

Cooling System Predictive Maintenance

AEMP CONNECT 2020

The Rest of the Story: A Preventive & Predictive Maintenance Program

- Today's Modern Engines
- Cooling System Criticality
- Coolant Formulations
- Benefits of Coolant Analysis

Bureau Veritas Fluid Analysis

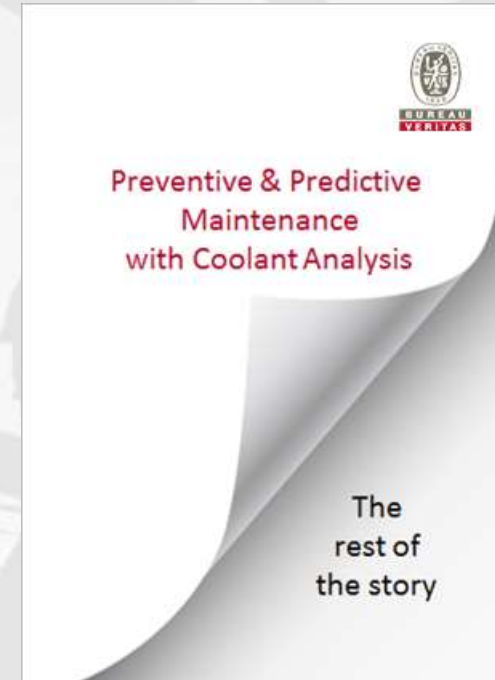
- Routine oil analysis is an effective way of gauging the condition of a lubricant and determining optimum change intervals — to get the most life out of the