

# Twin's Spark Plug Performance Study on Single Cylinder S.I. Engine with Gasoline Fuel a Technical Review

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## Abstract-

A new dual spark ignition engine has been developed by introducing two spark plugs at different. The results are compared with that of a single plug operation. The results have shown that performance of dual spark plug engine is comparatively better than the conventional single plugs. [1] This paper describes review on performance study and characteristic of two spark plugs. Two spark ignition engine 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 condition fuelled by gasoline and natural gas. 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 Ignition engine. Locations and the study are conducted at different load conditions for the two-spark arrangement, spark plugs were considered to be located diametrically opposite to each other on cylinder head axis symmetrically.

## Keywords-

Spark plug; Performance; Gasoline Fuel; Ignition; Engine

## 1. INTRODUCTION

A spark plug is device which is used to ignition of the engine cylinder. Gasoline and petrol engine is used for automotive application. The automobile plays an important role in the transportation system in India. With increase in population and living standard, the vehicles as well as pollution is increasing day by day. Among all of this, there is steep increase in the number of two wheelers during the last ten years. All these are increasing exhaust pollution. [3]

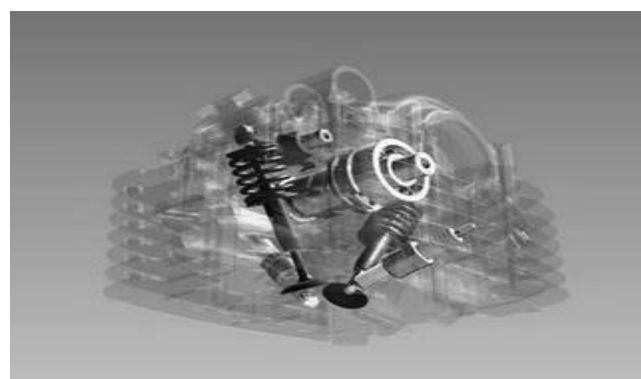


FIG.-Twin spark ignition engine

We can study of two spark plug performance, Twins spark plug is more power produce to the motorcycle engine. This Study is focused on using two spark plug as a design parameter to improve combustion. Dual spark are one of the important design parameters for SI engines. The primary benefit of using twin spark is to achieve a stronger and faster combustion. This enable the engine to operate with leaner fuel-air mixture, i.e. with more EGR (exhaust gas recirculation), for emission control. Although there are some experimental study about performance study of dual spark SI engine. Two spark plugs better than single spark plug this type of spark plug using modify engine. This study is focused on using two spark plug as a design parameter to improve combustion. Investigated from the result of the study it was found that the centrally located single-spark configuration gives the best performance and fuel economy in comparison to all other configuration. If central location of spark plug is not possible because of the some design constraints, twin-spark plug configuration can be preferred.[3]

## 2. HISTORY OF SPARK PLUG

The first known spark plug was invented on February 2, 1839 by Edmond Berger. France dominated the spark plug market in the early 1900s, supplying gasoline engine manufacturers with only a limited line of plug configuration. They were also

known to be quite costly and had substandard quality. Albert Champion was born in France in 1878. In 1889, renowned bicycle and motorcycle racer, Champion came to America to compete in a series of races. He had brought several bicycles and motorcycles, but found parts very hard to find in the United States. As a result, Champion made his own. To help pay bills and cover expenses, Champion began making spark plugs and sold them to friends. Champion's love of motors slowly turned towards automobiles and he later returned to France to open a shop that manufactured spark plugs and magnetos. [4]

### 3. ENGINE MODIFICATION TO SET UP TWO SPARK PLUGS

Study was conducted on a two-stroke air cooled gasoline engine with necessary modification to accommodate dual plugs. The fin over the engine dissipates heat to the surrounding air, thus preventing the overheating of the engine. A fan is provided to blow air over the engine fins for effective cooling. The inlet and exhaust valves are operated by a cam shaft driven by a crank shaft. The original spark plug 'A', whose diameter is 14 mm, one more hole is threaded in the engine cylinder head diametrically opposite to it, to fit the second spark plug 'B' shown in figure 2. [5]

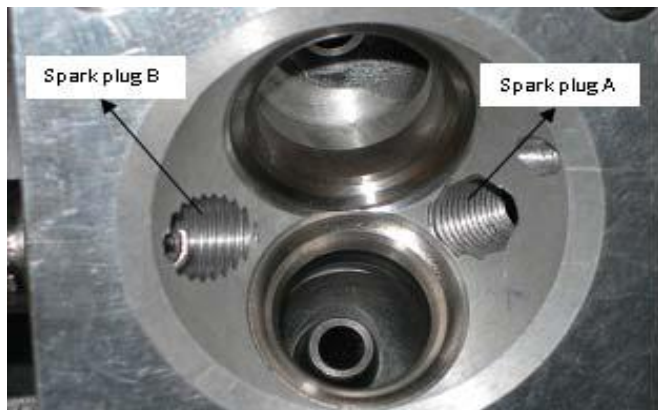


Fig.(2) view of cylinder head with provision for two spark plugs.

