MACHINE: L865, Lx865, Lx885, Lx985 Skid Steers

SUBJECT: Emissionized Engine Timing With LUCAS Fuel Injection Equipment

12/99 - I6

INFORMATION

The pump-to-engine relationship is accomplished by precisely timing the engine and the fuel injection pump separately, and then installing the fuel injection pump onto the engine.

NOTE: The pump timing cannot be adjusted once the pump is installed on the engine.

INSTRUCTIONS

This bulletin is divided into six (6) sections and you need to perform only those sections as needed based on your requirements. It is beneficial to read the entire document before proceeding with any one section.

1. Removing Injection Pump
2. Timing the Engine
3. Alternate Engine Timing Procedure
4. Bench Timing and Locking Fuel Injection Pump
5. Verifying Fuel Pump Timing to Engine Timing
6. Installing the Fuel Injection Pump

REMOVING INJECTION PUMP

NOTE: It is not imperative that the engine be spotted on the approximate location of fuel injection timing. When it is, the access to the pump mounting bolts can be achieved by using a socket through the holes in the fuel pump drive gear.

Set the engine close to the proper timing mark for your machine.

Remove the timing gear cover. This will expose the pump gear, and the pump mounting bolts will be accessible through the openings in the pump gear.

Remove the pump gear nut and washer. Use a gear puller to free the gear from the pump shaft.

Remove the high and low-pressure fuel lines, throttle rod, and electric fuel shut-off wire connector. Plug exposed openings to keep out dirt.

Loosen the mounting bolts and remove the pump. (On 3-cylinder engines, the starter must be removed before the fuel injection pump can be removed).

TIMING THE ENGINE

Locate the timing mark cover over the flywheel, loosen, and swivel it aside.

NOTE: If the timing hole is not accessible, see "Alternate Timing Method" following this section.

Use a breaker bar or long wrench to turn the engine clockwise (viewed from the water pump end) until the #1 cylinder is on compression stroke. To determine if #1 is on compression, remove the rocker cover and observe the valves and rocker arms of the #1 cylinder while rotating the engine. Rotate the engine in direction of normal rotation, until the exhaust valve begins to close.

When the exhaust valve is nearly closed, the intake valve begins to open. This is Top Center (TC) for the exhaust stroke.

NOTE: It is helpful to mark the flywheel or pulley with chalk and then continue to rotate the engine clockwise. Move it one full turn 360° minus the degrees of advance for your engine. This positions the #1 piston to nearly the proper advance position for fuel injection timing.

Align the specified timing mark on the flywheel precisely with the pointer.

NOTE: Most engines will have a series of marks with degree numbers showing. Some engines may have no timing mark and others may have only one timing mark at their specified timing positions, such as 28° or 29° BTDC. If no marks are found, use "Alternate Engine Timing Procedure" section.

ALTERNATE ENGINE TIMING PROCEDURE

NOTE: Use this method when no timing marks are available, or when the access window is inaccessible.

Remove the rocker cover and observe the valves and rocker arms of the #1 cylinder while rotating the engine. Rotate the engine until the exhaust valve moves fully open and then begins to close.

When the exhaust valve is nearly closed, the intake valve begins to open. This is Top Center (TC) for the exhaust stroke.

Mark the flywheel or pulley with chalk and continue to rotate the engine clockwise. Move it one full turn 360° minus the degrees of advance for your engine. (For example, 360° minus 28°, or a turn of 332°). This positions the #1 piston near the timing mark of 28° or 29° before TDC. Remove the rocker arm and shaft assembly and set it aside.

Use a suitable valve spring compressor to remove the valve keepers from either the intake or exhaust valve on the #1 cylinder. This allows the valve to drop slightly. Lightly tap the end of the valve with a soft mallet to be sure that the valve is against the piston and not resting on carbon buildup.

Set a dial indicator over the valve stem and set it to zero. Turn the engine clockwise, then counterclockwise, moving several degrees each direction. Reset the dial indicator to zero, with the valve stem at its highest observed point.

Turn the engine opposite normal rotation until the valve lowers and the dial indicator reads at least 12.52 mm (0.500″).

Next, slowly rotate the engine in the direction of normal rotation until the indicator shows the correct measurement for your engine, as indicated under the heading of "#1 Piston Drop" specified in Pump Timing Degree Chart below.

PUMP TIMING DEGREE CHART

Cylinder	Basic Timing	Pump Lock Degree	#1 Piston Drop
3	29° BTDC	340°	7.59 mm (+/-) 0.025 mm (0.299″ (+/-) 0.001″)
4 N/A	29° BTDC	29°	10.39 mm (+/-) 0.025 mm (0.409″ (+/-) 0.001″)
4 T/C	28° BTDC	29°	10.54 mm (+/-) 0.025 mm (0.415″ (+/-) 0.001″)
6	28° BTDC	40°	10.67 mm (+/-) 0.025 mm (0.420″ (+/-) 0.001″)

Without additional rotation of the engine, install the locked, pre-timed fuel injection pump (see "Installing the Fuel Injection Pump").

After the fuel injection pump is installed, rotate the engine in the direction of normal rotation until the dial indicator reads zero. Remove the dial indicator set-up. Position the valve spring, guide, and keepers in place over the valve stem. Compress the valve spring and fully seat the keepers into the groove in the valve stem.

Reinstall the rocker arm and shaft assembly. Tighten the bolts to the proper torque and verify the rocker arm and valve clearances for your engine. Turn the engine at least two full revolutions to ensure that all valves open and close fully.

Reinstall the rocker cover with its gasket. Tighten the rocker cover bolts to 20-27 N·m (15-20 ft. lbs.).

