

# **PREPRODUCTION INITIATIVE–NELP ENGINE OIL ANALYSIS EQUIPMENT TEST PLAN**

## **SITE: NAS OCEANA**

### **1.0 OBJECTIVE**

This test plan describes the data collection procedure for two onsite oil analysis systems. The data will be used to determine the efficiency, effectiveness, and overall success of the units in reducing the amount of used oil requiring disposal and time involved in the maintenance of common support equipment (CSE).

Oil changes performed on CSE (e.g., A/M32C-17, A/M27T-5, etc.) generate a considerable amount of waste that must be appropriately disposed at expense to the Navy. Oil changes also require that new oil and filters be purchased to replace those being changed. In addition, oil that has been subjected to extreme operating conditions or used too long can lose viscosity or become contaminated. In turn, loss of viscosity and contamination can lead to excessive engine wear and possible engine failure. Consequently, changing engine oil too soon leads to excess oil waste and expense, and not changing the oil soon enough can result in excess maintenance costs and reduced equipment life. It is therefore important to maintain an accurate picture of oil condition both to minimize waste generation and to maximize equipment life.

### **2.0 DESCRIPTION**

Currently, engine oil changes are performed based on the amount of time elapsed since the previous changeout; no regard is given to actual engine usage since the last oil change. As a result, an engine could undergo an oil change, sit idle for three months, and be pulled in for another oil change without ever having been used. Furthermore, no crankcase oil is tested to determine whether it has useable life remaining, has lost its protective properties, or has contaminants present that could signal possible engine problems. Manufacturer-developed oil change guidelines, based on contaminant concentrations and oil condition, are available for various CSE engines.

While it would be possible to collect oil samples on a regular basis and send them offsite for full-scale laboratory analysis, the turnaround time needed is incompatible with current operational requirements. Implementation of an onsite, full-scale laboratory for these analyses would solve the turnaround problem; however, this is impractical from both training and cost perspectives. A reduced-scale analysis system that could be operated onsite by existing maintenance personnel with minimal additional training would be preferable.

The Kittiwake Oil Test Center and the Predict Navigator have been selected for prototype assessment at the Naval Air Station (NAS) Oceana Aircraft Intermediate Maintenance

Department (AIMD). A variety of CSE from this location will be employed in this project. Oil samples will be collected regularly throughout the program and will be analyzed using both onsite oil analysis systems. In addition, split samples will be collected and sent to an independent laboratory, where they will be analyzed for the entire range of manufacturer-specified wear factors. This independent testing will provide the data necessary to observe any trends in overall oil condition. These trends will subsequently be used to evaluate the effectiveness of the current time-based oil change strategy. Because the onsite systems are not intended to perform all of the tests specified by the engine manufacturers, the laboratory tests will also be used to highlight any correlations between the reduced-scale onsite results and the full-scale lab results. An observed correlation may indicate that testing with one of the onsite analysis systems would be sufficient to determine the remaining life of the used oil. The results of these tests will be studied to establish whether the current time-based changeout program needs to be modified or replaced with one of the onsite analysis systems. All samples will be collected using sample bottles, manual sample pumps, and tubing supplied with the two onsite oil analysis systems.

### **3.0 TEST PLAN**

This test plan will be used to evaluate the effectiveness of the two onsite oil analysis systems versus the current time-based oil change. Emphasis will be placed on each system's ability to save money and time, reduce used oil waste volume, and integrate with existing maintenance procedures. The onsite analysis systems will be prototyped in the AIMD at NAS Oceana.

Five end items of CSE will be used in the oil analysis equipment test: A/S32A-30A aircraft tow tractor, A/M32C-17 air conditioner, NC-10A/B/C/D mobile electric power plant, A/M27T-5 hydraulic test stand, and A/S32A-42 aircraft tow tractor. These specific CSE were selected based on their widespread use throughout the fleet and availability for the test. Five representative units of each end item will be selected for inclusion in the test.

#### **3.1. Approach**

Before the test period starts, all equipment selected for this project will be inspected for mechanical problems. Before testing begins, an engine hour meter will be installed on any of the selected equipment that currently does not have one. In addition, any malfunctioning hour meters will be repaired at this time. It is projected that the prototype test period will run for a maximum of 24 months. Any equipment selected for this test will receive an oil change at the beginning of the test period. During the initial oil change process, one sample of each type of oil being used will be collected from one of the original containers. This sample will be split, with one portion sent for laboratory analysis and additional portions analyzed with each of the two onsite systems in accordance with the methods listed below. These analyses will be performed both to provide a baseline condition of the oil before its introduction into the engine and to ensure that no bad batches of oil were used.