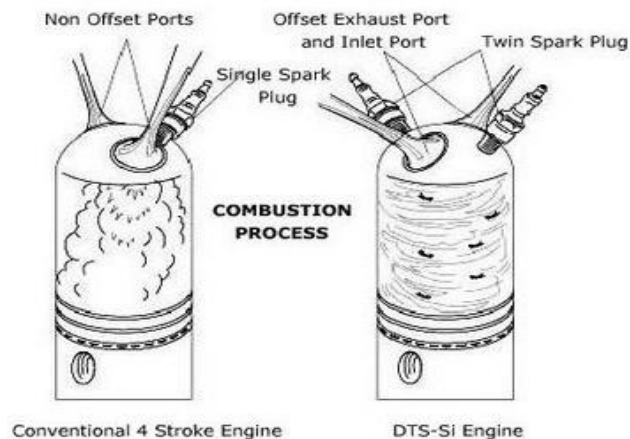


Fig.(3) using single and dual spark plugs

The original spark plug 'A' is made to fire as per the ignition timing set by the manufacturer. It is a centrifugally advanced ignition system where the ignition timing varies with speed. The ignition timing is 100 BTDC (Before Top Dead Centre) at 1300 rpm and 320 BTDC at 4000 rpm. The spark plug 'B' is connected to a battery coil capacitor discharge ignition system. Spark timing of spark plug 'B' is varied by using a spark timing variation unit fitted on to the engine shaft. The position of TDC (Top Dead Centre) and graduations of 10 are marked on the either side up to 400 before and after TDC. This helps in setting the correct ignition time for the spark plug 'B'. The ignition timing for the spark plug 'b' is set manually. To measure the air flow rate, an orifice is used. The pressure difference across the orifice is indicated by a manometer fitted to the tank.

By noting the difference in water level in the two limbs of manometer the air flow rate can be calculated. Engine specifications are given table 1.) [5]

Table 1: Specification of the engine

Number of cylinders	1
Number of strokes	2
Cooling	Air cooled
Rated power	6kw@7500rpm
Cylinder diameter	0.053m
Stroke length	0.045m
Compression ratio	9.5
Orifice diameter	0.013
Dynamometer	Eddy current type
Dynamometer arm length	0.185m
Coefficient of discharge for air flow orifice	0.64

The schematic diagram of the engine set up is shown in figure 3.

To measure the air flow rate, an orifice tank is used. The pressure difference across the orifice is indicated by a manometer fitted to the tank. By noting the difference in water level in the two limbs of manometer the air flow rate can be calculated. The rate of fuel consumption is computed by recording the time taken for consumption of 10 cc of fuel.

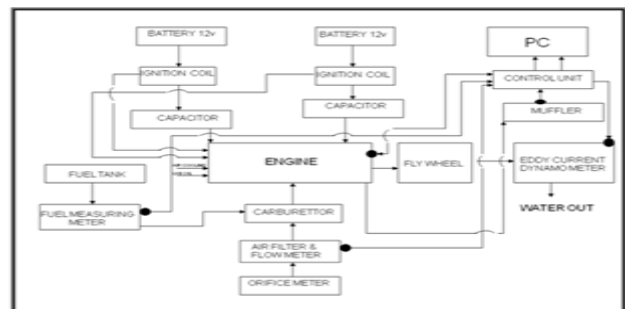
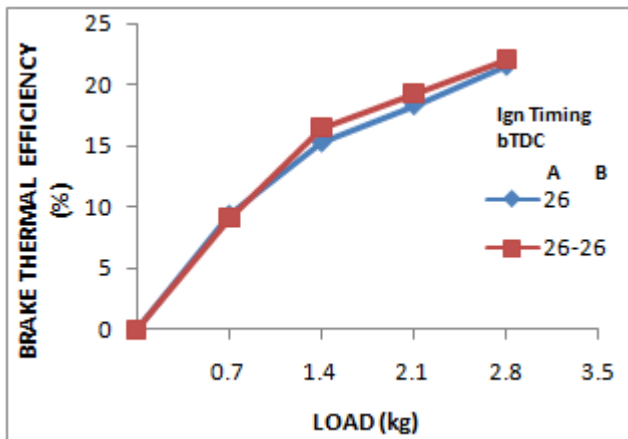
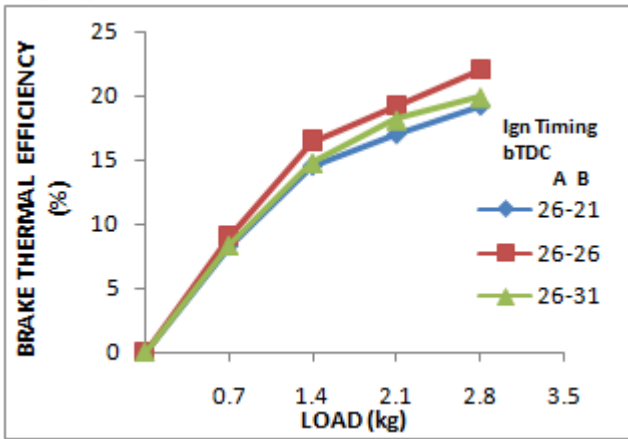


