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Effect of Twin Sparkplug in Two Stroke IC Engine

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Abstract: ***Two stroke spark ignition engines have high exhaust emissions and low brake thermal efficiency due to the short-circuiting losses and incomplete combustion, which occur during idling and at part load operating conditions. An effort is been made to improve the engine parameters i.e. specific fuel consumption and Thermal Efficiency of the engine. This is achieved by using dual spark plug in two stroke gasoline also its effect on the engine parameter is analyzed. On applying the dual spark plug in two stoke gasoline engine the combustion could be made proper and the specific fuel consumption could be made to decrease. In this two Stroke gasoline engine the scavenging process will also be improved which is poor in the present single spark plug. The present two-stroke twin spark plug gasoline engine can be made to operate either with single or dual spark plug as per the user's requirement. The engine is fitted with both the options. This two stroke gasoline engine is also has the luxury of a condenser which will enhance its sparking capability. Overall this engine is a far more technically improved engine than that of single spark plug. The main objective of this present study is to analyze the effect of Dual spark plug on engine performance parameters in two-stroke gasoline engine.***

Keywords: twin spark two stroke

Chapter 1

1. Project Planning

Before starting every project its planning is to be done. Planning is very important task and should be taken with great care, as the efficiency of the whole project largely depends upon its planning while planning a project each and every details should be worked out in anticipation and should carefully is considered with all the relating provisions in advance. Project planning consists of the following steps.

1.1. Project Capacity

The capacity of the project must be desided considering the amount of money, which can be invested and available of materials and machines.

1.2. Drawings

Drawing been decided for the project to be manufacture. Its detailed drawing specification for raw material and finished products should be decided carefully along with the specification of the machines requires for their manufacture.

1.3. Material Equipment

The list of materials required for the manufacture is prepared from the drawings. The list of is known "BILL OF MATERILS". This passes to the store keeper and the required material taken from the store under permission of store keeper operation, the person to do the job.

1.4. Machine Loading

While planning proper care should be taken to find the machining time for each operation as correct as possible. So that the arrangement for full utilization of machine can be made machine loading programmed is known.

1.5. Purchase Consideration

It is different to manufacture all the component needed for the equipment in the workshop it self. The decision about a particular item whether to purchase or to manufacture is taken by planning after making through study of relative merits demerits.

1.6. Equipment Consideration

Results obtained from "PROCESS PLANNING" and "MACHINE LOADING" helps in calculating the equipment requirement specification of the equipment should be laid down by considering the drawing. Drawing will also help in deciding and necessary requirement of tools, accessories.

1.7. Cost Calculation

The cost of the project can be calculated by adding following

1) Machine Cost
2) Machining Cost
3) Overhead Expenses.

1.8. Comparison

The various items in the finished are compared to the standards for the further correction.

1.9. Report

At the end of the project report is prepared for further reference. The report consists of all the items done the project work.

Introduction

A two-stroke, two-cycle, or two-cycle engine is a type of internal combustion engine which completes a power cycle in only one crankshaft revolution and with two strokes, or up and down movements, of the piston in comparison to a "four-stroke engine", which uses four strokes. This is

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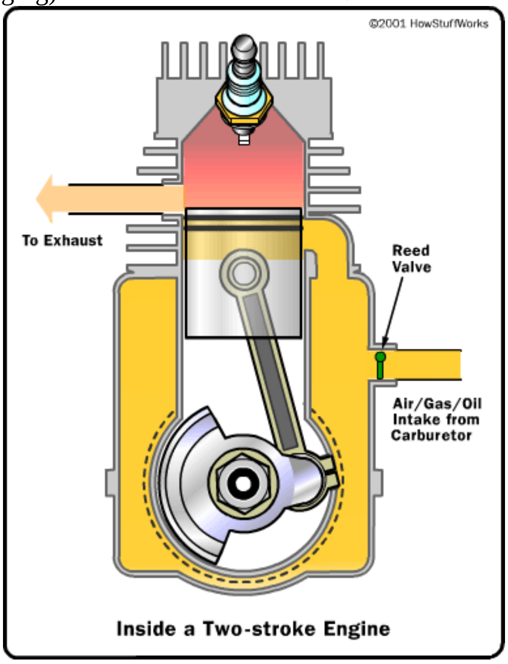
accomplished by the end of the combustion stroke and the beginning of the compression stroke happening simultaneously and performing the intake and exhaust (or scavenging) functions at the same time.