Following the oil change, oil samples will be collected from the equipment and analyzed using the two on-site systems. In addition, one of the provided laboratory sample bottles will be labeled, and an untested portion of the sampled oil will be assigned a sample ID, placed in the bottle, and sent to the specified independent laboratory in accordance with the methods listed below. No further oil changes will be performed on the selected equipment until either the results of one of the analyses (one of the onsite systems or the laboratory analysis) indicate that an engine's oil is out of specification or the entire test period has ended. During the test period, oil additions made by AIMD personnel, if shown to be necessary by low oil level, will be performed only **after** sample collection and analysis.

Commencing three months from the start of the project, the selected equipment will be brought in from their field assignments every three months for samples of their engine oil to be collected. These samples will then be split, with one portion designated for each of the two onsite analysis systems and a third portion sent to an independent laboratory for testing. Samples will be assigned identification codes (sample ID) consisting of the equipment serial number and the collection date. For example, if a sample is collected on 4 April 2000 from equipment with a serial number of BAV 033, the sample ID would be BAV 033-04-APR-00. Sample IDs should be written on the provided sample bottles immediately before the samples are collected. All laboratory testing will be conducted according to oil specifications supplied by the individual engine manufacturers.

Maintenance personnel will review results from the offsite laboratory analyses upon receipt to determine whether any of the tested oil parameters exceed manufacturer specifications. If any set of analytical results (either onsite oil analysis or the offsite laboratory analyses) shows that an engine's oil is out of specification, the associated piece of equipment will be removed from service and the Pollution Prevention Equipment Program (PPEP) point of contact (POC) listed on the data collection sheets will be alerted. In addition, all requests for repairs and reagents/consumables (e.g., sampling tube, sample bottles) for the two onsite systems should be directed to the PPEP POC at Lakehurst. ***While the vendors of the onsite oil analysis systems can be phoned for technical assistance, under no circumstances should AIMD personnel contact either vendor to arrange repairs or purchase reagents/consumables.***

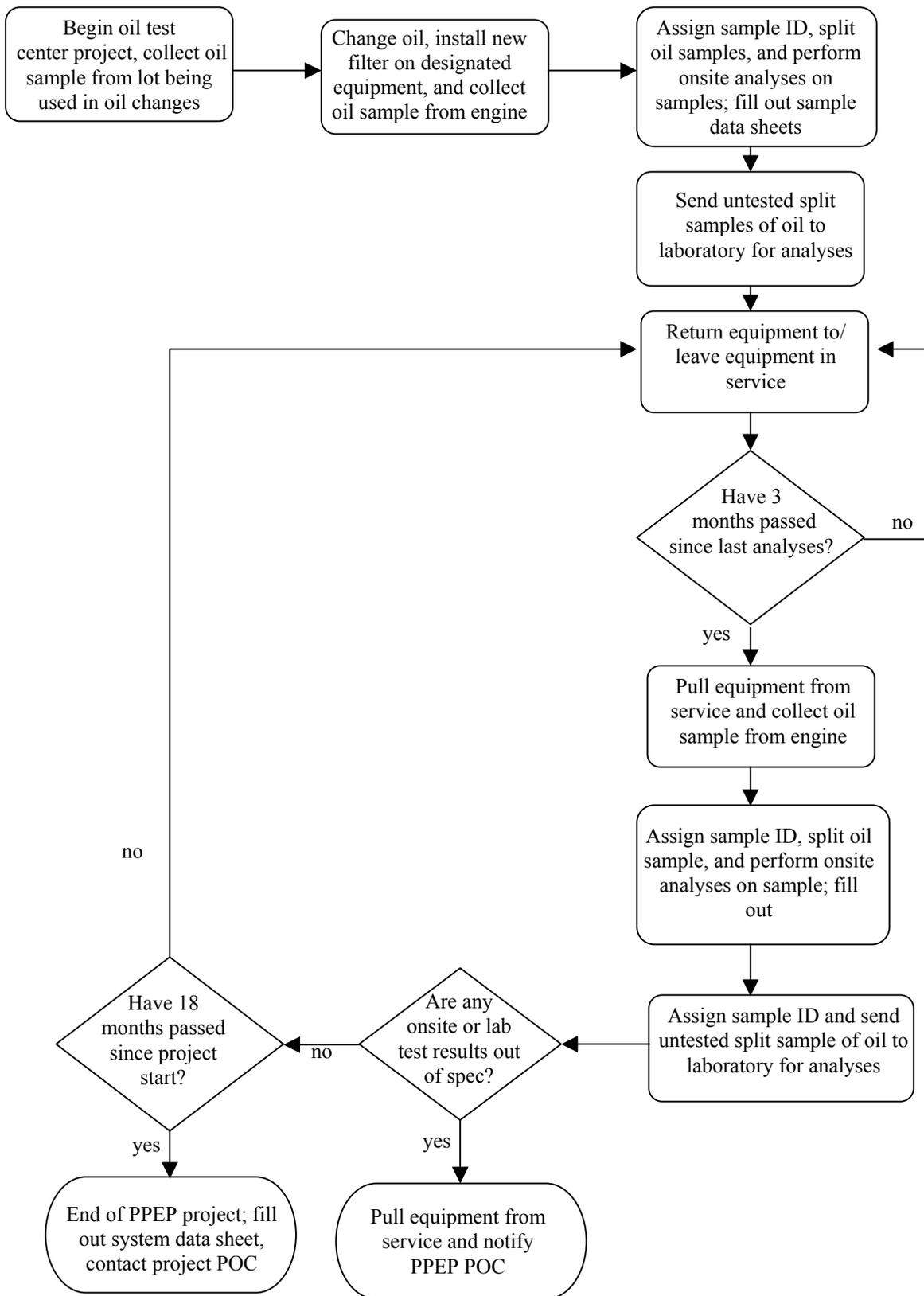
When collecting oil samples for this project, these rules must always be followed:

