

GE Transportation

Engine Lubricating Oil System, PH37AC PowerHaul[®] Series Locomotive

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imagination at work

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Revision History

Rev	Date	By	Description
NEW	Sep-2009	BMS	Initial release of publication.
A	Jun-2010	DAT	
B	Sep-2012	WHO	Add information for PowerHaul model -ai.
C	Nov 2012	WHO	Revised Functional Description

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1. GENERAL INFORMATION

1.1. INTRODUCTION

This publication defines the Lubricating Oil System for PowerHaul® Series locomotive components. The locomotive lubricating oil system provides pressurized lubrication for engine components and carries away heat produced by friction and combustion. The PowerHaul Series locomotives comply with the UIC emissions regulations for railway locomotives.

1.2. RELATED PUBLICATIONS

When using related publications, ensure the highest letter revision of the publication is used for the most current information. For the latest publication revision, visit the GE Website or contact the local GE Representative.

Table 1. Related Publications

Publication Number	Publication Name
GEK-114501	Scheduled Maintenance, PH37ACmi PowerHaul Series Locomotive
GEK-114502	Component Overhaul Schedule, PH37ACmi PowerHaul Series Locomotive
GEK-76679	Recommended Fuel, Oil, and Lubricants
GEK-114944	Component Overhaul Schedule, PH37ACai PowerHaul Series Locomotive

NOTE: Refer to the appropriate interval *Scheduled Maintenance* publication for PH37ACai PowerHaul SERIES LOCOMOTIVES, GEK-114940, GEK-114941, GEK-114942, or GEK-114943.

1.3. SAFETY INFORMATION

Safety precautions, which must be observed when working on this equipment, appear throughout this publication.



Indicates the potential for personal injury.



Indicates the potential for equipment damage.

2. CONTROLS AND INDICATORS

Not Applicable

Revisions are indicated by margin bars.

3. FUNCTIONAL DESCRIPTION

The engine lubricating oil system consists of two circuits, the main circuit and the cooling loop (Figure 1 or Figure 2). In the main circuit, the lubricating oil High Pressure (HP) pump draws oil from the oil sump through a small oil to water heat exchanger, then through the lube oil filters where it then returns the oil to the engine galley. In the cooling loop, the Low Pressure (LP) lubricating oil pump draws oil from the oil sump, through the air to oil heat exchanger then back to the oil sump. The major components are as follows:

- Oil Pan and Strainer – forms the reservoir that holds the lubricating oil. The oil capacity of the entire lubricating oil system is approximately 300 gallons (1135 liters). The majority of the oil is contained in the oil pan and the air-to-oil heat exchanger when the diesel engine is shutdown. A perforated metal strainer is fitted in the oil pan discharge line to prevent any large contamination from reaching the lube oil pump.
- Oil Pump (Low Pressure Auxiliary Pump) - purpose is to circulate the hot oil in the oil pan through the air-to-oil heat exchanger. The lube oil pump is located on the A-side of the locomotive and is mounted to the Integrated Front End (IFE) cover of the engine.

The pump is a positive displacement design and has an internal relief valve. The oil pump is gear-driven from the engine crankshaft by means of an auxiliary drive gear. The oil pump has a flow rate of approximately 280 gallons per minute (1060 liters) of oil at 1500 rpm engine speed and normal operating temperature.

- Air to Oil Heat Exchanger - part of the A-side radiator that consists of the air-to-air manifold air cooler, the air-to-oil heat exchanger and the shutter assembly.
- Oil Pump (High Pressure Main Pump) - Oil moves from the air-to-oil heat exchanger to the inlet of the HP oil pump and is discharged to the inlet of the BHE oil cooler. The minimum flow for the HP pump is 233 gpm (883 lpm) and is set to maintain 72 psig (5 kg/cm²) max output.
- Brazed Plate Heat Exchanger (BHE) - metal plates within the oil cooler housing separate the oil, flowing in one direction, from the cooling water, which flows in the opposite direction. The plates not only separate the two fluids, they form the medium to transfer the heat from the oil to the cooling water.
- Oil Filters - The oil filter housing removes contaminants larger than 3 microns from the engine oil. Each of the 2 oil filter housings contains a 2-piece filter element. To prevent unfiltered oil from being ingested by the engine there is NO bypass circuit in the oil filter housing. All oil flowing into the engine must flow through the oil filter elements.
- Engine Pre-Lube Pump - is used to lubricate the engine before cranking. The pre-lube pump assembly consists of a DC motor and a positive displacement pump.
- Coalescer Filter - removes harmful gasses from the engine crankcase. Gasses exit the diesel engine crankcase through the IFE cover to the coalescer. In the coalescer, the gasses pass through a screen filter cartridge. The filter separates or collects any oil mixed with the gasses. The oil drains back to the engine sump. The oil-filtered gasses vent through a flexible hose into the exhaust.
- Engine Lube In Temperature Sensor (ELIT) – measures oil temperature as it enters the engine. Protects engine from damage that might occur if it is operated at a temperature that is too high or too cold.
- Engine Lube Oil Inlet Pressure Sensor (FLIP) - measures oil pressure just in front of left high-pressure pump to prevent engine damage caused by low oil-pressure conditions.
- Crankcase Over Pressure Sensor (COP) - measures pressure in the engine crankcase. Provides protection if pressure starts to rise so that ECU can shut down the engine if pressure becomes excessive thereby preventing a crankcase explosion.
- Main Oil Discharge Pressure Sensor (MODP) - measures lubricating oil pressure at the discharge of the high pressure oil pump, used to monitor for high lube oil output pressures.

