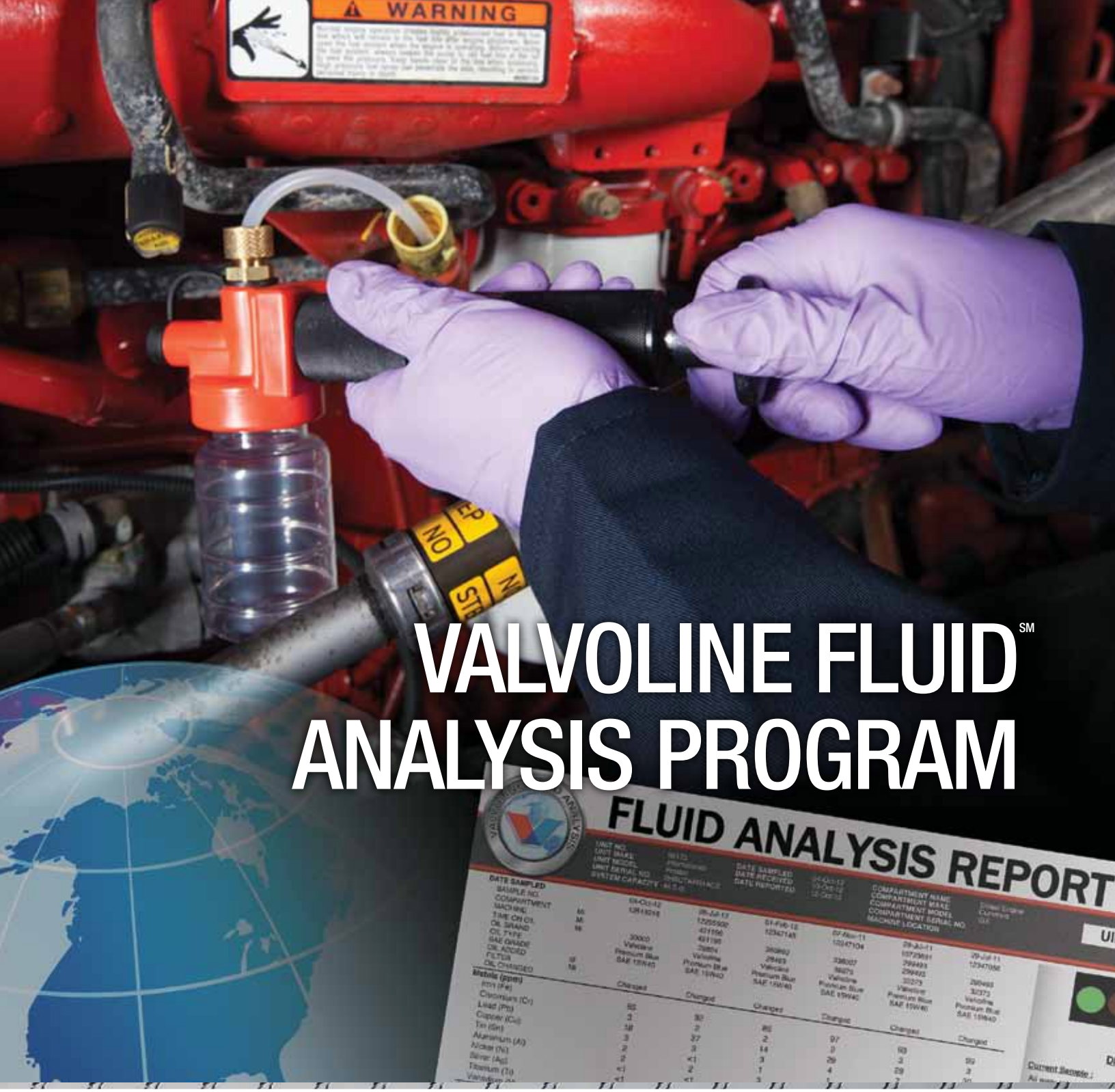


VALVOLINE FLUID ANALYSIS PROGRAM℠

Valvoline

What Can The Fluid Analysis Program Do For You?

The Valvoline™ Fluid Analysis Program is a monitoring and preventative maintenance service, designed to help our customers gain additional insight into equipment condition. This service gives vital information about the health of your equipment can help predict and prevent catastrophic failure.

