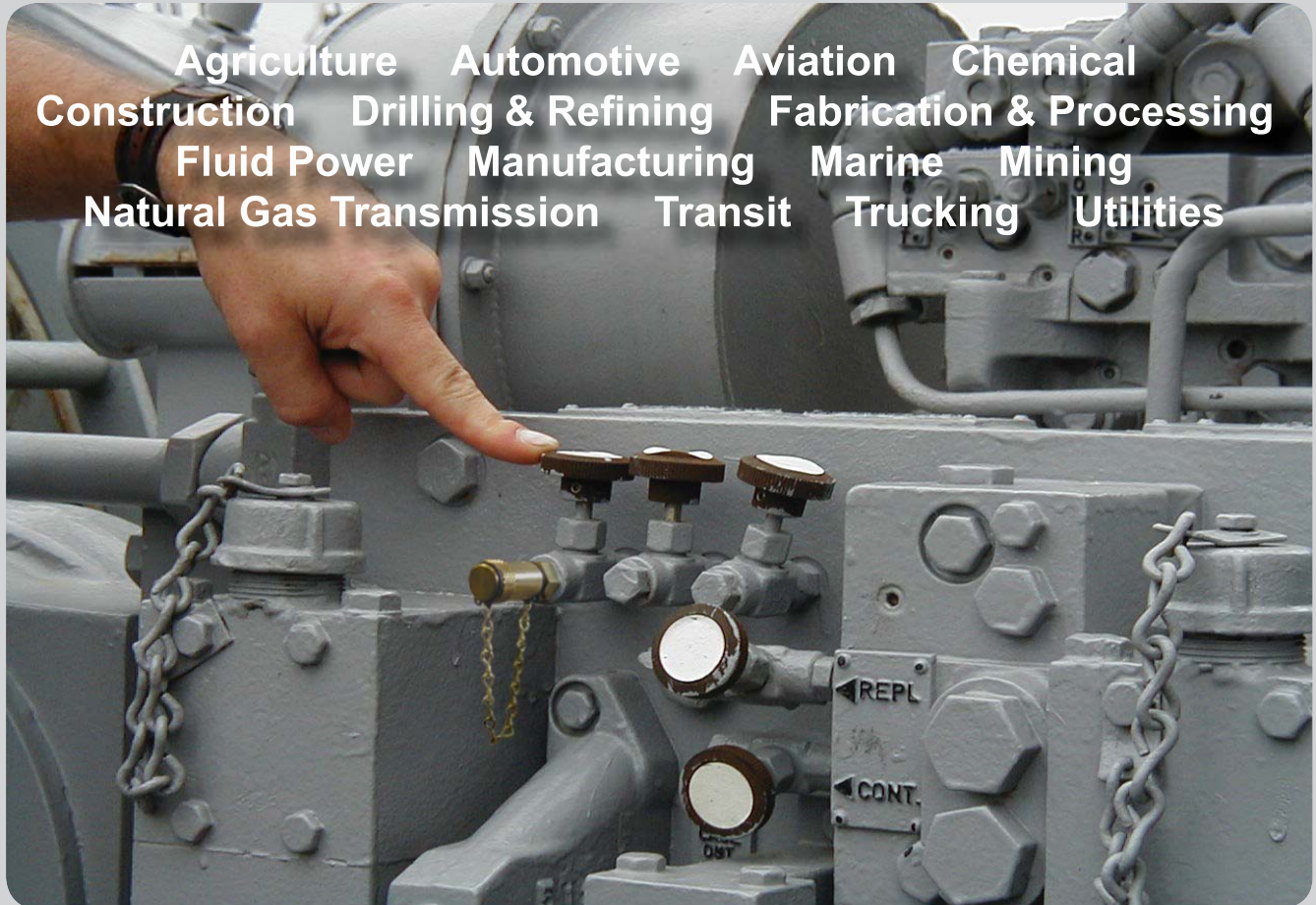


# INSTRUCTION MANUAL

## OIL ANALYSIS PROGRAM REFERENCE

FOR



Agriculture    Automotive    Aviation    Chemical  
Construction    Drilling & Refining    Fabrication & Processing  
Fluid Power    Manufacturing    Marine    Mining  
Natural Gas Transmission    Transit    Trucking    Utilities