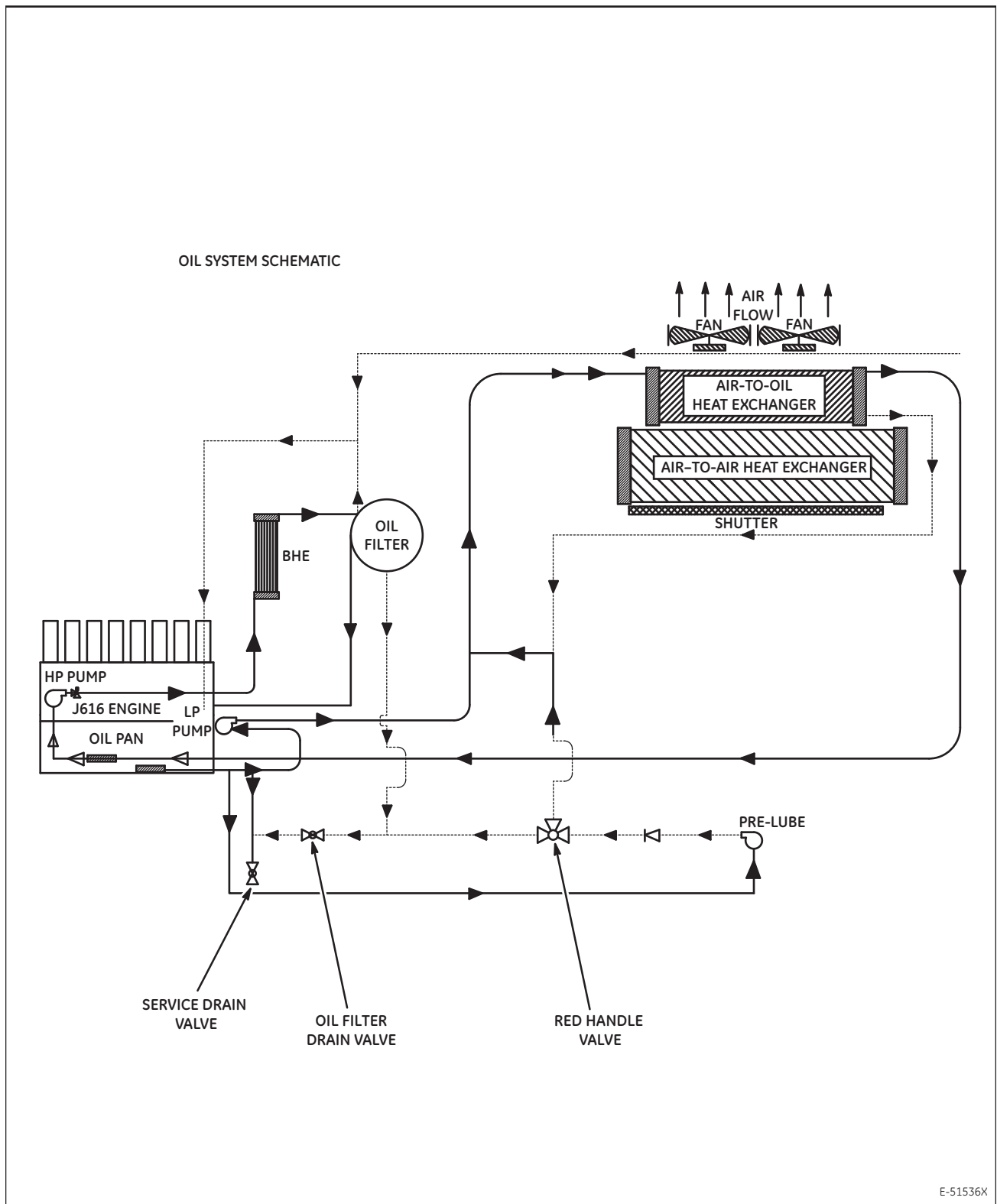


Figure 1. Lubricating Oil System for PH37ACmi

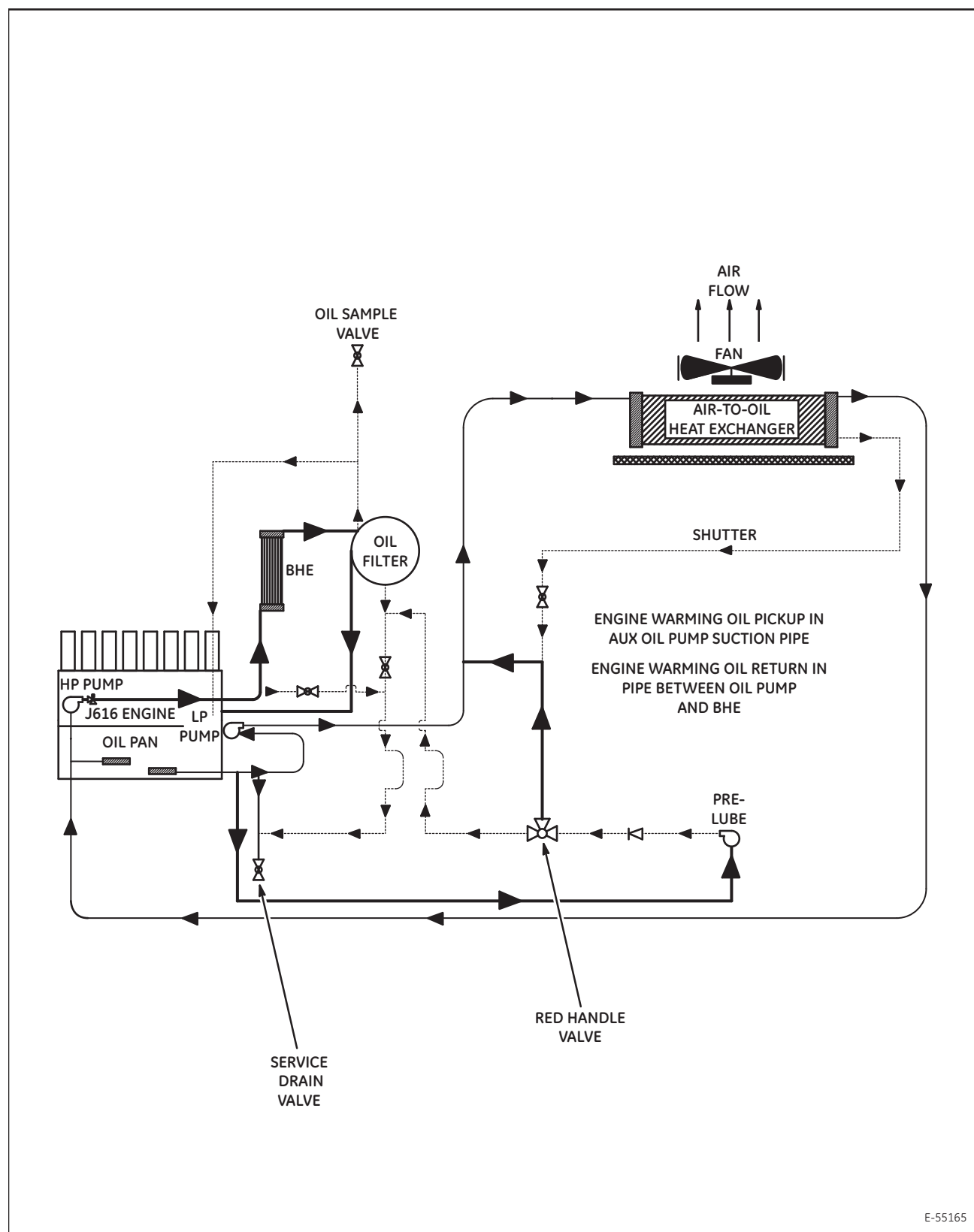


Figure 2. Lubricating Oil System for PH37ACal

3.1. DESCRIPTION OF PRE-LUBRICATING SYSTEM

The Pre-Lube Pump operates prior to engine cranking to circulate lubricating oil through the engine prior to starting. This is critical to engine protection at low temperature operation when the oil viscosity is high and oil flow characteristics are poor. Pre-Lube Pump operation is automatic and is controlled by the locomotive control system. The engine lube oil is pulled by the Pre-Lube Pump from a take off in the engine oil suction pipe that is connected between the engine oil pan and the engine lube oil pump. From the Pre-Lube Pump the oil is sent to the engine through a check valve connected to the engine oil system. The lube oil passes through the engine air to oil heat exchanger before being sent into the engine oil inlet. The following events take place during engine starting:

- The fuel priming pump starts immediately when the ENGINE START push button is pressed. A crank warning bell (located in the Auxiliary cab) will sound for approximately 10 seconds.
