PREPRODUCTION INITIATIVE–NELP
OIL ANALYSIS EQUIPMENT
TEST PLAN

SITE: NAS BRUNSWICK

1.0 OBJECTIVE

This test plan describes the data collection procedure for an onsite oil analysis system. The data will be used to determine the efficiency, effectiveness, and overall success of the unit 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, crankcase oil is not 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 current maintenance personnel with minimal additional training would be preferable.

The Oil View 5100 oil analysis system, made by Computational Systems, Inc. (CSI), has been selected for prototype assessment at the Naval Air Station (NAS) Brunswick

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 the Oil View 5100 system. 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 system is 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 the onsite analysis system 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 an oil analysis system. All samples will be collected using sample bottles, a manual sample pump, and tubing supplied with the Oil View unit.

3.0 TEST PLAN

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

Five end items of CSE will be used in the oil analysis equipment test: A/S32A-30A aircraft tow tractor, A/M32M-16 deicing truck, NC-10A/B/C/D mobile electric power plant, A/M42M-2 portable floodlight cart, and A/S32A-37 (T-35 Buddha) 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 12 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 new 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 the onsite system 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, an oil sample will be collected from the equipment and analyzed using the onsite system. 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 (either from the onsite system 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. Two sample bottles of engine oil will be drawn from each unit of SE involved in the test. The first bottle will be designated for testing with the onsite analysis system and the second bottle will be sent to an independent laboratory for testing. Samples will be identified by the serial number of the SE from which they are taken and their collection date. Both pieces of information 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.

Pollution Prevention Equipment Program (PPEP) 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 of the laboratory analysis results show that an engine's oil is out of specification, the PPEP point of contact (POC) listed on the data collection sheets will instruct the AIMD to remove the associated piece of equipment from service. If any of the onsite analytical results shows that an engine's oil is out of specification, the associated piece of equipment will be removed from service and the PPEP 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 onsite system should be directed to the PPEP POC at Lakehurst. ***While the vendor of the onsite oil analysis system can be phoned for technical assistance, under no circumstances should AIMD personnel contact the 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 the 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.

3.2 Data Collection

Every person who uses the onsite oil analysis system 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.

