

# Denso CRD Injectors: Toyota 1KD-FTV

2005 - 2018 Hiace  
 2005 - 2015 Hilux  
 2006 - 2015 Prado



The 3.0L 1KD-FTV turbo common rail diesel engine has gone through a few revisions since its introduction to Australia in 2005. This article will cover the injectors, which is one of the areas that is catching many technicians out, as they assume that all 1KD-FTV engines are the same, which is not the case.

## Injector Operation

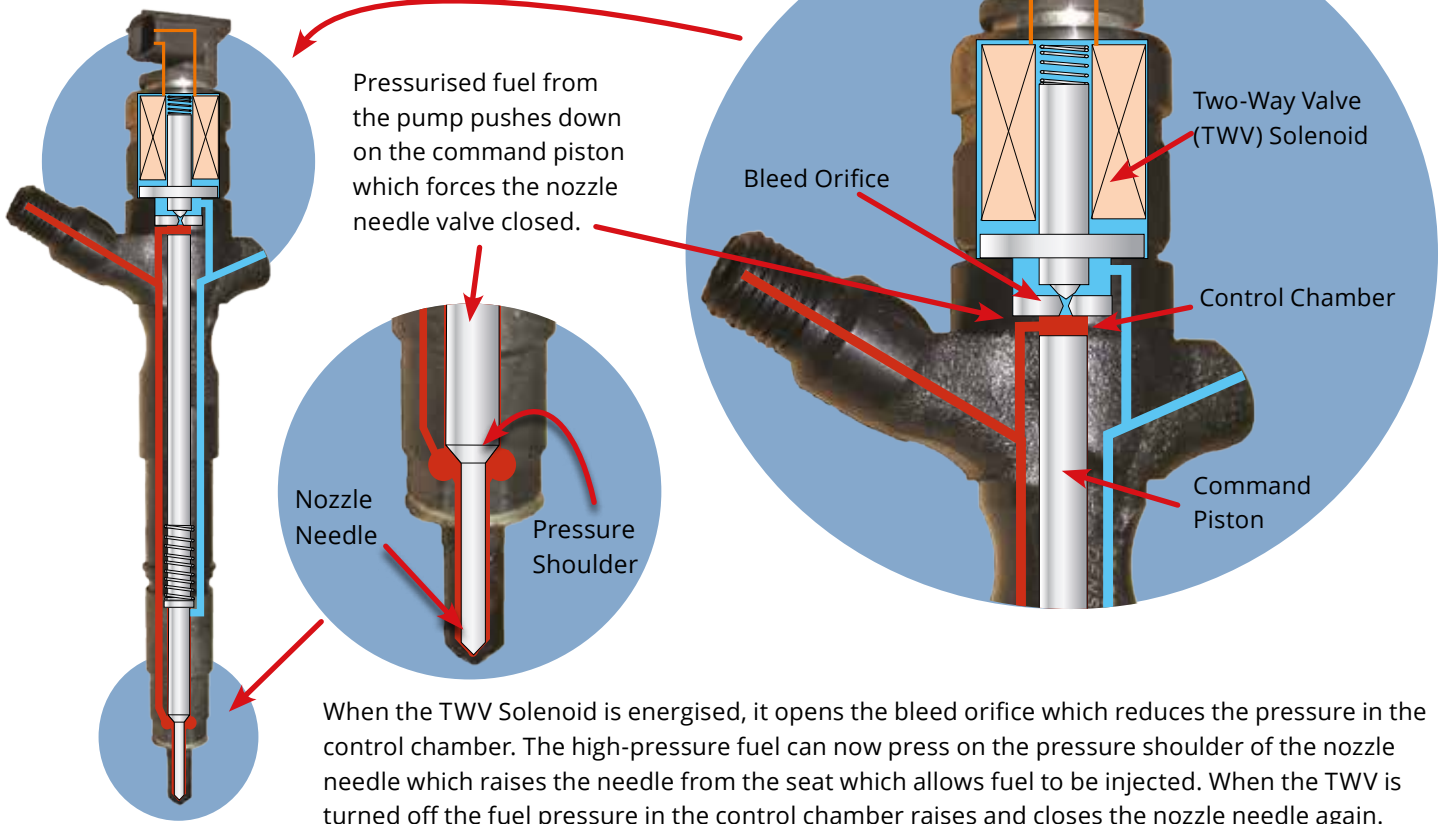
The 1KD-FTV uses the Toyota D-4D System which stands for "Direct Injection 4 Cylinder Common Rail Diesel Engine" of which the main components (pump and injectors) are supplied by Denso. Below is a basic overview of the injector, and its operation which is similar to other common rail systems.