**It does make a difference where you have your lubricants analyzed.**

**The Analysts' Difference.**

### North American LABORATORY LOCATIONS:

**WESTERN** 2910 Ford Street Oakland, California 94601 (800) 424-0099

**SOUTHWESTERN** 12715 Royal Drive Stafford, Texas 77477 (800) 248-7778

**MIDWESTERN** 2450 Hassell Road Hoffman Estates, Illinois 60195 (800) 222-0071

**SOUTHEASTERN** 3075 Corners North Court, N.W. Norcross, Georgia 30091-5000 (800) 241-6315

**EASTERN** 1803 Watterson Trail Louisville, Kentucky 40299 (888) 491-6063

### CORPORATE OFFICES:

2441 W 205<sup>th</sup> Street Torrance, California 90503 (800) 336-3637

**ANALYSTS, INC.** 

**ANALYSTS, INC.** was founded in 1960 and is a pioneer in diagnosing equipment and fluid conditions through lube oil analysis. We have established analytical laboratories conveniently located throughout the United States. Based on years of research and training, Analysts has selected and developed a series of tests covering the predictive maintenance needs of a wide variety of systems and applications.

## **HOW ANALYSTS' LUBE OIL ANALYSIS WORKS**

Analysts Inc.'s service includes evaluating the results of the tests we perform and providing detailed reports, including specific maintenance recommendations. You can use our data and recommendations to improve your maintenance, reduce equipment downtime and spend less on lubricants.

There are NINE steps to Analysts' lube oil analysis program:

1. **COLLECTING SAMPLES** (Page 2) — A portion of oil is taken out of a machine and sent to one of our labs. Suitable valves, pumps, sampling containers and mailers are available from Analysts.
2. **INFORMATION FORMS** (Pages 3 - 4) — For each new piece of equipment to be sampled, a *FORM 50-1* should be completed. Depending on the program type, the *Sample Processing Form* may be required to submit additional samples from each registered unit/component.
3. **LABELING THE SAMPLE** — The label on the sampling container should always be filled out completely to assist in our correct identification and analysis of the sample.
4. **SENDING THE SAMPLES** — Always use First Class Mail, UPS, FEDEX, or other commercial delivery service for quick transport of samples. *We strongly recommend you do not "hold" samples before mailing them to us.*
5. **TESTING** — Specific test packages are performed on each sample. The packages vary based on your equipment types, application, and individual program objectives.
6. **MAINTENANCE RECOMMENDATIONS** (Page 5) — After testing is complete, our experienced Data Analysts evaluate the results and make specific comments about the results, their significance, and recommended maintenance actions.
7. **CONTACTING THE LAB** (Page 5) — From time to time you will need to contact the lab to ask questions about the status of your samples, reply to questions we have asked you, and get additional information about results we have sent to you.
8. **FEEDBACK** (Page 5) — It is vitally important to inform us of any mechanical work or operating problems with the sampled system. This feedback influences our future recommendations and interpretations. Form F304A is provided for this purpose. Communication between you and the laboratory is essential for an effective oil analysis program.
9. **OUR LABORATORY REPORT** (Page 6) — This is the heart of the oil analysis program. The computerized report sent to you indicates the results of the tests we performed, plus comments and maintenance recommendations provided by our trained, certified Data Analysts.

## COLLECTING SAMPLES

Obtaining a representative sample is one of the most important parts of a scheduled oil analysis program. If a sample does not represent the true condition of the lubricant and component at the time of sampling, the reliability of the test results and their interpretation is affected.

