# A Review of Testing of Multi Cylinder S.I. Petrol Engine

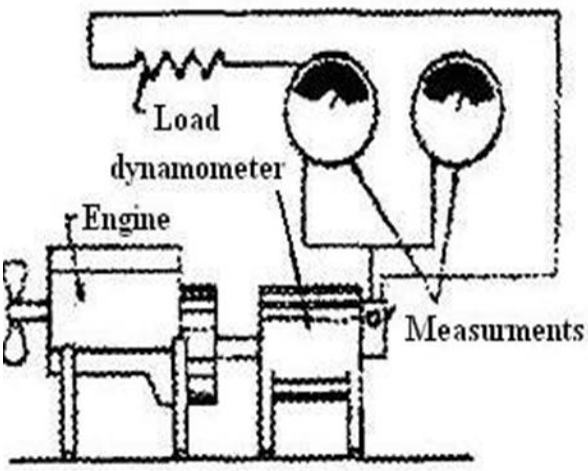
Prof. Mr. Narendra Patel[1], Rahul Patel[2], Abhishek Singh[3], Vishal Bathra[4], Tejpal Regar[5], Mehul Panchal[6]
[1]*Professor, Geetanjali Institute of technical studies, Udaipur, India*
[2,3,4,5,6] *Student, Geetanjali Institute of technical studies, Udaipur, India*

***Abstract-*** **The fundamental assignment of the advancement engineer is to diminish the expense and improve control yield and unwavering quality of the motor. Endeavoring to accomplish these objectives there is different structure ideas to discover the consequences for motor execution of a specific plan idea to resorts to testing. Subsequently, as a rule, advancements of motor should direct a wide assortment of motor tests. An IC motor is utilized to deliver mechanical power by burning of fuel. Power is alluded to as the rate at which work is finished. Power is communicated as the result of power and direct speed or result of torque and rakish speed. So as to quantify control one needs to gauge torque or power and speed. The power or torque is estimated by Dynamometer and speed by Tachometer. The power created by a motor and estimated at the yield shaft is known as the brake control. While figuring brake control for single barrel motor it is simple yet in the event of multi chamber motor its very troublesome due to the idleness powers created. In such cases the Morse test can be utilized to gauge the demonstrated power and mechanical productivity of multi chamber motors.**

**Index Terms- Indicated Power, Brake Power, Mechanical Efficiency, Dynamometer, Constant Speed**

## I. INTRODUCTION

The motivation behind Morse test is to acquire the estimated demonstrated intensity of a Multi barrel motor. It comprise of running the motor against the dynamometer at a specific speed, removing the terminating of every chamber thus and taking note of the fall in BP each time while keeping up the speed consistent. When one barrel is cut off, control created is decreased and speed of motor falls. Appropriately the heap on dynamometer is balanced in order to reestablish the speed of the motor. This is done to keep up FP steady, which is viewed as free of the heap and corresponding to the motor speed. The watched distinction in BP between all chamber terminating and one barrel cut off is the IP of the cut off chamber. Summation of IP of the whole chamber would then give the IP of the motor under test. The Morse Test is performed to discover the power created in every barrel in a multi chamber inward burning motor. It fundamentally gives the connection between demonstrated power and brake control. It is expected that grinding and siphoning misfortunes don't change and stays same when the chamber is in terminating condition just as in out of commission condition. Utilizing these test frictional misfortunes in the IC motor




can be effectively determined. It is a straightforward way to deal with locate the mechanical productivity of the motor. First power created by every one of the chambers is resolved tentatively.