When the engine is running high-pressure diesel is constantly supplied to all the injectors via the common fuel rail. Unlike diesel engines of the past, a solenoid or piezo-actuator along with the high-pressure diesel is ▶

Diagram #1

### Basic Operation of the Denso CRD Injector

⚠ High Pressure    Return    Wiring



used to open and close the injectors to allow a more accurate delivery of fuel into the combustion chamber.

The high-pressure fuel that enters the injector is split in two directions. Some is directed down to the nozzle and the majority is sent to the control chamber. The actuator circuit is used to alter the pressure between the control chamber and the nozzle, therefore, allowing the

opening and closing of the injector for fuel delivery. **See Diagram #1**

As these injectors are computer controlled, it is now possible to have multiple injection events for one combustion cycle which greatly increases output and efficiency of the engine. To overcome the high fuel pressures present, and to operate fast enough for the multiple injection

events to occur, common rail system injectors require high voltage and a current control mechanism to operate effectively.

As a result, the ECU uses an Electronic Driving Unit (EDU), which generates approximately 110 volts and high current to open the injectors. Once open the voltage drops back to 12 volts in a current controlled mode to keep the injector open. As the EDU is a significant contributor to the operation of the injectors its operation should not be overlooked when diagnosing systems. A more detail explanation of its operation is a story for another day.

**See Diagram #2**

To cope with the extremely high pressures, multiple injections per combustion cycle and high voltage and current, modern injectors are built to very fine tolerances, which means small changes can affect ▶

**Diagram #2**

**Injector Driver Unit**

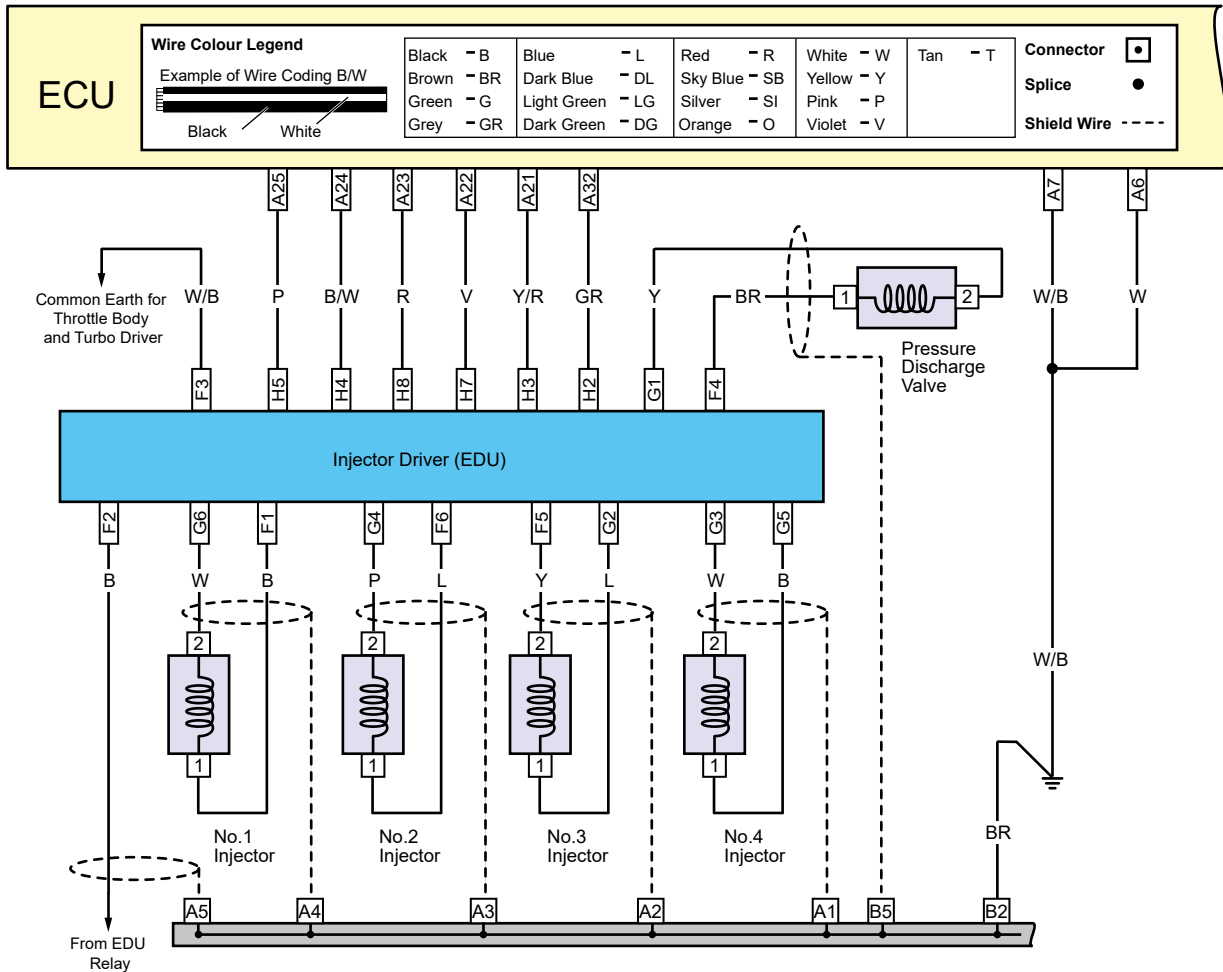
The injector driver is used to raise the voltage and current to allow the injectors to complete multiple injection events for each compression stroke.



