CHAPTER 6

LUBE OIL SYSTEMS

6-1. Minimum maintenance activities for lube oil systems

The tables located at the end of this chapter indicate items which must be performed to maintain systems and equipment at a minimum level of operational readiness. The listed minimum action items should be supplemented by manufacturer-recommended maintenance activities and procedures for specific pieces of equipment. These should be used to develop a comprehensive maintenance plan for the facility. Maintenance actions included in this chapter are for various modes of operation, subsystems, or components. Table 6-1 provides maintenance information for diesel engine lube oil systems in standby mode. Table 6-2 provides maintenance information for diesel engine lube oil systems in operating mode. Table 6-3 provides maintenance information for central lube oil storage dispensing systems. Table 6-4 provides maintenance information for lube oil instrumentation and electrical systems.

6-2. General maintenance procedures for lube oil systems

This section presents general instructions for maintaining the types of components associated with lube oil systems.

a. Oil testing. Oil testing is performed to verify the quality of oil delivered to a facility. In-service testing is performed to determine the condition of the oil, and the test results are used to determine the level of oil maintenance required, conditioning, additive addition, partial replacement, or full replacement. It is always important to use the same test procedure. As shown in listing of consensus standard organization tests for characterizing oils, there are often several different test methods available to quantify a particular characteristic of the oil. The answers provided by different test methods on the same oil sample for a particular parameter may not be the same. Maintaining accurate records of tests is important. The results from a single test usually have no meaning by themselves. Test results usually only have meaning by indicating changes since previous tests.

(1) A supplier should provide certified documentation prior to or with the lube oil delivery verifying that the oil has been tested in accordance with the Army Oil Analysis Program and meets the specifications for the lube oil used by the facility. If documentation is not provided for the lube oil, the facility should sample and analyze the lube oil prior to use. The facility should take samples of all lube oil delivered to the facility and retain the samples until that lot of lube oil is used. Even if certified test reports are provided by the supplier, the facility should periodically have independent analyses performed to ensure compliance with purchase order or contract requirements.

(2) The lube oil change or conditioning interval may be determined by oil analysis as recommended by the diesel engine manufacturer. Proper lube oil sampling is critical to ensure long engine life. Facilities that develop and follow a sampling program which triggers follow-up lube oil conditioning may never have to change the full volume of lube oil from an engine sump. Consideration should be given to utilizing the Army Oil Analysis Program (AOAP) lube oil testing laboratories for analyses of samples taken.

(a) Samples must be taken and analyzed at regularly scheduled intervals. The operator should also record the number of hours that the engine has been operated and the number of operating hours

since the last lube oil conditioning or change cycle. It is very important for the operator to develop an accurate history of each engine. By doing so, samples can be compared over time so that any changes in oil properties can be detected.

(b) The result of oil analyses can show wear on metal. These results can be used to determine when the oil needs conditioning or replacing and whether an engine or one of its support systems is developing problems that must be remedied. A high iron level usually indicates cylinder liner wear. High chromium indicates piston ring wear. High aluminum indicates piston and/or bearing wear. High silicone indicates dirt which may indicate a damaged intake air filter and/or a leak in the engine air intake duct system. High copper can indicate bearing wear. If all of the preceding element levels are high, except for silicone, this may indicate acid attack due to overcooling which can result from running the engine with little or no load.

(c) Running under no load increases the buildup of carbon in the lube oil because this overcooled condition causes increased acid and soot buildup in the oil. As a result, the lube oil conditioning or change interval will vary a great deal and will depend on how the engines are operated (loaded or unloaded) and the frequency operation. For emergency service diesel engines, if engines are operated and loaded at least once a month for a few hours (preferred engine exercise interval), samples from each engine should be taken during every other engine exercise cycle. However, if the engines are operated at less frequent intervals, lube oil samples should be taken every time the engines are operated.

(d) The engine lube oil for each engine should be sampled using new and clean individual sample bottles and sampling tubes for each engine. The contaminants must be suspended in the oil for samples to be accurate. Samples must be taken while engines are operating at normal operating temperature. Do not reuse sample bottles or tubing. While thorough lube oil evaluation requires a certified, well-equipped testing laboratory, a number of tests that can be performed at the facility which can provide good information are listed below. However, the value of these tests can be very dependent on the skill and experience of the person performing the tests, and having a database of results from the same tests over a long period of time.

(e) Measure viscosity using a commercially available instrument known as a "Visgage".