At that point utilizing the power supply slice off to the flash fitting of barrel, powers created by individual chambers are resolved. At that point for the rest of the barrels, control created by motor is resolved tentatively and acquired esteem is subtracted from the principal esteem and this gives control created in the chamber whose sparkle plug was cut off. In the comparative design, this test is performed on every one of the chambers of the motor separately. The principle goal of completing the Morse test in an IC motor is to give a simple strategy for computing

the frictional misfortunes. It gives a sort of top-down methodology in figuring frictional misfortunes effectively and computes mechanical proficiency. The complete break intensity of the motor is first determined utilizing a dynamometer. The procedure is rehashed with one chamber off at each progression. This the distinction between complete break power and break intensity of the rest of the chambers gives the demonstrated intensity of the main barrel; thus on. In along these lines, showed intensity of all chambers are determined and summed to get the demonstrated intensity of the motor Friction control = demonstrated power - absolute brake control. When rubbing power is gotten, the mechanical productivity of the motor can be determined. Then using the power supply cut off to the spark plug of cylinder, powers developed by individual cylinders are determined. Then for the remaining cylinders, power developed by engine is determined experimentally and obtained value is subtracted from the first value and this gives power developed in the cylinder whose spark plug was cut off. In the similar fashion, this test is performed on all the cylinders of the engine individually. The main intention of carrying out the Morse test in an IC engine is to provide an easy method of calculating the frictional losses. It provides a kind of top-down approach in calculating frictional losses easily and helps calculate mechanical efficiency. The total break power of the engine is first calculated using a dynamometer. The process is repeated with one cylinder off at each step. This the difference between total break power and break power of the remaining cylinders gives the indicated power of the first cylinder; and so on. In this way, indicated power of all cylinders are calculated and summed to obtain the indicated power of the engine Friction power = indicated power - total brake power. Once friction power is obtained, the mechanical efficiency of the engine can be calculated.

1.1Dynamometer


Fig 1.1 Dynamometer

A dynamometer or "dyno" for short is a gadget for estimating power, torque, or power. For instance, the power delivered by a motor, engine or other turning prime mover can be determined by at the same time estimating torque and rotational speed (RPM).

Notwithstanding being utilized to decide the torque or power qualities of a machine under test, dynamometers are utilized in various different jobs. In standard outflows testing cycles, for example, those characterized by the United States Environmental Protection Agency, dynamometers are utilized to give recreated street stacking of either the motor (utilizing a motor dynamometer) or full powertrain (utilizing a body dynamometer). Truth be told, past straightforward power and torque estimations, dynamometers can be utilized as a feature of a testbed for an assortment of motor improvement exercises, for example, the alignment of motor administration controllers, definite examinations concerning ignition conduct, and tribology.

1.2 Multi Cylinder Petrol Engine

A multi-cylinder engine is a reciprocating internal combustion engine with multiple cylinders. It can be either a 2-stroke or 4-stroke engine, and can be either Diesel or spark-ignition. The cylinders and the crankshaft which is driven by and co-ordinates the motion of the pistons can be configured in a wide variety of ways. Multi-cylinder engines offer a number of advantages over single-cylinder engines, chiefly with their ability to neutralize imbalances by having corresponding mechanisms moving in opposing directions during the operation of the engine.

A multiple-cylinder engine is also capable of delivering higher revolutions per minute (RPM) than a single-cylinder engine of equal displacement. This is true for two reasons. First of all, the stroke of the pistons is reduced. This decreases the distance necessary for a piston to travel back and forth per each rotation of the crankshaft, and thus limiting the piston speed for a given RPM. Secondly, in an engine with multiple cylinders, the piston mass is reduced. This reduces stress on internal components at higher RPM's. Typically, the more cylinders an engine has, the higher the RPM's it can attain for a given displacement and technology level, at a cost of increased friction losses and complexity. Peak torque

is also reduced, but the total horsepower is increased due to the higher RPM's attained.