### General comments on sampling:

*Areas where lube flow is restricted or where contaminants and wear products tend to settle/collect should be avoided as sampling points.*

*We recommend that you sample a component while it is running (if it is safe to do so) or within 30 minutes after shutdown.*

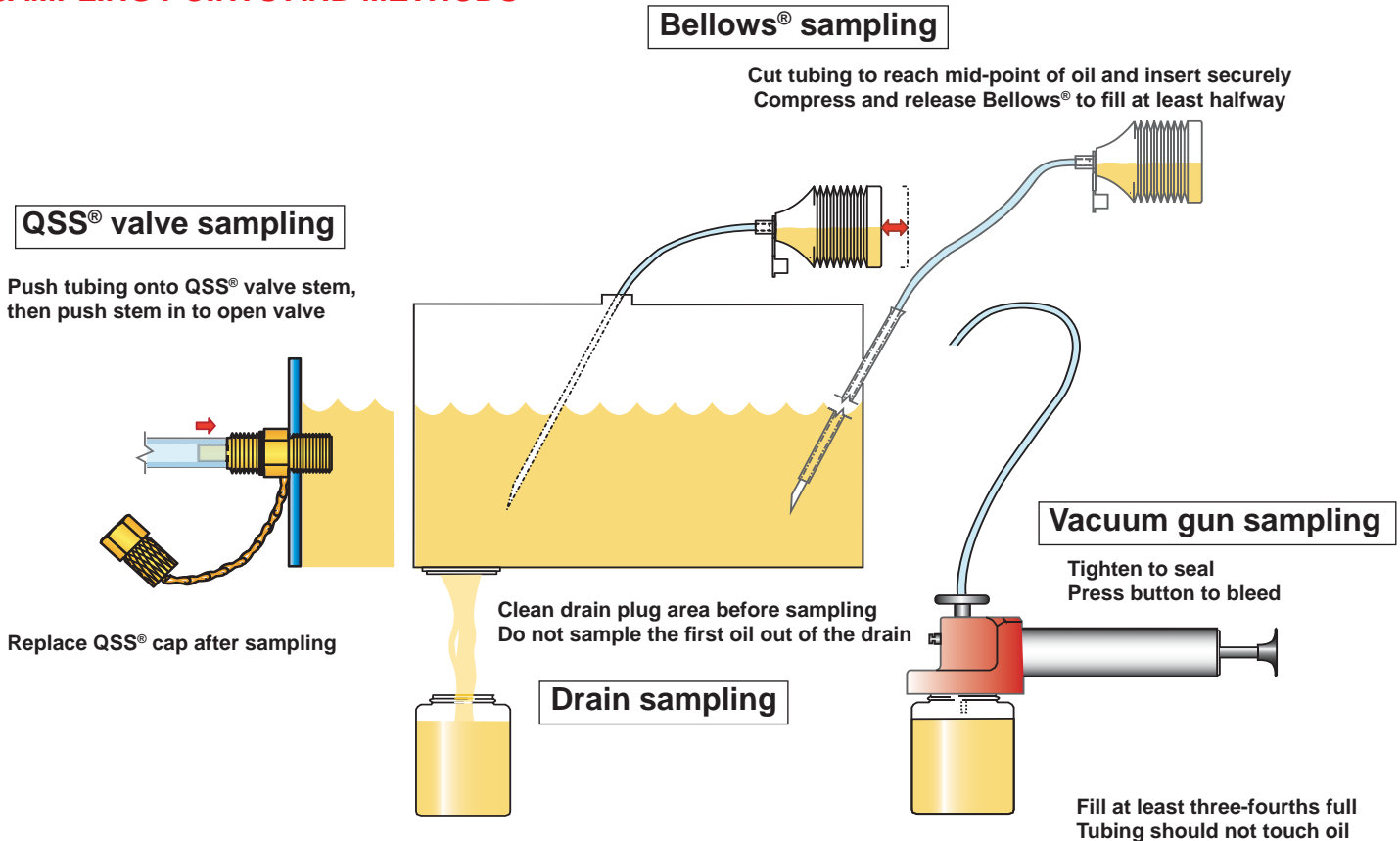
Both of these practices ensure that wear products and lubricant contaminants are thoroughly mixed with the lubricant and that the heavier wear particles have not settled out.

### We recommend the following sampling points:

- A QSS® sampling valve or petcock installed PRIOR to the oil filter
- The oil dipstick tube or other service opening using the Bellows® or a vacuum pump
- The sump or reservoir drain


*Once a proper sampling point and method is chosen for a particular component, oil samples from that component should always be taken from the same point with the same method.*

## SAMPLING POINTS AND METHODS



## The FORM-50 SAMPLE REGISTRATION FORM

The Form-50 is the sampling registration form used by Analysts when additional detailed information is needed to properly file or interpret your test results.