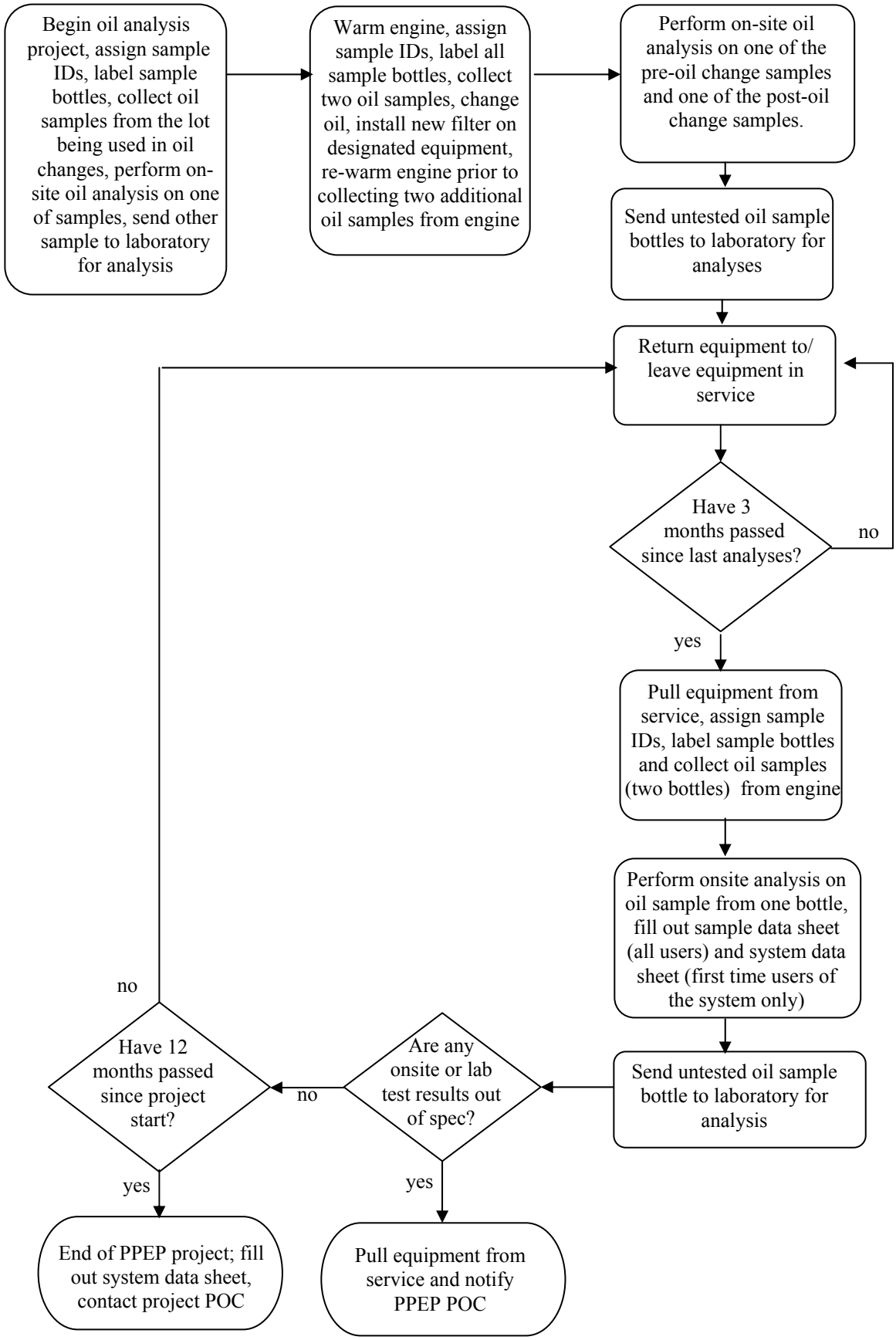

Figure 1: Oil Analysis Equipment Prototype Project Flow Chart

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/S32A-30A).
- **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.
- **Analytical Results (Oil View 5100):** Enter the viscosity data and the wear, contamination, and chemistry numbers returned by Oil View 5100 system in the appropriate boxes.
- **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.

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 (Oil View 5100)**: Discuss how easy or difficult it was to analyze the sampled oil with the Oil View 5100 system. Highlight any specific difficulties that were encountered. Include maintenance and cleaning problems encountered.
- **Problems**: Discuss any problems encountered while using the onsite analysis unit.

- **Recommended Improvements**: List any improvements that would enhance the performance of the analysis unit.

- **Additional Comments**: Provide any additional comments that would be useful in evaluating the analysis unit.

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 unit over the course of the test. Data will be collected for a maximum of 12 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 the analysis unit, and evaluate the ability of the unit 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 Brunswick)
Fax to: Joe Cruz 732-323-7243 and Bill Smykowski (732-323-4810)

Name: _____ **Date of Collection:** _____

Equipment Type: _____ **Equipment Serial Number:** _____

Hours of Engine Use (or Mileage): _____

Analysis Results: Oil View 5100

Test	Viscosity @ 100°C	Wear	Contamination	Chemistry
Warning Limits		**3.0**	**3.0**	**3.0**
Result				

Sample Analysis Time (viscosity): _____

Sample Analysis Time (wear, contamination, and chemistry): _____

PPEP POCs: Joe Cruz, 732-323-2966 (phone), e-mail: cruzja1@navair.navy.mil;
Bill Smykowski, 732-323-4258 (phone), e-mail: smykowskiwj@navair.navy.mil

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

Name:_____ **Date:** _____

System Name: _____

Ease of Use (Collection Pump): _____

Ease of Use (Oil View 5100): _____

Problems: _____

Recommended Improvements: _____

Additional Comments: _____

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