Design and Fabricate Of The Fuel Injector Cleaning And Testing Rig

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Project Definition

- To Design and Fabrication Of the Fuel Injector Cleaning And Testing Rig.

Introduction

- Fuel injection is a technology used in internal combustion engines to mix the fuel with air prior to combustion. As in a traditional carburetor, fuel is converted to a fine spray and mixed with air. However, where a traditional carburetor forces the incoming air through a venturi to pull the fuel into the air stream, a fuel injection system forces the fuel through nozzle under pressure to inject the fuel into the air stream without requiring a venturi.
- The modern electronic systems that cars are equipped with today utilize a number of sensors to monitor engine conditions, and an electronic control unit (ECU) to accurately calculate the needed amount of fuel. Thus fuel injection can increase fuel efficiency and reduce pollution.

Objective

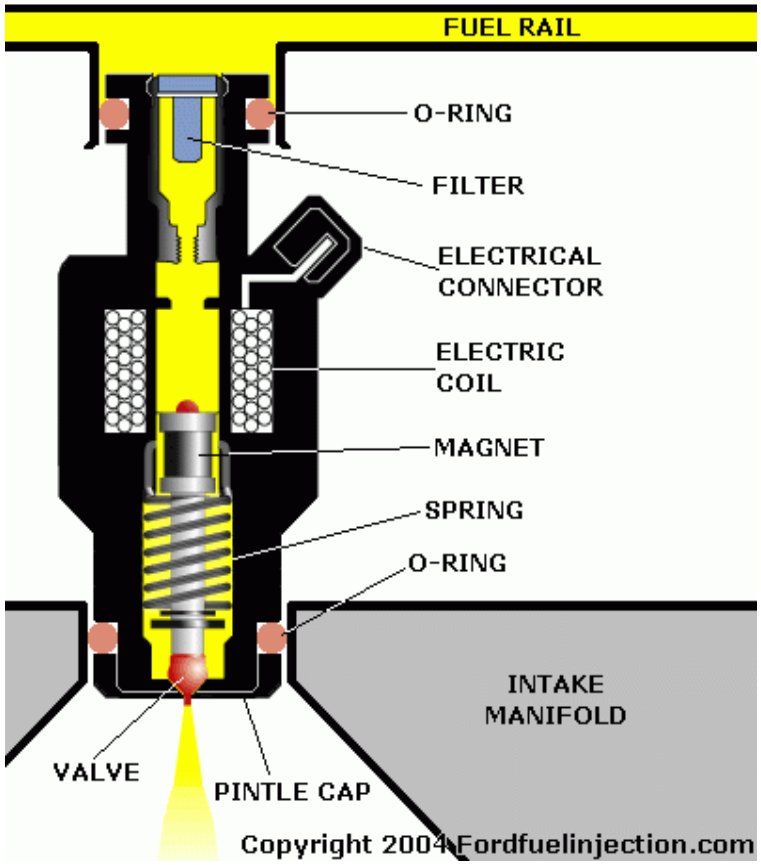
- To study the various types of fuel injector failures .
- To study the causes of fuel injector problems.
- To identify the solution of fuel injector problems.
- To make the device affordable for small scale service centers.

FUEL INJECTOR:-

A fuel injector is nothing but an electronic controlled valve. It is supplied with pressurized fuel by the fuel pump in our cars, and it is capable of opening and closing many times per second. Fuel injection is a system for mixing fuel with an internal Combustion engine.