**WARNING:** The injector driver can produce dangerous levels of voltage and current.

**Diagram #3**

**2009-2011 Hilux 1KD-FTV Injector Wiring Diagram**



the operation of the common rail systems.

I will now run through the different areas that cause problems.

## Fuel Quality

As stated earlier common rail injectors are working very hard under extreme pressures. Depending on the quality of the fuel that has been used the average life-span of the injectors may decrease. Good fuel quality can see your common rail diesel system continue to operate up to and beyond the expected life of the vehicle.

## Injector Compensation Values

A scan tool's live data can be very helpful in finding the cause of engine trouble. The ECU will tune itself over time to achieve the smoothest idle by increasing or decreasing the amount of fuel injected. Injector compensation values are a guide to potential issues and need to be looked at in conjunction with other data to assess the performance of the injectors.

**NOTE:** Compensation values should only be used as a guide as there are other mechanical variables that can cause them to be out of specification. Some of the main culprits are intake manifolds blocked with carbon and low compression. You should check for these problems first, then move on to the fuel system starting with the suction control valve, then the injectors and high-pressure pump.

## Electrical Problems

As these injectors are electrically triggered, there can be electrical faults which can cause problems. Loose connections and damaged wiring will usually trigger a fault code in the system. The injector solenoid can be checked with the following procedure.

- Turn Ignition OFF.
- Disconnect the harness from the injector.
- Measure the resistance across the injector terminals
- It should be 0.42 -0.52  $\Omega$  at 20°C

## Injector Seals / Washers

When first released the 1KD-FTV engine used copper washers to seal the injectors to the head. Failures in this area would allow combustion gases into the valve cover which would turn the oil into sludge. If left unchecked it has been known to block the oil pickup in the sump and starve the engine of oil, which destroys the bearings. However, the turbo bearings seem to be the first to go.

There has been an updated part for the injector seals. So, if you are replacing the injectors, never reuse the old seals and make sure you are using the updated seals.

Some technicians are inspecting the oil pickups for carbon build up at each service with an endoscope through the sump plug hole, and if it is looking blocked they remove the sump and clean it out and replace the injector seals. If you are replacing the injectors you should check the oil pick up.