(f) Monitor relative soot and residue levels using a blotter test. Blotter test kits with comparison charts are commercially available. Soot indicated by color of spot made by oil drop while particulate content indicated by residue left on blotter surface.

(g) Monitor total contaminants by the centrifuge method [American Society for Testing and Materials (ASTM) D 91]. Requires laboratory centrifuge, graduated cone-shaped sampling bottles, and chemical reagents (naphtha). Percentage of total contaminants read off graduated scale on sampling bottles.

(h) Monitor the detergent capacity of the lube oil using a blotter test. Blotter test kits with comparison charts are commercially available. Size of oil spot on blotter indicates detergent capacity of lube oil.

b. Determine lube oil change interval. How often lubricating oil should be changed is difficult to answer because of many factors, including the make of the engine, the load condition (constant versus variable), atmospheric conditions, engine operating temperatures, etc.

(1) To establish an approximate frequency for a specific engine installation, the following procedure may be used.

(a) Operate the engine for 300 hours on new oil.

(b) Replace the oil with new oil and have the used oil analyzed.

(c) If the used oil is found to still be usable, increase the hours of operation before changing oil by 200 hours.

(d) Repeat steps *(b)* and *(c)* until the used oil analysis indicates that the used oil is unsatisfactory for further use.

(2) After the oil change period for an engine type operated at a specific facility has been determined, subsequent oil changes can be scheduled far in advance with a high degree of certainty. Nevertheless, the lube oil condition should be regularly tested to verify proper lube oil performance. Remember, if the engine operating conditions change (higher or lower operating temperatures, different loads, etc.), the oil change interval should be reevaluated.

c. Inspect lube oil system. Start at the main clean and dirty lube oil storage tanks and follow the lube oil system piping all the way to the points of end use. Inspect for the following.

(1) Leaking pipe joints and/or corrosion

(2) Missing identification tags on system valves and components

(3) Sagging or misalignment of piping

(4) Lube oil leaks or spills. Inspect containment area for the storage tanks for cracks or any other inconsistencies.

d. Exercise valves. Exercise all valves in the lube oil system.

(1) Inspect packing gland and tighten if necessary.

(2) Check for correct positioning and operation.

(3) Check for leaking seals.

(4) Adjust operator linkages and limit switches on control valves.

e. Test alarms. Verify that the horns sound and all annunciator lights illuminate by pressing the appropriate test push buttons. Press the ACKNOWLEDGE and RESET push buttons when proper operation has been confirmed.

f. Check tank heaters. Verify that all storage tank, piping, and equipment heaters are operating correctly.

g. Self-contained temperature control valves (thermostats). Remove the engine thermostat valve from the cooling system. Clean valve and inspect sliding valve for scoring or damage that prevents free movement or tight shutoff. Repair by gently lapping or replace components as necessary. Thoroughly clean thermostat valve interior surfaces before reinstalling thermostat valve in engine cooling system. Verify valve operation as follows.

(1) Remove the element assembly from the valve and place in a bucket of water which is heated to 10°F below the temperature rating of the valve.

(2) Stir the water vigorously for about five minutes. The sliding valve should not be off the seat.

(3) Place the element assembly in a bucket of water which is heated to 15°F above the temperature rating of the valve.

(4) Stir the water vigorously for about five minutes. The sliding valve (and temperature element) should be fully stroked. Full stroke can be verified by placing the element assembly back into the valve housing and pushing the valve seat spider fully into the housing counterbore. If the spring action of the overtravel spring can be felt, the element is fully stroked. (This procedure must be done very rapidly.)

h. Transfer pump end clearance adjustment. After long service, the running clearance between the end of the rotor teeth and the head may increase to the point where the pump is losing capacity or pressure. Resetting the end clearance will normally improve pump performance. Refer to the manufacturer's technical service manual.

i. Examine internal pump parts. Periodically, remove the head and examine idler bushing and head and pin for wear. Replacing a relatively inexpensive idler bushing and idler pin after only moderate wear will eliminate the need to replace more expensive parts at a later date.

j. Clean all equipment. Clean equipment is easier to inspect, lubricate, and adjust. Clean equipment also runs cooler and looks better.

k. Inspect engine lube oil components. Inspect diesel engine mounted lube oil system components daily. Check for leaks or any inconsistencies.