**ANALYSTS, INC.**

**UNIT / COMPONENT REGISTRATION FORM 50**

*A separate Form 50 must be completed for each unit / component from which an oil sample will be taken*

**ALWAYS RETAIN A COPY OF EACH FORM 50**

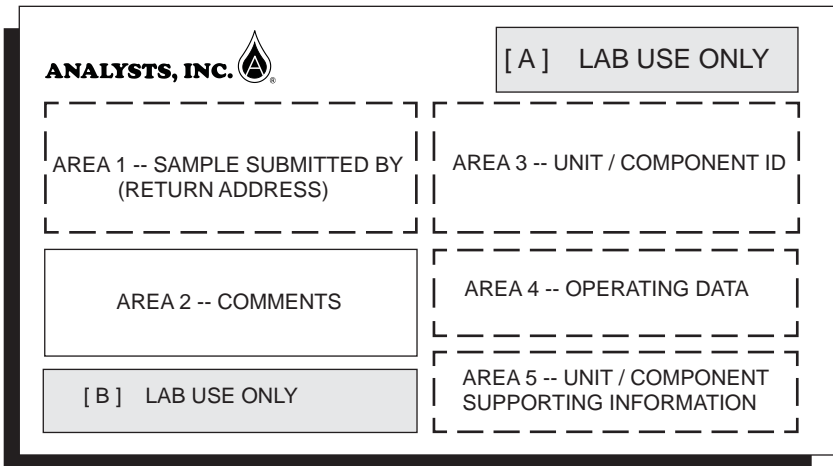
*Future samples must be labeled with the exact unit and component ID as shown on each Form 50*

<p><b>Section I: Mail reports to:</b></p> <p>Company _____</p> <p>Attn: _____</p> <p>Address _____</p> <p>_____</p> <p>City _____ State _____ Zip _____</p> <p>Country _____</p> <p>_____</p>	<p><b>Section II: Contact Information</b></p> <p>Name/Title _____</p> <p>Phone # _____</p> <p>Fax # _____</p> <p>Name/Title _____</p> <p>Phone # _____</p> <p>Fax # _____</p>
<p><b>Section III: Unit Information</b></p> <p><b>UNIT ID</b> _____</p> <p>Unit manufacturer _____</p> <p>Unit model _____</p> <p>Work Site _____</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p><b>Please add any additional comments that apply</b> (set-time maintenance, abnormal conditions, common problems)</p>     </div>	<p><b>Section IV: Component Information</b></p> <p><b>COMPONENT ID</b> _____</p> <p>Component manufacturer _____</p> <p>Component model _____</p> <p>Serial number _____</p> <p>Oil Mfg _____ Brand _____ Grade _____</p> <p>Sump/reservoir capacity _____ <input type="checkbox"/> gals <input type="checkbox"/> qts <input type="checkbox"/> ltrs</p> <p>Coolant type _____</p> <p>Coolant additives _____</p> <p>Oil filters: no. _____ type _____ rating _____</p> <p>Fuel additives (engines) _____</p>
<p><b>SECTION V: Sample Data</b></p> <p><b>COMPONENT SAMPLED</b></p> <p><input type="checkbox"/> Piston engine (fuel type) _____</p> <p><input type="checkbox"/> Jet turbine engine</p> <p><input type="checkbox"/> Gas turbine engine</p> <p><input type="checkbox"/> Transmission _____</p> <p><input type="checkbox"/> Differential</p> <p><input type="checkbox"/> Planetary</p> <p><input type="checkbox"/> Final Drive</p> <p><input type="checkbox"/> Steering</p> <p><input type="checkbox"/> Swing gear</p> <p><input type="checkbox"/> PTO</p> <p><b>Position:</b> <input type="checkbox"/> Left <input type="checkbox"/> Right <input type="checkbox"/> Front <input type="checkbox"/> Rear</p> <p><input type="checkbox"/> Gearbox (type) _____</p> <p><input type="checkbox"/> Bearing (type) _____</p> <p><input type="checkbox"/> Electric motor (type) _____</p> <p><input type="checkbox"/> Pump (type) _____</p> <p><input type="checkbox"/> Steam turbine (type) _____</p> <p><input type="checkbox"/> Hydraulic (type) _____</p> <p><input type="checkbox"/> Compressor <input type="checkbox"/> Centrifugal <input type="checkbox"/> Recip <input type="checkbox"/> Screw</p> <p style="font-size: small;">Refrigeration? Y N    Hermetic? Y N</p> <p><input type="checkbox"/> Other _____</p>	<p><b>Current Operating Data</b></p> <p>Miles / hours since oil change _____</p> <p>Miles / hours since new / o'haul _____</p> <p>Makeup oil added _____ <input type="checkbox"/> gals <input type="checkbox"/> qts <input type="checkbox"/> ltr</p> <p>Sample date _____</p> <p>Oil changed at sampling?    Y    N</p> <p>Filter changed at sampling?    Y    N</p>
<p><b>Section VI: Operating/sampling conditions</b></p> <p>Environment / Amount of time operated _____</p> <p>Sampling interval _____</p> <p>Present oil drain interval _____</p> <p>Required maintenance/inspections _____</p> <p>Scheduled start on oil analysis program _____</p>	