BENCH TIMING AND LOCKING FUEL INJECTION PUMP

Tool Required: NH01384 Timing Gauge (consists of NH01341, NH01342)

Unlock the pump by loosening the locking screw.

Install a key, part #74145S, into the slot in the fuel injection pump drive shaft.

Place the small adapter (gear), part #PD67/3, onto the shaft. Guide the key through the slot to make sure the adapter is properly aligned. Use the lock washer, part #D8NN9G593AA, and nut, part #D8NN9N904AA. Hold the adapter counterclockwise while tightening the nut to 27 N·m (20 ft. lbs).

Place the guide, part #MS67B/8, over the shaft and pilot area of the pump housing, followed by the protractor assembly.

NOTE: Preset the protractor to the degree mark specified for your engine.

PUMP TIMING DEGREE CHART

Cylinder	Basic Timing	Pump Lock Degree	#1 Piston Drop
3	29° BTDC	340°	7.59 mm (+/-) 0.025 mm (0.299" (+/-) 0.001")
4 N/A	29° BTDC	29°	10.39 mm (+/-) 0.025 mm (0.409" (+/-) 0.001")
4 T/C	28° BTDC	29°	10.54 mm (+/-) 0.025 mm (0.415" (+/-) 0.001")
6	28° BTDC	40°	10.67 mm (+/-) 0.025 mm (0.420" (+/-) 0.001")

Place the protractor on the adapter and into the support. The marker (pointer) should be extended to allow maximum visibility of the pump timing mark in the pointer slot.

Rotate the pump until the timing mark on the pump flange is centered in the marker (pointer) slot.

Lock the pump shaft as follows:

1. Loosen the locking screw, remove or realign the washer so the large hole aligns with the shoulder of the screw, then retighten the screw against the pump shaft to 41 N·m (30 ft. lbs).

   NOTE: Verify that the pointer still aligns with the pump timing mark.

2. Remove the timing tool, nut, and lock washer adapter gear and key from the fuel pump shaft.

   IMPORTANT: Remember to remove the key from the pump.

3. Install the pump on the engine following instructions under the section "Installing the Fuel Injection Pump."

VERIFYING FUEL PUMP TIMING TO ENGINE TIMING

Tool Required: NH01384 Timing Gauge (consists of NH01341, NH01342)

Precisely set the engine on its basic timing mark (see chart).

Lock and remove the pump (see "Removing the Injection Pump").

Install a key, part #74145S, into the slot in the fuel injection pump drive shaft.

Place the small adapter, part #PD67/3, onto the shaft in alignment with the key. Use the lock washer, part #D8NN9G593AA, and nut, part #D8NN9N904AA. Hold the gear counterclockwise to prevent the pump from rotating while tightening the nut to 27 N·m (20 ft. lbs).

Place the guide, part #MS67B/8, over the shaft and pilot area of the pump housing.

PUMP TIMING DEGREE CHART

Cylinder	Basic Timing	Pump Lock Degree	#1 Piston Drop
3	29° BTDC	340°	7.59 mm (+/-) 0.025 mm (0.299″ (+/-) 0.001″)
4 N/A	29° BTDC	29°	10.39 mm (+/-) 0.025 mm (0.409″ (+/-) 0.001″)
4 T/C	28° BTDC	29°	10.54 mm (+/-) 0.025 mm (0.415″ (+/-) 0.001″)
6	28° BTDC	40°	10.67 mm (+/-) 0.025 mm (0.420″ (+/-) 0.001″)

Loosen the marker (pointer) and place the protractor on the adapter and into the support. The marker should extend to allow maximum visibility for the pump timing mark in the slot.

Slide the pointer holder and bar until it aligns with the timing mark on the pump flange.

Compare the reading on the tool with the timing for your engine in the chart above.

If the reading and the chart are the same, the pump is properly timed for your engine.

If the reading differs from the chart, the pump is out of time. Follow the procedure in "Injection Pump Lock Timing" to retime the pump. Each degree the pump varies from the proper timing equals two engine degrees of timing.

INSTALLING THE FUEL INJECTION PUMP

IMPORTANT: Clean the fuel injection pump drive shaft taper of all residual oils and lubricants, as well as the taper in the fuel pump drive gear. Use a non-residual solvent. This is to prevent possible drive gear slip when in operation.

Place the locked, pre-timed fuel injection pump on the engine. The mounting bolts install from inside the front cover. Two thread into the pump flange, while the third uses a nut on the outside of the pump flange. Tighten to 20-25 N·m (15-18 ft. lbs.).

IMPORTANT: Position O ring, part #14437585, on each mounting bolt before inserting it through the mounting holes. Failure to install fresh O rings on the bolts may allow engine lubricant to leak out.

Place the washer and start the retaining nut onto the fuel injection pump drive shaft.

Hold the gear counterclockwise (viewed from front of engine) to take up any backlash between the pump gear and idler gear. While holding the gear, tighten the nut to 82 N·m (60 ft. lbs).

Unlock the fuel pump by loosening the lock screw and realigning the washer so that the small opening is under the screw shoulder. Retighten the lock screw to 11-13 N·m (8-10 ft. lbs). Do not overtighten.

Reinstall all fuel lines, tubing, access covers, and other hardware that was removed during service. Use gaskets, as specified, and tighten all hardware to the specified torque values.

Prime the fuel system and start the engine. Inspect the fuel system and repair any leaks.

NOTE: Always run the engine and inspect all connections and components to be sure they function properly before returning the unit to service.

Return the vehicle to service or customer.

WARRANTY STATUS

For information only.

02/22/18/26