Table 6-1. Diesel engine lube oil system – standby mode

Diesel Engine Lube Oil System – Standby Mode	
Action	***Frequency***
Prelube Pump	
Inspect prelube pump for normal operation and report any discrepancies as follows:	
Pump running.	8 hrs
Inspect and adjust packing glands and seals.	week
Inspect and adjust shaft coupling	week
Lubricate bearings.	3 mos
Lube Oil	
Check and record oil level.	week
Obtain oil sample for analysis as follows:	
Exercise engine and obtain samples after every second exercise.	mo
If the interval between engine exercises is more than 1 month, obtain sample after every exercise.	as req'd
Change lube oil as required by oil analysis.	as req'd

Table 6-2. Diesel engine lube oil system – operating mode

Diesel Engine Lube Oil System – Operating Mode	
Action	***Frequency***
Lube Oil	
Check level in lube oil sump. Log oil temperature and pressure readings.	hr
Tank lube oil sample and test fuel oil containment level.	week
Take lube oil sample for laboratory analysis. Monthly or after 250 hours of operation, whichever occurs first.	mo/250 hrs
Change lube oil (as indicated by laboratory analysis).	as req'd
Lube Oil Filter	
Check pressure drop.	shift
Change in service filter elements. As indicated by pressure drop, or after 1,000 hours of operation or every 3 months, whichever occurs first.	1K hrs/3 mos
Final Lube Oil Filter	
Check pressure drop.	shift
Change filter element. As indicated by pressure drop, or after 1,000 hours of operation or every 3 months, whichever occurs first.	1K hrs/3 mos

Table 6-3. Central lube oil storage and dispensing system

Central Lube Oil Storage & Dispensing System	
Action	***Frequency***
System	
Start at the lube oil storage tanks (clean and dirty) and follow the lube oil system to all final use points. Inspect for and report any discrepancies as follows:	
Leaking pipe joints.	day
Leaking heat exchangers.	day
Leaking around packing glands on valves and pumps.	day
Leaking gaskets on filter housings.	day
Excessive noise or unusual vibration from motors, pumps, and other rotating equipment.	day
Wipe oil and dirt from equipment and report all discrepancies to supervisor.	mo
Main Storage Tanks (Clean and Dirty)	
Check and record oil level.	week
Intermediate Storage Tanks (Clean and Dirty)	
Check and record oil level.	shift
Refill tank when level decreases to action level.	as req'd
Valves	
Exercise all valves and report all discrepancies to supervisor. Exercising valves shall include the following routine maintenance activities:	
Grease stems on OS&Y valves.	mo
Inspect packing gland and tighten if necessary.	mo
Check correct position and operation.	mo
Check for leaking seals.	mo
Pumps	
Lubricate bearings.	mo
Inspect and adjust packing glands. Replace as necessary.	mo
Inspect and adjust shaft coupling.	mo
Disassemble, rebuild and adjust mechanical elements in accordance with manufacturer's recommendations.	yr

Table 6-3. Central lube oil storage and dispensing system (continued)

Central Lube Oil Storage & Dispensing System	
Action	***Frequency***
Lube Oil Heaters	
Verify that heaters are operating.	mo
Strainers – Y-Type and Single Element Basket Type	
Clean strainer element.	mo
Controls	
Verify control function.	mo
Test alarms.	mo
Centrifuge	
Check gearbox lubricating oil level.	week
Grease sliding surfaces of bowl assembly.	3 mos
Clean operating water filters and desludgers.	3 mos
Change lubricating oil and clean gear chamber.	6 mos
Lubricate hand-operated parts such as lock screws.	6 mos
Clean dirty oil pump inlet filter.	6 mos
Disassemble self-cleaning bowls and clean all bores, nozzles, and chambers of the hydraulic system.	6 mos
Remove and inspect gaskets of bowl, and clean the grooves. Check for corrosion. Check if disk set is properly compressed.	6 mos
Check starting time and thickness of clutch linings.	6 mos
Check thickness of brake linings.	6 mos
Check rubber-metal bushing in neck bearing.	6 mos
Pack motor bearings.	yr
Remove bottom bearing and thoroughly clean all parts.	yr
Remove bowl and clean interior of upper frame.	yr
Inspect spindle bearings.	yr
Inspect worm gear drive.	yr
Check spindle speed.	yr