oil in use as well as provide maximum continuous protection of equipment.

Oil Analysis: An Invaluable Tool



Bureau Veritas Fluid Analysis

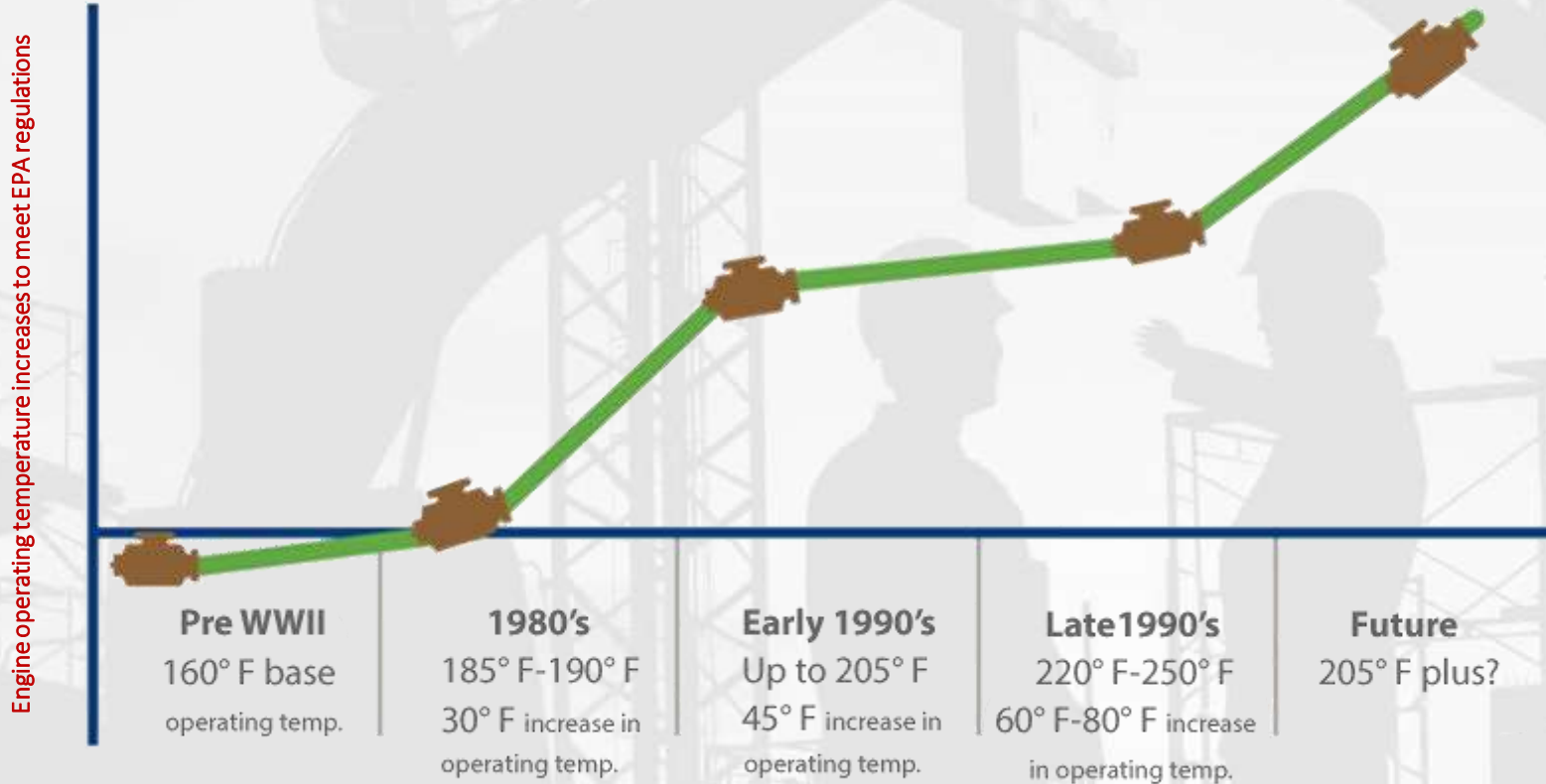
- While oil analysis is an invaluable condition monitoring tool, it tells you very little about what is happening inside the cooling system. Coolant analysis provides the rest of the story by pinpointing coolant and cooling system issues that can lead to premature engine failure.



