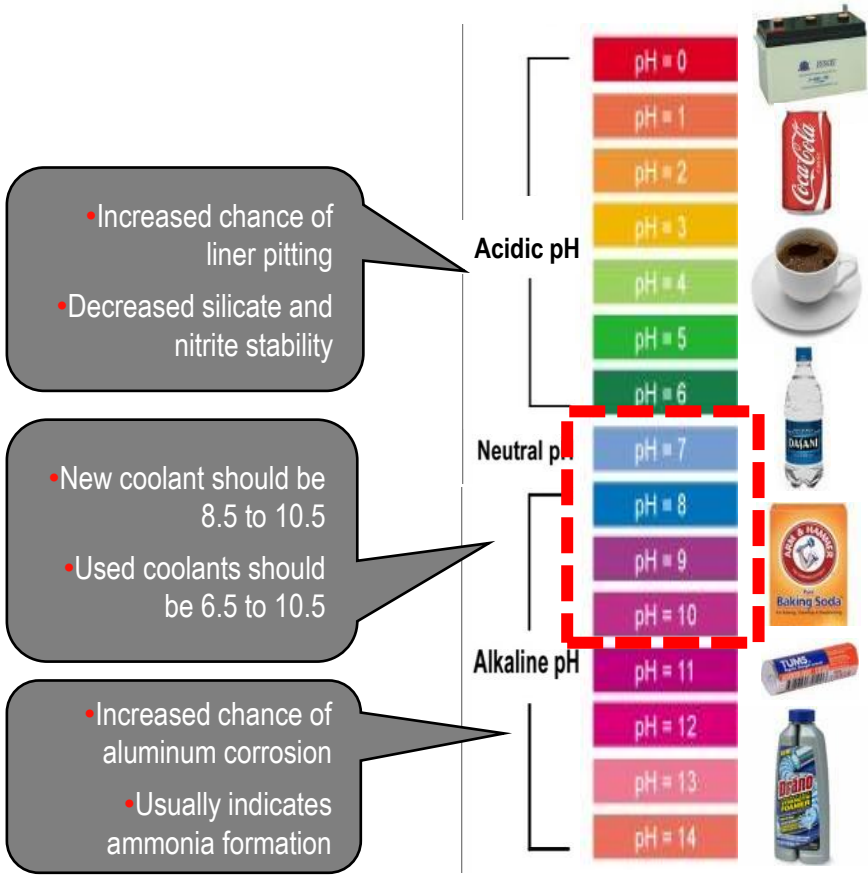
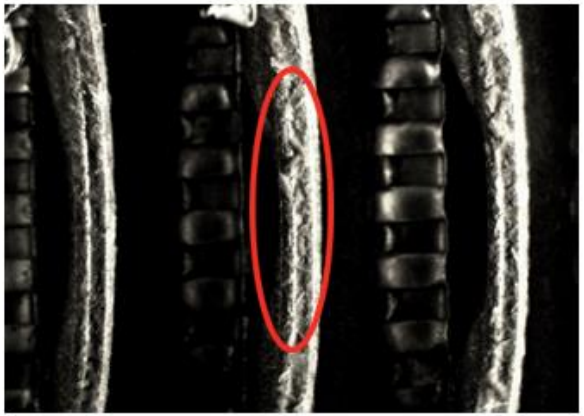
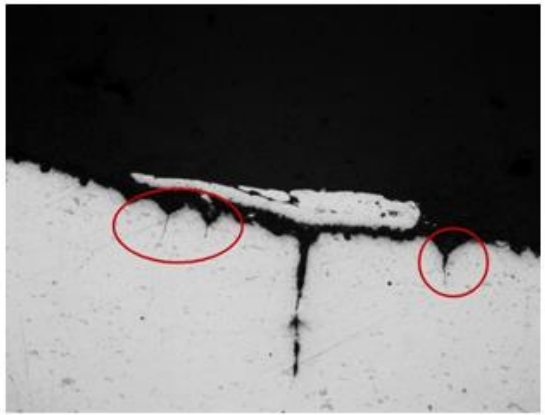
- Corrosion
- Cavitation and Erosion
- **Changes in pH**