Benefits include:

- Identify minor problems before they become major failures
- Optimize oil drain intervals*
- Provide back-up for warranty claims
- Centralized Global data base with Web access, can monitor information internationally
- Regional Labs Across The U.S. Ensure Rapid Sample Processing
- E-Mail Alerts Provide Immediate Indication Of Potential Concerns
- Online Portal For Oil Sample Data, With Tools For Report Generation And Data Analysis
- Ongoing Assistance Available From Valvoline Application Engineers

When using Valvoline's Fluid Analysis program, you can be confident that the test results are accurate, repeatable and performed to consistent methodologies and interpretation, whether the sample was processed in Western USA, or Western Australia. All Valvoline analysis laboratories provide consistent, global support, testing and diagnostic interpretation.

* Fluid analyses are one supporting component of a comprehensive maintenance program. Equipment manufacturer(s) should be consulted for specific recommendations regarding maintenance practices, including (but not limited to) fluid drain intervals

Valvoline™ | The ONLY ONE.

Visit us at **www.valvolinehd.com** or call us at **1-800-354-9061.**
Learn more about all of our full line of Off-Road, On-Highway and Industrial products at www.valvolinehd.com or phone 1-800 354-9061 to put the Valvoline Advantage PERFORMANCE and PROTECTION to work for you.

Results and Interpretation

Valvoline's Fluid Analysis program offers our customers a great deal of flexibility in the delivery and management of their data. We can transmit reports via e-mail, provide access to our Valvoline Fluid Analysis web-site to view and manage data or send a data file that can be imported into other software programs.

Valvoline Fluid Analysis has a full suite of management reports and data mining capabilities to assist you with improving and managing your maintenance programs.

Searching for information based on a compartment type and/or other variables is easy and quick through Valvoline's global web portal. Web users are able to assess compartments by problem and number of occurrences to aid in root cause analysis. This application allows your organization to review, e-mail and print reports, print sample labels and run various management reports. The system is easy to use and allows for numerous levels of access and data viewing permissions.

www.http://ValvolineFluidAnalysis.com

Reference Guides

Many times, users that test their in-service lubricants will look at reports and ask "what do these tests mean?" Most routine analysis reports display similar test parameters for monitoring the condition of the operating equipment and the lubricant in service. This simple guideline will help explain the use and meaning behind the routine tests you are likely to see on an analysis report. Please note that this serves only as a guideline; the elements listed do not purport to include all possible resources.

Physical and Chemical Tests for Lubricant Condition and Service Life

Viscosity: Improper viscosity can affect a lubricants performance.

- Too low of a viscosity will not create sufficient surface film to keep moving parts separated and prevent rubbing on opposing metal surfaces.
- Too high of a viscosity will create excessive heat and reduced fluid flow within circulating systems.
- A change in viscosity will indicate a change in the fluid performance integrity. A drop in viscosity generally indicates contamination with a lighter product, addition of an incorrect viscosity grade, and in some cases thermal cracking. An increase in viscosity can indicate oxidation and reduced service life due to age, addition of an incorrect viscosity grade, or excessive soot or insolubles content.

Wear Metal Reference Guide

When trace elements are detected, the following areas could be responsible	Aluminum (Al)	Chromium (Cr)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Nickel (Ni)	Tin (Sn)	Silver (Ag)	Titanium (Ti)	Vanadium (V)
Bearings	•	•	•	•	•	•	•	•		
Bushings	•		•	•	•		•	•		
Compressor Piston	•			•			•			
Cylinder / Liners	•	•		•						
Clutch Discs			•		•			•		
Engine After Cooler	•						•	•		
Gears		•		•		•			•	
Housing/Blocks	•			•		•				
Hydraulic Cylinders	•	•	•	•	•		•			
Hydraulic Pumps	•		•	•	•	•	•			
Oil Cooler	•		•				•	•		
Pistons	•			•						
Piston Skirt Overlay	•	•		•		•				
Rings							•			
Rust				•						
Shafts		•		•		•			•	
Thrust Plates	•		•		•		•			
Thrust Washers	•		•	•	•	•	•	•		
Turbine Blades									•	•
Valve Guides/Stem	•	•		•		•				
Valve Trains		•				•			•	
Washers										