Two-stroke engines often provide high power-to-weight ratio, usually in a narrow range of rotational speeds called the "power band". Compared to 4-stroke engines, they have a greatly reduced number of moving parts, are more compact and significantly lighter. The two-stroke engine is mechanically very simple. There are no valves, camshafts, etc., just the piston connected by the con-rod to the crankshaft. Lubrication is achieved by mixing oil with the fuel, the resulting mixture then bathing all the moving parts.

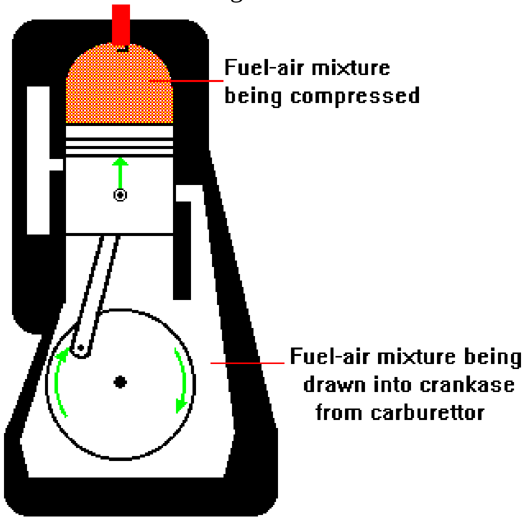
However, the complete cycle takes only one upstroke and one downstroke of the piston, so some elements of the four phases of operation must occur simultaneously.

The fuel and air are mixed in the carburetor in the usual way, but instead of going directly to the top of the cylinder, the mixture enters the sealed crankcase, i.e. the space underneath the piston. The crankcase is connected to the combustion chamber in the cylinder by an inlet port, sometimes known as a transfer port.

Opposite the inlet port there is another port, the exhaust port. The piston in the bottom part of its stroke, thus replicating the function of the valves in the four-stroke engine and allowing gases to enter and leave the cylinder, uncovers both the inlet and exhaust port. In the top part of the stroke both ports are covered, sealing the cylinder. This allows compression to occur at the top of the upstroke and allows the power of the expanding gases to be harnessed at the top of the downstroke.

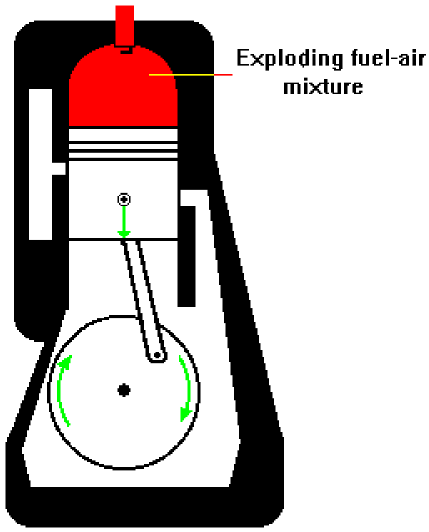
Induction/Exhaust Stroke

The piston has moved down, uncovering both the inlet (transfer) and exhaust ports. The descending piston has increased the pressure in the crankcase, so the fuel-air mixture is being pumped from the crankcase via the transfer port into the combustion chamber. In some engines (not in a Vire 7) there is a valve between the carburettor and the crankcase which stops any tendency for some of the fuel-air mixture to blow back through the carburettor.