Although there are 1, 3 and 5-cylinder engines, almost all other inline engines are built with even numbers of cylinders, as it's easier to balance out the mechanical vibrations. Another form of multiple-cylinder internal combustion engine is the radial engine, with cylinders arranged in a star pattern around a central crankshaft. Radial engines are most commonly used as aircraft engines, and in basic single-row configuration are built with odd numbers of cylinders (from 3 to 9). An odd number of cylinders is necessary in a four stroke radial, since the firing order is such that every other cylinder fires as the crankshaft rotates. Only with an odd number of cylinders will all cylinders evenly fire in this manner in two crankshaft revolutions (first the odd cylinders, followed by the even cylinders). "Twin-row" or "multi-row" radials are also built, which is basically two or more single-row radials connected front-to-back and driving a common crankshaft. In this "twin row", or "multi-row" configuration, the total number of cylinders will be an even number, although each row still has an odd number. For example, a typical single row radial such as the Wright Cyclone has 9 cylinders. The twin row Wright Twin Cyclone is based on this engine and thus has two banks of 9 cylinders, for a total of 18, an even number.

The design and development of test setup and experimental data collection and analysis are equally important for any experimental research. For the success of test rig development depends on proper planning, design and selection of right kind of equipment and measuring instruments and skill in fabrication and the precession and accuracy of the observations during trial. All the above mentioned parameters are discussed in this paper.

## 2. LITERATURE REVIEW

2.1 Professor R. S. Benson, has investigated the Performance and Emission Predictions for a MultiCylinder Spark Ignition Engine. A comparison is made of experimental results and predictions of performance and emissions from a multi-cylinder spark ignition engine over a range of air-fuel ratios and two throttle settings. The results showed that a simplified two zone combustion model, a seven reaction scheme for nitric oxide formation, a partial freezing model for carbon monoxide and the inclusion of chemical reactions and variable specific heat along the path lines in the wave equations gave good agreement with the measurements at the common pipe junction and exhaust outlet, but due to cyclic dispersion and misdistribution of fuel between cylinders the predictions of the emissions in the exhaust manifold adjacent to the cylinder were not so good.

2.2 Dyer, T., has given a New Experimental Techniques for In-Cylinder Engine Studies. A wide variety of new experimental diagnostic techniques have been developed to more fully characterize the physical and chemical processes occurring in an IC engine. The advent of lasers has spurred interest in the development and application of optical techniques for no perturbing, in situ measurements of temperature, species concentration, velocity and turbulence. These supplement and expand the capability of those classical techniques that are reviewed in a companion paper. The new diagnostics are categorized according to the particular part of the engine cycle under investigation: precombustion fluid motion, fuel preparation, combustion, and emission formation. Current applications of each technique to engine experiments are surveyed and put into the perspective of resolving critical issues facing the engine design community

2.3 Mitsuhiro Soejima.Yutaro Wakuri.Yoshito Ejima. Have done a Study on the measuring method of the total friction loss of internal combustion engines. In the given study a new test method is investigated to measure the total friction loss of engines over the whole range of speed and load. It is based on the idea that the friction loss close to the true one of fired and braked engines can be measured by the run-out method because the temperature mainly influencing the friction loss is almost stable for the short runout test duration.

2.4 A Chow, M. L. Wyszynski, have made a Thermodynamic modeling of complete engine systems review. This paper gives an overview of engine systems modeling by first and second law analysis. Complex engine systems are becoming more commonly implemented to meet the increasing demands of fuel efficiency and emission legislation.

Future engine systems may also include both exhaust gas treatment and fuel processing devices. This leads to complex interactions within the thermodynamics and chemistry of power plant systems. There is therefore a need to improve the systems modeling methods. This concerns first of all the composition tracking and the models of three-way catalytic exhaust converters and fuel processors. The applicability of gas dynamics modelling to chemically complex systems is also discussed. All these processes need to be modelled as interacting parts of one system.

2.5 Abdalla, M., have investigated a "Cut-Off Control: A Promising Method of Load Regulation in Spark Ignition Engine," This paper presents a theoretical and experimental study of the effect of cut-off control on engine performance. Cut-off control is an alternative method of load regulation in spark ignition engine. During cut-off operation, the charge is admitted at wide open throttle; hence the inlet charge passage is to be shut down before the completion of intake stroke. Cut-off is to be attained by means of an additional rotary valve mounted in series with the conventional inlet valve. The study indicates that cut-off control can provide a significant improvement in fuel economy. The effect of some important design parameters is also considered.