Lubricant Reference Guide

Purpose of lubricant additive	Antimony (Sb)	Barium (Ba)	Boron (B)	Calcium (Ca)	Magnesium (Mg)	Molybdenum (Mo)	Phosphorus (P)	Sodium (Na)	Silicon (Si)	Titanium (Ti)	Zinc (Zn)
Alkalinity Reserve				•	•						
Anti-foam									•		
Anti-wear	•						•			•	•
Anti-oxidant	•										•
Corrosion Inhibitor								•			•
Detergency			•	•	•						
Extreme Pressure	•		•			•	•				
Friction Modifier							•				
Lubricity						•					
Rust Inhibitor		•									
Water Separability		•									

Contaminant Reference Guide

When contaminants are detected, the following could be the source	Aluminum (Al)	Boron (B)	Magnesium (Mg)	Potasium (K)	Silicon (Si)	Sodium (Na)
Aftercooler Grazing Flux	•			•		
Coolant		•		•	•	•
Dirt	•				•	
Gasket/Seal Material					•	
Natural Gas (Wet Gas) Transferring						•
Seawater			•			•

Base Number: Base number provides a relative measure of alkalinity reserve available for neutralizing acids formed during the combustion process. As the lubricant ages and the additive package depletes, the base number will decrease from its initial fresh oil value. As there are various methods for measuring base number, caution should be exercised when comparing results from different labs.

Acid Number: Acid number in a new lubricant represents a certain level of additive compounding. This can come from antirust, antiwear or other additives. The acid number can drop a bit after a lubricant has been in service for a certain period, which indicates some initial additive depletion. After a time the acid number will start to increase, which indicates the creation of acidic degradation products related to oxidation.

Oxidation Number: The oxidation number is a relative number that monitors increase in the overall oxidation of the lubricant by infrared spectroscopy. This test parameter generally complements other tests for fluid service life, such as viscosity and acid number. Generally this test is not used as a primary indicator when all other tests are within normal limits. Accurate oil information is required to get the most valid test results.

Nitration Number: The nitration number is a form of oxidation that relates to chemical reaction with nitrogen, forming nitrogenous compounds also. Nitration is a relative number that monitors increase in the overall fluid degradation due to reaction with nitrogen and oxygen by infrared spectroscopy. This test parameter generally complements other tests for fluid service life, such as viscosity and acid number. Generally this test is not used as a primary indicator when all other tests are within normal limits. Accurate oil information is required to get the most valid test results. Contributors to increased nitration can come from exhaust gas blow-by or reaction with natural gas products with the lubricant and heat. It is also an indicator of electrostatic discharge across filter surfaces in turbine oil.

Physical and Chemical Tests for Lubricant Contaminants

Water: Water as a contaminant will generally lead to increased corrosion, depletion of proper lubricating film, decreased lubricant performance life and increased acid formation.

Coolant: Coolant contamination will degrade lubricant service life and performance, create sludge and block lubricant passageways.

Fuel Dilution: Fuel dilution will decrease fluids viscosity, therefore affecting its lubricity properties. Fuel dilution also promotes degradation of lubricant service life and additive properties.

Soot: Excessive soot increases viscosity, creates excessive wear, and will tie up active additives needed for lubricant performance.

Particle Count: "Clean Systems" require a minimum level of cleanliness in order to operate reliably. This is especially true for circulating systems with high pressure and close tolerance components. The ISO Cleanliness Rating is a convenient way to communicate the level of particulate contamination within a system based on the particle count for micron sizes greater than 4, 6, and 14.

Tests for Wear Debris

Particle Quantification Index (PQI): PQI is a valuable trending tool for monitoring the relative level of ferrous wear material within a lubricant sample.

Filter Patch: Filter patch inspection provides a visual assessment of wear particle and other solid debris present in a sample after collection on a 0.8 micron to 5.0 micron filter membrane and examined by a microscope.

Microscopic Particle Examination (MPE): Analytical Ferrography provides detailed information on different wear particles present in a sample. This is generally an exception test that provides information on the type of metal makeup of the wear particles present and how they were formed.