There are several types of the sample processing form, but all follow the general layout shown at the right. Please refer to the instructions below for each area.

If required for your program type, one original form should be sent in with each sample. We use the form for proof of payment (prepaid analysis), to obtain important information from you, and to track each sample throughout the lab.

Please do not write in LAB ONLY area A (Kit, purchaser, and accounting info) or area B.



The diagram shows a rectangular form layout with the following sections:

- Top left: ANALYSTS, INC. 
- Top right: [ A ] LAB USE ONLY
- Middle left: AREA 1 -- SAMPLE SUBMITTED BY (RETURN ADDRESS)
- Middle right: AREA 3 -- UNIT / COMPONENT ID
- Bottom left: AREA 2 -- COMMENTS
- Bottom right: AREA 4 -- OPERATING DATA
- Bottom center: [ B ] LAB USE ONLY
- Bottom right (below Area 4): AREA 5 -- UNIT / COMPONENT SUPPORTING INFORMATION

**AREA 1 -- SAMPLE SUBMITTED BY (RETURN ADDRESS)**

This is the MAIN address / person who will receive the report and phone / fax contact for critical results or questions. If this information is incomplete, there may be difficulty returning your results or contacting you. In this area, please fill out the complete return mailing address for the analysis report, including attention name, and phone number for that person if it is different from the preprinted information in LAB ONLY area B.

**AREA 2 -- COMMENTS**

This area is reserved for you to write any information you want us to make note of or add to the data returned on your analysis report. Examples of "Comments" include maintenance/servicing feedback, abnormal performance, abnormal conditions suspected or found, etc.

**AREA 3 -- UNIT / COMPONENT ID**

In this area, you must provide two unique reference identifications for us to file your results under:

- 1 - UNIT NUMBER -- your ID for an entire functional machine
- 2 - COMPONENT SAMPLED -- the ID for the oil-wetted system from which the sample was drawn (engine, transmission, etc.)

Each sampled component may have its own unit number (industrial applications), or several components may fall under one unit number (engine, transmission, etc. from one vehicle/unit). Once this ID is established (at the first sample), you must provide it exactly the same way for any future samples from that sampling point.

**AREA 4 -- OPERATING DATA**

Please record here the machine operating data we need to accurately evaluate your results. This info includes:

- 1 - Hours or miles of component use between the time the oil was last changed and when the sample was taken;
- 2 - Hours or miles of use since the sampled component was first used, or since the last major rebuild/overhaul;
- 3 - The calendar date on which the sample was taken.

Depending on the application, we may ask for additional information such as the amount of oil added to maintain a correct oil fill level, and what oil/filter servicing was done at sampling.

**AREA 5 - UNIT / COMPONENT SUPPORTING DATA**

In this area, please complete:

- 1 - Machine manufacturer and model information;
- 2 - The manufacturer, product name, and SAE or ISO viscosity grade for the oil that was sampled;
- 3 - Other descriptions that help us reference specific engineering data supporting your analysis.