- There will be a 5 to 10 second delay between the time the ENGINE START push button is pressed and the pre-lube pump starts to rotate.
- The diesel engine will crank upon completion of the engine pre-lube cycle.
- If proper engine fuel pressure does not build up within approximately 40 to 60 seconds, the control system will log a non-restrictive fault and continue to crank.

3.2. ENGINE OIL — DIPSTICK AND FILL

For proper oil criteria, refer to **GEK-76679 RECOMMENDED FUEL, OIL, AND LUBRICANTS**.

An engine oil dipstick and fill (Figure 3) is located on the A-side and B-side of the locomotive at the Integrated Front End (opposite the alternator end). Each dipstick has two sides or faces. The A-side of the dipstick is marked FULL and ADD. Proper level with the engine idling is between FULL and ADD. The B-side is marked with Oil Pan Top Rail position and relative graduations. The capacity between each graduation corresponds to 19.8 gallons (75 litres). Figure 4 shows the dipstick markings on each side.

3.2.1. Oil Fill and Oil Volume Inspection

The proper oil level can be verified **ONLY** in engine idle condition. The oil level must be in the hash-marked area between the FULL and ADD mark of the dipstick during idling. For proper oil criteria, refer to **GEK-76679 RECOMMENDED FUEL, OIL, AND LUBRICANTS**.

NOTE: Always maintain the oil below FULL mark and above ADD mark during engine idle condition. Overfilling the engine lubricating oil will cause engine to shut down from excessive crankcase pressure.

At Oil Change:

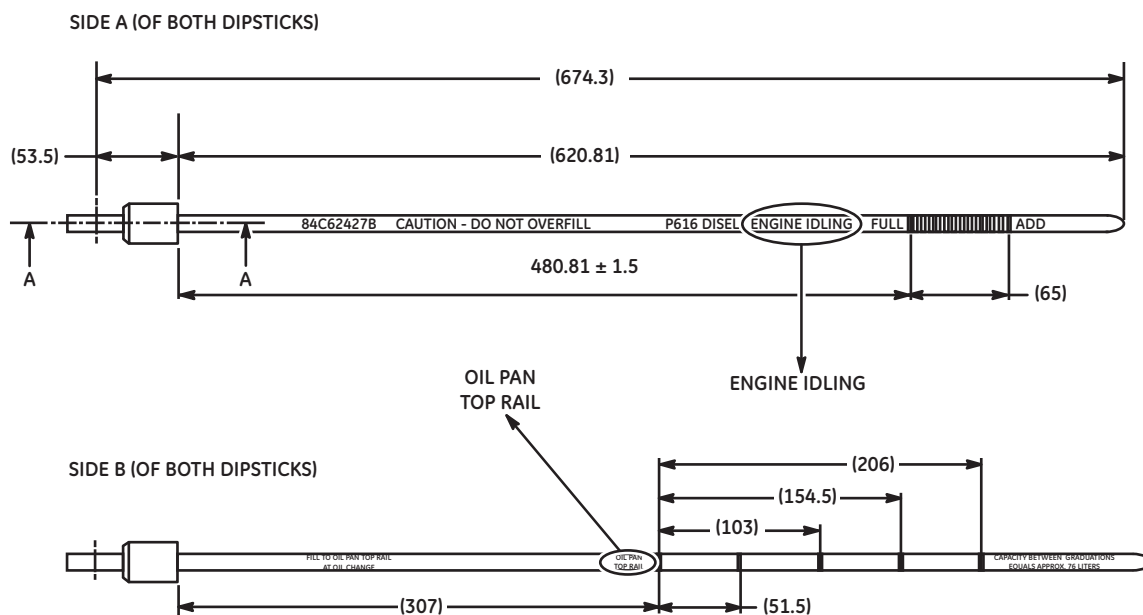
1. Initially, fill oil to oil pan top rail. The operator/maintenance personnel can make use of the B-side of either dipstick having “oil pan top rail” indicator. The B-side contains a reference mark used to avoid oil flowing above the oil pan. The B-side of each dipstick also provides graduations to facilitate estimation of volume of oil being filled.
2. After filling oil to the top rail and before cranking the engine, rotate the red-handled valve down (Figure 5) and turn-on the pre-lube pump to fill the Air-To-Oil Heat Exchanger (filter, cooler, etc.) with oil.
3. Rotate the red-handled valve up and refill oil to the top rail. Thereafter add or remove oil, based on the oil level indicator on A-side of the dipstick (during ENGINE IDLE).