Compression Stroke

The piston has passed Bottom Dead Centre (BDC) and is now rising. The inlet and exhaust ports are both covered, so the fuel-air mixture in the combustion chamber is being pressurised and is heating up. At the same time, a vacuum is developing in the crankcase, so a fresh charge of fuel-air is being drawn into the crankcase from the carburettor. As the piston rounds TDC, a high voltage discharge from the spark plug ignites the mixture in the combustion chamber.



Ignition/Power Stroke

With both ports still closed, the pressure of the expanding gases forces the piston down again. The pressure in the crankcase is already rising. Later in the downstroke the exhaust port will be uncovered, allowing the spent gases to escape. Very shortly after that the inlet/transfer port will also be uncovered, which takes the engine back to where it was at the start of the cycle.

Two types of internal combustion engine, the spark ignition, SI, and the compression ignition, CI exists. Both have their merits. The SI engine is rather a simple product and has a lower first cost. The problem with the Two Stroke SI engine is its poor part load efficiency

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1.2 Emission Standard

Emission standards are requirements that set specific limit to the amount of pollutants that can be released into the environment. Many emission standard focus on regulating pollutants released by automobiles and other powered vehicles. They can also regulate emissions from industry , power plants, small equipments such as lawn movers and diesel generators.

1.3 Emission Standard in India

Bharat stage emission standards are emission standards instituted by the Government of India to regulate the output of air pollutants from internal combustion engine equipment ,including motor vehicles. The standards ,based on European regulations were first introduced in 2000.Progressively stringent norms have been rolled out since then .since October 2010,Bharat stage III norms have been enforced across the country .In 13 major cities, Bharat stage IV emission norms are in place since April 2010.

Table 1.1: Emission Standards in India

Standard	*Reference*	*Date*	*Region*
India 2000	Euro 1	2000	Nationwide
Bharat Stage II	Euro 2	2001	NCR*, Mumbai, Kolkata, Chennai
		2003.04	NCR*, 12 Cities†
		2005.04	Nationwide
Bharat Stage III	Euro 3	2005.04	NCR*, 12 Cities†
		2010.04	Nationwide
Bharat Stage IV	Euro 4	2010.04	NCR*, 12 Cities†

* National Capital Region (Delhi)
† Mumbai, Kolkata, Chennai, Bengaluru, Hyderabad, Ahmedabad, Pune, Surat, Kanpur, Lucknow, Sholapur, and Agra

Chapter 2

2. Literature Survey

2.1 CO2 Capturing in Vehicle

John M. Sullivan and Michael Sivak, University of Michigan Transportation Research Institute, apart from reduced fuel consumption ,CCS technology is key to reducing CO_2 emissions produced by the use of fossil fuels in transportation by means of post combustion ,pre combustion and air circulation.

2.2 Inorganic Oxides for Co_2 Capture From Exhaust Systems

This invention relates to the utilization of regenerable water tolerant solid materials for the abatements of CO_2 emissions from internal combustion engine exhaust streams through repetitive sorption/desorption cycles. The system, which is designed to be used in a gasoline, lean gasoline, diesel passenger car, diesel truck, stationary engine with 50Hz or 60Hz electrical frequency, or a SOFC, will contain a solid sorbent which contains zirconium and will be able to reduce on board the average carbon emissions by up to 10wt%. The preferred materials have been selected from the class of hydrotalcite type compounds and/or earth and alkaline earth zirconates.

2.3 Carbon Di Oxide Continuous Scrubber

The project scope included concept generation of a device to remove CO_2 from air, the development of CO_2 measurement technique uses the temperature swing chemistry of a liquid chemical adsorbant, monoethanolamine, and a packed bubble column apparatus to provide gas, liquid interaction. The CDOCS was capable of reducing CO_2 in air from 380 to 80 ppm for 30 days, providing low cost, low maintenance scrubbing compared to soda lime.