Analysis and Sampling Supply Options

Lubricants

Test Package	Element Analysis (ICP D5185)	Water % by Crackle or FTIR, positive WKF (E203/D6304)	Viscosity @ 40°C (D445)	Viscosity @ 100°C (D445)	Fuel Dilution % (D3524 GC or D3828 Seta Flash Point)	Fuel Soot % (Wilks Soot Meter)	TAN (D664)	TBN (D4739)	TBN (D2896)	Oxidation/Nitration (E2412)	ISO Particle Count (ISO11500/4406)
Level I Basic Analysis	•	•	• Non Engine	• Engine	• Engine	• Engine					
Level II Extended Drain	•	•	• Non Engine	• Engine	• Engine	• Engine	• Non Engine	• Engine			
Level III Extended Drain Comprehensive	•	•	• Non Engine	• Engine	• Engine	• Engine	• Non Engine	• Engine		•	
Level IV Natural Gas Engine	•	•	•				•			•	
Level V Advanced Natural Gas Engine	•	•	•	•			•	•	•	•	
Level VI Hydraulic	•	•	•				•				•
Level VII Technical Service Package	•	• (D203/D6304)	•	•	•	•	•	•		•	

Coolants

Test Description	Appearance (Visual Assessment)	Boil Point (D3321)	Elemental Metals by ICP (D5185)	Freeze Point (Refractometer)	Glycol % (Refractometer)	Nitrate (D5827)	Nitrite (D5827 or Titration)	pH (D1287)	Total Dissolved Solids (D1125, modified)	Carboxylate Acid Cumulative Percent Concentration (UPLC)
Level VIII Basic Analysis	•	•		•	•		•	•	•	
Level IX Advanced Coolant Analysis	•	•	•	•	•	•	•	•		•

Sampling Supplies

Sampling Supplies		Inventory Item Description
PART NUMBER		
C-PPDLBL		Postage Paid Return Mailing Labels
C-VKP14		1/4" KP Pushbutton Valve - recommended for pressurized systems (5-3000psi), max sample pressure 750psi. Suitable for engines, transmissions, compressors and in-line hydraulics
C-VKP18		1/8" KP Pushbutton Valve - recommended for pressurized systems (5-3000psi), max sample pressure 750psi. Suitable for engines, transmissions, compressors and in-line hydraulics
C-PUMP		Suction Dual Pump
C-TUBING		100' Roll of Tubing (precut is also available)
VB14		1/4" B Series Valve - recommended for pressurized systems (5-3000psi), max sample pressure 750psi. Suitable for general industrial, plant and utility
PROBEB14		Probe Adapter for use with the B Series Valve. Designed to transfer between valves/ remove after sampling. (Tubing also required for use with Adapter)
VK18		1/8" KST Series Valve - recommended for vacuum systems, pressurized systems (5-3000psi), max sample pressure 750psi. Suitable for general off-highway, mobile and marine applications
CAPPROBE		Needle probe samplyzer, for use with needle port valves and required with the KST Valve
LT Tube Extender		LT High Flow tube extender for non-pressurized and low pressure systems. Use for splash lubricated gearboxes and bearings, etc. Steel tube positioned permanently inside to draw consistent representative samples. (For use with adapter)
VLT14NT12		1/4" OD Probe adapter for L/LT valve fitting

OTHER SUPPLIES AVAILABLE. CONTACT US FOR A FULL LIST.

Take a Sample

Equipment manufacturers provide recommendations for preventative maintenance practice, but how critical a piece of equipment is to productivity should be a major factor in determining sample frequency. High temperatures, dirty operating conditions, short trips, heavy loads and excessive idle times can significantly affect the optimum sample frequency.

For Optimum Results

- Determine optimum sample schedule
- Identify sample points and take samples from the same point each time
- Take sample while the machine is at normal operating conditions or immediately after shut down
- Utilize storage and handling best practices

General Guidelines for Taking a Quality Sample

Each sample drawn must be taken regularly from a single location in a system. Take samples during normal operating conditions, downstream of pumps, cylinders, bearings, and gearboxes and upstream from the filter. When obtaining a sample from a lubricated system, always have the oil hot and thoroughly mixed before sampling. When possible and safe, always take the sample while the machine is running.

- Make sure that the sample bottle is clean and free of any moisture before obtaining sample.
- When utilizing the vacuum pump method, make sure that sample is not obtained from the bottom of the oil compartment where sludge accumulates. Aim for the midpoint of the reservoir.
- Obtain samples during normal equipment operation or at least within 30 minutes after equipment is shut down. This is the best way to obtain a truly representative sample of conditions within a lubricated compartment or a machine compartment.
- Make sure that sample bottle and container are properly sealed before shipping.
- Fill out the sample information form correctly and completely.
- Ship sample to laboratory promptly to receive analysis results as soon as possible.