### See Diagram #4

Some of the symptoms of this problem are:

- White smoke from the exhaust and engine rattles from a cold start
- Sludgy oil
- Blocked oil pick up

## Injectors Worn: Cold Engine Knock

As the injectors wear through normal operation over the life of the product or have had premature wear through

poor fuel quality they can start to jam the nozzle and command piston when the engine is cold. This will allow an incorrect amount of fuel to be injected. Some of the symptoms of this problem are:

- Loud engine knock when the engine is cold
- Rough idle

## Injectors Worn: Hot Engine Knock

If the clearances inside the injectors become too large, this will also allow excess fuel to be injected

Symptoms include:

- Lack of fuel economy
- Rough idle
- Rough running with low load and engine speed
- Black smoke from the exhaust

**NOTE:** Further diagnosis is required at this point as these are similar symptoms to a cracked piston. Conduct a compression test to confirm.

Once you have completed the above diagnostic checks you should be confident that the injectors are the problem.

## Injector Coding Problems

VACC's Technical Advisory Service has been receiving calls from members that have fitted a set of injectors and they will not code to the ECU. After some interrogation from our Technical

### Diagram #4

#### Oil Pick Up

*If an injector seal fails, it will cause the oil to become sludgy, and it will block the oil pickup. You can check this through the sump plug hole after draining the oil.*



Advisors, the full story comes out. What has happened is that a second-hand set of injectors or an entire second-hand engine has been fitted to a vehicle and the ECU will not accept the codes or if it does the engine is over fuelling or lacking power. This is a common trap as many people assume that all 1KD-FTV engines are the same as parts can be fitted from early to later models. This is an incorrect assumption.

Since this engines introduction it has had to be updated to meet the tighter emissions regulations and one of the ways this has been done is by changing the specifications of the injectors. As you can see in the table, this engine has had to comply with Euro III, IV and V specifications. Each change has brought with it new components and updated systems. **See Diagram #5**

Even though the injectors will look identical they are not interchangeable from one Euro specification to another.

The first piece of advice is, do not fit second-hand injectors as you might be fitting more trouble. New and reconditioned injectors will be sealed, second-hand injectors might have been open in a dusty shed and it only takes a very small amount of contamination to cause problems.

Second, only fit new or reconditioned

injectors which are compatible with the Euro specification of your engine and its ECU. Use the table as a guide for what you have. If your vehicle is close to the changeover date for Euro III and Euro IV it could be either. If the EGR valve does not have coolant pipes it is Euro III, if it does have coolant pipes running to it, then it is Euro IV.

**See Diagram #6**

To be sure, remove one injector and quote the part number which is on the body of the injector to make sure you get the same Euro specification.

**See Diagram #7**

**WORKSHOP TIP:**

It is recommended that you attempt to code the injectors to the ECU before you fit them to the engine. This will save you time and a set of high-pressure pipes if they are not compatible.

**NOTE:** Many suppliers will not accept returned injectors if they have been fitted to an engine.

It is good practice to write the injector codes on a piece of paper in the order you will be fitting them before entering the codes into the scan tool. Human error is also common in failures to code injectors, as the codes are small it is easy to misread the digits and letters (B's and 8's are a common mix up).

**Pilot Quantity Learning**

After the injectors have been fitted and coded to the ECU, the Euro IV and above specification engines will need to go through a separate relearning procedure. Failure to complete this will result in the ECU recording the DTC P1601: Injector compensation code.

1. With a compatible scan tool, under special or guided functions, select "Pilot Quantity Learning" **NOTE:** This is the same for other vehicles with Denso system, Mitsubishi call it "Small Injection Quantity Learning" other manufacturers will have a different variation.
2. With the vehicle in neutral, start the engine and allow it to idle.
3. When operating temperature is reached, select the option to commence the relearn procedure. The "Glow Plug" light on the dash should now be flashing, indicating that the relearn procedure has started.
4. Quickly increase the engine speed to 3000 rpm for 1 second, then allow it to return to idle.
5. Continue to cycle the engine in the above step until the scan tool indicates that learning is complete. **NOTE:** This might take a long time. 30 cycles on average, we have heard that some take over 100 cycles.