2.4 Reduction of Co_2 to Fuels

This concept was developed by Thomas F. Jaramillo , Jens K. Norskov . they developed three types of catalysts metal surface for CO_2 reduction, metal sulphides for Co_2 reduction and metal oxides for the oxygen evolution reaction. The fossil fuels when acting with this catalyst reduces the amount of carbon content in the fuel. When this fuel is used by the engine , it emits less pollutant than the normal fossil fuel.

The fossil fuel obtained from the mining process can be initially treated by reducing agents which reduces the carbon content of the fuel. When this carbon reduced fuel is used as a commercial vehicle fuel it emits low carbon emission than the fuel used in the vehicles. Due to this, the carbon content in the atmosphere released by the vehicles so that the global warming created by the greenhouse gas is prevented from the primary stage itself.

The metal sulphides for Co_2 reduction and metal oxides for the oxygen evolution reaction. The fossil fuels when acting with this catalyst reduces the amount of carbon content in the fuel. When this fuel is used by the engine , it emits less pollutant than the normal fossil fuel. The metal oxides used in this process can release more amount of oxygen while combustion of carbon reduced fuel than the normal fuel.

Chapter 3

3. Proposed System of Twin Spark

A large number of different designs for Internal Combustion Engines have been developed and built, with a variety of different strengths and weaknesses. Powered by an energy-dense fuel (which is very frequently gasoline, a liquid derived from fossil fuels). While there have been and still are many stationary applications, the real strength of internal combustion engines is in mobile applications and they dominate as a power supply for cars, aircraft, and boats. The problem with the present Two Stroke Petrol Engine is the incomplete combustion, poor thermal Efficiency, poor scavenging process.

3.1 Applied on Two Stroke Engine

The dual spark plug on Two Stroke Gasoline Engine is

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applied at identical to the present position of the spark plug. The combustion could be made proper so that less fresh charge moves out unburnt.

The conventional spark-ignition two-stroke engine burns a homogenous charge. The air fuel mixture is supplied to the cylinder via the transfer ports with much of the fuel already vaporised during its residence in the “hot” crankcase. The remainder of the liquid fuel vaporizes during the compression process so that by the time ignition takes place, the combustion chamber is filled with the vapour exhaust gas residual mixture which is evenly distributed throughout the combustion space. This is known as homogenous combustion mixture.

Heat release in internal combustion engines is one of the most important factors Influencing on engine work parameters and exhaust gas emission. Very fast combustion process leads to rapid increase of cylinder pressure and temperature and is the main reason of a big NOx emission and knocking. The main problem of conventional loop scavenged two stroke spark ignition engines is a big hydrocarbon emission and high specific fuel consumption, which is caused by flow of a part fuel mixture to the exhaust port during scavenge process. This internal exhaust gas recirculation in a two- stroke engine influences on lower NOx emission in comparison to four stroke engine. The flow of fresh fuel-air mixture from the transfer ports causes that most of burnt gases occupy the space near the exhaust port. Usually the space near the spark plug is fulfilled by fresh mixture and there is no problem with the ignition of the charge. The authors in Cracow University of Technology worked out the new fuelling system of two-stroke engine in order to eliminate their basic faults and imperfections. The high pressure direct fuel injection system was applied to the industrial small capacity (115 cm3) two-stroke engine Robin EC12 from Fuji Heavy Industries. Simulation analysis and experimental work indicated that direct fuel injection decreases both specific fuel consumption and hydrocarbon emission. Simulation of combustion process in0-dimensional model requires a verified model of heat release. One cannot find such model for two-stroke engine with direct fuel injection in the world’s literature. Therefore much work was concerned to find an approximation Vibe function for full loads and rotational speed of tested engine.

The addition of one more spark plug to the Two Stroke SI Engine i.e. making Two Stroke Petrol Engine to operate with the dual spark plug. On applying the dual spark plug in 2-stroke gasoline engine will improve the combustion and thereby helps in reducing the specific fuel combustion, automatically will help in increasing the Thermal Efficiency. The Scavenging process in the two-stroke gasoline engine will also be improved by applying the dual spark plug.