2.6 Misty, C. And Gandhi, have done an., Experimental Investigation on Multi-Cylinder Engine Using Petrol and LPG as a Fuel. Today's changing social and industrial scenario demands extensive use of fuel in vehicles which may lead to its depletion in near future. In view of the possible depletion of fossil fuel reserves, research is being done on various alternative fuels including renewable and nonrenewable resources. In the present study, experiments have been conducted on a conventional multi-cylinder engine, which was modified to work on a duel fuel mode with LPG and petrol as fuels. Engine testing was carried out at variable speed and load using both the fuels. For the measurement of friction power loss Morse test was carried out. In order to measure the unaccountable losses heat balance sheets were prepared.

2.6 J.D.V. at el in this paper the study of petrol engine using compressed Biogas as a fuel is carried out and the following results are obtained Fuel consumption on petrol mode is less than compressed biogas. BSFC of compressed biogas is higher. Brake thermal efficiency on petrol mode will be higher compared to compressed biogas. Exhausts gas temperature of petrol fuel engine is more compared to compressed biogas Engine produces somewhat less Power Ranger run on compressed biogas compared to petrol.

2.7 N.B.G. at el in this paper contains performance analysis of multi cylinder CI engine by using various alternate fuel. Experiment is conducted with fuel with mixing of cashew nut oil, cottonseed oil and its blends in various proportions by volume and then following results are obtained on multi cylinder Hindustan 4 stroke diesel engine BSFC is less for the blend 20 over the entire range of load compared to diesel fuel. Mechanical efficiency B20 blend was considered higher over entire load range Volumetric efficiency for B40 blend was consider higher over entire load range. B20 blend is preferred to use because of low specific fuel consumption, power utilized is more, and low exhaust gas temperature

## 3. FUTURE SCOPE

It becomes easy to calculate the performance of the Multicylinder IC engine with the help of Morse test. In future it may be most useful engine testing technique over any other because of the increase in the use of high speed vehicles and the high speed vehicles mainly contains the Multicylinder engines. Slow speed vehicles are going to escape very soon as every consumer demands the high speed vehicle. And the manufacturers also like to produce the Multicylinder engines. In that case for the testing of Multicylinder engines, Morse test will be more useful. In future this manual test rig can be computerized using software’s which would be operator friendly. Modifications can be made for Morse test and also for specific Fuel consumption which can be measure by volume difference or by weight difference. Radiator can be eliminated with direct connection. And flow meter is required to measure mass and flow of exhaust gas

## 4. CONCLUSION

After performing the Morse test we can conclude that it is the most useful engine test to calculate the performance of the engine mainly the Multicylinder engines and in future the use is going to increase and it is very easy to calculate the performance of the engine. We can calculate the individual power developed by the engine cylinders separately and total indicated power is also calculated .we can also calculate the brake horse power of the engine It is also very easy to calculate the frictional losses of each cylinder.

The complete design of each component has been discussed in detail and the same details are used for fabrication. The trail is carried on the engine and various performance parameters such as Break thermal efficiency, mechanical efficiency and heat balance at various load conditions.

1. As brake power increases fuel consumption also Increases
2. Brake specific fuel consumption decreases with Increase in brake power
3. Exhaust temperature increases as brake power Increases
4. As brake power increases both brake thermal efficiency and mechanical efficiency increases our project might be have some its own limitations but an effort has been made to the fullest to make it successful.
5. Other than this theoretical view, in a real life scenario, the performance, comfort and fuel efficiency of a car depends on many other factors starting from the aerodynamics to the passenger weight.
6. There is no generalization that all three cylinder ones are fuel efficient and all four cylinder ones are better to drive.
7. It depends on many other factors like the manufacturer, engine refinement, quality components, and performance of the subsystems ET

REFERENCES


[1] Gamelan, V (2012). "Internal Combustion Engine". McGraw Hill Education (India) Pvt. Ltd.