Sample Valve Method

Install valves upstream of any filter in order to capture wear particles. Make sure the valve is clean and adequately flushed. Using a sample valve, such as the 1/8” NPT Push Button Valve, helps in producing reliable test results. Install valve properly on a pressurized oil line or oil galley. Avoid areas where oil does not circulate as freely, such as the bottom of a sump.

1. Unscrew dust cap from sample valve.
2. Depress the button on the sample valve.
3. Flush the oil line allowing several ounces to drain before taking the sample.
4. Place the empty sample bottle under the sample valve discharge opening.
5. Fill the sample bottle 3/4 full and release the sample valve.
6. Tighten the cap on the sample bottle to secure a tight seal.
7. Screw the dust cap back on the valve. Prepare for shipment.

Sample Pump Method

If taking an oil sample using the pump method, operate the equipment long enough to mix the oil thoroughly; bringing the oil to operating temperature is a good indication that the oil is adequately mixed. It is important that vacuum pumps are used with appropriate tubing. Make sure that new tubing is used for each sample in order to avoid cross contamination. Cut the tubing to the same length each time you sample. Avoid scraping the tubing along the sides or bottom of the tank or reservoir. Use this method with systems not equipped with sampling valves.

Taking an Oil Sample Using the Pump Method:

1. The objective is to insert the tubing into the sump at the same depth as the tip of the dipstick. Measure and cut new tubing to the length of the dipstick PLUS the amount required to comfortably position the vacuum pump for sample extraction (a common rule of thumb is to add about 6" to the length of the dipstick, but this may vary according to the position and accessibility of the dipstick tube
2. Insert the tubing through the head of the vacuum pump and tighten the retaining nut. The tubing should extend about 1/8 inch beyond the base of the vacuum pump head.
3. Install a new sampling bottle onto the vacuum pump and insert the end of the tubing into the oil – do not allow the tubing to touch the bottom of the compartment.
4. Pump the vacuum pump handle to create a vacuum. Hold the pump upright to avoid oil from contaminating the pump. If oil enters the pump, disassemble and clean it before taking the sample. Fill the oil sample bottle at least 3/4 full.
5. Remove the tubing from the compartment and dispose of it correctly. Do not reuse tubing. Remove the bottle from the vacuum pump and secure the cap on the bottle. Prepare for shipment.


Valvoline Fluid Analysis
Sample Information Form

Online results at:
http://valvolinefluidanalysis.com

DO NOT PHOTOCOPY
RETURN ORIGINAL FORM WITH SAMPLE

UIN

Please complete next section or attix compartment label from website

Drain Line Method

The drain line method is considered the least preferred method of sampling. If used, make sure that an ample amount of oil is drained before collecting a sample. The sludge, particles and water that settle to the bottom of a tank or reservoir provide poor and sometimes unreliable results.

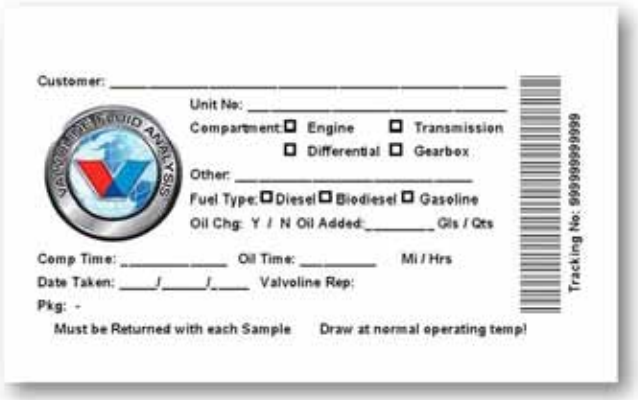
Taking an Oil Sample Using the Drain Method:

1. Clean area around the drain plug to avoid sample contamination.
2. Allow ample amount of oil to flush through the oil pan drain hole.
3. Fill sample bottle 3/4 full.
4. Screw bottlecap on tightly. Wipe bottle clean and prepare for shipment.

Proper identification from each unit sample is crucial for tracking critical reports and unusual wear. Each sample submitted to the designated laboratory should include a Sample Information Form (SIF).