- The engine being sampled must reach operating temperature before sampling.
- The tube from the sample collection pump provided with the oil analysis system should be inserted down the dipstick tube to collect the samples. At the beginning of the project, an exact length of tubing will be specified for use in sampling each type of equipment. Use only the length of tubing specified for the equipment being sampled.
- No collection tube or sample bottle should be used more than once.

- The sample must not be collected from the bottom of the oil pan. If sludge from the bottom of the pan is noticed in the collected sample, the fouled sample will be discarded and a new sample collected in a new sample bottle.

The effectiveness of each onsite analysis system will be measured by evaluating the system's accuracy (compared to the offsite laboratory analysis), its ability to interface with site operations, the projected reduction in used oil waste as resulting from its use, and its cost of implementation and operation. The data required for this evaluation will be acquired by completing the test plan data sheets. The overall project approach is presented on Figure 1.

None of the analysis equipment being prototyped during this project is the responsibility of PMA-260. All analysis equipment is to be returned to PPEP at the end of the project.



**Figure 1: Oil Analysis Equipment Prototype Project Flow Chart**

## 3.2 Data Collection

Every person who uses one of the onsite oil analysis systems during this program will fill out a copy of the system performance and usage data sheet. In addition, a sample collection/analysis data sheet will be completed for each sample collected and analyzed during the test period. Data sheets will be filled out in accordance with the instructions outlined below. Units of measurement should be included where appropriate. At the end of the test period, copies of the maintenance logs for each piece of CSE tested will be submitted with the data sheets. These logs must include the date of any repairs or scheduled preventive maintenance, a description of the repair work completed, the number of hours required to complete the repair, and a list of parts and consumables needed for the repair.

### 3.2.1 *Instructions for Completing the Sample Collection/Analysis Data Sheets*

- **Name:** Enter the name of the person completing the data sheet.
- **Date of Collection:** Record the date on which the sample is being collected.
- **Equipment type:** Enter the name of the equipment being sampled (e.g., A/M32C-17).
- **Equipment Serial Number:** Record the serial number of the equipment being sampled.
- **Hours of Engine Use Since Start of Program:** Record the number of hours that the engine has been in operation since the start of the test program. This number should be taken from the hour-meter on the engine or, in the absence of an hour-meter, from the usage log for that equipment.
- **Sample ID:** Enter the sample ID assigned to the portion of the sample being sent for laboratory analysis. For example, if a sample is collected on 4 April 2000 from equipment with a serial number of BAV 033, the sample ID would be BAV 033-04-APR-00. This sample ID should also be entered on the chain of custody for the laboratory and should be written on the label of the sample bottle being sent to the laboratory.
- **Volume of Oil Collected:** Record the volume of oil collected from the engine being sampled (*to be determined following choice of laboratory and tests*).
- **Analytical Results (Kittiwake):** Enter the data returned by the Kittiwake system for the water, viscosity, total base number (TBN), and insolubles tests in the appropriate boxes.