Working Of Fuel Injector

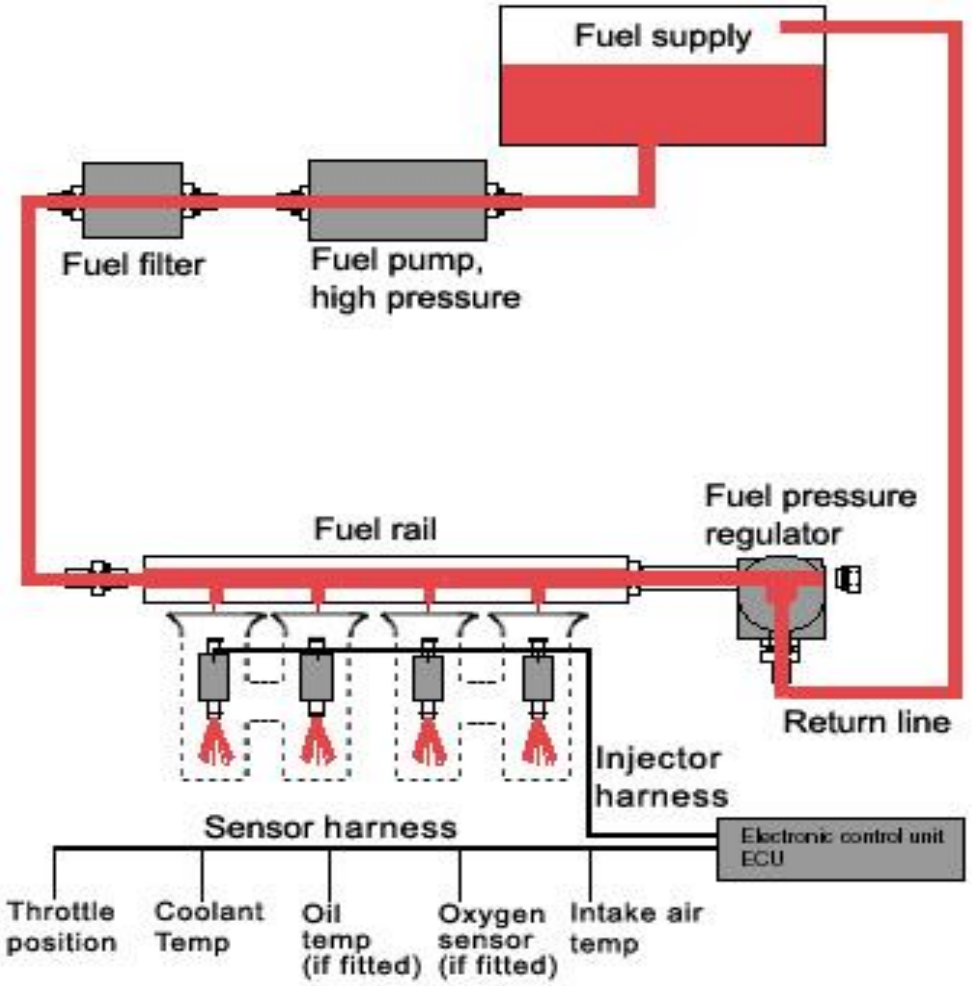
- When the injector is energized, an electromagnet moves a plunger that opens the valve, allowing the pressurized fuel to squirt out through a tiny nozzle. The nozzle is designed to atomize the fuel-to make as fine a mist as possible so that it can burn easily.
- The amount of fuel supplied to the engine is determined by the amount of time the fuel injector stays open. This is called the pulse width, and it is controlled by the ECU.
- The injectors are mounted in the intake manifold so that they spray fuel directly at the intake valves. A pipe called the fuel rail supplies pressurized fuel to all of the injectors.
- In order to provide the right amount of fuel ,the engine control unit equipped with a whole lot of sensors.



Fuel Injection System

- Uses pressure (not Vacuum) from an electrical pump to spray fuel into the intake manifold.

- Provides the engine with proper air-fuel ratio (14.7 : 1)



FAILURE /PROBLEMS IN FUEL INJECTORS

FAILURE 1...Unburned fuel additives are baked on the injector pintle and orifice altering flow volume, altering fuel spray pattern.

CAUSE OF FAILURE 1:- Normal use of vehicle but lack of fuel system maintenance; after engine shutdown "heat-sink" resulting in higher "baking" temperatures for unburned fuel and/or fuel additives remaining on injector; overheating of engine (and the injectors) from faulty cooling system, improper engine timing, contaminated fuel, incorrect fuel octane, vacuum leaks.

EFFECTS OF FAILURE 1:- Lack of engine power, sluggish pickup/performance, poor fuel economy, leaking fuel injector, potential for engine overheating, sensor damage, remaining injectors/cylinders are over fuelled to compensate for under fuelled injectors/cylinders.

FAILURE 2...Injector filters become clogged.