Sample Identification Forms (SIF)

Keep in mind that the laboratory cannot perform accurate analysis and interpretation, unless they have all the information required on the Sample Identification Form properly filled out.


Customer: _____

Unit No: _____

Compartment: ☐ Engine ☐ Transmission
☐ Differential ☐ Gearbox

Other: _____

Fuel Type: ☐ Diesel ☐ Biodiesel ☐ Gasoline

Oil Chg: Y / N Oil Added: _____ Gls / Qts

Comp Time: _____ Oil Time: _____ Mi / Hrs

Date Taken: ____/____/____ Valvoline Rep:

Pkg: -

Must be Returned with each Sample Draw at normal operating temp!

Tracking No: 999999999999

Laboratories and Services

All Valvoline Fluid Analysis laboratories are able to assist our customers with new customer set up, equipment registration, sampling kits and equipment and other general questions.

Global map of locations and contact address/phone and fax

UNITED STATES

3121 Presidential Drive
Atlanta, GA 30340
Tel: 800.394.3669
Fax: 770.451.1500

935 Sunshine Road
Kansas City, KS 66115
Tel: 800.332.8055
Fax: 913.281.9885

1375 Greg Street, Suite 104
Sparks, NV 89431
Tel: 800.524.7848
Fax: 775.358.3871

4943 NW Front Avenue
Portland, OR 97210
Tel: 800.770.4128
Fax: 503.286.1562

18419 Euclid Avenue
Cleveland, OH 44112
Tel: 800.726.5400
Fax: 216.383.9633

3319 W. Earll Drive
Phoenix, AZ 85017
Tel: 800.445.7930
Fax:602.252.4639

CANADA

1240 Burloak Drive Suite 6
Burlington, ON L7L 6B3 Canada
Tel: 877.732.9559
Fax: 905.632.9304

10717-176 Street
Edmonton, Alberta T5S 1K1
Tel: 888.489.0057
Fax: 780.486.2257

To order sampling supplies, please contact your local Valvoline representative, or e-mail us at Vavoline@alsglobal.com

Example Of Fluid Analysis Report

FLUID ANALYSIS REPORT

UNIT NO.	Diesel Engine Demo	DATE SAMPLED	6-Aug-09	COMPARTMENT NAME	Diesel Engine
UNIT MAKE		DATE RECEIVED	26-Sep-09	COMPARTMENT MAKE	
UNIT MODEL		DATE REPORTED	3-Mar-11	COMPARTMENT MODEL	
UNIT SERIAL NO.	123456			COMPARTMENT SERIAL NO.	4A2001
SYSTEM CAPACITY	10.0 gal			MACHINE LOCATION	

UIN 00A5EE8

DATE SAMPLED		6-Aug-09	4-Jul-09	6-Jun-09	4-May-09	5-Apr-09	1-Jan-09
SAMPLE NO.		8694160	8694159	8694158	8694157	8694156	8696031
COMPARTMENT	Hrs	10774	10521	10250	9994	9746	
MACHINE	Hrs	10774	10521	10250	9994	9746	
TIME ON OIL	Hrs	253	271	256	248	254	
OIL BRAND		Unidentified	Unidentified	Unidentified	Unidentified	Unidentified	Conoco
OIL TYPE		Unidentified	Unidentified	Unidentified	Unidentified	Unidentified	fDCR Powerdriv
SAE GRADE		Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
OIL ADDED	gal	1.0	2.0	1.0	5.0	3.0	
FILTER	Hrs						
OIL CHANGED		Changed	Changed	Changed	Changed	Changed	
Metals (ppm)							
Iron (Fe)		44	22	21	23	20	24
Chromium (Cr)		1	1	1	1	<1	4
Lead (Pb)		16	11	10	11	8	<1
Copper (Cu)		10	1	4	2	1	<1
Tin (Sn)		4	2	1	3	2	<1
Aluminium (Al)		2	3	3	2	2	3
Nickel (Ni)		3	3	2	1	2	<1
Silver (Ag)		<1	<1	<1	<1	<1	<1
Titanium (Ti)		<1	<1	<1	<1	<1	<1
Vanadium (V)		3	1	2	3	1	<1
Contaminants (ppm)							
Silicon (Si)		19	8	10	10	9	3
Sodium (Na)		35	4	7	3	5	7
Potassium (K)		73	16	9	11	10	5
Additives (ppm)							
Magnesium (Mg)		811	823	819	825	798	148
Calcium (Ca)		3197	3221	3206	3198	3178	3303
Barium (Ba)		<1	<1	<1	<1	<1	<1
Phosphorus (P)		1608	1615	1605	1625	1587	1276
Zinc (Zn)		1711	1704	1699	1693	1674	1352
Molybdenum (Mo)		21	5	4	3	4	<1
Boron (B)		12	9	12	13	10	27
Contaminants							
Water (%)		<0.05	<0.05	<0.05	<0.05	<0.05	0.10
Coolant		No	No	No	No	No	No
Fuel (%)		1	1	1	1	1	<1
Physical / Chemical							
Viscosity (cSt 100C)		14.8	14.6	14.9	14.9	14.7	1.0
Base Number (mgKOH/g)		10.8	11.6	11.3	11.0	11.2	1.0
Soot (%)		1.1	1.4	1.0	1.1	1.0	1.0
Oxidation (Abs)		4.3	4.7	4.3	4.0	4.1	1.0
Nitration (Abs)		1.6	1.3	1.1	1.1	1.2	1.0
		Caution	Normal	Normal	Normal	Normal	Normal

