

'97 Dodge Ram Diesel CTD Injection Pump Timing Adjustment and Valve Lash Adjustment Procedures:

Injection pump timing procedure involves 2 processes: 1) Determining true TDC of #1 cylinder and marking harmonic balancer accordingly, and 2) Checking/adjusting amount of #1 injection pump delivery lift at TDC of #1 cylinder. In other words, at TDC, 14° timing equates to 4.5mm, or 0.17717" lift of #1 pump delivery. This will be explained in the timing procedure.

Finding TDC Process is as follows:

Initially, since the timing pin in timing gear cover can be off by a degree or more due to slop, it cannot be relied upon as true TDC. To find true TDC on compression stroke of #1 cylinder, refer to the following steps:

1. Remove the #1 valve cover (15mm socket), which is the nearest to front of engine. From front of engine towards the rear, cylinders are numbered 1,2,3,4,5,6, and are arranged, from front to rear, I,E, I,E, I,E, Etc.
2. Turn over engine manually with alternator pulley (backward, counter clockwise as viewed from front) to valve overlap of cylinder #1(intake closing, exhaust opening) (22mm or 7/8" socket on 1/2" drive with breaker bar). This will position #6 cylinder close to TDC.
3. Make a temporary mark on harmonic balancer and manually turn engine forward (clockwise as viewed from front) 180 degrees using harmonic balancer bolt (15mm socket on 1/2" drive with breaker bar) from under engine.
4. Loosen #1 cylinder exhaust valve adjuster and remove all lash clearance (14mm and reg. screwdriver)
5. Crank in exhaust valve adjuster 2 full turns (screwdriver)
6. Manually turn engine backwards until it stops. Also, had dial indicator positioned on #1 exhaust valve and noted valve beginning to close and then piston coming up started to raise valve just prior to engine not moving any further. You can use engine stop as reference or dial indicator just starting back up, but whatever method you use here, be sure to use same method in step 8.
7. Mark harmonic balancer with white fine paint line. I also painted white line to highlight the right corner edge of the crank sensor to use as a pointer.
8. Manually turn engine forward until it stops. Also, had dial indicator positioned on #1 exhaust valve and noted valve beginning to close and then piston coming up started to raise valve just prior to engine not moving any further.
9. Mark harmonic balancer again

10. Measure the distance between the two lines (was 1-13/32") and mark the new line between the two original lines, which is actually TDC of #1 cylinder. In this case it was 45/64". Rub off the original 2 lines and leave only the TDC line.

11. Reset exhaust valve lash (.020" feeler gauge, 14mm and screwdriver)

Injection Pump Timing Procedure:

1. Remove valve cover and smaller covers to access valve rocker arm assembly. Manually turn over the engine in reverse rotation (CCLK) with a 7/8" socket, 1/2" drive, on a long extension bar on the alternator pulley. To turn engine over in normal rotation (CLKwise), use one of the vibration damper 15mm bolts from under engine.
2. Find #1 cylinder TDC reasonably close by using the crossover method (to locate TDC of #1 cylinder, watch #6 cylinder valves until they are at crossover where one rocker going up and the other going down at the same time with exhaust valve almost closed and intake valve just starting to open). This is called the companion cylinder method. Then rotate the engine backwards (CCLK) about 1/4 revolution and then rotate engine forward so TDC marks (damper and cover/indicator) line up. You are now at true TDC of #1 Cylinder compression stroke.
3. Remove #1 fuel injection line from the fuel injection pump (Figure 4), using 7/8" open end wrench.

Cautions:

Blow out all residue from around #1 delivery valve assy. to ensure that no debris enters the injection pump when delivery valve is out.

Do not bend the fuel line. Bending the line will cause line or injector failure. Instead, follow #1 fuel line and loosen the 2 fuel line brackets that house several lines to allow you to be able to raise and tie off the #1 fuel line so delivery valve can be removed.

4. With the engine at TDC, loosen but do not remove, the front #1 delivery valve holder using special socket, Snap-on tool number SP503, Figure 5).

