

# **Fuel Injection Testing Equipment-A Review**

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**Abstract-** During the compression stroke in a four-stroke diesel engine, air is compressed in the engine cylinder. The pressure of the air is increased and its temperature is also increased. The diesel fuel is injected at the end of the compression stroke and the fuel is ignited.

The fuel feed system ensures that the diesel oil is injected into the cylinders at the correct time. It consists of a diesel tank, a feed pump, a filter, an injection pump, an injector and connecting lines. Regular testing of the fuel injection system ensures that the diesel pump works effectively.

**Keywords:** USB cameras, Raspberry Pi, Relay, 3G dongle, Smart phone, Security etc

## **1. INTRODUCTION**

To run an engine, the fuel from the tank must reach by some means to the engine cylinder. In diesel engine, the fuel is injected into the engine cylinder by an injector. The fuel burns in the cylinder and during the exhaust stroke, the burned gases leave the cylinder passing through the exhaust pipe and silencer.

The injector tester consists of a small tank, pump, pressure gauge and handle. There is a separate bowl for receiving the fuel sprayed from the nozzle. The injector to be tested is fitted in the injection testing equipment. A valve which is used to control the fuel is first opened, and then the handle is pressed downward.

The downward movement of the handle causes the fuel to be sprayed through the injector. The reading in the pressure gauge shows the atmospheric pressure. If this pressure is equal to the pressure specified by the manufacturer, then the injector is a good one. If the pressure is either more or less, the spring in the injector should be accordingly adjusted.

## **Literature Review**

The fuel injection equipment is the essential component for the proper working of the diesel engine. The function of the fuel injector is to disperse the fuel through compressed charge of air in the engine cylinder. Proper functioning of injector should be ensured for proper functioning of engine as fuel injector has to spray fuel uniformly. By this project we could learn the construction, design, working operation and calibration of fuel

injection instrument fuel injectors, nozzle, testing of nozzles and timing of injection.

This research paper work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between institution and industries.

We are proud that we have completed the work with the limited time successfully. The FUEL INJECTOR TESTING EQUIPMENT is working with satisfactory conditions. We are able to understand the difficulties in maintaining the tolerances and also quality. We have done to our ability and skill making maximum use of available facilities.

In conclusion remarks of our project work, let us add a few more lines about our impression project work. Thus we have developed an "FUEL INJECTOR TESTING EQUIPMENT" which helps to know how to achieve low cost testing equipment. By using more techniques, they can be modified and developed according to the applications.

## **Types of fuel injection system**

- a) Throttle Body Injection.
- b) Multi-Port Fuel Injection.
- c) Late-Model Fuel Injection.
- d) Direct Fuel Injection.

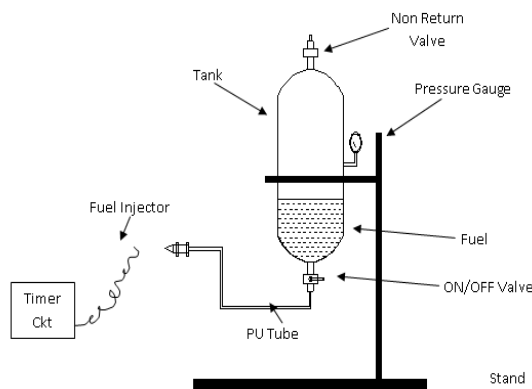
## **2. WORKING PRINCIPLE**

The compressed or pressurized air is given to the input supply of this fuel injector testing equipment. The inlet valve is opened and the inlet

pressure is noted down. The fuel tank contains the some amount of fuel to conduct the testing operation.

The outlet gate valve is opened and the outlet pressure is noted down with the help of outlet pressure gauges. The fuel injector is fitted to the holder with the help of suitable arrangement. The 12v power supply is given to the fuel injector coil.

The coil gets energized to open the nozzle hole so that the pressurized fuel sprayed by the injector nozzle. That sprayed pressure is noted, this is compare to the company pressure specification so that the injector is tested.



**Fig.1: Schematic diagram of Fuel injection testing equipment**

### 2.1 Pressure test:-

Clamp the injector on the tests and operate the test pump. Note the reading of the dial indicator at which the injector nozzle starts spraying. It gives pressure reading. It should be the same as recommended by the company. If, it is less, then tighten the adjusting screw. Repeat the process until the correct pressure reading is obtained. Finally, tighten the lock nut.

### 2.2 Leak-off test:-

Clamp the injector on the tester and build up the pressure about 150 kg/cm<sup>2</sup> by operating the tester pump. Keep this pressure for about ten seconds. If the pressure drops, it shows that there is leakage in the injector. Check the nozzle seat and nozzle valve needle and nozzle body. Correct the seat and needle by grinding and lapping, and after that again do the leak-off test[1].

