Technical Bulletin
A POLARIS Laboratories Publication

Higher Operating Temperature Engine Cooling Systems Require Controlled Maintenance Procedures

The new engines introduced by manufacturers in the last few years are designed to lower fuel consumption and meet impending federal emission laws. As a result, the cooling systems for these new designs must operate at much higher temperatures making careful cooling system maintenance necessary to avoid engine damage due to boiling, deposits or pitting.

The cooling system guidelines below are designed to help operators and fleet maintenance personnel maintain and control cooling system maintenance procedures.

Basic Rule: 4 - 8- 16

1. Every 15°F to 17ºF (8.4°C to 9.5°C) increase in cooling system operating temperature above 160ºF (71.1°C) can result in a potential doubling of deposits or acid pitting of metal for the same coolant problem, in the same amount of time, with the same rate of flow. See example below:

a. ***160ºF (71.1°C) engine operating temperature:***
(Base Point)

b. ***190ºF (87.9°C) engine operating temperature:***
Potential increase of pitting or deposit is 400%, but reduces ring and bearing wear by 40%.

c. ***205ºF (96.1°C) engine operating temperature:***
Potential increase for pitting or deposit is 800%.

d. ***220ºF (132°C) engine operating temperature:***
Potential increase for pitting or deposit is 1600%.

2. If a coolant is corrosive, doubling the rate of flow, at high temperatures, will double the rate of corrosion.

Example:

An increased rate of corrosion due to temperature - 400%

Doubling the rate of flow for the coolant past a piece of metal <u> x 2</u>

Potential increase in metal corrosion to be corrected in the field - 800%

3. At increased operating temperatures, improperly maintained coolants will become acidic with time. The hotter the system, the more acidic the coolant will become. This turns the engine into a wet cell battery. The coolant becomes the electrolyte between dissimilar metals in the engine and cooling system.
4. Pressure raises the boiling point of the coolant about 2.7ºF (1.6°C) per pound of pressure at sea level.
5. Pressure and antifreeze levels control coolant boiling points. Coolant boiling points drop about 3ºF (1.7°C) per every 1000 feet of elevation. About 80% of preventable engine failures caused by a cooling system problem are due to one of the following:

    a. What water is in the coolant? Does it meet ASTM engine manufacturer specifications for use in engine coolants?

    b. Is the coolant designed for what you want it to accomplish?

    c. Is there an internal or external air leak into the coolant? Is the system pressure tight? Are there dissolved gases present from air pit metal?

    d. Is there an electrical ground problem? One 1/2 volt of current grounding through a coolant can destroy the engine, regardless of any coolant maintenance inhibitor levels.
6. One-tenth of an inch of calcium silicate scale has approximately the same insulating potential as three quarters of an inch of fire brick. The greatest amount will form at the point where the greatest heat transfer is needed. The basic 4-8-16 rule applies.

7. Coolant will expand to 4.7% of its total volume at 180°F. Newer higher operating temperature engine coolants expand about 6%. Distilled water vapor is always given off through the overflow. Air and its contaminated moisture comes in through the overflow unless it’s a closed system.

These guidelines can enable operators and maintenance personnel to identify problems before engine failure occurs. If failure does occur, they can provide valuable insight as to the cause.