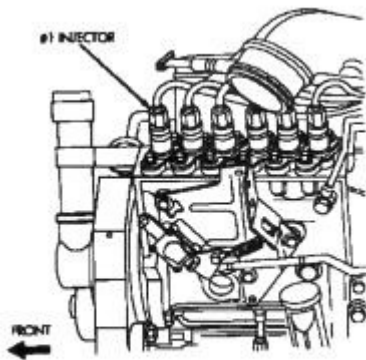


Figure 4

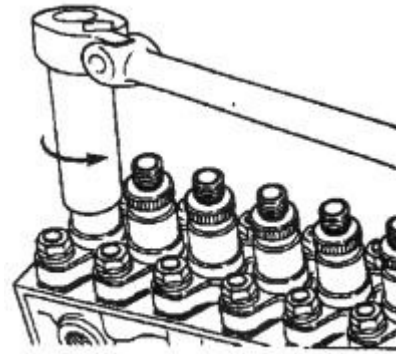


Figure 5

Note: There is an external O-ring on the holder to help prevent debris from getting into the pump. This may create a slight resistance as the holder is unscrewed.

5. Remove the delivery valve holder by carefully tipping the holder outboard with one hand while using your other hand to hold the spring, fill piece, and any shims from slipping out of the holder. Place these as an assembly on a clean surface out of the way (Figure 6).

6. Using a magnet, remove the two piece delivery valve assembly from the pump. Place these pieces on the clean surface with the delivery valve holder (Figure 7).



Figure 6

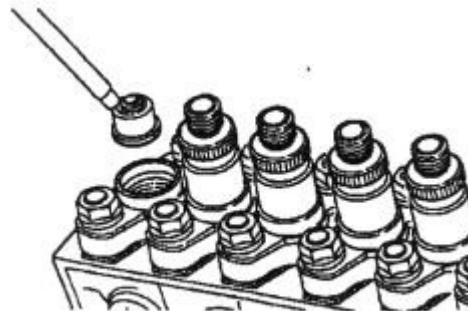


Figure 7

7. Using a pick, remove the copper delivery valve washer from the top of the pumping element. Be careful not to scratch the top of the plunger/barrel assembly during this process. Discard the used delivery valve washer. A new washer, P/N 4778483, will be used during reassembly (Figure 8). NOTE: May not necessarily want to remove washer unless it is loose and may hinder dial indicator setup.

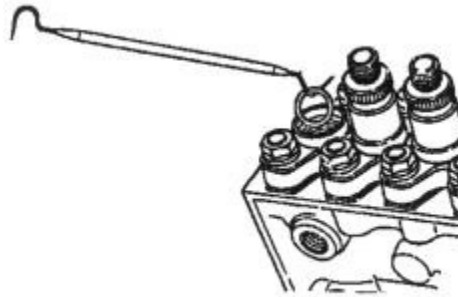


Figure 8

8. Install the dial indicator adapter, Miller P/N 6842, in place of the #1 delivery valve holder and tighten finger tight. NOTE: I used magnetic dial indicator assembly and set the magnetic base on right side of valve manifold, with one arm going to right and the other coming back to left that housed the indicator.

9. If using Miller or Snap-on dial indicator, loosen the set screw on the dial indicator adapter and install the dial indicator, Miller P/N 6859, into the adapter. Position the dial indicator to read between 7.0 and 9.0 mm and tighten the set screw (Figure 9). **NOTE:** If using US magnetic dial indicator assy., set up accordingly to read between 0.276" and 0.355".

10. Using the alternator nut, rotate the engine backwards (counter clockwise) 1/4 turn or until you see the dial indicator reading stop dropping. This is the inner base circle of the injection pump cam. Zero the dial indicator after tapping the dial indicator plunger shaft on the top to ensure the dial shaft is seated at the lowest point on top of the plunger as it is not flat.

11. Rotate the engine clockwise slowly to TDC. Note the pump lift setting on the dial indicator. Factory setting is 14° BTDC, indicated by plunger lift of 4.5mm (0.177165"). Refer to following table for P7100 injection pump lift timing settings:

Static injection timing degrees BTDC	Lift in inches and mm
13.5°	0.17323", 4.4mm
14° (Factory Setting)	0.17717", 4.5mm
14.5°	0.18110", 4.6mm
15°	0.18504", 4.7mm
15.5°	0.18898", 4.8mm
16° (New setting)	0.19291", 4.9mm

12. If a change in injection timing is required, remove the oil filler tube and adapter elbow from the front of the gear housing. Unscrew the tube from elbow first; then unscrew the elbow from the timing gear cover to expose the gear.

