

## 1 Introduction

*Background information can be found in the detailed lubes document normally located by HP cylinder on the cam gallery and on the web site. This procedure assumes some experience.*

Note that the engine crankshaft main bearing lubrication "Aquarium" tank oil flows are the responsibility of the Driver as they are adjacent to his operating position and in his line of sight.

Likewise, lubrication of the Barring Engines is the responsibility of their operator, who is usually the Assistant Driver.

Clean up oil spills promptly (using old towels for minor spills or the spills kit on the cam floor for larger ones).

Initially the lube oil will be relatively cold and sluggish, but it will quickly warm up during circulation and from the residual heat of the engine, so expect needle valve flows to change during the start of the running period.

## 2 60 minutes before first start

- 1 **Basement:** Ensure that the Electrical Team has switched on the mercury arc rectifier (MAR). If not, and if you are an authorized user, obtain key no 2 for the MAR from the basement keybox and turn it on.
- 2 **Basement:** Switch on and momentarily start the oil pumps to ensure they operate. If not, confirm that the DC panel is active and that the circuit breaker in the basement beneath the oil pump fuse box under the mercury arc rectifier is on.
- 3 **Basement:** Check there is sufficient lube oil in the tank associated with the mechanical engine driven pump. The level should be about 12 to 14 inches below the top of the tank and covering the pump suction inlets.
- 4 **Basement:** Check the small mechanical pump mounted on the outside of the tank that has a crosshead greasing cap, screw it in slightly to apply lubrication to the traveling crosshead.
- 5 **Basement:** Rotate the handle of the Auto-Klean fine-mesh strainer above the pump tank three or four times to clean the surfaces and open the drain into a bucket and discharge any accumulated solids or condensate.
- 6 **Top Gallery:** Check the quantity of lube oil in the tanks by viewing their sight glasses. The longer glass should be at least three-quarters full and the upper glass nearly full, top up if necessary using the electric pump.
- 7 **Cam gallery:** Check that the reservoirs of steam oil in the T&K injection units on each cylinder's cam units are at least 1/3rd full. Top up with steam oil if necessary.
- 8 **Cam gallery:** Prime each of the steam oil injection units by operating the small levers below the sight glasses until globules of steam oil can be seen to rise up the wire threads.
- 9 **Cam gallery:** Top-up the mechanically driven DELVAC pump at the rear of the right hand end of the HP cylinder cam box that injects steam oil directly into the HP Cylinder. Pump the plunger to prime it.
- 10 **Cam gallery:** Sparingly apply oil to the engine counter rod drive bearings if the counter is connected.

### 3 20 minutes before first start

1. **Top Gallery:** The catchment dish reservoirs at the top of the valve push rods should be flooded so that lube oil starts to drain down to the rod's bottom bearings before the engine begins to rotate.
2. **Top Gallery:** Top up each of the reservoirs on the outer end of the valve levers to their discharge pipe.
3. **Top Gallery:** Open the lube oil system's main isolating valve so that the Driver can get oil flowing to each of the "Aquariums" sat on top of the crankshaft main bearings and oil is available to fill the bevel gear box.
4. **Top Gallery:** Check that the needle valves (colour coded blue) supplying the small square cups on each valve spring cover are fully closed (3 pairs at the front and one pair at the rear on the intermediate cylinder). Top up all of the small square cups using the oilcan. Note: very little oil is consumed through all of these square cups so they should only be replenished manually to prevent oil spillages.
5. **Receiver gallery:** The crosshead pin bearings and slides should be flooded before start-up. Ask the driver to rotate the engine if necessary.
6. **Receiver gallery:** The connecting rod reservoirs at the top of the little ends (providing oil to the big end bearings) should be filled to the overflow pipe. Ask the driver to rotate the engine if necessary.
7. **Cam gallery:** Use a torch to check if oil has been retained in the bevel gear box on the lay-shaft drive at the cam-boxes level. Top up if necessary.

### 4 5 minutes before each start

BE AWARE-when cool or cold, the oil will take far longer than you imagine to percolate down from the needle valve racks even though the pipes are open ended. Also note that when cold, oil will flow from the needle valves very slowly and valves may require to be opened a little to achieve the correct flows. These are as follows:-

**Red Banded Needle Valves:** From a dripping condition, open each valve slowly until a continuous flow is just maintained

**Unbanded and Yellow Banded Needle Valves:** Set the valves to drip at approximately 2-3 drips per minute

Initially, primary attention must be given to the flows to the cross slides and connecting rod bearings on each cylinder, as these are critical load bearing points as soon as the engine is started. These are marked on each cylinder's needle valve rack by red bands (X-Head Slides, X-Head Pin and Crank-Pin, Roller spindles, Top Gear Case, Cross Head Pins).

1. **Top Gallery:** Open the needle valve racks isolating cocks (3 front and 1 rear). Check and set flows as detailed above; leave blue coded needle valves closed (item 3.4 above)
2. **Cam gallery:** Open the needle valve racks isolating cocks (3 front and 1 rear). Check and set flows as detailed above.
3. **Cam gallery:** Open the lower gearbox cock teed off the HP rack inlet pipe that feeds oil to the cam-shaft gearbox at the crank-shaft level. NOTE: THIS ITEM IS EASILY MISSED !!