CAUSE OF FAILURE 2... ("Foreign particles" in fuel tanks or fuel lines or fuel rail). Foreign particles in almost all instances will be rust. Larger rust particles may be collected within the injector filter, or the fuel filter, and reduce fuel flow. Microscopic rust particles may also pass through the injector filter, and cause the spray pattern to alter, fuel flow to alter, and/or the injector pintle to not seat properly. This is a common problem on vehicles that have sat unattended, or suffered from lack of routine maintenance. Incorrect fuel tank fuel filter; holes/tears in fuel tank fuel filter; breakdown/degradation of interior wall of fuel supply line; breakdown/degradation of interior wall of fuel injector hose, and rust in the fuel rail.

EFFECTS OF FAILURE 2...the injectors leak at the pintle and/or the spray pattern is altered, and/or the fuel flow is altered. Lack of engine power due to under fuelling; potential for engine overheating

FAILURE 3...injector pintle doesn't fully seat on orifice.

CAUSE OF FAILURE 3...fuel additives "baked" on pintle or orifice, weak injector return spring, rust/corrosion internal to injector body.

EFFECT OF FAILURE 3... Leaking fuel injector, after shutdown fuel leak in affected cylinder (causing hard start), overfilling of affected cylinder with resultant under fuelling of remaining cylinders in the "closed loop" system.

FAILURE 4...external electrical connectors broke/corroded.

CAUSE OF FAILURE 4...mishandling during installation/removal/testing, water/moisture leaking past injector plug connector, inadequate vehicle maintenance, and improper storage.

EFFECTS OF FAILURE 4...no firing, intermittent firing, or weak firing of injector is due to poor electrical conductivity, poor engine performance and poor fuel economy. It results in Engine overheating, potential engine damage and overfilling of other cylinders as sensor reads excess in exhaust and adjusts "rich" to compensate them.

Measurement

- To accurately measure each injector's fuel flow ability.
- Acquire quantitative data on injector performance the vehicle owner can use in matching injectors or tuning the engine's fuel system
- Test the injecting volume.
- Test the injecting uniformity.
- Test the spray angle.

Literature review

RESEARCH PAPER	CONCLUSION
1. Development of Mechanical Fuel injector Cleaning Machine in cost effective Manner.	1. The conclusion is that now a days company manufacture electronic fuel injector cleaning machine is very costly. 2. Mechanical Fuel injector cleaning system cost is 10 time less than the existing electronic type fuel injector cleaning system.
2. Automotive spark-ignited direct-injection gasoline engines	1. Injector fouling due to deposit formation be minimized for the wide range of fuel quality and composition in the field such that reasonable service intervals can be Achieved and ignoring late fuel injection and fuel loss will be reduced due to using port fuel injection system.

3. Diesel Fuel Additive Providing Clean Up Detergency Of Fuel Injectors.	**3. The present invention provides a diesel fuel composition comprising a major portion of a middle distillate fuel oil and a minor portion, effective to clean deposits from diesel fuel injectors, of a diesel fuel detergent comprising the reaction product.**
4. Cleaning apparatus and Method for Fuel And Other Passages.	4. The apparatus includes means for blocking flow of cleaning fluid through the conduit means so as to direct the cleaning fluid therein to flow through the passage from the second end toward the first end and into the container.

Fuel pressure

Manufacturer	Displacement (cm3)	No. of cylinders	Compression ratio	Fuel pressure (MPa)
Audi	1196	3		10
Ford	575	1	11.5	5
Honda	1000	3		
Toyota	1198	4	10	8-13
Renault	2000	4		5-10
Fiat	1995	4	12	
Mercedes	539	1	10.5	4-12