The background of the slide features a grayscale silhouette of a construction site. In the foreground, two workers in hard hats are shown in profile, facing each other as if in conversation. Behind them, the skeletal structure of a building under construction is visible, including scaffolding, rebar, and a large crane arm extending across the upper portion of the frame. The overall scene is set against a light, hazy sky.

Today's Modern Engines

Ever Increasing Temperatures

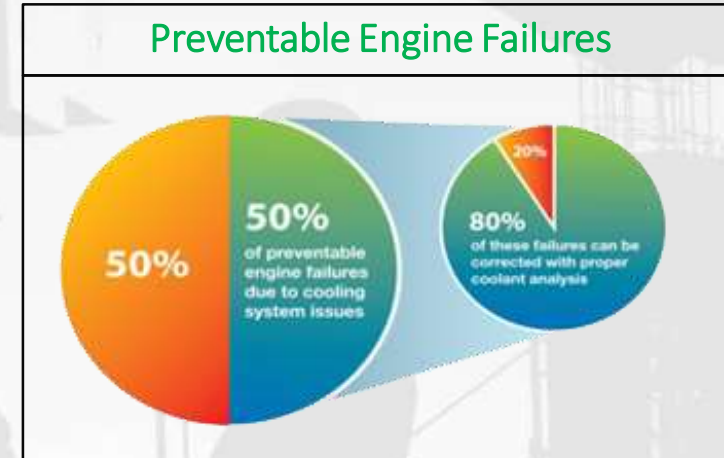


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Cooling System Criticality

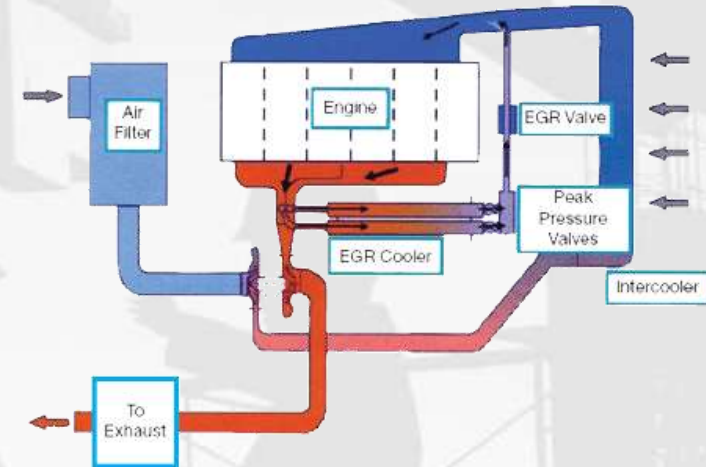
Industry Research

- Ø 80% of preventable engine failures caused by cooling system problems are due to:
- Water used to mix concentrate coolant
 - Coolant design
 - Internal/external air leaks
 - Low pH
 - Coolant mixing



Cooling System Issues Affects

- ∅ Life and efficiency of liquid cooled brakes
 - Can cause them to fade and burn up
- ∅ Emission control
 - Cooled EGR



Cooling System Issues Affects

Ø Engines

- High coolant temperatures cause high oil temperatures
 - Reduces oil's operating viscosity
 - Leads to oil oxidation and eventual engine wear
 - Evident in ring sticking, piston glazing or varnishing, valve wear
 - Often masks the fact cooling system issue was contributing factor

Cooling System Issues Affects

Ø Transmissions

- Overheated cooling system can:
 - Shorten transmission life
 - Transmission disc slippage may occur due to reduced oil viscosity
 - Creates more heat
 - Causes oil oxidation

Cooling System Issues Affects

Ø Hydraulics

- Overheated cooling system can:
 - Cause motors and pumps less efficient
 - Cause reduced oil viscosity and oil oxidation
 - May reduce life of valves, pump slippers, barrels and seals

Effects of Improper Cooling System Maintenance

Ø Lubrication

- Excessive heat can degrade lubricants to a point where they no longer protect
- Transmission life
- High fluid temperature
 - Reduces life
 - Lowers lubricity
 - Increases internal component temperatures

Effects of Improper Cooling System Maintenance

Ø Computer systems

- Scale or sludge formation on sensors



Where Does Cooling System Maintenance Start?

Ø A thorough knowledge of the cooling system requires:

- Understanding system's physical parts
- Understanding system maintenance procedures
- Understanding source water
- Understanding inhibitors
 - Conventional, OAT, NOAT, HOAT, NAP-Free, P-OAT
- Understanding coolant analysis

A grayscale silhouette of a construction site. In the foreground, two workers in hard hats are silhouetted against the background, one appearing to be gesturing or talking. Behind them, a large crane is positioned on a structure, and various scaffolding and steel frameworks are visible. The overall scene is industrial and active.

Coolant Formulations

Importance of Proper Coolant Formulations

∅ Coolant must

- Meet OEM specifications
- Must meet ASTM and TMC specifications
- Duty cycle
- Fluid must be able to handle increase in temperatures and flow rates
- Environmental operating conditions



- **Note:** Price per gallon alone cannot be the only deciding factor. How many millions of dollars are you trying to protect?

Why Test Extended Life Coolant?

∅ Fluid design can't correct

- Mechanical issues
- Contamination from poor maintenance practices
- Coolant Mixing
 - Mixed fleets are more vulnerable to coolant mixing

High exposure area for
"hot spot vaporization"