### 2.3 Spray test:-

Spray test is also done on the same injector-testing machine. While operating the tester pump, see carefully the spray. It should not be like

a current of oil, or with drops splitting away, but it should be fully atomized.

## 3. FUEL SYSTEM REQUIREMENTS

If the engine is to develop full power and operate efficiently, its fuel system must do the following.

### 3.1 Meter (Measures).

The fuel injection system must measure the fuel supplied to the engine accurately since fuel requirements vary greatly from low to high engine speed. Fuel is measured with in the injection pump or injector by measuring it as it fills the pumping chamber (inlet metering) or as it leaves the pumping element (outlet metering). Although many variations of these two concepts exist, the basic principles have changed very little.

#### 3.1.1 Time

The timing of fuel injected into the cylinder is very important during engine starting, full load and high-speed operation. Diesel engine starts best when fuel is injected at or very close to top dead center (TDC), since it is at this point that air in the chamber is the hottest.

After the engine is started and running at high speed, the injection timing may have to be advanced to compensate for injection lag, ignition lag, and other factors that influence combustion with in the engine cylinder.

Many modern injection pumps have an automatic timing device built into them that automatically changes the timing as the engine speed changes. These devices have been given names by their manufactures, such as automatic advance, intravance any many others. Their major purpose is the varying fuel injection timing to produce a powerful yet efficient engine.

#### 3.1.2 Pressurize.

The fuel system must pressurize the fuel to open the injection nozzle (a spring loaded valve) or the pressure required to open the nozzle, some pressure is required to inject fuel into the combustion chamber to offset the pressure of compression, which may be 350 to 450 psi (25 to 32 kg/cm<sup>2</sup>). The pressure setting of the injection nozzle or injector tip is directly related to the degree of atomization required. As the fuel is pumped through the holes in the tip (multi-hole type nozzle) or around the pintle (pintle type nozzle) at high pressure, 1500 to 4000 psi (105 to 280 kg/cm<sup>2</sup>), atomization occurs. This atomization can be compared to the atomization that occurs when you attach a spray nozzle to the end of a garden hose.

### **3.2 Atomize (the Breaking up of Fuel into Small particles)**

The fuel must be atomized when it is injected into the combustion chamber since un-atomized fuel will not burn easily. The degree of atomization required will vary from engine to engine depending on the combustion chamber design. Consider the following examples: A pre-combustion engine will require very little atomization since the fuel is injected into the pre-chamber engines, the fuel is heated in the pre-chamber to start burning; as it burns, the resulting expansion forces it through a passage way into the main chamber. Turbulence created by the rapidly burning and expanding fuel help mix air and fuel for complete combustion, therefore, a high degree of atomization is not required during the initial injection.

A direct injection engine relies solely on atomization of fuel during injection and piston crown design to mix air and fuel for combustion. This engine design will obviously require a higher degree of atomization if complete combustion is to occur. A multi-hole type nozzle tip is generally used with this combustion chamber design.

Distribute Closely related to timing, the distribution of fuel must be accurate and according to the engine's firing order. Distributor pumps deliver fuel to each pump outlet in succession and the lines are hooked to the cylinders in the correct firing order, much like a distributor used on a gas engine. In – line pumps have the camshaft designed to permit the pump outlets to fire in the required engine cylinder firing order. Along with distributing the fuel to the various cylinders, the fuel system must distribute the fuel with in the combustion chamber during initial injection. The fuel must be injected through out the chamber so that all of the air with in the chamber is utilized. The injection nozzle or injector, its hole size and angle, fulfills the requirement.

### **3.3 Control, Start and Stop injection.**

Injection of fuel must start quickly and end quickly. Any delay in beginning will alter the pump to engine timing, causing hard starting and poor running engines. Any delay in injection ending can cause a smoky exhaust and irregular exhaust sound. The end of injection should be instantaneous with no dribbling or secondary injections. In many systems this is accomplished by a valve called delivery valve. Other pumps have a camshaft designed with sharp drop on the cam lobe that stops injection very rapidly.

### **4. MAINTENANCE OF INJECTION SYSTEM:-**

- The most important maintenance of the injection system is that clean diesel oil should flow in it.
- Replace the filter element at the correct interval of time. If the vehicle is used in dirty areas, the filter element should be replaced before time
- Don't run the engine overheated.

### **5. ADVANTAGES**

1. It requires simple maintenance cares
2. The Diesel engine vehicles fuel injector can be easily checked.
3. Checking and cleaning are easy, because of the main parts are screwed.
4. Repairing is easy.
5. Replacement of parts is easy.
6. No Oil wastage.

### **6. APPLICATIONS**

1. Four Wheeler Diesel Engine Application
2. In Automobile Quality control unit
3. Two wheeler Application.

### **7. CONCLUSION**

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