13. Manually rotate the engine backwards (CCLK) until the pump plunger is at its lowest point. Place a pencil magnet on the end of the shaft (fig. 11) and remove the shaft nut and washer and pull the gear with gear puller or steering wheel puller (see figure 12 for gear pulling and figure 13 for using barring tool to keep engine from rotating). Reasoning is to not

pull the gear where you are trying to set the timing at TDC as the shock can cause the pump to move. Once the gear is pulled, shoot brake cleaner between the shaft and the gear liberally; then use compressed air to dry it (use a single puller bolt screwed into one of the holes in the gear to move the gear front to back while shooting cleaner and air). Do this about 3 times to ensure that any oil that seeps in between after the gear is pulled will be cleaned and completely dry. This is a critical step in ensuring gear does not slip after being tightened on the shaft after timing is set. Once nut and washer removed, from puller kit, install a thrust washer, bearing and another washer on gear shaft. This will prevent gear from turning on shaft when tightening nut. Now install nut back on shaft; allow clearance between thrust washes and bearing but do not tighten nut at this time. Use puller to remove gear.

CAUTION: If the input shaft nut and washer are removed, without using a magnet, the nut or washer may drop down inside the timing gear cover, requiring significant disassembly of the engine in order to recover them.

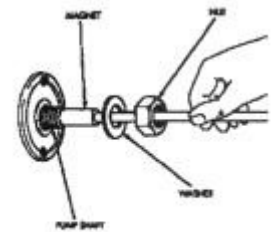


Figure 11

14. Position pencil magnet against shaft and reinstall the gear lock washer and nut and snug to about 5'-10' lbs., which will be enough to hold it. Slowly rotate the engine clockwise until reaching the required lift setting on the dial indicator. The injection pump should rotate with the engine since the pump gear is still locked to the injection pump shaft. Use pencil magnet again and remove lock washer and lock nut and pull the gear; the shock will be much less and the pump may not move at all. Rotate back before TDC about 20°-30° (fig 13), then up to TDC to remove gear backlash. It won't hurt to repeat backing engine up and forward to TDC to absolutely guarantee all gear backlash is removed. Can also shoot brake cleaner between shaft and gear again and blow out. Now reinstall the gear, lock washer and lock nut (use pencil magnet against shaft) and snug the nut to about 5' lbs. Can also try using the gear puller bolted to gear, and rotate the pump gear counterclockwise by hand while pushing the gear onto the pump shaft. This will remove backlash between the injection pump and camshaft gears (Figure 14). Rotate engine back to needle zero reading on dial indicator and then forward to TDC to check your setting. If all is still good, torque the gear nut to spec (160' lbs.) and then recheck to ensure nothing has moved.

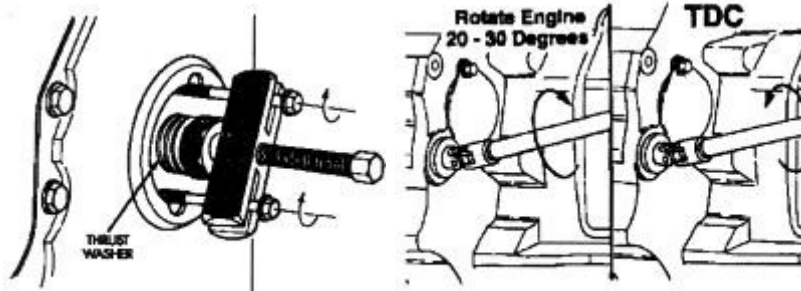


Figure 12

Figure 13

(Another style of gear puller shown in figures 14 and 15 below)

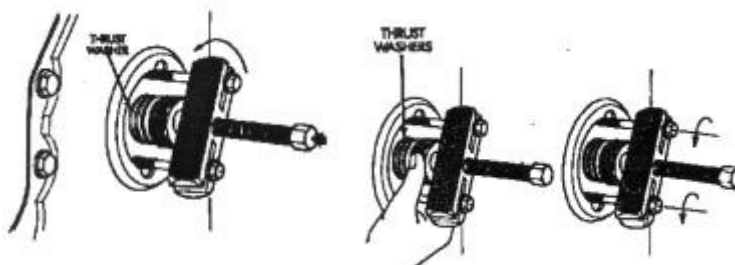


Figure 14

Figure 15

(Figure 16 below depicts torquing to 144' lbs. This spec has been changed to 160' lbs.)

15. Remove the dial indicator and adapter from the injection pump.

CAUTION: The following installation and torquing procedure must be followed exactly. Improper installation of the delivery valve will result in damage or leaks.