Future planning

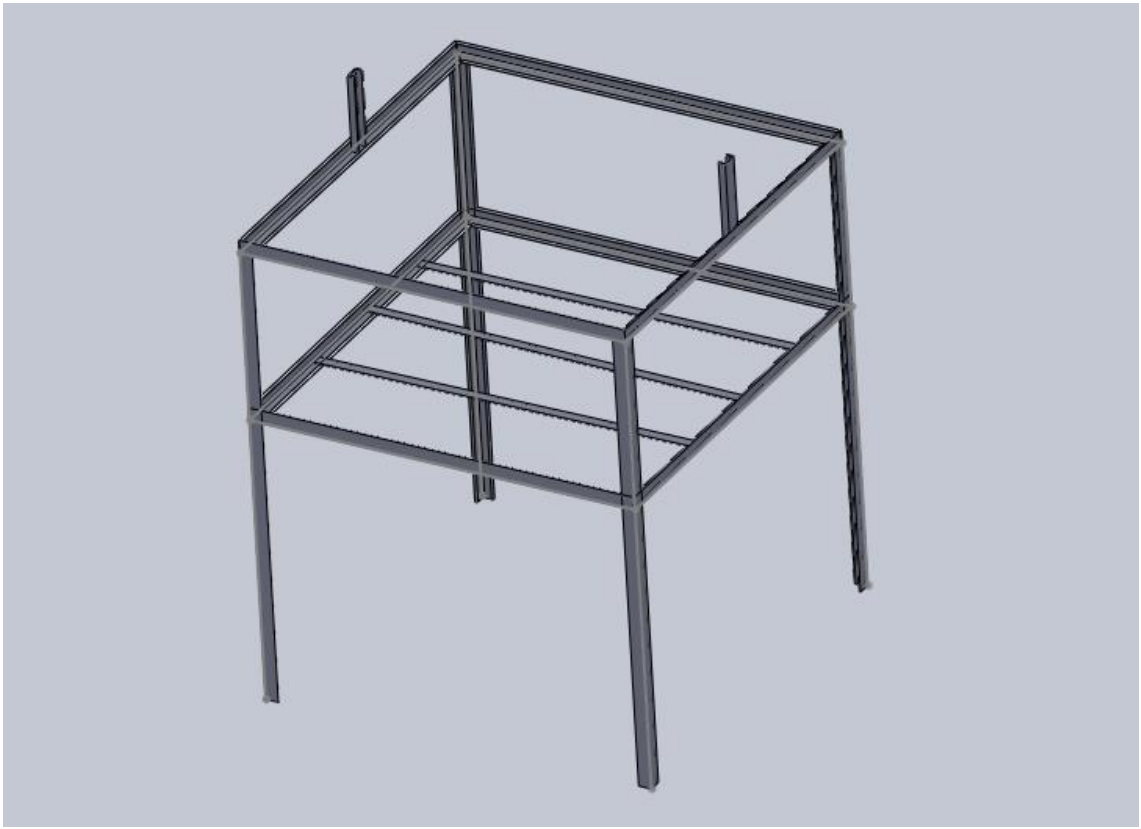
month	Activity
July-	Defining title of project
Aug-Sept	Literature review
Oct-Nov	Literature review and Probable design
Dec-Jan-feb	Fabrication and testing and measurements
March-april	Modification if required

Components used in the fabrication of the test rig.