Chapter 4

4. Fabrication

4.1 Milling

Milling is the machining process of using rotary cutters to remove material from a work piece advancing (or *feeding*) in a direction at an angle with the axis of the tool. It covers a wide variety of different operations and machines, on scales from small individual parts to large, heavy-duty gang milling operations.

It is one of the most commonly used processes in industry and machine shops today for machining parts to precise sizes and shapes. Milling is a cutting process that uses a milling cutter to remove material from the surface of a work piece. The milling cutter is a rotary cutting tool, often with multiple cutting points. As opposed to drilling, where the tool is advanced along its rotation axis, the cutter in milling is usually moved perpendicular to its axis so that cutting occurs on the circumference of the cutter.

4.2 Tig Welding

Gas tungsten arc welding (GTAW), also known as tungsten inert gas (TIG) welding, is an arc welding process that uses a non-consumable tungsten electrode to produce the weld. The weld area is protected from atmospheric contamination by an inert shielding gas (argon or helium), and a filler metal is normally used, though some welds, known as autogenously welds, do not require it.

A constant-current welding power supply produces energy, which is conducted across the arc through a column of highly ionized gas and metal vapors known as a plasma. GTAW is most commonly used to weld thin sections of stainless steel and non-ferrous metals such as aluminum, magnesium, and copper alloys.

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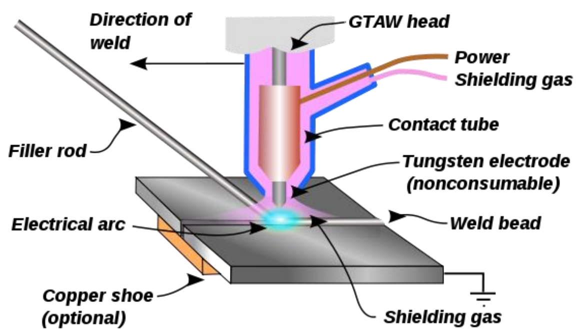
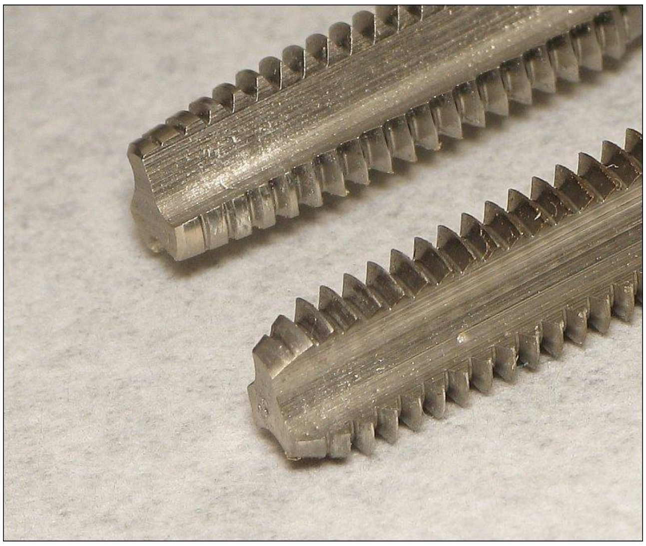


4.3 Angle Drilling

Angle Drilling is a cutting process that uses a drill bit to cut or enlarge a hole of circular cross-section in solid materials. The drill bit is a rotary cutting tool, often multipoint. The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work piece, cutting off chips from the hole as it is drilled.

4.4Threading using Taps

Taps and dies are cutting tools used to create screw threads, which is called threading. A tap is used to cut the female portion of the mating pair (e.g., a nut). A die is used to cut the male portion of the mating pair (e.g., a bolt). The process of cutting threads using a tap is called tapping, whereas the process using a die is called threading. Both tools can be used to clean up a thread, which is called chasing.