Table 6-4. Lube oil instrumentation and electrical

Lube Oil Instrumentation & Electrical	
Action	***Frequency***
Level Gauges	
Check for accuracy. Remove manhole cover and check gauge reading against calibrated dipstick. Recalibrate as required following equipment manufacturer's instructions.	yr
Thermometers	
Check for accuracy. Remove thermometers from their wells and check against calibrated thermometer in controlled temperature bath.	yr
Pressure Gauges	
Isolate gauge by closing the proper valves. Remove and check in a fixture against a calibrated gauge. Adjust as required following equipment manufacturer's instructions.	yr
Motors	
Check and clean cooling airflow passages on electric motors as necessary so that nothing obstructs airflow.	6 mos
All Electrical Devices	
Check, clean, and tighten terminals at motors, starters, disconnect switches, etc.	6 mos
Wiring	
Check insulation on conductors in starters, switches, and junction boxes at motors for cracks, cuts, or abrasions. Replace wiring as required and correct cause of damage.	6 mos

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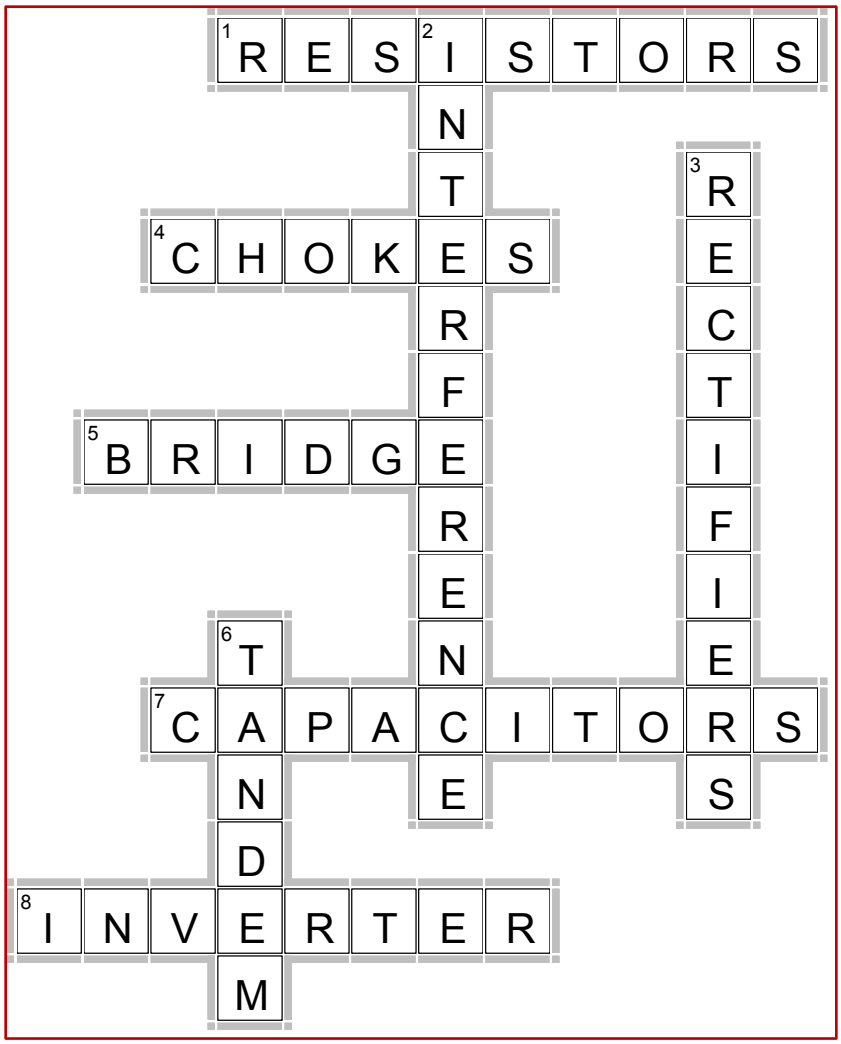
Solution for Last week Techuzzle



Across

1. **RESISTORS**—Braking is obtained by using _____ across the DC circuit
4. **CHOKES**—These are installed in input circuit of drives to avoid harmonics _____
5. **BRIDGE**—Three Phase AC is converted to pure DC using _____ rectifier system
7. **CAPACITORS**—These devices store excessive energy from motor and avoid speed variations _____
8. **INVERTER**—The DC is again converted to AC using _____ in a frequency drive

Down

2. **INTERFERENCE**—I stands for _____ in RFI - Radio Frequency _____
3. **RECTIFIERS**—On a frequency drive, the input AC is first converted into DC using _____
6. **TANDEM**—Common name for operating multiple motors using single drive is _____