[2] Raj put, R K. Thermal Engineering. Laxmi Publications. p. 1125. ISBN 9788131808047. 3.

[3] "I C Engine Testing" (PDF). Retrieved 20111022. 4. A Text Book of Automobile Engineering – R.K. Raj put – Google Books. Books.google.co.in. 20070101.ISBN 9788170089919. Retrieved 20111022.

[4] The Internal combustionngine in – Charles Fayette Taylor –Google Books. Books.google.co.in.19850101.ISBN978026270027

[5] Retrieved 20111022. 6. "Methodology for Thermal Efficiency and Energy Input Calculations and Analysis of Biomass Cogeneration Unit characteristic's" (PDF). U.S. Environmental Protection Agency Office of Air and Radiation. Retrieved 20111022.

[6] Ricardo, H.R, 1958. ―The high speed internal combustion engine‖, blackie&sons Ltd., London.

[7] Rogowski, A.R, 1961. ―Method of measuring the instantaneous friction of piston and friction of piston ring in affirming engine‖, SAE, paper no. 379F.

[8] Taylor, C.F., 1966. ―The internal combustion engine in theory and practice‖, The M.I.T. Press, Cambridge, Mass.

[9] Willard, W.P., 2011 ―Engineering fundamentals of the internal combustion engine‖, PHI, New Delhi. 1) James D.Vaghmashi1 Mr.D.R.Shah2 Mr.D.C.Gosai3 - An Experimental Study of Petrol Engine Using Compressed Biogas as fuel - IJSRD Vol. 2, Issue 04, 2014 ISSN (online): 2321-0613

[10] N. BalajiGanesh1,Dr. B Chandra Mohan Reddy2 - Performance Analysis of Multi-Cylinder C.I. Engine by using Various Alternate Fusel- Tijeras Volume 2,Issue 4, June-July, 2014 ISSN 2091-2730

[11] SavitaPatil 1, Rupees Kumar Malviya2, Auber Dwivedi3 -Investigation on Performance Characteristics of Petrol Engine Using Alternate Fuel - IOSR e-ISSN: 2278-1684,p-ISSN: 2320-334XIssue 4 Ver. V (Jul- Aug. 2014),

[12] Adina T Folayan,"influence of engine parameter on performance characteristics of spark ignition engine", Pelagic research (200 8) pp1915-1922.

[13] Ganeshan.V "Internal Combustion Engines",7 Tata McGraw Hill Publishing, New Delhi, 2002.

[14] A Text Book on "Internal Combustion Engines" by Domkundwar

[15] E.porpatham, A. Ramesh, B. Nag lingam (2011) Effect of compression ratio on the performance and combustion of a biogas fuelled spark

ignition engine journal homepage: www.elsevier.com/locate/fuel

[16] Hey wood John's, "Internal Combustion Engineers Fundamental", Mc. Grew Hill Book Company, New Delhi, 1988.

[17] Carl S. Hansen, Coyly Hansen, Greg Sullivan, "Using Biogas as a Fuel for Trucks and Tractors", paper number: 074145, ASABE Meeting at Minnesota during 17 - 20 June 2007

[18] C.C.M. Lucite, E. Kerchief, "Atrophic oil and biogas In a dual fuel CI engine for rural electrification ", Energy Conversion and Management 52 (2011) 1426–1438

[19] R. Chandra, V.K. Vijay , P.M.V. Subarea , T.K. Kura, "Performance evaluation of a constant speed IC engine on CNG, methane enriched biogas and biogas ",Applied Energy xxx (2011)

[20] A. S. Gautama, R .Garrick. J. H. Lee, C. M. Demise, P. E. Hanne and L. A.Villasmil, "A Comparison of the Emission from Gasoline vs. Compressed Natural Gas for an Electronic Fuel Injected Two Cylinder, Four- Stroke Engine" SAE Technical Paper 2012-32-0016, 2012.