



Prescient: An Intelligent Agent for Oil Analysis

PRESCIENT OVERVIEW

Modern oil analysis was first commercialized over 50 years ago. Then, as now, equipment operators were concerned about the specific tests used for oil analysis and the cost of these tests. However, testing is only one aspect of oil analysis. Equally important is the *analysis and interpretation* of test results. *Prescient* is an intelligent agent for analyzing the results obtained from performing laboratory tests on oil samples.

WHAT IS AN INTELLIGENT AGENT?

An intelligent agent simulates the behavior and decisions of a human, whether in battle field operations, medical diagnosis, or equipment condition assessment. Intelligent agents behave intelligently because they incorporate domain knowledge provided by experts. *Prescient* uses equipment condition monitoring knowledge to reliably interpret oil test results.

WHY IS THIS IMPORTANT?

Evaluation – the generation of an equipment condition advisory – is a rarely discussed aspect of oil analysis. Usually it is “free”, meaning that evaluation is included with oil sample testing. CMI believes that there has been too much emphasis on sending in samples and collecting reports and too little emphasis on accurate and consistent analysis of test data. *Prescient* has two key value propositions. For testing lab operators, *Prescient* provides a means for reliably automating test evaluation, resulting in considerably lower operational costs. For end users, *Prescient* has a different yet perhaps more significant value: it provides *reliable* and *repeatable* evaluation results for *every sample, every time* even for global organizations that use labs scattered across the world.

HOW DOES IT WORK?

Prescient employs a two step evaluation process. The first step is statistical analysis to flag contaminants which exceed limits established through analysis of customer data. This statistical process considers both trends measured over many months and unacceptable excursions in contaminant levels. *Prescient* then uses its expert knowledge base to interpret the contaminant patterns discovered through lab testing and statistical analysis. Like an experienced oil analyst, *Prescient* is “smart enough” to understand how flagged contaminants (e.g., Fe and Si) may be interpreted together with up to four phase interactions. *Prescient* not only diagnoses and recommends corrective actions but also explains the reasons for its assessment.

Powered by **Prescient**

Account: Hepler Molding Equip Name: Hyd 21 Comp Name: Pump Lube Mfr: Lube Brand: Lube Grade: ISO 46
 Application: Industrial Equip Type: Molding Machine Comp Type: Hydraulic, Vane Comp Mfr: Comp Model: Equip SerNo: 84700-1

Critical

DIAGNOSTIC ADVISORIES:

- Perform pump DIAGNOSTICS checks
- Check SEALS for leakage or compromise

MECHANICAL ADVISORIES:

- CONSIDER INSPECTING FOR ABNORMAL WEAR IN THE FOLLOWING AREAS:
 - PUMP / PUMP HOUSING
 - VALVES
 - BEARINGS
 - BUSHING

Observations and Reasoning:

- Upward wear metals trend is ALARMING, suggesting close monitoring, or possibly maintenance action
- Logical Iron Source: Pump Housing, Vanes, Bearings, Rotor, Shaft
- Logical Copper Source: Vane Pump; Bushing or Bearing Caps, as applicable
- Abrasives are rated at MINOR level
- Particle Count is MODERATELY HIGH
- Logical or Possible Silicon Source: Seal Material

Lube Maintenance:

- Change lube and flush system
- Change filter

Notes:

- Performing Analytical Ferrography on this sample may help clarify the data, and subsequent decision-making

	11/15/06	10/04/06	08/09/06	06/24/06	11/15/06	10/04/06	08/09/06	06/24/06
Fe	37	23	18	12	47.1	43.2	36.0	40.0
Cr	1	1	1	1				
Mo	1	1	0	0				
Al	3	2	1	2				
Ni	3	2	2	2				
Cu	5	9	8	7				
Pb	1	2	1	1				
Sn	1	1	1	0				
Si	37	38	41	41				
Na	2	3	3	3				

	11/15/06	10/04/06	08/09/06	06/24/06
PC >4 mic	1842	1266	392	391
PC >6 mic	434	270	47	36
PC >14 mic	92	80	8	7
PC >21 mic	29	31	4	1
PC >38 mic	1	1	0	0
PC >70 mic	0	0	0	0
ISO Code	18/16/14	17/15/14	16/13/10	16/12/10
PQ Index	27	14	16	18



SPOT-ON DATA ASSESSMENT

SEVERITY is a rating strategy.

Two sets of terminologies: one for Data, one for Component Condition

Severity	1	2	3	4
Data	NOTABLE	ABNORMAL	HIGH	SEVERE
Component Condition	NOTABLE	ABNORMAL	URGENT	CRITICAL

STRONG MAINTENANCE ADVISORIES

Based on diagnostic efforts and on-site information, inspect the seal(s) or vents and breather for wear or compromise

	10/26/09	08/19/09	06/18/09	02/04/09
Analysis Date	04/20/10	08/13/09	06/30/09	02/26/09
Lab Sample ID	0910310008	0908130001	0906270015	0902200011
Lube	0 mi	0 mi	0 mi	0 mi
Component	173293 mi	155229 mi	140947 mi	98588 mi
Oil/Filter Chg'd	N / N	N / N	N / N	N / N
Iron	251	242	239	214
Aluminum	9	10	10	10
Copper	3	3	3	2
Lead	2	0	0	0
Silicon	89	74	55	34
Molybdenum	0	0	0	0
Chromium	3	3	3	3

2-Phase Rules Set for Iron Wear and Abrasives (Silica?)

	SI SEV 1	SI SEV 2	SI SEV 3	SI SEV 4
Fe SEV 4	Severe Wear Notable Silicon	Severe Wear Abnormal Abrasives	Severe Wear High Abrasives	Severe Wear Severe Abrasives
Fe SEV 3	High Wear Notable Silicon	High Wear Abnormal Abrasives	High Wear High Abrasives	High Wear Severe Abrasives
Fe SEV 2	Abnormal Wear Notable Silicon	Abnormal Wear Abnormal Abrasives	Abnormal Wear High Abrasives	Abnormal Wear Severe Abrasives
Fe SEV 1	Notable Wear Notable Silicon	Notable Wear Abnormal Abrasives?	Notable Wear High Abrasives?	Notable Wear Severe Abrasives?

ACCOMMODATES YOUR UNIQUE NEEDS

INCREASING TOLERANCES
(Decreasing Aggressiveness)

Tailorable statistical limit tables, rule sets, and commentary

1.5
1.0

4 SEVERE
3 HIGH
2 ABNORMAL
1 NOTABLE

CONSERVATIVE

4 SEVERE
3 HIGH
2 ABNORMAL
1 NOTABLE

AGGRESSIVE

4
3
2
1

Save Calculate Select All Unselect All Close

	Facult	Lo Lim	Hi Lim	UVC	MP/C	MA	MA	RED	AVG	Sigma	Pop	Range	POS Dev				NOSigma Factors				MC
													1	2	3	4	1	2	3	4	
Fe	K	59	90	95	95	95	95	95	7.73	142.99	1281	06(896)	199	320	416	603	1.20	2.41	3.62	5.40	
Fe - New	K	168	90	95	95	95	95	95	7.73	142.99	1281	06(896)	290	496	654	1040	1.20	2.41	3.62	5.40	1.18
Fe	F	5	90	95	95	95	95	95	145	975	1281	10(10)	5	9	15	24	3.45	6.91	10.38	16.65	
Fe - New	F	4	90	95	95	95	95	95	145	975	1281	10(10)	4	7	12	20	3.45	6.91	10.38	16.65	0.88