5. Experimental Setup

a) **Alternator:** In the apparatus involved a YAMAHA RX135 two stroke engine is used to run an alternator (both of which are mounted on a cast iron stand specially made for the purpose). An alternator is an electromechanical device that converts mechanical energy to electrical energy in the form of alternating current. Coupling it to a 3-phase induction motor and making it work for 1kw, 2kw, 3kw, 4kw & 5kw at 1000 rpm calculate its efficiency.
b) **Load bank:** The load bank consists of 10 halogen bulbs with rating 500 watt each. They are connected across the alternator terminals. Testing is done by turning on two bulbs subsequently which makes total of 5000 W.
c) **Ammeter:** An ammeter is a measuring instrument used to measure the electric current in a circuit. Electric current are measured in amperes (A) as the load is increased, it withdraw more current. Current is directly is proportional to load.
d) **Voltmeter:** A voltmeter is an instrument used for measuring electrical potential difference between two points in an electric circuit.
e) **Wattmeter:** The wattmeter is an instrument for measuring the electric power (or the supply rate of electrical energy) in wars of any given circuit. The electric power also increases with increase in load.
f) **Tachometer:** A tachometer (revolution-counter, tech, rev-counter, RPM gauge) is an instrument measuring the rotation speed of shaft or disk, as in motor or other machine. The device usually displays the revolution per minute (RPM) on a calibrated analogue dial, but digital displays are increasingly common. It is coupled with the alternator shaft. Testing is done at constant rpm i.e 1000 rpm.
g) **Burette:** A burette is a vertical cylindrical piece of laboratory glassware with a volumetric graduation etched permanently on its full length and a precision tap, or stopcock with plug and bore, on the bottom. The gasoline fuel mixed with oil is filled burette. During testing, per second fuel consumption is noted in burette for different load and at constant rpm. Fuel consumption increases with increase in load.

Chapter 6

6. Testing

6.1 Testing for Emission Control

An emission test cycle is a protocol contained in an emission standard to allow repeatable and comparable measurement of exhaust emissions for different engines or vehicles. Test cycles specify the specific conditions under which the engine or vehicle is operated during the emission test. There are many different test cycles issued by various national and international governments and working groups. Specified parameters in a test cycle include a range of operating temperature, speed, and load. Ideally these are specified so as to accurately and realistically represent the range of conditions under which the vehicle or engine will be operated in actual use. Because it is impractical to test an engine or vehicle under every possible combination of

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speed, load, and temperature, this may not actually be the case. Vehicle and engine manufacturers may exploit the limited number of test conditions in the cycle by programming their engine management systems to control emissions to regulated levels at the specific test points contained in the cycle, but create a great deal more pollution under conditions experienced in real operation but not represented in the test cycle.

6.2Testing for Fuel Efficiency

Fuel consumption is the amount of fuel used per unit distance; for example, liters per 100 kilometers (L/100 km). In this case, the lower the value, the more economic a vehicle is (the less fuel it needs to travel a certain distance).

7. Test Result

7.1.Test for Emission Control

Single Spark Plug

Serial No. 29723
Transport Dept. Seal

FORM (Computerised Pollution under Control Certificate/Petrol/CNG/LPG)
(See Rule 116-B (10) (C) (Authorised by the Transport Department)

SHOBITHA EMISSION CHECK CENTRE
NO. 225, TTK ROAD, ALWARPET, CHENNAI - 600 018.
PHONE : 044-32422097, MOBILE : 98413 49603
CENTRE CODE : TN-07-009 Authorisation No. 62/99 Valid Till : 11-3-2014

I.D. Number : TNtn07 009000834
Vehicle Number : TN04 D 2216
Month & Year of Manufacture : 08-07-1996
BS II Complaint : 0
Odometer Reading (Kms) : NON BS
Test : IDLING