We may also ask for details concerning how the sample was taken. Please note that this section should only be completed for new units/components or if the data is incomplete/incorrect.

## MAINTENANCE RECOMMENDATIONS

Once all of the tests are complete, the results are evaluated by a Data Analyst. The evaluation includes: (1) a statement summarizing the overall component and lubricant condition, and (2) specific maintenance recommendations including suggestions for servicing and resampling. In all cases, the final decision to follow the recommendations is yours. We provide you with test results and recommendations. You can use this information, often in conjunction with other diagnostics, as a tool to make more accurate maintenance decisions. The quality of this tool is related to the quality of the sample, the information you provide us, and your desire to use our service.

## RECOMMENDATION CATEGORIES

**NORMAL** — Physical properties are within acceptable limits, and no signs of excessive contamination or wear are present. Keep in mind that it is important to know that component/lubricant conditions are “normal”. This can save you unnecessary maintenance and inspections.

**MONITOR** — Specific test results are outside acceptable ranges, but are not yet serious enough to justify an 'abnormal' status. Caution is advised; the beginning stages of a problem often show the same pattern of results as temporary conditions such as extended usage or high load.

**ABNORMAL** — Lubricant physical properties, contamination, and/or component wear is clearly unsatisfactory, but not yet critical. A confirming resample should be submitted. Additional diagnostic procedures may be needed to verify each condition. Corrective actions are necessary to prevent reduced service life or overall loss of performance. *We do NOT recommend that you “tear down” a component on an ‘abnormal’ recommendation unless you have indications that there is a more serious problem present than the results indicate—and then only after you have discussed the analysis with a Data Analyst.*

**CRITICAL** — Lubricant physical properties, contamination and/or component wear is clearly serious enough to require immediate diagnostic and corrective maintenance to prevent major long-term loss of performance or failure in service. Increases in operating hazard may occur. Short-term loss of performance may already be present. Large-scale inspections (including physical teardown) and repairs will probably be required. It may be necessary to remove the unit/component from service until a confirming resample is tested and/or diagnostics confirm that inspection/repair is justified.

*These assessments are relative and are assigned using both trend analysis and condemning limits.*

## CONTACTING THE LAB

There are many reasons for directly contacting the lab. Phone and fax numbers are found on the top of each report. Our laboratories divide work into departments, and you can best get information or answers by contacting:

- \* **Data Analysts** if you have specific questions about evaluations, the significance of tests, and overall technical aspects of your oil analysis program. The ID for the Data Analyst that evaluated the current sample is found on the left side of the report.
- \* **Data Entry** if you have questions about the status of a sample you have sent, want to update/change report distribution or clerical info such as unit ID's, makes and models, or to obtain reprints of analysis reports.
- \* **Customer Service** to order kits/sampling supplies, check on the status of an order, inquire about invoicing or billing, obtain price quotes or general information on pricing, find out about additional/special services available from Analysts, or to receive published literature about our services.

***Please refer to the component reference number on the upper right of each report for quick access to your sample results!***

The accuracy of our evaluations is verified by comparing the lab test result-based predictions with actual conditions confirmed by inspection. In this way, our interpretations are continually refined by practical experience.

“Feedback” includes:

- \* Lubricant or component conditions that you suspect are present
- \* The findings of any inspection, especially those performed as a result of oil analysis program recommendations
- \* Lubricant or component conditions discovered that were not previously indicated by oil analysis
- \* Notification of servicing and maintenance performed

These items may be noted on the sample processing form, or detailed on the ‘Maintenance Feedback’ Form 304A available from Analysts, Inc..

**UNDERSTANDING THE ROUTINE OIL ANALYSIS REPORT**

The summary below shows the basic layout of our routine oil analysis report. As each report is printed, the address and phone number for that particular lab is also printed at the top center of the form.

**SECTION A**

In section A you will see the date when the oil sample was drawn and its status. You will also find the unit ID number along with the name of the component being sampled. The Component Reference Number is assigned by our system for quick access to your results. Just below the Component Reference Number is your Purchase Order or accounting number.

