



Problems in Bosch Diesel Fuel Injection Pump and It's Effects – A Review

KEYWORDS

Fuel injection pump, efficiency, noise pollution, air pollution.

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ABSTRACT

Abstract-In the following review paper, we have explained in brief the basics of Bosch Diesel Fuel Injection Pump which was mostly used in automobiles. Also we have focused on the main problems which are generally observed during the operation of the pump and highlighted the adverse effects caused due to these problems. Diesel Fuel Injection Pumps are of low efficiency, produce much noise and create air pollution to great extent. Efficiency of the Bosch PF Diesel Fuel Injection Pump is approximately only 32%. Approximately 102 decibels sound is produced and pollutants like SO_x , CO_x and NO_x are emitted to great extent during the operation of the PF pumps. Thus, because of these major reasons, the use of Bosch PF pump is diminishing. But Bosch PF Diesel fuel injection pumps are of great use in the agriculture, marine, commercial vehicles, railways, etc. Thus, necessary steps and methodology can be adapted to bring PF diesel fuel injection pumps back in use in different fields. This can be done by changing the measurements of the plunger in the diesel pump and adding additives in the fuel.

INTRODUCTION

A BOSCH Diesel fuel injection pump is a frequently (but not always) an essential component on a car or other internal combustion engine devices. Many engines (older motorcycle engines in particular) do not require any fuel pump at all, requiring only gravity to feed fuel from the fuel tank through a line or hose to the engine. But in non-gravity feed designs, fuel has to be pumped from the fuel tank to the engine and delivered under low pressure to the carburetor or under high pressure to the fuel injection system.

Often, carbureted engines use low pressure mechanical pumps that are mounted outside the fuel tank, whereas fuel injected engines often use electric fuel pumps that are mounted inside the fuel tank (and some fuel injected engines have two fuel pumps: one low pressure/high volume supply pump in the tank and one high pressure/low volume pump on or near the engine). Taking one of the fuel pump, is BOSCH Diesel PF Fuel Injection Pump. Bosch Ltd. started manufacturing of PF pumps – “PumpenmitFremdantrieb” (Pump with a foreign drive) way back in 1954. Since then, Bosch Ltd. has been catering to the needs of a large number of Engines manufacturers worldwide. These pumps cater to a wide range of applications from Generator sets to Automobiles to Locomotives. They are also use widely in the agricultural fields. These PF pumps are very less efficient and they emit extremely large amount of air pollutants.

• Classification of BOSCH Diesel PF Fuel Injection Pump

Bosch Diesel PF Fuel Injection Pumps are classified as:

1. Monoblock Type (PF)
2. Q Type (PFE)
3. K Type (PFR)

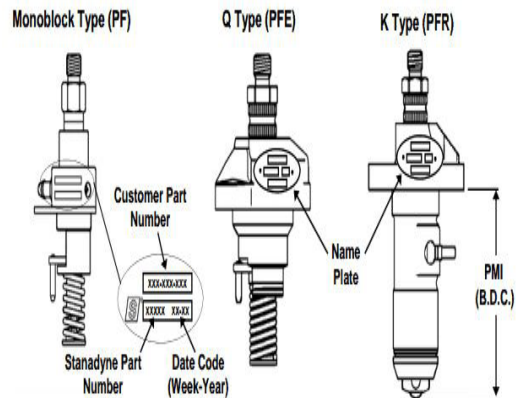


Figure 1: Types of BOSCH PF Diesel Fuel Injection Pumps

• Features of BOSCH Diesel PF Fuel Injection Pump

Delivery pressures in the range 400 bar to 1900 bar. The pressure obtained during the forcing of diesel to the engine cylinder via intake port ranges from 400-1900 bar. Higher the pressure, better the atomization of the fuel. More the fuel is clustered to particles; high rate of complete combustion is obtained.

• Modular design to cater a wide-range of Single cylinder engines.

PF Pumps are so very well designed that changes can be made easily in it if any new improved technology for it develops. Changes in the size of plunger, camshaft and its profile of the same pump can be changed with small good calculations and positive results can be obtained.