NOTE: The B-side of each dipstick (showing OIL PAN TOP RAIL) does NOT provide any reference mark for oil level monitoring.



E-51363

Figure 3. Engine Oil Dipstick and Fill



E-51528

Figure 4. Engine Dipstick and Fill

3.3. LUBRICATING OIL — DRAIN AND FILL

3.3.1. Draining the lubricating oil system:

1. Shut down the engine. Open the Local Control Circuit Breaker (LCCB), Fuel Pump Circuit Breaker (FPB) and Battery Charge Circuit Breaker (BCCB) on the Engine Control panel (EC1). Open the Battery Switch (BS) in Control Area 1 (CA1) to ensure the engine cannot be started.
2. Vent the filter housing. Open the lube oil filter drainback and BHE drain valves, and lower the red handled valve. Allow 15 minutes for HOT oil to drain. If the oil is cold, draining will take much longer.
3. Remove the pipe plugs from the Crankcase Oil Drain pipe under the platform. Arrange barrels or a hose system to collect the drained oil.
4. Open the crankcase lube oil drain valve.
5. When the lubricating oil is completely drained, close the crankcase drain valve and replace the drain pipe plugs.

NOTE: *Lubricating oil filter elements should be replaced whenever the lubricating oil is changed. Refer to section 3.4., OIL FILTER ELEMENTS.*

6. Close the filter housing vent. Close the filter drainback and BHE drain valves, and raise the red handled valve.

3.3.2. Filling the lubricating oil system:

1. Fill the crankcase through one of the oil fill pipes located on each side of the IFE with the proper quantity of new GE-approved lubricating oil. Approved lubricating oils are listed in **GEK-76679 RECOMMENDED FUEL, OIL AND LUBRICANTS** publication.
2. Initially, fill oil to oil pan top rail. The operator/maintenance personnel can make use of the B-side of either dipstick having “oil pan top rail” indicator. The B-side contains a reference mark used to avoid oil flowing above the oil pan. The B-side of each dipstick also provides graduations to facilitate estimation of volume of oil being filled.
3. After filling oil to the top rail and before cranking the engine, rotate the red-handled valve down (Figure 5) and turn-on the pre-lube pump to fill the Air-To-Oil Heat Exchanger (filter, cooler, etc.) with oil.
4. Rotate the red-handled valve up and refill oil to the top rail. Thereafter add or remove oil, based on the oil level indicator on A-side of the dipstick (during ENGINE IDLE).

NOTE: *The B-side of each dipstick (showing OIL PAN TOP RAIL) does NOT provide any reference mark for oil level monitoring.*

5. Close the Battery Switch (BS) and then close the LCCB, FPB, and BCCB circuit breakers on the Engine Control (EC1) panel and start the engine. With the engine at IDLE, check the crankcase lubricating oil level. Add oil if needed.

3.4. OIL FILTER ELEMENTS

A sufficient supply of clean oil is a critical requirement to keep the P616 engine running efficiently and reliably. To satisfy this requirement, there is a filter housing (Figure 5) with two canisters located on the skid in the Radiator Cab. The oil filter assembly consists of two steel tanks (oil filter canisters), each with a two-piece, twelve-micron two-stage filter element. A gradual drop in oil flow and reduction in oil pressure indicates that the oil filter elements have

become restricted (clogged) and should be replaced if the pressure drop across the filter assembly increases beyond 30 psi.

NOTE: Lubricating oil filter elements should be replaced whenever the lubricating oil is changed.