Type of Vehicle 2W
Type of Engine 2S
Maker's Name YAMAHA
Maker's Class RXG

Fuel : PETROL
Date 09-Mar-2014
Time 17:47

PARAMETER	Regulation Limit	Actual
CO (% by Vol)	4.5	2.94
HC (PPM)	9000	4306
CO2 / LAMBDA	0	2.3 / 16.2

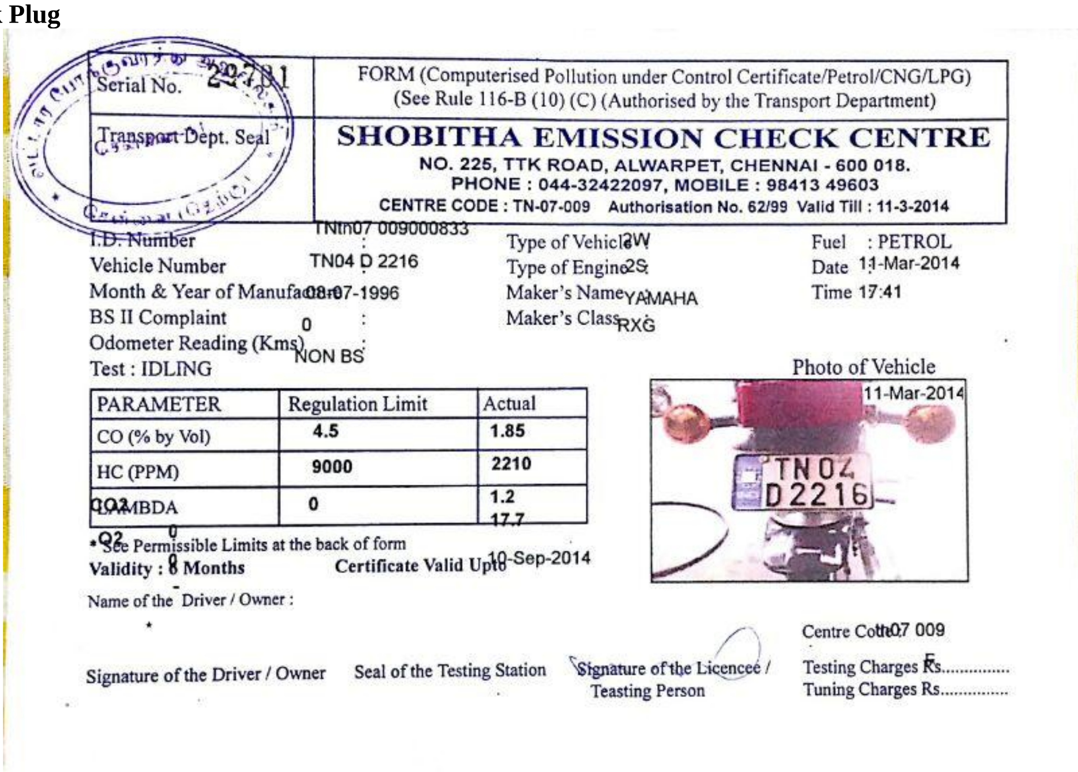
* See Permissible Limits at the back of form
Validity : 6 Months Certificate Valid Upto 08-Sep-2014

Name of the Driver / Owner :

Photo of Vehicle
09-Mar-2014

Signature of the Driver / Owner
Seal of the Testing Station
Signature of the Licencee / Teasting Person
Centre Code tn07 009
Testing Charges Rs..............
Tuning Charges Rs..............