6. P1601 can now be cleared.

**Injector Removal**

1. Remove the engine cover.
2. Remove the vacuum hoses and wiring from the MAP sensor.
3. Remove the intercooler.
4. Disconnect the wiring harness from the injectors.
5. Remove components as necessary to gain access to the high-pressure injector pipe at the fuel rail.
6. With a 17mm injector pipe socket ▶

**Diagram #5**

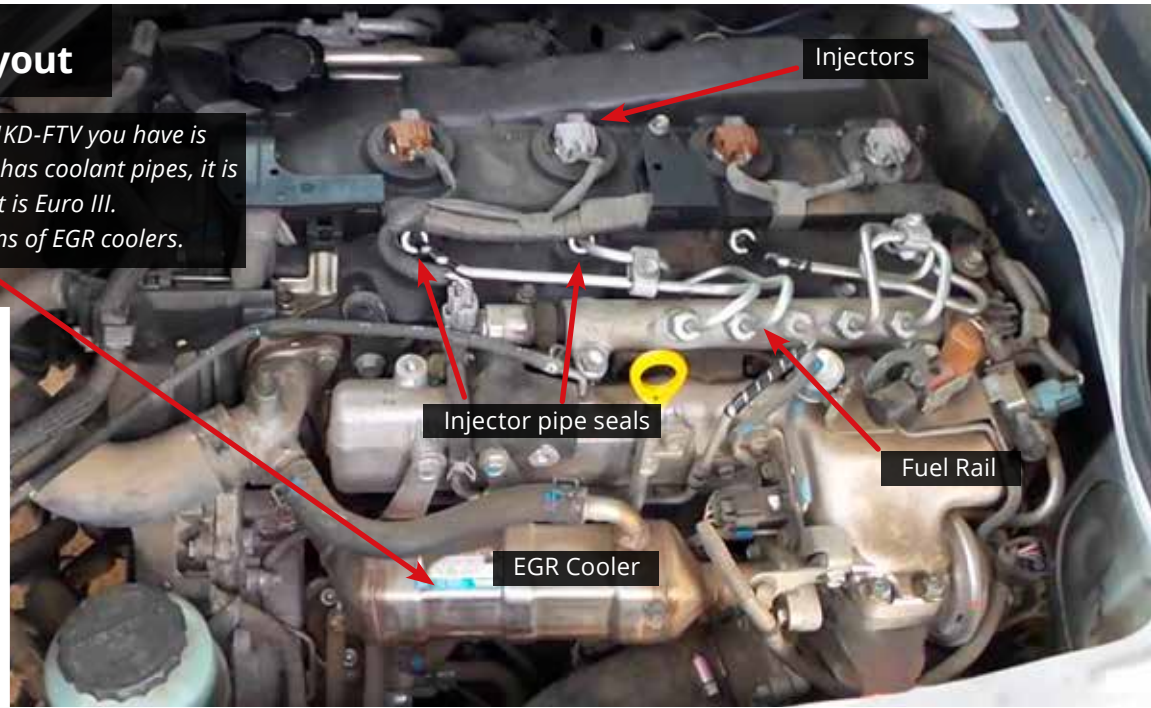
Types of 1KD-FTV engines. Euro Emission Specification

Model	Euro Specification	Year Range	Output
Hiace	Euro III	2006 to 2010	80 kW
Hiace	Euro IV	2010 to 07/2015	100 kW
Hiace	Euro V*	07/2016 to 2018	100 kW
Hilux	Euro III	2005 to 07/2006	120 kW
Hilux	Euro IV	08/2006 to 05/2008	127 kW
Hilux	Euro V*	2009 to 2015	127 kW
Prado 120 series	Euro IV	08/2006 to 11/2007	127 kW
Prado 150 series	Euro IV	2009 to 2009	127 kW
Prado 150 series	Euro V*	2009 to 2015	127 kW

\*NOTE: There is some debate about what is classed as a Euro V spec 1KD-FTV engine. There was a change in injector design in 2009 which some injector re-manufacturers are calling a Euro V spec injector. However, Denso does not agree. They say the only Euro V Hilux and Prado are those fitted with the new 1GD engine. There is a Euro V 1KD-FTV in the Hiace from 2016. Always check the injector part numbers to get the correct injector for your engine and vehicle.