To replace the oil filter elements:

1. Shut down the engine and open the battery switch
2. Drain the oil as per instructions in section 3.3., *LUBRICATING OIL — DRAIN AND FILL*

NOTE: Be sure to drain oil from crankcase prior to opening oil filter housing door to ensure oil level is below bottom canister.

3. Have shop rags available to absorb any oil that may drip from the seal surfaces at the tank to cover interface. There is a catch pan below the lower tank.
4. Un-torque and back off the nuts (to the end of the bolts) but do not remove the nuts holding the oil filter element doors in place.
5. Using the cover handle support the weight of the cover and swing the (2) cover bolts adjacent to the handle free of the cover slots.
6. Using the hinge bolt (opposite the handle) as a pivot point, swing the cover open to access the filter elements. Use care to position the door in an area where it will not cause a pinch hazard in future operations.
7. Remove both sections of the old filters. Inspect the elements for any damage during removal. If any damage is evident, contact GE Representative to see if further engine evaluation is required.
8. Clean the internal surface of the canisters with clean rags.

NOTE: Ensure that no debris or rags enter the clean side of the filter housing through the index tube inside the housing (tube connecting the dirty side and clean side at the in-board end of the housing). Also, avoid cleaning inside the index tube to ensure that no debris/rags enter the clean side. DO NOT use compressed air or solvent to clean the housing while connected to the engine.

9. Lubricate filter element O-rings with engine oil.
10. Install new GE approved filter elements. Inspect each element before installation to assure the elements are not damaged and all O-rings are properly located. Install elements in order as shown in Figure 6. Use care during installation to not damage the critical O-ring seal interfaces.

NOTE: Confirm no shipping damage on tabs, outer filter media, O-rings or stem pipe before installation

11. The elements should mate to housing stem pipe and inter-element stem pipe with only slight pressure required. If easy assembly does not occur, determine cause and properly assemble to ensure no dirty oil by-passes the elements, which would result in engine damage or failure. Contact GE Representative if any questions.
12. Replace the O-ring on the face of the canisters, at the door. Consult the latest revision of the parts catalog to determine the correct O-ring. Close and seal the doors of the filter canisters assuring that the O-ring is not crushed in the door closure. Torque the cover nuts to 177 ft.-lbs. (240 Nm).
13. Ensure the drain-back and vent valves are fully closed.