Suitable for 2 – 2300 kWh Diesel engines. PF Diesel fuel injection pumps are well suited for the small power generated vehicles like mopeds, scooters, rickshaws to high power generated vehicles like cars, trucks, buses.

CONSTRUCTION AND WORKING OF BOSCH PF DIESEL FUEL INJECTION PUMP

The main components of the BOSCH PF Diesel Fuel Injection Pump are enumerated as under.

- Plunger Spring for pump element
- Helical Spring
- Housing
- Locating Screw
- Spring Ring
- Sealing Ring
- Banjo
- Control Rack
- Delivery valve
- Plunger guide in pump housing

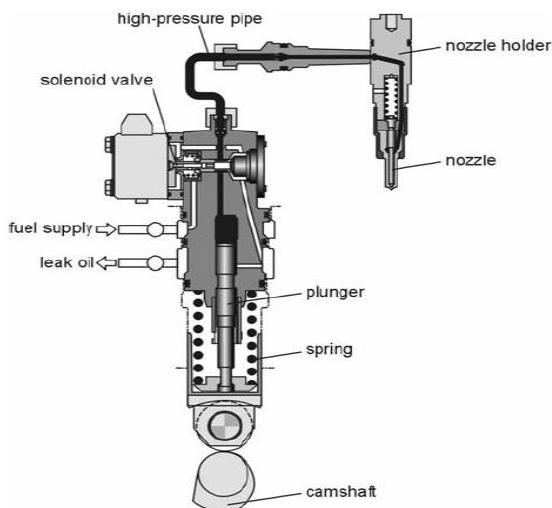


Figure 2: Cross - section of BOSCH PF Diesel Fuel Injection Pumps

This Diesel fuel injection pump works just like the engine combustion process. The fuel gets in the cylindrical space of the housing through fuel intake valve. Then it is pushed to the nozzle at pressure of 750 bar by the plunger. The plunger is of the size – 9mm diameter and 10cm in height. It reciprocates with the help of helical spring which works by the effect of cam follower on the cam shaft. The pressure of the fuel reduces to 300 bar only when it reaches to nozzle for atomization into very fine particles.

PROBLEMS IN BOSCH PF DIESEL FUEL INJECTION PUMP

PF pumps are less efficient generally. There are several problems which are faced during the operation of PF pumps. The general problems of the PF pumps are described below:

- PF pumps are generally less fuel efficient. They consume more fuel than other mechanical pumps.
- Due to incomplete combustion process in the ignition chamber, it gives less efficiency of the pump. Incomplete combustion process leads to detonation and knocking of the engine.
- Incomplete combustion also leads to very large amount of noise during the working. It varies from 95-102 db. Thus it is very harmful for the humans and other living animals.
- The working pressure of the PF pump generally ranges from 250 to 350 bar. Current technologies work on pressurized fuel injection process, which are more efficient and latest.
- Incomplete combustion process results in generation of very harmful gases like SO_x, NO_x, CO, CO₂ which are extremely harmful for the environment of the Earth. It contains approximately 4% NO_x, 10% CO and CO₂, and 7% SO_x. (Based on Practical experiments).

Thus there are several problems like air pollution, noise pollution and less mechanical and fuel efficiency in the BOSCH PF PUMPS. They have very harmful effect on environment and mankind respectively

EFFECTS OF PROBLEMS IN BOSCH PF DIESEL FUEL INJECTION PUMP

During the operation of the PF Diesel Fuel Injection Pump, few problems arises that makes its usage limited and now-a-days, very rare. Problems that arise during the operation of PF Diesel fuel Injection Pump as stated above are Air Pollution, Noise Pollution and Low Efficiency.