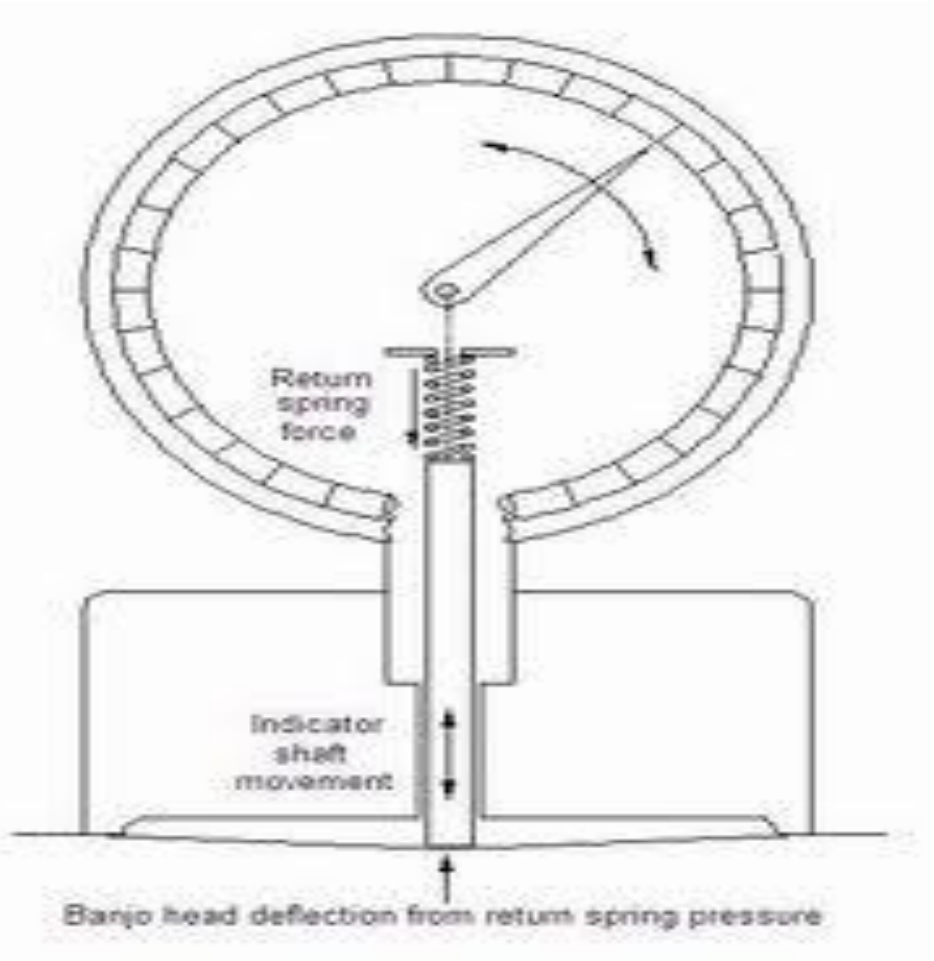
SR.NO.	COMPONENT	QUANTITY
1	Frame	1
2	Fuel Tank	1
3	Fuel Pump	1
4	Fuel rail	1
5	Pressure guage	1
6	Injector	4
7	Electronics circuits	1
8	Measuring cylinder	4
9	Horizontal wooden board	1
10	Vertical wooden board	1