### Diagram #6 1KD-FTV Engine Layout

One way to check what sort of 1KD-FTV you have is by checking the EGR cooler. If it has coolant pipes, it is Euro IV spec. No coolant pipes it is Euro III.  
**NOTE:** There are different designs of EGR coolers.



loosen the high-pressure injector pipes at the injectors.

**NOTE:** Cover the injectors with a rag to prevent fuel from running into the valve cover.

7. Remove the injector pipe brackets that attach to the intake manifold.
8. Remove the high-pressure injector pipes from the injectors

and fuel rail and discard.

**NOTE:** These are single-use items.

9. Using a screwdriver, pry out the four injector pipe seals from the valve cover. **See Diagram #6**
10. Remove all hoses from the valve cover.
11. Remove the valve cover.
12. Remove the banjo bolts from the

injector leak off pipes. Discard the washers.

13. Remove the banjo bolt from the leak off pipe to the head.
14. Remove the bolts from the injector clamps and discard the washers.
15. Remove the injectors. If they are to be refitted record their ▶

### Diagram #7 Injector Part Number Location

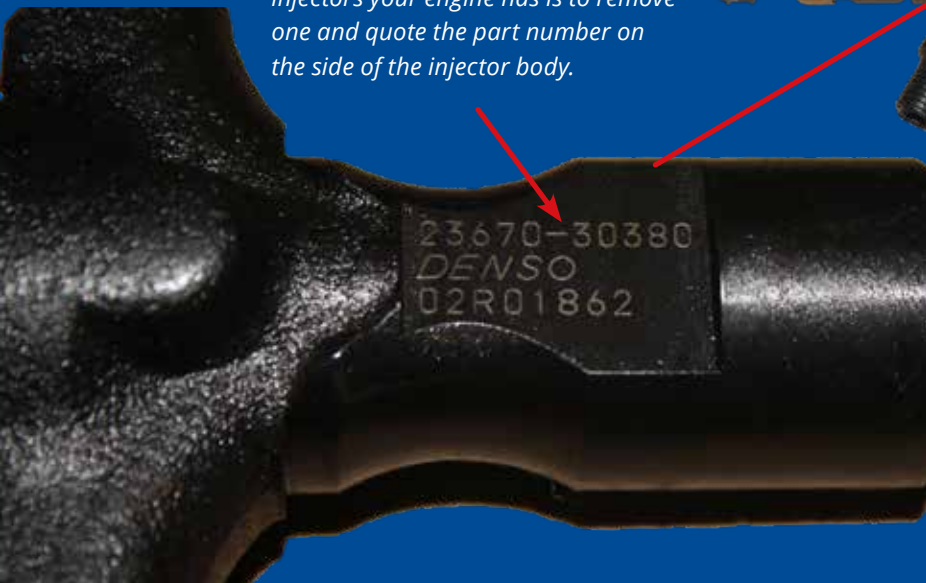
The only way to know for sure which injectors your engine has is to remove one and quote the part number on the side of the injector body.



When ordering parts, you need the following information to get the correct injectors:

1. Make, Model and Year
2. VIN
3. Part Number from the injectors

It is essential to give the correct vehicle details to make sure that you get injectors which are compatible with the ECU in the vehicle. Otherwise, the injectors will not code to the ECU.



original position. **NOTE:** If the injector seal has failed the injector might be stuck in the head due to carbon build up. A puller might be required to remove the injector.

16. Remove all injector seals from the head and discard.

## Installation

**NOTE:** If fitting new injectors, you should code them to the ECU before installation to make sure they are correct for the vehicle.

**NOTE:** If refitting the injectors, be sure to refit them in their original positions otherwise you will have to re-code them to the ECU.