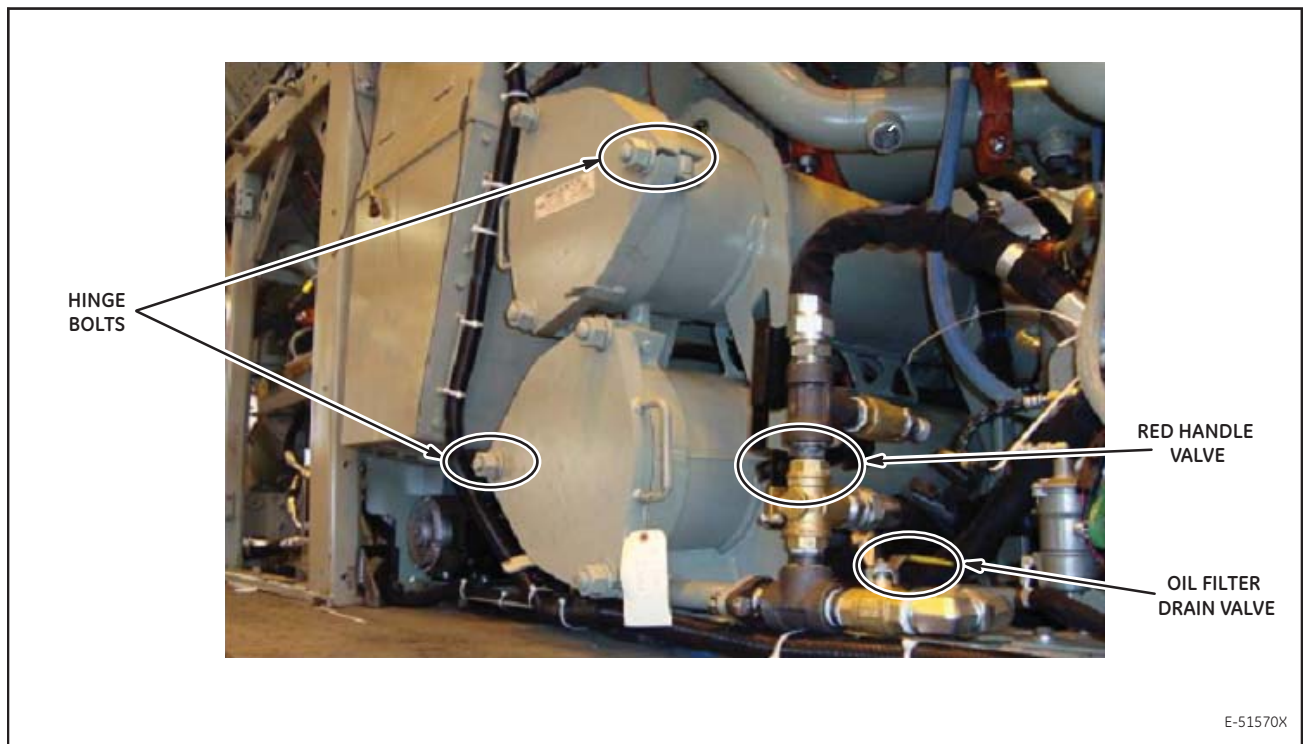


Figure 5. Lube Oil Filter Housing (PH37ACmi Unit shown).

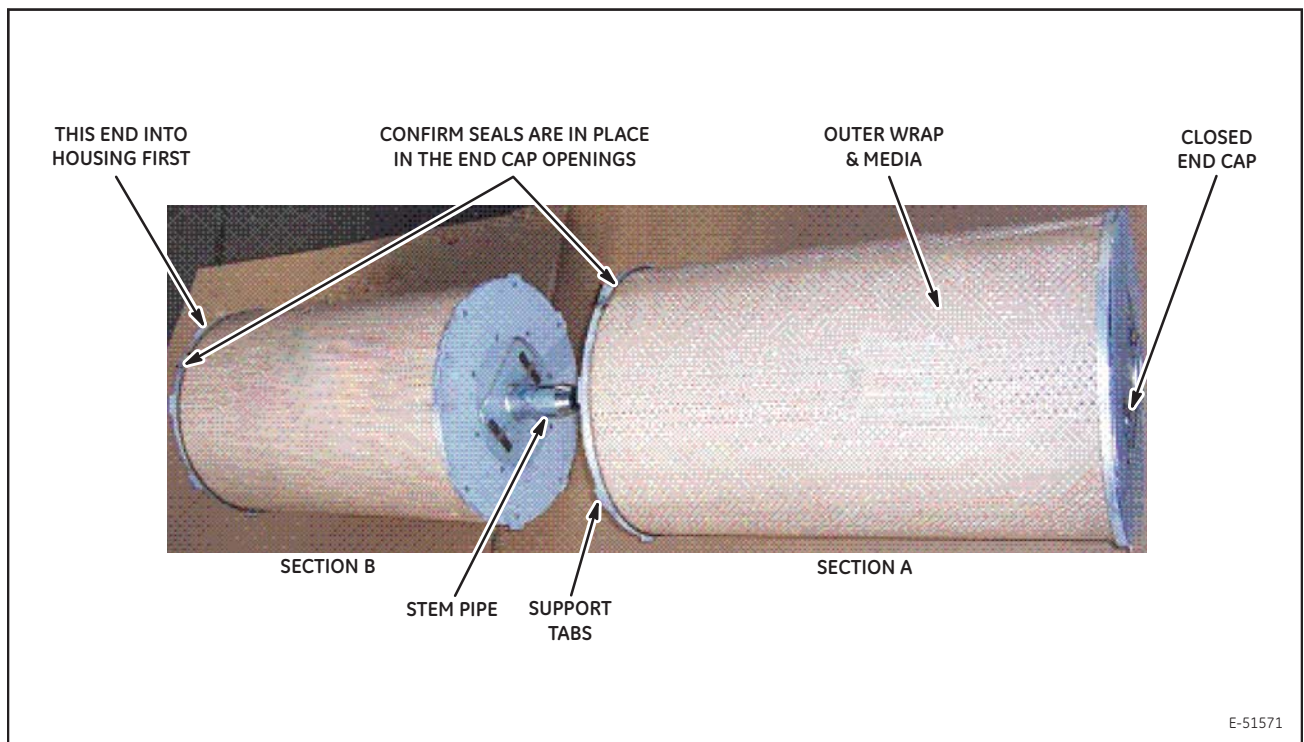


Figure 6. Oil Filters

14. Close appropriate breakers and start the pre-lube pump. Use self-test or initial portion of engine start sequence. If engine start sequence is used, may have to interrupt sequence (press stop button) to prevent engine from cranking if pressure has not built while lube system is filling the first time after oil change.
15. Inspect the entire lube oil system for leaks and make corrections as necessary.