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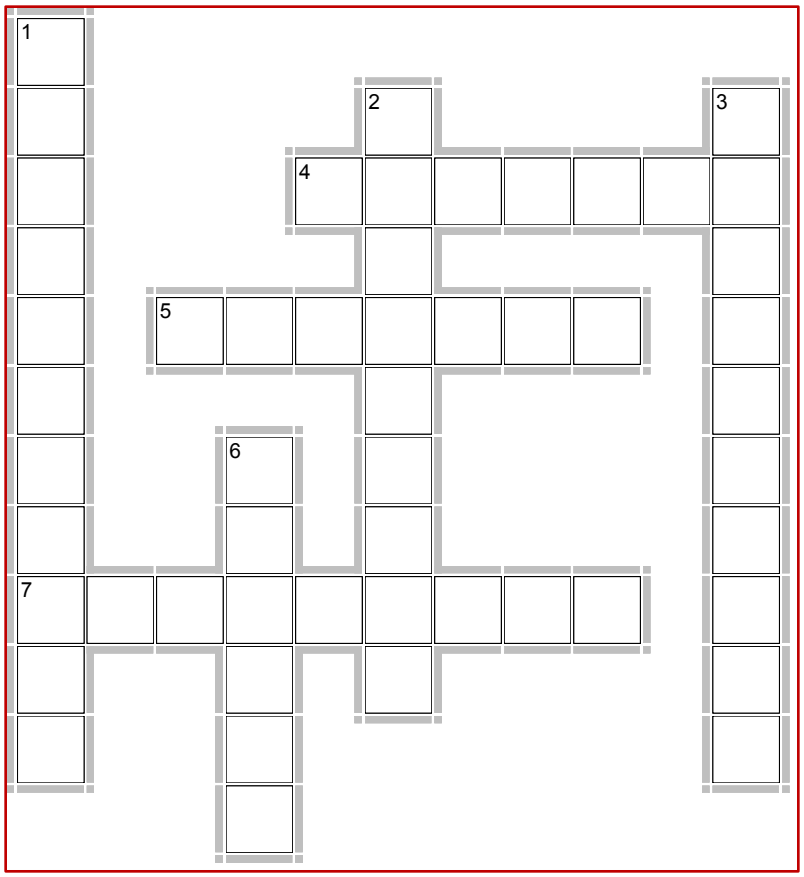
NEWSLETTER FOR MANUFACTURING COMMUNITY

This week Techuzzle



Across

4. Chemical composition of sand, which is also an engine oil contaminant
5. Additive to hold and & suspect contaminates
7. Technical term for thermal decomposition of oil under high temperature

Down

1. Anti-wear & Extreme pressure additive
2. 10W40 or 20W40 primarily indicates this property of oil
3. This contamination causes extreme sludge formation
6. This additive acts as dispersant and detergent

SAE - Society for Automotive Engineers

It is quite impossible imagine any product, service that are related to automobile without having some relevance to SAE. Either they will use products that are SAE certified or follow SAE production standards. Even the production processes, product specifications strictly follow SAE standards to produce reliable, efficient and safe automobiles. SAE, originally started as Society for Automobile Engineers, in 1905 with Andrew L Riker as President and legendary Henry Ford as Vice-President gradually became a global platform not only for exchange of knowledge and expertise, but for setting standards quite similar to ISO and other practices. With inclusion of types of automobile related equipments, the name was changed to Society for Automotive Engineers and is still valid. One of the most widely used product where we come across SAE standard is lubricating oil. SAE10W40, SAE20W40 are not unfamiliar to any of us. Even thread sizes, washer dimensions and all micro details pertaining to an automobile are specified by SAE, which ensures universal parts availability, seamless exchange of components. SAE also helps in reducing production costs by specifying lean production practices.

Henry Ford

Born in a village, close to Detroit - Automobile Capital of the World - he founded Ford Motor Company and revolutionized the production process of automobiles. He invented mass production lines, using which cars can be produced in large quantities like other commercial products. This meant higher output and less effort, resulting in increased wages to workers as well. Ford Assembly Line, especially the ones used for manufacturing its legendary Model T became a world standard and finds relevance, even today in modern automobile manufacturing plants. Ford was also responsible for introducing franchisee based automobile dealership system which has become a regular business today. Productivity based incentives, work center models were all created by Ford in his automobile plants. Many models production models like TQM, Lean Manufacturing have their fundamentals dependent on Ford production practices.