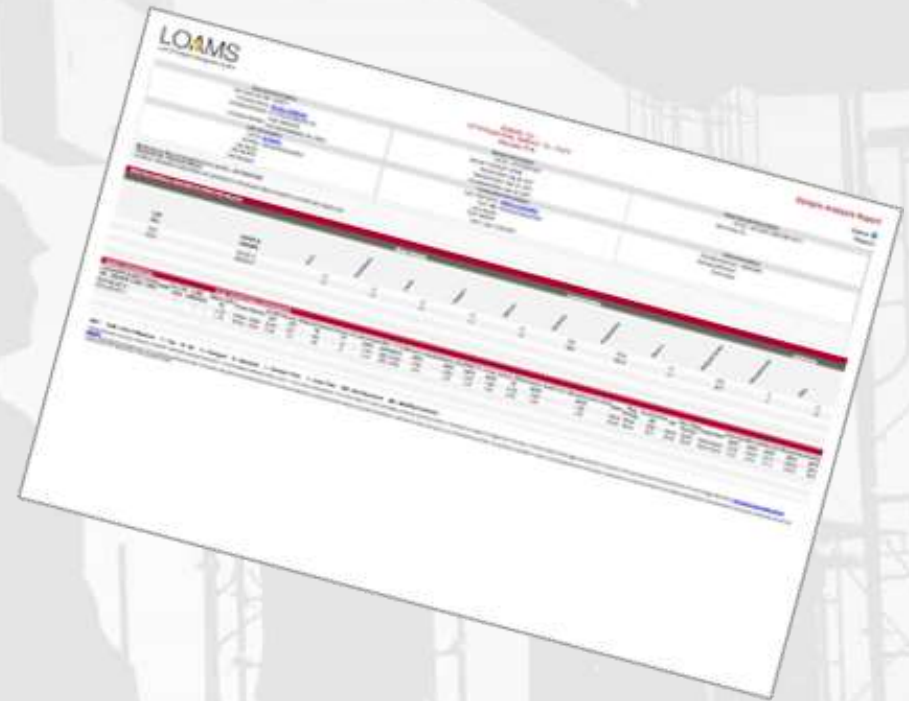


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Benefits of Coolant Analysis

Coolant Analysis

- Ø Coolant Analysis can identify cooling system maintenance problems before catastrophic failure occurs.
 - Ø Less downtime
 - Ø Fewer repairs
 - Ø Proper drain intervals established
 - Ø Reduced costs



LOAMS		Analysis Report	
Item	Value	Unit	Notes
Oil Level	100%	%	OK
Oil Pressure	100	PSI	OK
Oil Temperature	150	F	OK
Oil Viscosity	150	Centistokes	OK
Oil Acidity	0.5	mg KOH/g	OK
Oil Water	0.1	%	OK
Oil Solids	0.1	%	OK
Oil Oxidation	0.1	%	OK
Oil Contamination	0.1	%	OK
Oil Life	1000	Hours	OK

Primary Goals of Coolant Analysis

∅ Preventive Maintenance

- Determine if coolant is suitable for continued use
- Coolant mixing has occurred
- Contaminants present that can form scale or acid
- Additive depletion is compromising metal protection

Primary Goals of Coolant Analysis

∅ Predictive Maintenance

- Predict impending failures by noting abnormalities and trends
 - Trends can pinpoint mechanical or formulation concerns
 - Formation of acids or scale
 - Contamination ingress
 - Electrolysis
 - Localized overheating or hot spots

Primary Goals of Coolant Analysis

Ø Root Cause Analysis

- Failure has occurred coolant analysis can determine root cause of issue
 - Experienced data analysts can
 - Make informed recommendations for correcting issue
 - Assist in establishing fluid maintenance procedures to prevent recurrence