**SECTION B**

Section B lists specific information about the unit and component sampled; the worksite or location, and the oil type in service.

**SECTION C**

This portion of the report is where our Data Analysts make their evaluations and recommendations. This evaluation is based on the specific tests performed on the individual samples and the information provided by you about the sample and the sampled system.

**SECTION D**

The Spectrochemical Analysis section identifies and reports 21 metallic elements from the atomic emission spectrometer. These elements provide a positive means of identifying wear, contamination and additive content. This section also documents the date when each sample was drawn, and shows the lab ID number we assigned to each sample.


**SECTION E**

Section E consists of unit operating information provided by you.

**SECTION F**

Section F lists the Physical Test Results, a series of related tests run to determine the classification, contamination and degradation of a lubricant.

ANALYSTS, INC.  
 FIELD SERVICE EXAMPLE REPORT  
 INDUSTRIAL APPLICATIONS



ISO 9002 CERTIFIED LABS  
 CONTACT YOUR DISTRIBUTOR  
 WWW.ANALYSTSINC.COM

STATUS WAS  
 ABNORMAL  8-Jan-01  
 UNIT I.D.: IND HYD XMP1 3  
 COMPONENT: HYDRAULIC SYSTEM  
 COMP.REF NO.: 108417  
 P.O./REF NO.:

WORKSITE IPN PROCESSING 4	UNIT MANUFACTURER SUMITOMO	OIL TYPE TEXACO RANDO HD ISO 68
COMPONENT TYPE HYDRAULIC SYSTEM	COMPONENT MANUFACTURER AND MODEL SUMITOMO SYCAP MIII	COMPONENT SERIAL NUMBER 401 CC6 A8

1534 Reported on 08-Jan-01

ANALYSIS INDICATES ABNORMAL COMPONENT & LUBRICANT CONDITIONS! Additive levels are not typical for the reported product. VISCOSITY is LOW. DIFFERENT PRODUCT in service. Pump, valve and/or cylinder area wear. MODERATE level of WATER present. PARTICLE COUNT level(s) are HIGH. CHECK for filter bypass, recent filter servicing and metal or debris within the in-line screens (if applicable). Assure proper sampling technique from a clean sampling point. CONDUCT a performance evaluation. PERFORM (or continue) additional filtration (sidestream filters or a portable cart). ASSURE use of a proper product per the component and lubricant manufacturer's guidelines. RESAMPLE IMMEDIATELY following inspection and/or corrective action. Telephone contact established and a follow-up FAX has been dispatched regarding this report.

FEEDBACK (from cust): Mis-serviced with Turbine 46. Reservoir cover left open. Cleaned and flushed system, return to service.

SPECTROCHEMICAL ANALYSIS IN PARTS PER MILLION BY WEIGHT

EVAL ID:																						Sample Date
# 9999	Be	Ba	Bi	Br	Ca	Co	Cr	Fe	Li	Mg	Mn	Ni	P	Pb	Si	Sr	Ta	Ti	V	Zn	Other	
1918	8	<1	<1	<1	2	7	<1	<0.1	<1	1	13	<1	1	0	233	304	27	<10	22	<30	<1	17-Sep-00
2071	3	<1	<1	<1	3	<1	<1	<1	1	15	1	5	<1	281	301	31	<10	25	<1	<1	16-Oct-00	
1534	<u>23</u>	<u>4</u>	1	2	<u>6</u>	<u>19</u>	1	<1	<1	2	10	<1	<1	<u>81</u>	<u>108</u>	16	<10	<10	<1	<1	8-Jan-01	

SAMPLE INFORMATION				PHYSICAL TEST RESULTS									
LAB NO.	Mi/Hr Unit	Mi/Hr Oil	Oil Add	WATER PPM	VIS CS 40C	TAN	PARTICLE 2-5u	PARTICLE >5-15u	PARTICLE >15-25u	PARTICLE >25-50u	PARTICLE >50-100u	PARTICLE >100u	ISO CODE +2-5u
1918	79838.0	4696.0	2.0	17	66.4	0.39	<u>595100</u>	<u>137800</u>	<u>21000</u>	<u>7500</u>	<u>600</u>	<u>10</u>	<u>2018/15</u>
1918	80440.0	5268.0	1.0	55	65.9	0.56	238000	95100	12100	3200	1070	500	19/17/15
1918	85468.0	10246.0	3.0	<u>307</u>	<u>82.4</u>	<u>0.81</u>	<u>1172400</u>	<u>101800</u>	<u>34000</u>	<u>10900</u>	<u>2260</u>	<u>470</u>	<u>2118/16</u>