- **Air Pollution:** - Pollutants like NO_x, SO_x, CO and CO₂ are emitted during the combustion and exhaustion of the diesel fuel. These pollutants are very harmful for the environment as well as for the living beings. Effects of these pollutants on living beings and environment are mentioned below :-

TABLE – 1
EFFECTS OF DIFFERENT POLLUTANTS

Pollutants	Source of pollutant	Harmful Effects
NO _x	Most of the NO _x is emitted as NO which is oxidized to NO ₂ in the atmosphere. Formation of the NO _x may be due to oxidation of nitrogen present in the fuel. Some of the NO ₂ will be converted to NO ₃ in the presence of O ₂ . In general, higher the combustion temperature, the higher NO _x is produced.	On man: Produces sharp irritating effect especially on mucous membrane of eyes, penetrate deep into lungs and cause injury to the epithelium and bronchi, people suffer from reduced respiration function. On vegetation: NO _x absorb the natural radiation and thus reduce the transparency of the atmosphere and provoke the formation of photochemical mist or smog.
SO ₂	The combustion of sulphur containing fossil fuels, especially coal is the primary source of SO _x . About 97 to 99% of SO _x emitted from combustion sources is in the form of SO ₂ which is a criteria pollutant; the remainder is mostly SO ₃ . SO ₃ in turn interacts with atmospheric moisture and forms H ₂ SO ₄ .	On man: Suffocation, irritation of throat and eyes, respiratory, asthma, lung cancer. On vegetation: Destruction of sensitive crops and reduced yield.
CO	It is produced by the incomplete combustion of carbonaceous matter of the fuel.	CO combines with corpuscular haemoglobin and thus very quickly drains the organism of O ₂ for man and animals, poisoning cardiovascular disease. It increases accident liability.
CO ₂	Burning of fuel produces large amount of CO ₂ .	Increase CO ₂ content in the atmosphere can affect the climate of the planet. CO ₂ absorbs radiant energy of the long wave type emitted from the surface of the earth, heat up and thus prevents the heat from being lost by the earth, resulting rise in the temperature of the earth.

· **Noise Pollution:** - During the combustion of the diesel fuel in the engine cylinder, where diesel is pumped through PF pump to the engine cylinder, very loud noise is generated, up to 102 decibels.

· **Low Efficiency:** - Main disadvantage or problem of the PF Diesel fuel injection pump is the lower efficiency that is only 32%.

Adverse effects of noise pollution are:-

1. **Decreases the efficiency of a man-**Regarding the impact of noise on human efficiency there are number of experiments which shows that human efficiency increases with noise reduction.
2. **Lack of concentration-** Results have proved that for better quality of work there should be concentration. Noise causes lack of concentration. In big cities, mostly all the offices are on main road. The noise of traffic or the loud speakers of different types of horns divert the attention of the people working in offices.
3. **Fatigue** - Because of noise pollution, people cannot concentrate on their work. Thus they have to give their more time for completing the work and they feel tiring.
4. **Abortion is caused**-There should be cool and calm atmosphere during the pregnancy. Unpleasant sounds make a lady of irritative nature. Sudden Noise causes abortion in females is also observed in several researches.
5. **Causes increase in Blood Pressure**-Noise Pollution causes certain diseases in human. It attacks on the person's peace of mind. The noises are recognized as major contributing factors in accelerating the already existing tensions of modern living. These tensions result in certain disease like blood pressure or mental illness etc.
6. **Temporary or permanent deafness**-The effect of noise on audition is well recognized; Mechanics, locomotive drivers, telephone operators etc. All have their hearing impairment as a result of noise at the place of work. Physicians & psychologists are of the view that continued exposure to noise level above. 80 to 100 db is unsafe. Loud noise causes temporary or permanent deafness.

Few effects of low efficiency are:-

1. **Less work done** – Very less output is obtained with respect to the fuel used for the work.
2. **Cost** – Because of the low efficiency, there is more requirement of diesel fuel to achieve the desired amount of work done and this leads to increase in investment of the diesel fuel.

CONCLUSIONS

Because of these several problems arising during the operation of PF Diesel Fuel Injection pump like noise pollution, air pollution and low efficiency, its usage has been avoided and can be seen operating very rare. In place of PF pumps, Common Rail injection pumps and Distributor pumps have replaced. Necessary technical steps can be taken to surpass the problems of the PF pump and can be made to use again in the market at various places as its initial and operating costs are very less in compare to the other pumps.

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