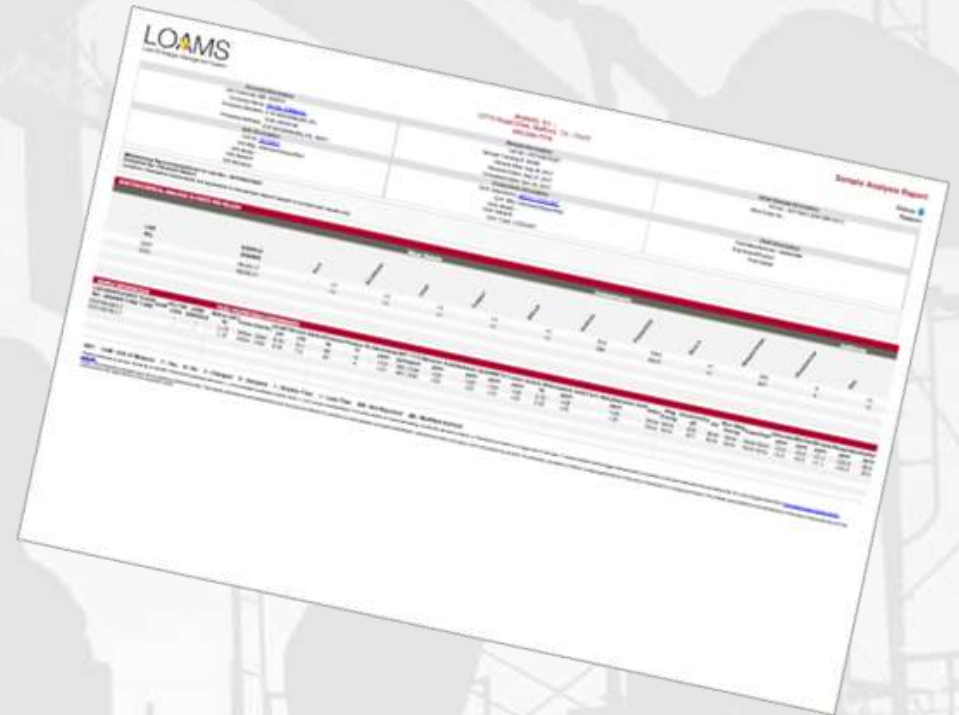
Primary Goals of Coolant Analysis

∅ Life-Cycle Management

- Detect deficient maintenance practices
- Assist in implementing actions to ward off issues within the cooling and lubrication system
- Provide indications of shortcomings in operational practices and maintenance procedures

Primary Goals of Coolant Analysis

- Ø Determine program goals
- Ø Discuss current equipment issues
- Ø Determine bulk coolants in use
- Ø Formulate a workable plan
- Ø Determine program moving forward
- Ø Reading and responding to the report



The image shows a tilted document titled "LOAMS" (Lead and Oil Analysis Monitoring System) with a "Sample Analysis Report" header. The report contains several tables of data, including a table with columns for "Date", "Sample", "Oil", "Lead", "Copper", "Iron", "Nickel", "Manganese", "Sulfur", "Phosphorus", "Zinc", "Silver", "Cadmium", "Chromium", "Cobalt", "Molybdenum", "Vanadium", "Selenium", "Antimony", "Bismuth", "Tin", "Copper", "Iron", "Nickel", "Manganese", "Sulfur", "Phosphorus", "Zinc", "Silver", "Cadmium", "Chromium", "Cobalt", "Molybdenum", "Vanadium", "Selenium", "Antimony", "Bismuth", "Tin". The report also includes sections for "Equipment Information" and "Analysis Results".

Steps To A Successful Program

- Ø Implementation of recommendations
- Ø Following up

The image shows a tilted screenshot of a LOAMS (Loss of Manpower) analysis report. The report is titled "LOAMS" and includes a "Summary Analysis Report" section. It contains a table with columns for "Activity", "Start", "End", "Resources", and "Manpower". The data table is complex, with multiple rows and columns, and is separated by red horizontal lines. The background of the slide features a silhouette of a construction worker in a hard hat, looking at a large crane structure.

Bottom Line

- Coolant analysis can dramatically improve machine performance, reduce unnecessary repair and maintenance costs, and extend the life of equipment by optimizing the condition of the mechanical systems involved and the fluids that keep them running.

Oil Analysis: An Invaluable Tool



MOVE FORWARD WITH CONFIDENCE

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