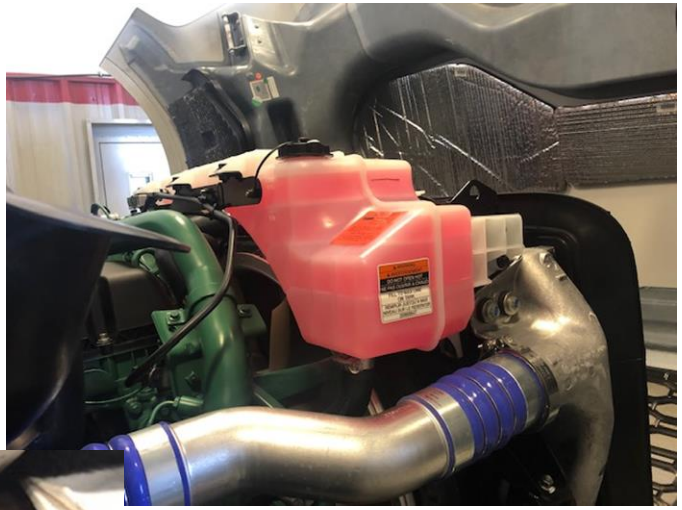
Flux Contamination

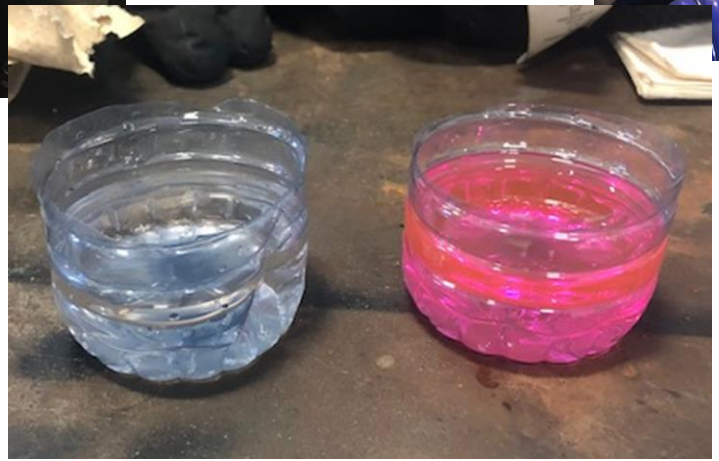
- When exposed to large areas of aluminum, some additives may become unstable, leading to corrosion of aluminum components





Flux Contamination Bleaching



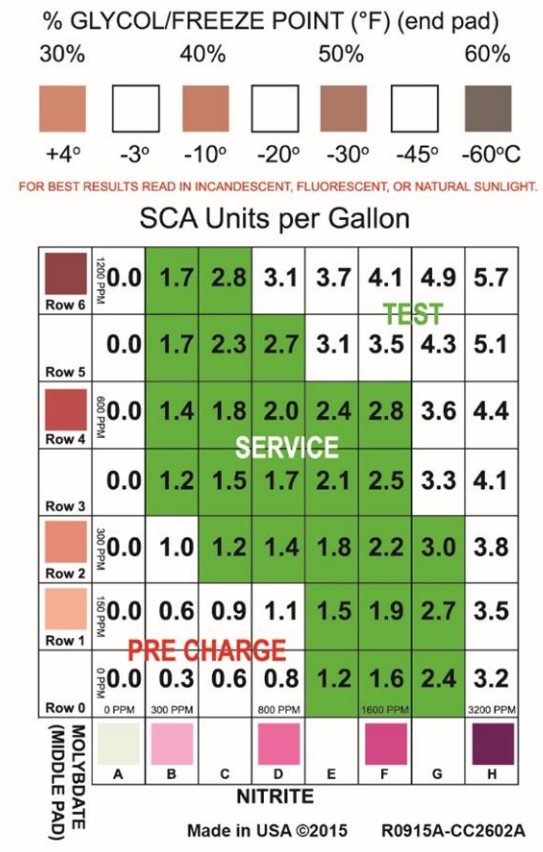


Using Cooling System Cleaners

- Dish soap not recommended. Foaming in the cylinder head can cause engine damage.
- Use directions on package to determine proper water to chemical concentration.
- Prolonged use of any cleaner longer than 3 hours is not recommended.
- Flushing the cooling system of chemical cleaners completely and thoroughly, at the conclusion of the cleaning process, is critical.
- Flushing must be done with water, and will require more than one flushing to purge the cooling system of the cleaning chemicals