Fig.(4) Schematic layout of engine test set up



**Fig.5): Variation of BTE with load for (a) Twin plug under different ignition timings (b) Comparison with Single plug**

An exhaust gas analyzer was used to indicate the value of CO in % NOx and UBHC in ppm present in the exhaust gas. The exhaust gas analyzer was initially tested into for leakage and then allowed to warm us for 60 second. After that the hose pipe of the analyzer was inserted into the tail pipe of the engine. The reading displayed was then recorded in the first study was conducted at 3000rpm. [5]

#### 4. THE SPARK-IGNITION PROCESS

The gasoline is observed to burn as a vapour mixed with air above remaining liquid, but quickly vaporising gasoline. The auto-ignition temperature of a hydro carbon fuel is that temperature where the fuel now sufficient internal energy to break its hydrogen carbon bond structure and be oxidised to carbon dioxide and steam. In case of gasoline the auto ignition temperature is about 220. The velocity of the flame front has been recorded in two stroke engines between 20 and 50 m/s. It will be observed this hardly an explosive process. [6] Although it is sufficiently rapid to allow the engine burn its fuel efficiency even at highest engine speeds. When the spark occurs in a lean mixture the mass of fuel vapour and air which is ignited in the vicinity of the spark is too small to provide an adequate release of heat to raise the surrounding layer of unburned mixture to the auto ignition temperature.

Consequently the flame doesn't develop and combustion doesn't takes place. In this case intermittent misfire is the normal experience as unburned mixture forms the bulk of the cylinder contents during the succeeding scavenge process and will supplement the fuel supplied by it. [7-8]

#### 5. RACING SPARK PLUG AND TESTING PERFORMANCE APPLICATION

Spark Plugs technical support staff receives numerous technical calls concerning automotive racing applications. Many of these calls reveal racers have installed incorrect spark plugs and engines are inaccurately tuned.

##### 5.1 Planning Ahead

Properly building and tuning your race engine for optimum performance is essential. Similar to a finely tuned instrument, engine components need to work simultaneously in order to build maximum horsepower. Racers often spend less time planning and more time installing various parts with expectations they will work. Taking your time to plan ahead will save time, money and hours of aggravation. Contact reputable parts manufacturers, engine builders and tuners when building your race engine. Highly trained engine builders and tuners should be able to provide references. [9]

##### 5.2 Understanding Spark Plugs

The spark plug has two functions; one is to ignite the air/fuel mixture and the other is to transfer heat from the combustion chamber. Spark Plug heat range is selected through a series of pre-ignition tests. Thermal couple spark plugs are used to record internal centre electrode and ground electrode tip temperatures. Optimum firing end temperatures must fall between 500°C to 800°C. If the tip temperature falls below 450°C the spark plug is considered to be in the fouling region. This means the tip temperature isn't hot enough to burn off carbon deposits. If the tip temperature raises above 800°C the spark plug tip temperature is too hot and the spark plug is considered to be in the pre-ignition region. Pre-ignition is detrimental to an engine and can ultimately lead to spark plug failure and extensive engine damage. [9]

#### 6. CONCLUSION

Based on the experimental data obtained on a single cylinder, vertical, air cooling, self governed two stroke spark ignition engine with petrol fuel .The engine is run with single spark plug mode and dual spark plug mode after performing several experimental run and based on result obtained, following conclusion's are made. Any given engine configuration there exist an optimum compression ratio, which gives best performance with respect to efficiency and exhaust emissions, in dual plug mode. Hence it is suggested that care must be taken to select a compression ratio in the design stage, so as to obtain maximum benefits from the dual plug combustion engines. The performance parameter of the engine are significantly improve-

- 1) Two stroke engine's have a good potential if two spark plug technologies is employed.
- 2) Applying the two spark plug in two stroke gasoline engine combustion process hence efficiency of the engine is improved.
- 3) On applying the two spark plug in two stroke petrol engine the problem of fuel economy will also be improved due the proper combustion inside the cylinder.
- 4) The brake thermal efficiency of the engine is more with two spark plugs configuration when compared single spark plug mode at 1500rpm.
- 5) Using two spark plug obtain maximum benefit of the engine performance.
- 6) More power can be generated from the same size of engine by employing two spark plugs its mean improvement in power without changing other parameter. [10]

## 7. ACKNOWLEDGEMENT

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