3.5. LUBRICATING OIL ANALYSIS

For proper oil criteria, refer to **GEK-76679 RECOMMENDED FUEL, OIL, AND LUBRICANTS**.

Take a sample from the lubricating oil sampling valve. Have the sample analyzed by the laboratory and take the appropriate action based on analysis. For example: change lubricating oil; find and correct the cause of dilution by diesel fuel or water; find and correct the cause of an increase of metals such as copper, iron, chromium, aluminum, and others.

4. SCHEDULED MAINTENANCE

Refer to **GEK-114501, SCHEDULED MAINTENANCE PH37ACmi PowerHaul SERIES LOCOMOTIVE**. Refer to the appropriate interval Scheduled Maintenance publication for **PH37ACai PowerHaul SERIES LOCOMOTIVES, GEK-114940, GEK-114941, GEK-114942, or GEK-114943**.

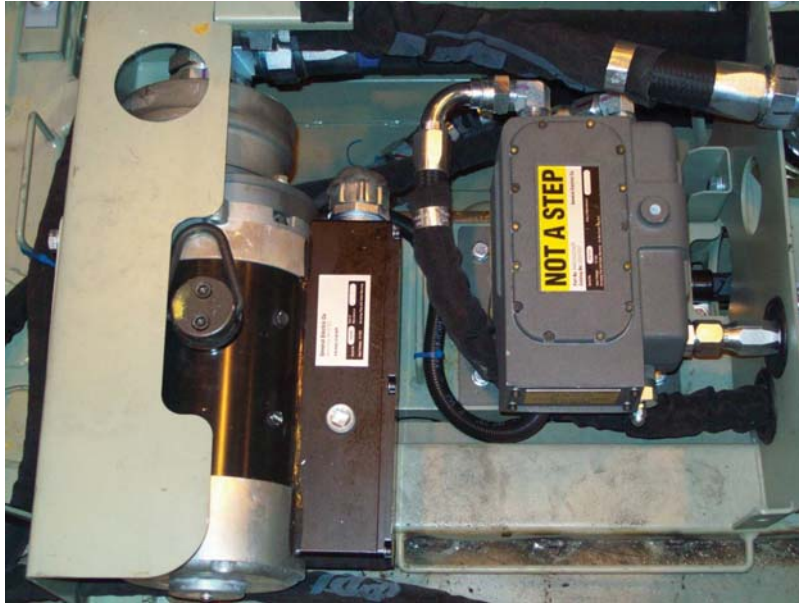
5. REMOVE AND REPLACE/RENEW PROCEDURES



To prevent the pre-lube pump (Figure 7) from operating during removal or installation, ensure the locomotive engine is shut down and the battery switch (BS) is open.

5.1. PRE-LUBE PUMP REMOVAL

1. Open the battery switch (BS) in Control Area 1 (CA1).
2. Follow steps for draining the lubricating oil housing as outlined in section 3.3., *LUBRICATING OIL — DRAIN AND FILL*, in this publication.
3. For PH37ACmi units 1 through 7 perform the following steps. For all other units proceed to step 4.
 - a. Remove the Baggie air filters.
 - b. Remove the Baggie air filter housing.
 - c. Disconnect the low pressure fuel lines from the low pressure fuel transfer pump.
4. Disconnect the electrical connection.
5. Remove the 4 mounting bolts and remove the low pressure fuel transfer pump.
6. Disconnect the pre-lube oil lines.
7. Disconnect the electrical connection.
8. Remove the 4 mounting bolts and remove the pre-lube oil pump.



E-51539

Figure 7. Pre-Lube Pump

5.2. PRE-LUBE PUMP INSTALLATION

1. Install the pre-lube oil pump and apply its mounting bolts.
2. Connect the pre-lube oil pump electrical connection.
3. Connect the pre-lube oil lines.
4. For PH37ACmi units 1 through 7 perform the following steps. For all other units proceed to step 5.
 - a. Install the low pressure fuel pump and apply its mounting bolts.
 - b. Connect the low pressure fuel transfer pump electrical connection.
 - c. Connect the low pressure fuel transfer pump fuel lines.
 - d. Install the Baggie air filter housing and Baggie air filters.
5. Follow the steps for filling the lubricating oil as outlined in section 3.3., *LUBRICATING OIL — DRAIN AND FILL* in this publication.
6. Start the diesel engine and check for leaks.

6. SUMMARY DATA

Not Applicable