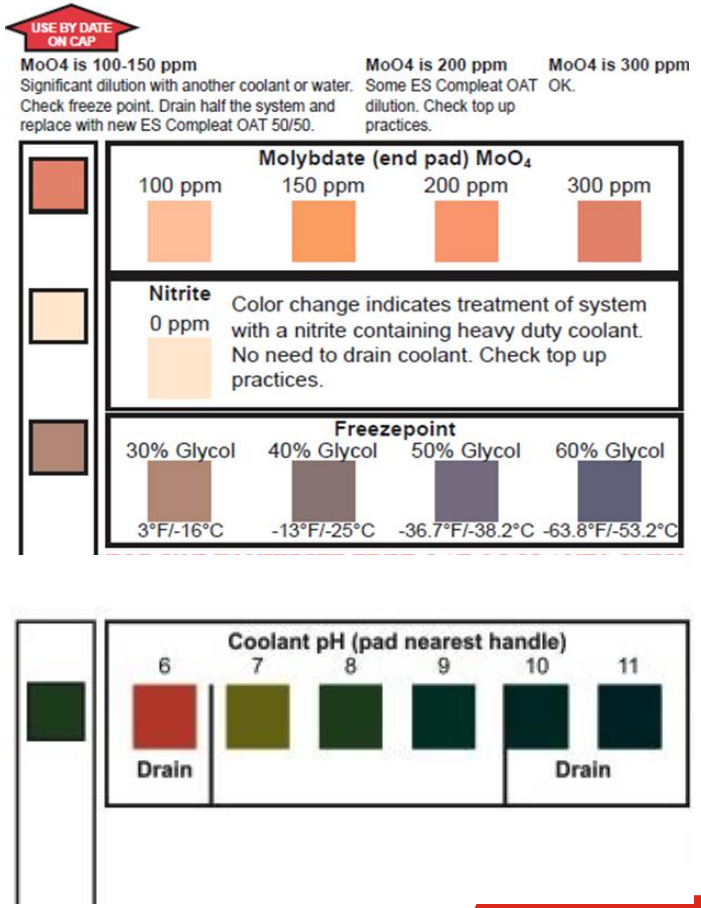
Test Strips- 3 Way

- The 3-way test kit tests for
  - Freeze Point
  - Molybdate
  - Nitrite
- Nitrite and Moly are used to units of SCA which is a measure of liner pitting protection in conventional and hybrid coolants
- A new heavy-duty coolant should read between 1.2 and 2.8
- This kit can be used with competitive Hybrid and Conventional coolants