Twin Spark Plug



Serial No. 29781
Transport Dept. Seal

FORM (Computerised Pollution under Control Certificate/Petrol/CNG/LPG)
(See Rule 116-B (10) (C) (Authorised by the Transport Department)

SHOBITHA EMISSION CHECK CENTRE
NO. 225, TTK ROAD, ALWARPET, CHENNAI - 600 018.
PHONE : 044-32422097, MOBILE : 98413 49603
CENTRE CODE : TN-07-009 Authorisation No. 62/99 Valid Till : 11-3-2014

I.D. Number : TNtn07 009000833
Vehicle Number : TN04 D 2216
Month & Year of Manufacture : 08-07-1996
BS II Complaint : 0
Odometer Reading (Kms) : NON BS
Test : IDLING

Type of Vehicle 2W
Type of Engine 2S
Maker's Name YAMAHA
Maker's Class RXG

Fuel : PETROL
Date 11-Mar-2014
Time 17:41

PARAMETER	Regulation Limit	Actual
CO (% by Vol)	4.5	1.85
HC (PPM)	9000	2210
CO2 / LAMBDA	0	1.2 / 17.7

* See Permissible Limits at the back of form
Validity : 6 Months Certificate Valid Upto 10-Sep-2014

Name of the Driver / Owner :

Photo of Vehicle
11-Mar-2014

Signature of the Driver / Owner
Seal of the Testing Station
Signature of the Licencee / Teasting Person
Centre Code tn07 009
Testing Charges Rs..............
Tuning Charges Rs..............

Engine's Efficiency for various loads can be calculated by the formula
Engine Efficiency= Overall efficiency/Alternator's Efficiency.

Density of petrol = 737.22 × 10-3 gm/ml
Calorific value of petrol = 50 kJ/gm

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7.2 Test for Overall Efficiency

Single Spark Plug

S. no	Laod (in kw)	Voltmeter (volts)	Wattmeter (watts)	Ammeter (amperes)	Fuel consumption (ml/s)	Overall efficiency
1	1	175	355	2.3	0.21	4.52%
2	2	170	610	4.1	0.23	7.28%
3	3	180	1100	8.7	0.28	10.44%
4	4	185	1340	10.3	0.32	11.27%
5	5	185	1650	2.7	0.4	11.19%

Twin Spark Plug

S no.	Load (kw)	Voltmeter (watts)	Wattmeter (in watt)	Ammeter (amperes)	Fuel consumption (ml/s)	Overall efficiency
1	1	185	360	2.6	0.20	4.8%
2	2		670		0.22	8.36%
3	3	180	1180	9.2	0.25	12.8%
4	4	185	1410	10.8	0.28	13.7%
5	5	190	1720	13.1	0.35	12.8%

Engine Efficiency

Single Sparkplug

Load (kw)	*Engine efficiency*	*Mean efficiency*
1	17.98%	20.12%
2	22.64%	
3	18.90%	
4	22.00%	

Twin Sparkplug

Load (in kw)	*Engine's efficiency*	*Mean efficiency*
1	19.09%	23.36%
2	26.00%	
3	23.16%	
4	26.74%	

Testing for Brake Power

S.no.	*Load (kw)*	*Power (watts)*	
		Single spark plug	*Twin spark plug*
1	1	1391.79	1407.35
2	2	1919.42	2108.44
3	3	1950.68	2134.25
4	4	2595.01	2759.85
5	5	2801.43	2818.49

List of Material and Estimation

Sl.No	*Product*	*Quantity*	*Price*
1	Head	1	2500
2	Spark Plug	2	115
3	Tig Welding		1600
4	Electrical Wiring		1350
5	Engine Oil	700ml	450
6	Plug Holder	2	60
7	Ignition Coil	2	560
8	Pollution Report	2	100
9	Taps	1	350
10	Petrol	5L	350
11	Machining		1000
12	Labour		1200
	TOTAL		**9635**

8. Conclusion

The experimental study confirms that:

1) Two stroke engines have a good potential if dual spark plug technology is employed.
2) Applying the dual spark plug in two stroke gasoline engine combustion process have improved hence efficiency of the engine is improved.
3) Less fresh charge will move out in the scavenging process by applying the dual spark plug. It means scavenging process have been improved.
4) On applying the dual spark plug in two Stroke Gasoline engine the problem of fuel economy will also be improved due to proper combustion inside the cylinder.
5) More power can be generated from the same size engine by employing dual spark plug its mean improvement in power without changing the fuel input.

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