- **Analytical Results (Navigator):** Enter in the appropriate boxes the data returned by the Navigator system for the water, metals, and oxidation tests.
- **Sample Analysis Time:** For each of the listed tests, record how long it took to prepare and analyze the sample. Include the time to measure the appropriate amount of sample and reagent, the time for the analysis to run, and the time to dispose of the sample and clean the equipment for the next test. Record this value for each onsite analysis unit.
- **Miscellaneous Items Consumed:** List any consumables (e.g., tissue paper, rags, etc.) required by the analysis unit to complete the analysis of an individual oil sample. Do **not** list items that were needed to complete other analysis tasks. Enter these items for each onsite analysis unit.
- **Quantity/Volume of Misc. Consumed:** Indicate how much/how many of the miscellaneous items listed above were needed. Record these values for each onsite analysis unit.

### ***3.2.2 Instructions for Completing the System Data Sheets***

- **Name:** Enter the name of the person completing the data sheet.
- **Date:** Record the date on which the data sheet is being completed.
- **System Name:** Enter the name of the oil analysis system being reviewed.
- **Ease of Use (Collection Pump):** Discuss how easy or difficult it was to maintain and use the sample collection pump for each piece of equipment. Highlight any specific difficulties that were encountered.
- **Ease of Use (Kittiwake):** Discuss how easy or difficult it was to analyze the sampled oil with the Kittiwake system. Highlight any specific difficulties that were encountered. Include maintenance and cleaning problems encountered.
- **Ease of Use (Navigator):** Discuss how easy or difficult it was to analyze the sampled oil with the Navigator system. Highlight any specific difficulties that were encountered. Include maintenance and cleaning problems.
- **Problems:** Discuss any problems encountered while using the onsite analysis units.
- **Recommended Improvements:** List any improvements that would enhance the performance of either analysis unit.
- **Additional Comments:** Provide any additional comments that would be useful in evaluating the analysis units.

#### **4.0 REPORTING**

The data entry forms are a concise method of data collection. One sample collection/analysis data sheet should be completed each time oil from one of the pieces of test equipment is sampled and analyzed. The system performance/usage data sheet should be completed once by each person who has used the sample collection pump and/or the on-site analysis units over the course of the test. Data will be collected for a maximum of 24 months. During this time, periodic status reports on the testing will be submitted to NAWCADLKE. The final report will include detailed results and observations, assess the efficiency and cost-effectiveness of each analysis unit, and evaluate the ability of each to interface with site operations. This report will also provide an analysis of any observed trends in oil condition during the test period.

**Sample Collection/Analysis Data Sheet (NAS Oceana)**

**Fax to: Bill Smykowski (732-323-4810)**

Name: \_\_\_\_\_

Date of Collection: \_\_\_\_\_

Equipment Type: \_\_\_\_\_

Equipment Serial Number: \_\_\_\_\_

Hours of Engine Use (or Mileage): \_\_\_\_\_

Sample ID: \_\_\_\_\_

Bottles of Oil Collected: \_\_\_\_\_

**Analysis Results: Kittiwake**

Test	Water	Viscosity @ 40°C	Viscosity @ 100°C	TBN Pressure	TBN Number	Insolubles
Warning Limits	0.2%	Above 127.9 or below 77.7	Above 14.84 or below 9.01	50% Decrease from Ref. Oil TBN Number		0.8%
Result						

Sample Analysis Time: \_\_\_\_\_

**Analysis Results: Predict Navigator**

F1: \_\_\_\_\_

F2: \_\_\_\_\_

F3: \_\_\_\_\_

F4: \_\_\_\_\_

Sample Analysis Time: \_\_\_\_\_

**PPEP POC:** Bill Smykowski, 732-323-4258 (phone), e-mail: [smykowskiwj@navair.navy.mil](mailto:smykowskiwj@navair.navy.mil)

**System Performance/Usage Data Sheet (NAS Oceana)**  
**Fax to: Bill Smykowski (732-323-4810)**

**Name:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**System Name:** \_\_\_\_\_

**Ease of Use (Collection Pump):** \_\_\_\_\_

\_\_\_\_\_

**Ease of Use (Kittiwake):** \_\_\_\_\_

\_\_\_\_\_

**Ease of Use (Navigator):** \_\_\_\_\_

\_\_\_\_\_

**Problems:** \_\_\_\_\_

\_\_\_\_\_

**Recommended Improvements:** \_\_\_\_\_

\_\_\_\_\_

**Additional Comments:** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**PPEP POC:** Bill Smykowski, 732-323-4258 (phone), e-mail: [smykowskiwj@navair.navy.mil](mailto:smykowskiwj@navair.navy.mil)