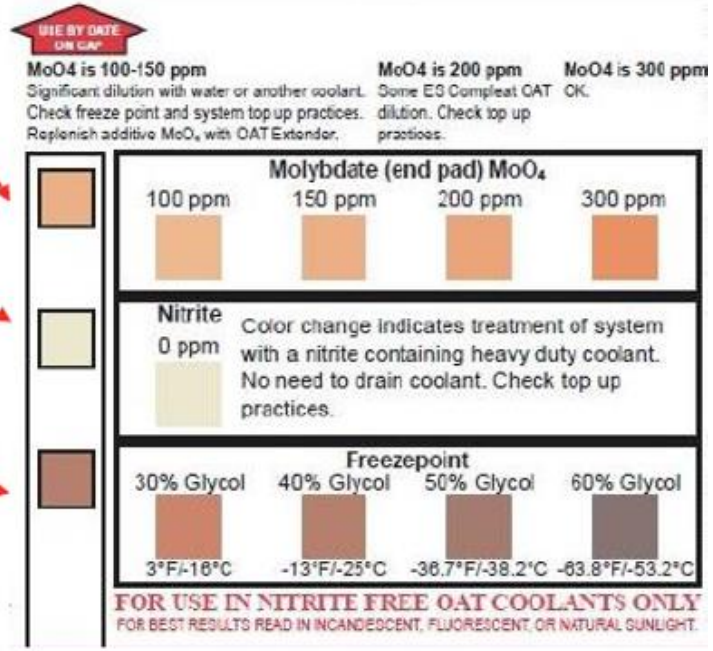
Test Strips- 4 Way OAT

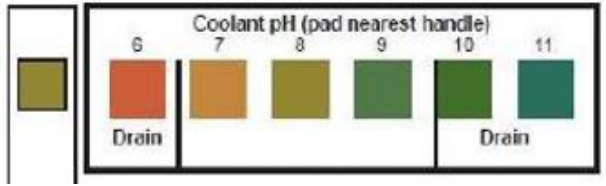
- The 4-way test strip test for
  - Molybdate
  - Nitrite
  - Freeze Point
  - pH
- In this test kit Nitrite indicate mixing with a non-OAT product
- Molybdate depletes faster than the organic acids so it provides a conservative measure of the coolant protection
- This kit is designed to work for ES Compleat OAT and does NOT provide accurate recommendations when used with competitive OAT products



Interpretating 4 Way Test Strip Results

- Molybdate - Instructions are provided with test kits and in following slide.
- Nitrite – Color change indicates mixing of coolants. Customer should closely monitor top up practices to avoid transitioning from a long-life OAT coolant to a conventional or hybrid through mixing.
- % Glycol - Adjust per instructions previously provided if not in acceptable range.
- pH - If the pH is outside of the acceptable range, immediately drain and replace with new coolant.
  - Customer is also recommended to check overall engine condition when pH drops to ensure overheating and/or combustion gas leaks are not occurring.





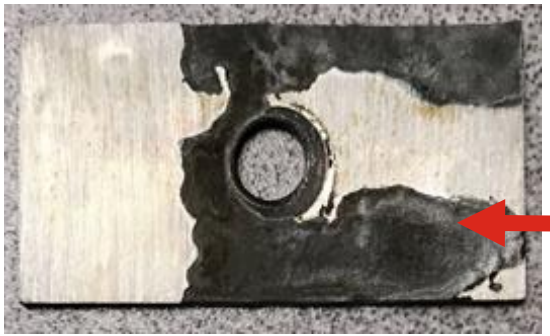
OAT Coolant Maintenance

Recommendation based on **molybdate** reading:	
Molybdate Test Result:	Action Required
≥200ppm	**No Action Required.**
150-200ppm	**Drain 1/3 total coolant capacity and refill with new 50/50 ES Compleat OAT.** Example: For 12 Gallon system drain 4 gallons (12 gallons X 1/3 = 4 gallons) and replace with 4 gallons of new coolant.
≤150ppm	**Drain ½ total coolant capacity and refill with new 50/50 ES Compleat OAT.** Example: For 12 Gallon system drain 6 gallons (12 gallons X 1/2=4 gallons) and replace with 4 gallons of new coolant.

- OAT coolants do not need Extenders or SCAs, so there is no equivalent to DCA2 or DCA4 for use.
- **OAT coolants should only be used with blank water filters.**

Red Flags on Lab Report for HD Coolants

- Coolants that are promoted and labeled as Nitrite Free or OAT and contain Nitrite
- Excessively high 2-EH numbers on HD coolants (5-digit range)
- Chloride > 25ppm
- Chloride, Fluoride and Bromide combined max levels >200ppm
- Outside the normal pH on new OAT coolant of 7.5 to 9.0
- Outside the normal pH on new conventional coolant of 9.0 to 10.5
- Outside the normal pH on new hybrid coolant of 7.5 to 10.5



Corrosion test failure and did not pass D3306 Specs

Thank You

For Your Time and Attention!