DRAWING RELATED TO PROJECT

1.FRAME

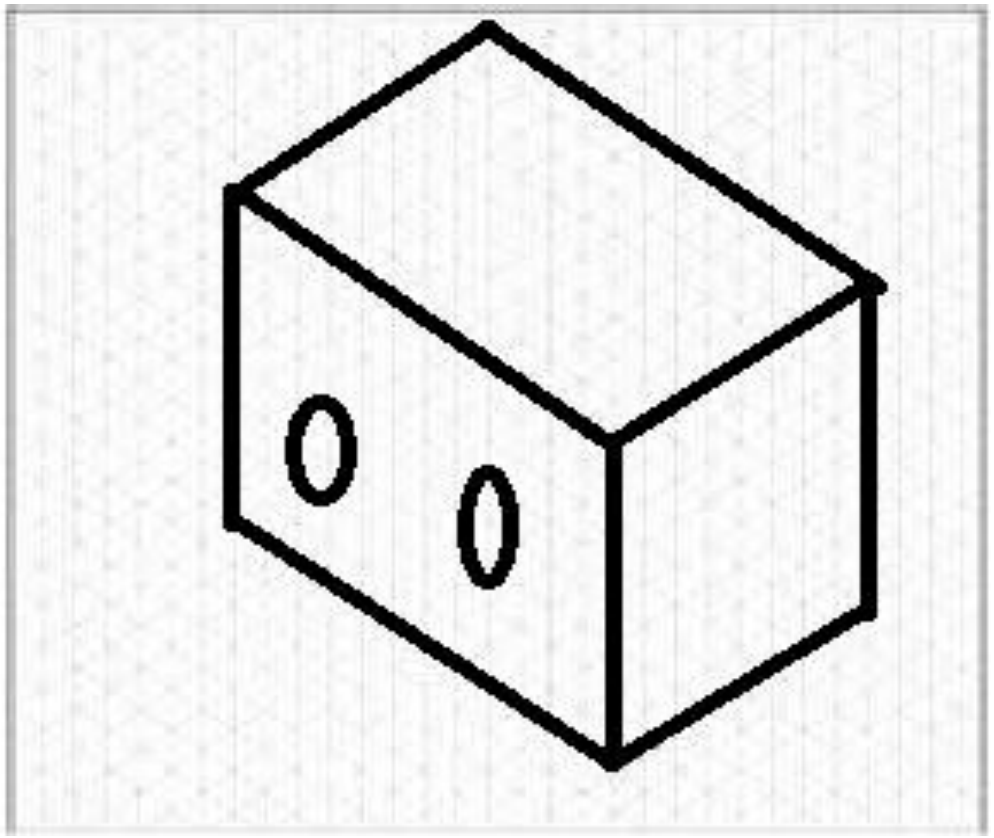


2.PRESSURE GAUGE



3.FUEL RAIL

4.CIRCUIT BOX



5 MEASURING CYLINDER

STATIC FLOW RATE

SR NO	INJECTOR 1 (VOLUME OF FUEL IN ml)	INJECTOR 2 (VOLUME OF FUEL IN ml)	INJECTOR 3 (VOLUME OF FUEL IN ml)	INJECTOR 4 (VOLUME OF FUEL IN ml)	TIME (Min)
1	59	59	60	60	1
2	60	58	59	60	1
3	60	59	60	60	1

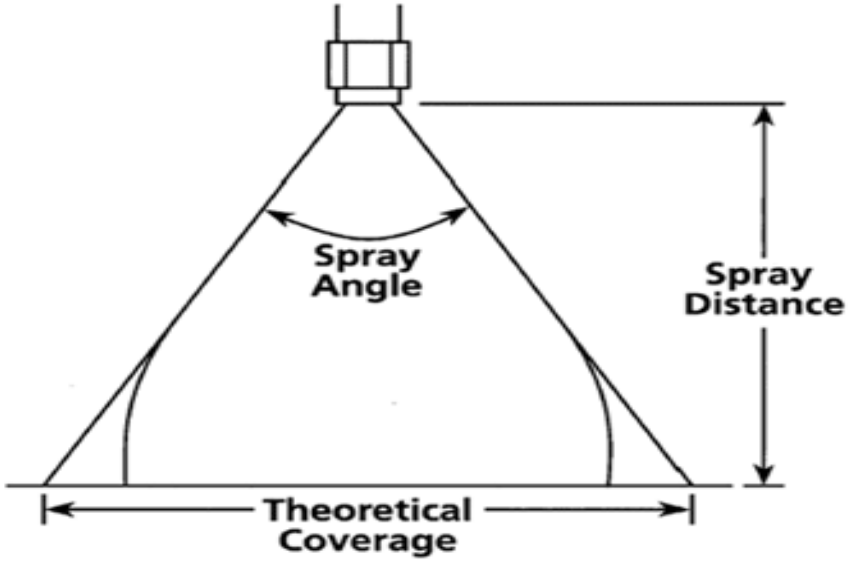
Static flow rate observation table of the injectors

Average flow rate = volume of fuel collected / Time

SR NO	INJECTOR 1 (FLOW RATE IN ml/min)	INJECTOR 2 (FLOW RATE IN ml/min)	INJECTOR 3 (FLOW RATE IN ml/min)	INJECTOR 4 (FLOW RATE IN ml/min)
1	59	59	60	60
2	60	58	59	60
3	60	59	60	60
MEAN	**60**	**59**	**60**	**60**