16. Install a new copper delivery valve washer, P/N 4778483, into the fuel pump.

17. Install the delivery valve assembly on top of the sealing washer (Figure 17).

NOTE: The two pieces of the delivery valve **must** be assembled as shown in Fig 17.

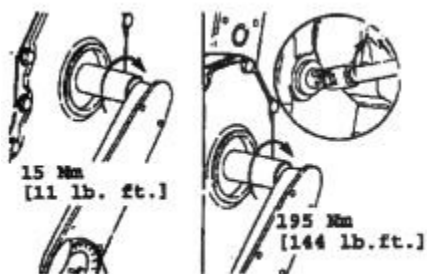


Figure 16

Figure 17

18. Lubricate the threads and clamping surface of the delivery valve holder with a few drops of SAE 90 hypoid gear oil. Do not lubricate the copper delivery valve washer or its seating area.

19. Install the delivery valve holder assembly taking care not to displace the delivery valve spring, fill piece, or any shims (Figure 18).

NOTE: The delivery holder **must** be assembled as shown in Fig 18.

20. Pre-torque the holder to 40 NM (29 lb. ft.). **Next, in one motion, torque the holder to 115 NM (85 LB. FT.).** (Figure 19).

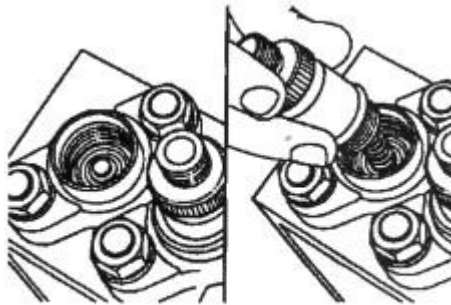


Figure 18

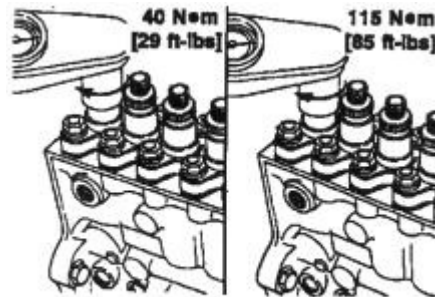


Figure 19

21. Install remaining engine components removed during the timing process. Leave the injector side of the #1 high pressure fuel lines loose to facilitate 'bleeding' the air out of the system.

CAUTION: The pressure of the fuel in the line is sufficient to penetrate the skin and cause serious bodily harm.

22. Crank the engine until fuel is observed at the #1 injector. Tighten the high Pressure line at the injector. Start the engine and check for leaks.

Valve Adjustment Procedure – Valve clearance should be adjusted when the engine is cool (70° recommended). Intake valve clearance=0.010"; Exhaust valve clearance=0.020". Service interval: 24,000 miles.

- A. Manually turn over the engine in reverse rotation (CCLK) with a 7/8" socket, 1/2" drive, on a long extension bar on the alternator pulley. To turn engine over in normal rotation (CLKwise), must use one of the vibration damper 15mm bolts from under engine. Oil the valve cover bolts when removing to ensure o'rings well lubed so they can be reused. In relation to valve cover gasket, when you install it on the cover, make sure you have the thick part of the gasket towards the engine. The gasket slips over the edge of the cover and the thickest side should be towards the engine block. There is also a front to back position as well, but it is marked on the gasket.
- B. To locate TDC of #1 cylinder, manually turn engine backwards (counterclockwise) with alternator bolt and watch #6 cylinder valves until they are at crossover (one rocker going up and the other going down at the same time with Exhaust valve almost closed and Intake valve just starting to open). This is called the companion cylinder method. With #1 cylinder at TDC, adjust the following valves: #1:I&E; #2:I; #3:E; #4:I; #5:E. Adjust intake valves for 0.010" clearance and exhaust valves for 0.020" clearance. Tighten the lock nut, torque to 18 ft.lb. and check the valve lash again. When the feeler gauge slides between the valve stem and the rocker lever with "some" resistance, the clearance is correct.
- C. Now rotate engine crankshaft 360° (crankshaft rotates 2 revolutions for each engine complete cycle) until #1 cylinder valves are at crossover (one rocker going up and the other going down at the same time with Exhaust valve almost closed and Intake valve just starting to open). #6 cylinder will now be at TDC. Adjust the following valves: #2:E; #3:I; #4:E; #5:I; #6:I&E.