FOR LEGEND AND EXPLANATION OF PHYSICAL PROPERTIES TESTS PLEASE SEE REVERSE SIDE  
 N/R = TEST NOT PERFORMED

UNDERLINED FIGURES INDICATE SIGNIFICANT VALUES. MAINTENANCE THAT MAY BE REQUIRED IS INDICATED ABOVE UNDER MAINTENANCE TESTS. RECOMMENDATIONS AND SHOULD BE PERFORMED BY A QUALIFIED MECHANIC. PLEASE ADVISE US OF ANY MAINTENANCE PERFORMED ON THIS UNIT.  
 ACCURACY OF RECOMMENDATIONS IS DEPENDENT ON REPRESENTATIVE SAMPLE AND COMPLETE, CORRECT DATA ON BOTH UNIT AND SAMPLE. THIS REPORT IS NOT AN ENDORSEMENT OR RECOMMENDATION OF ANY PRODUCT OR SYSTEM.  
 ORIGINAL REPORT MAINTAINED IN ANALYSTS, INC. DATA FILES. COPYRIGHT © 1990 ANALYSTS, INC. FORM 6001-A 09/00

A

B

C

D

E

F

**Features of the Report:**

- Up to 6 sets of test results (current and 5 previous) displayed
- Spectrochemical and Physical results underlined where applicable
- Full headings for all results
- Guide to tests and their meaning on back of the report

**GENERAL SAMPLING INTERVAL RECOMMENDATIONS**

UNIT TYPE	RECOMMENDED SAMPLING FREQUENCY	
	ROUTINE USE	INTERMITTENT USE
<b>MOBILE EQUIPMENT (Over the road)</b>		
<b>DIESEL ENGINES</b> <b>GASOLINE / LPG ENGINES</b>	15,000 miles / 250 hours 5000 miles / 150 hours	Quarterly
<b>NON-ENGINES</b>	30,000 miles / 500 hours	Quarterly
<b>MOBILE EQUIPMENT (Off road)</b>		
<b>DIESEL ENGINES</b> <b>GASOLINE / LPG ENGINES</b>	250 hours / monthly 150 hours / monthly	Quarterly
<b>NON-ENGINES</b>	500 hours / monthly	Quarterly
<b>MARINE</b>		
<b>MAIN ENGINES</b> <b>SUPPORT ENGINES</b>	250 hours / monthly 150 hours / monthly	Quarterly
<b>NON-ENGINES</b>	500 hours / monthly	Quarterly
<b>INDUSTRIAL / STATIONARY</b>		
<b>DIESEL/NAT GAS ENGINES</b> <b>GAS TURBINES</b>	500 hours / monthly 250 hours / monthly	Quarterly
<b>COMPRESSORS, STEAM TURBINES</b>	250 hours / monthly	Quarterly
<b>GEARED DRIVES, BEARINGS</b>	500 hours / monthly	Quarterly
<b>HYDRAULICS</b>	500 hours / monthly	Quarterly
<b>AVIATION</b>		
<b>PISTON ENGINES</b> <b>TURBINE ENGINES</b>	50 hours / at oil change 150 hours	Oil change, 100 hour inspection & annual
<b>GEARED DRIVES</b>	350 - 500 hours	100 hour inspection
<b>HYDRAULICS</b>	150 - 250 hours	100 hour inspection
<b>REFRIGERATION</b>		
<b>CHILLERS (all refrigerant types)</b>	Beginning, Middle, and End of season	

**NOTE:** These sampling periods are general guidelines. We will work with you to tailor specific sampling intervals suitable for your operation. These intervals can be changed to fit OEM or maintenance program requirements. You will not need to change your normal maintenance procedures.