Static flow rate of the injectors

SPRAY ANGLE MEASUREMENT



$$\mathbf{S}pray\ Angle = \tan\theta = \frac{\sin\theta}{\cos\theta}$$

SPRAY ANGLE

INJECTOR NO.	SPRAY ANGLE IN DEGREE
1	21.5
2	14.7
3	20.6
4	20.6

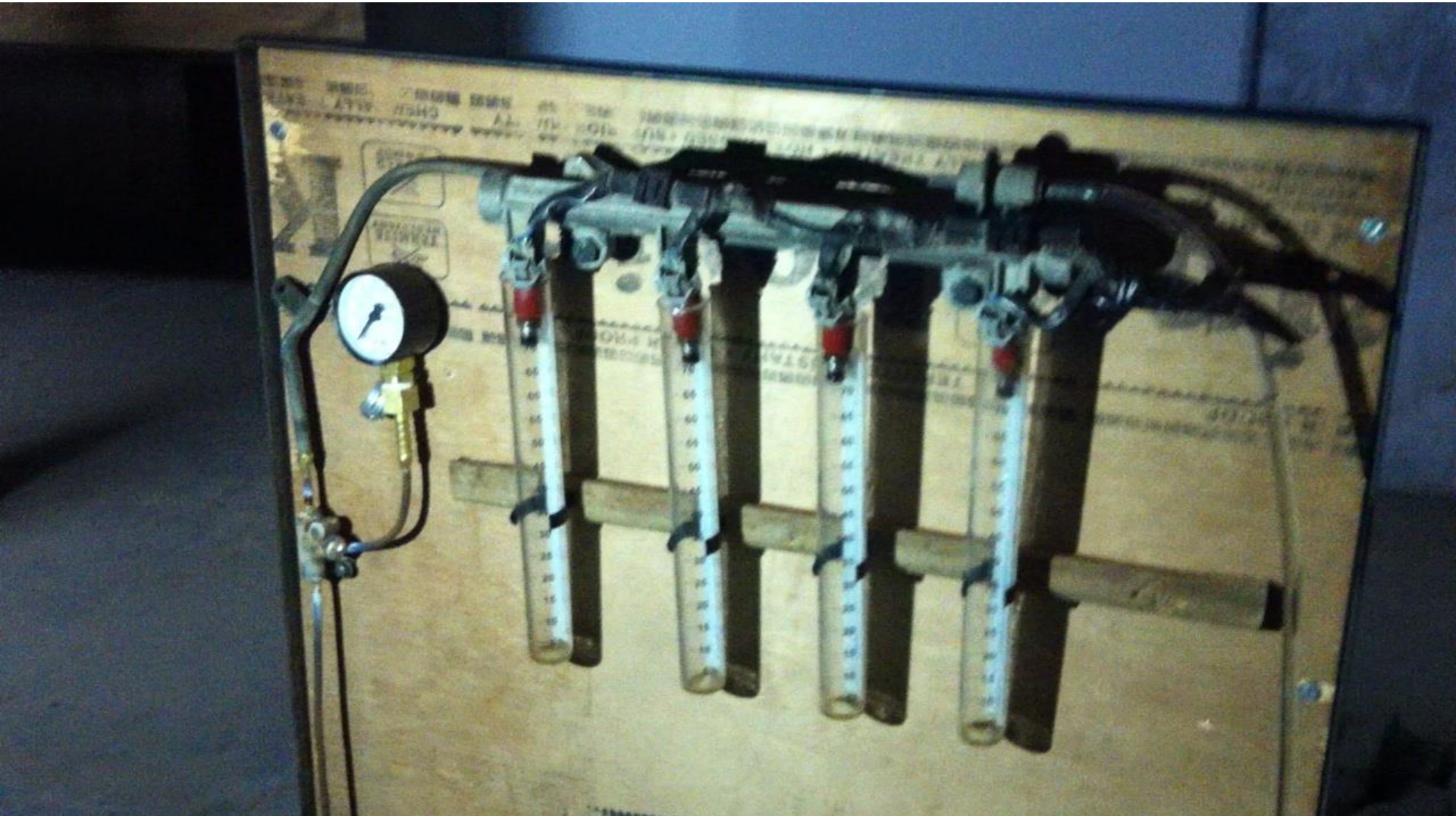
Visit To Service Station


Fuel Injector Diagnosis &
Cleaning Equipment
RESET
DRAIN
INDICATOR
ROTATION SPEED
PULSE DURATION
DOWN
UP
LIGHT
INEFFECT RANGE


Fuel Injector Diagnosis &
Cleaning Equipment
DO NOT EXCEED
90PSI (6.4kg/cm²)
RESET
DRAIN
PUMP
INDICATOR
ROTATION SPEED
PULSE DURATION
REV.COUNT
TIMING
DOWN
UP
LIGHT
SELECT
TEST
ATOMIZATION
STOP
AUTOMATIC
PULSE
SYSTEM PRESSURE
INEFFECT RANGE
NEWTURN

Model Photo

Model testing video



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Thank You