Caution

DIAGNOSIS

Current Sample :

Increase in wear rates noted. Sodium, silicon, potassium and molybdenum level (possible coolant chemical) elevated. Viscosity of oil appears typical of an 15W40 grade.

Action: As oil and filter(s) already changed, Advise monitor coolant top-up rate as a precaution. Resample 100 hrs to further monitor.

Last Sample :

All wear rates normal. Abrasive and other contaminant levels are acceptable. Viscosity of oil appears typical of an 15W40 grade.

Action: As oil and filter(s) already changed, resample next service interval to further monitor.

Customer:

ALS TRIBOLOGY DEMO

Engine Coolant Reference Guide

Engine coolants are a mixture of glycol, inhibitors, and water. Each formula is designed for specific protection and engine requirements. Mixing different coolants is not recommended and can compromise the coolant's general overall protective capability, resulting in decreased coolant life and damage to the cooling system and/or engine. The following is a reference guide to assist in understanding the engine coolant data.

Appearance

Appearance Assessment	Target	Observation	Possible Result	Corrective Action
Clarity	Clear	Appear hazy or opaque	Degraded or contaminated engine coolants or a mixture of incompatible coolant types	Check shelf life of the coolant; check coolant handling practices
Color	Clear, bright, and representative of the original engine coolant color	Brown could indicate improper mixing of different coolants	Decreased coolant protection	Verify original coolant color of product in use; if brown was reported, check coolant handling practices
Visible Sediment	None	Presence of sediment is typically indicative of additive fallout, corrosion, rust, scale buildup, or other contaminants	Water pump and seal deterioration, liner pitting, copper and aluminum corrosion, plugged oil cooler and radiator; poor sampling technique.	Add a non-SCA filter for ELC coolants; add an SCA filter to conventional coolant systems
Visible Petroleum Layer	None	Indication of fuel or oil contamination will be observed usually in the form of a separated layer	Combustion gas blow-by into the coolant, leaking oil cooler; poor sampling technique	Check for any seal failures and system integrity

pH

pH	Target	Observation Low pH	Observation High pH	Corrective Action
ELC Engine Coolant and Conventional Engine Coolant	Extended Life 7.5 - 9.5 pH Conventional 8.5 - 11.0 pH	**ELC Low pH (< 7.5) Conventional Low pH (< 8.5)** Low pH can lead to metal corrosion Air leaks will lower pH Improper coolant volume Shelf life of coolant, age will lower the pH Under additized SCA concentration (conventional coolant)	**ELC High pH (> 9.5);** **Conventional High pH (>11.0)** Mixed coolant types Over additized SCA concentration	Check coolant volume Check for air leaks Pressure check radiator cap Check SCA filter and replace if needed (conventional coolant only) Electrical grounding issues (if coolant has a burnt smell) Combustion gas leak if pH is below 7.0 Remove SCA filter when ELC coolants are in use, this will add pH buffer and raise the pH Drain, flush, refill then resample