1. Fit new injector washers/seals into the injector hole in the head.  
**See Diagram #8**
2. Fit new "O" rings to the injectors with clean engine oil.
3. Install the injectors into the head in the correct order
4. Fit the leak off pipe to the injectors with new washers on the banjo bolts. Do not tighten fully at this stage.
5. Install the injector clamps and bolts with NEW washers.  
**See Diagram #8**
6. Tighten the injector clamp bolts to **22 Nm**.
7. Tighten the injector leak off banjo bolts to **16 Nm**.
8. Tighten the injector leak off banjo bolt to the head to **13 Nm**.  
**NOTE:** The workshop manual now recommends that you pressure test the leak off pipes as follows. Remove the leak off fitting from the rear of the head outside of

the valve cover. Then fit SST 09280-00010 to the head and apply 250 kPa of air into the leak off pipes. Then drip engine oil over each of the banjo bolts and check for bubbles. Repair leaks as necessary.

9. Fit a new valve cover gasket and refit the valve cover. Tighten the bolts to **9 Nm**.
10. Install four new injector pipe seals into the valve cover.  
**See Diagram #6**
11. Fit the **NEW** injector pipes to the injectors and fuel rail, along with the clamps. Do not tighten them at this stage.
12. Tighten each injector pipe at the fuel rail first then at the injector to **32 Nm** if using SST 09023-12701

(17 mm crows foot spanner), or **35 Nm** if using an injector pipe socket.

13. Tighten injector pipe clamps to **5 Nm**.
14. Refit all other components in reverse order.
15. Bleed the system by pumping the lift pump on the fuel filter until it goes hard.
16. Carry out the Pilot Quantity Learning procedure with a scan tool. See page 4604.
17. Start the engine and check for fuel and oil leaks.

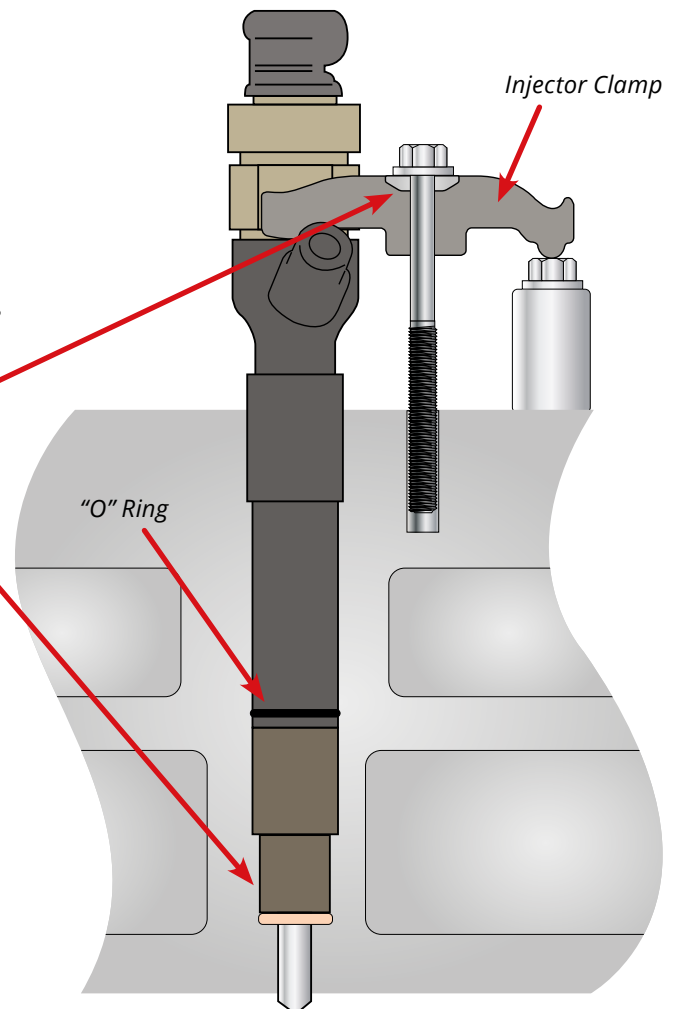
For more information on the 1KD-FTV engine, log in to Tech Online or call VACC's Technical Advisory Service. [🔗](#)

### Diagram #8

#### Injector Clamp and Washers.

*When replacing injectors they must be all of the same type, you can not mix and match Euro specifications.*

*You must also replace the washer on the injector clamp and the washer at the nozzle end.*



We would like to thank the team at Cornell Diesel Systems for their assistance with this article  
[cornells.com.au](http://cornells.com.au)