4. **Cam gallery:** Apply oil to the reservoir on top of the sheet metal housing covering the drive-shaft coupling on the right-hand side of the LP cylinder cam unit. The drive-shaft couplings between the IP cam unit and gearbox and on the gearbox and HP cam units that have open topped oil-cups on them and do not need routine lubrication, once a running session is sufficient.
5. Advise the Driver when the lube systems have been prepared and functioning so he can proceed with the engine start-up.
6. If the engine start is delayed then carefully monitor the oil levels in the top tank and top up if necessary using the electric pump(s).

## 5 Running phase

Keep a close watch for any overflows from the needle valve distribution racks, and cam-box oil cups as these can run down the rack's pipe-work, cam-box and steam valve casing to eventually drip through to the next floor. Reduce flows as necessary to prevent overflows.

When the engine is running and stabilised, the needle valve oil flows on the various racks can be normalised as appropriate for the duties of each feed line. As systems prime up it will be possible to reduce most of the flows to just regular drips.

1. **Top Gallery:** During the first 10 Minutes of engine running keep a very close watch on the oil level in the engine's top tank and ensure the level is being restored by the engine's mechanical pumps. Do not let the oil level of the top tank fall below about 8 inches from the bottom of the gauge glass. If it does, stop the engine and replenish the tank level by use of the electric pump. Do not attempt to introduce new oil into the system by running the DC electric transfer pump when the engine is running, this will overwhelm the return pipe flooding the top floor and dripping down through all other floors to the basement.
2. **Top Gallery:** Check periodically that the level in the head-tank at the top of the engine is at least three-quarters full and being maintained by the mechanical pumps in the basement. Check red banded needle valve have a just continuous flow. Check for needle valve cups that are overflowing and reduce the drip rate accordingly.
3. **Top Gallery:** Check periodically that the small square cups on the valve spring covers are full and top up if necessary using the oil can.
4. **Receiver gallery:** Periodically verify that the cross-head slides are receiving oil at their tops and that it is not excessive.
5. **Receiver gallery:** Monitor that a more than adequate oil flow is reaching the crankshaft bevel gearbox because if not, the gears will be running dry and noisy.
6. **Receiver gallery:** Also verify that oil is discharging from each cylinders cross-head bearing lubricator that operates when the cross-head strikes the lubricator at the top of each stroke of the engine causing an oil discharge into the funnel feeding oil to the connecting rod reservoirs.
7. **Receiver gallery:** Periodically check with a torch that, where visible, oil is reaching the various lower valve rod lever bearings.

8. **Cam Gallery:** Periodically check that the needle valve oil flows are sufficient. Pay particular attention to those that need a steady flow (i.e. those marked with a red band). Check for needle valve cups that are overflowing and reduce the drip rate accordingly.
9. **Cam Gallery:** Periodically check the cups on the camshaft assemblies that are fed by the yellow coded needle valves. If the cups are partly full or full the relevant yellow coded needle valve should be fully shut. If, on subsequent checks, any of the camshaft cups have emptied, the corresponding yellow coded needle valve should be reopened to a slow drip.
10. **Cam Gallery:** Periodically check that the T&K lubricator sight-glasses are performing correctly. A sight-glass full of steam-oil indicates that the outlet pipe-work is blocked somewhere in the system.
11. **Driving Floor:** Check that oil can be seen seeping from around the HP and LP connecting rods bottom bearings and from the adjacent tail pipe verifying that lubrication is present and adequate. On the IP only the tail pipe will be visible.
12. **Driving Floor:** Periodically check that oil is reaching the teeth of the engine's crankshaft bevel gearbox next to the flywheel. The gearbox has an inspection lid on top and with care and by use of a torch the outflow can be seen.
13. **Ram Floor:** Check that the three oil points on the HP Auxiliary Beam are receiving oil.
14. **Basement:** Check the basement tank periodically to ensure oil is returning by looking inside the tank top to make sure that the pump body/ inlet filter are covered. The small mechanical pump's discharge pressure on the gauge above it should be showing 30 p.s.i. or more.

## 6 Shutdown Phase

It is advisable to leave the needle-valve settings where they are in preparation for the next engine run.

1. During short engine shut-down periods (less than 10 minutes) close each of the needle-valve rack isolating valves to prevent loss of level in the top tank.
2. During longer engine shut-down periods close the rack isolating valves and the top lube-tank tank isolating cocks.
3. At the end of the day close the rack isolating valves and the top lube-tank isolating cocks. Switch off the oil pumps. Return key no 2 to the basement keybox.

## 7 Prolonged shutdown

If the engine is to be shut down for a prolonged period (eg after a Sunday run) then the oil system should be drained to prevent bacterial growth.

1. Close each of the needle-valve rack isolating valves; fully open the inlet valve and one dripper in each of the aquarium.
2. When the main tank is 1/3<sup>rd</sup> full or less, drain the top tank into the main tank via the fied pipe and drain valve (this should allow draining at a slow rate). Caution; a fast flow from the top tank may cause an overflow.