Freeze Point / Percent Glycol

Glycol Concentration	Target	Observation Low Glycol Concentration	Observation High Glycol Concentration	Corrective Action
Percent Glycol	40% to 60%	**Low Glycol (< 40 %)** **Freeze Point (> -15 F)** Confirm adequate protection requirements for application Improper adjustment with water	**High Glycol (> 60 %)** **Freeze Point (< - 60 F)** Too high indicates over use of concentrate or water is boiling off This can reduce heat transfer properties resulting in cavitations and liner pitting	Check proper coolant volumes Pressure check radiator cap Confirm bulk source of coolant for inadequate concentration Adjust using Valvoline® under or over concentrated chart and recheck freeze point or resample

Conductivity / Total Dissolved Solids (TDS)

	Target	Observation Low TDS	Observation High TDS	Corrective Action
TDS	20000 max	Normal	Improper source water, over concentration of SCAs	Confirm water source; distilled or deionized is recommended Check for improper SCA filter drain, flush and refill

Nitrites

Nitrites	Target	Observation Low Nitrites	Observation High Nitrites	Corrective Action
Nitrite	**Initial coolant concentration typically: > 1200 PPM** **Nitrite only formulas > 300 PPM for nitrite/molybdate formulas** **< 25 for nitrite free**		Verify coolant type in use Over concentration of glycol Improper coolant mixing Over concentration of SCAs for conventional coolants	Check the coolant mixture, if under or over concentrated, this will impact the nitrite level when present If low, look at nitrate level; if pH has dropped, check for head gasket leaks, low coolant volumes, and pressure check radiator cap Rapid depletion could indicate overheating of the cooling system and localized hot spots, check; this will occur along with an increase in glycolates Rapid depletion could also indicate electrical shorts; check grounding, coolant will have a burnt smell If using ELC, check for a pre-charged SCA filter and replace with a non-pre-charged filter If nitrites are low, but carboxylate acid inhibitor passed, resample at next service interval Drain 50% of system and add 50/50 coolant, resample

Carboxylate Acid Technology

Carboxylate Acid	Target	Observation Low OAI	Observation High OAI	Corrective Action
OAI	Passing level depends on the initial extended life coolant's inhibitor level formula	Verify coolant type in use Under concentrated with glycol Improper coolant mixing Coolant is brown – possible improper conversion from conventional to extended life	Verify coolant type in use Over concentrated with glycol Improper coolant mixing	Adjust coolant concentration; if over concentrated, add proper source water; if under concentrated, add glycol concentrate; check freeze point and resample at next service interval > 25 % diluted, adjust using OEM recommended inhibitor package If the coolant was improperly mixed with conventional and extended life coolant, significantly affecting the inhibitor level's protection capability, either drain and flush or contact your OEM for corrective action

Other Ion Chromatography Data

Ion Chromatography Results	Source
Chlorides	Outside contaminants and can come from improper source water or air leaks. It has the potential to form acids and cause corrosion. It can also come from coolant degradation due to aging.
Glycolates	Is among a group of acids that form as coolant degrades. This will also increase when overheating or hot spots are occurring. As this acid increases, iron corrosion is at risk.
Molybdate	Provides protection of cast iron corrosion and cavitations.
Nitrates	Provides protection of light alloys also provides aluminum and solder protection. If nitrites are being exposed to air, they will chemically transform to nitrate – when this occurs look for air leaks.
Phosphates	pH buffer utilized in some coolant brands and provides iron corrosion protection. Over treating the cooling system can lead to sediment detection resulting in possible plugged oil cooler or radiator. Some engines that are aluminum must be phosphate free, check OEM requirements before using a phosphate coolant.
Sulfates	This contaminant can combine with calcium to create scale. This can also indicate coolant degradation due to aging or improper source water is being used.

Coolant Spectrochemical Data

Coolant Spectrochemical Data	Aluminum (Al)	Boron (B)	Calcium (Ca)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Magnesium (Mg)	Molybdenum (Mo)	Phosphorus (P)	Potassium (K)	Silicon (Si)	Sodium (Na)	Silver (Ag)	Tin (Sn)	Zinc (Zn)
Additive Elements		•						•	•	•	•	•			
Wear Elements	•			•	•	•							•	•	•
Water Elements			•				•								

Additional information and resources are available through the ALS Tribology eSource, our electronic newsletter.
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