PAPER ID –D08

DESIGN OF TURBOCHARGER FOR KTM 390RC

Suyoj Kamble,
Department Of Mechanical Engineering
Indira College Of Engineering And Management, Pune, India
suyoj8888@gmail.com
Rahul Pawar,
Department Of Mechanical Engineering
Indira College Of Engineering And Management, Pune, India
realrjrahul@gmail.com,
Anubhav Srivastava,
Department Of Mechanical Engineering
Indira College Of Engineering And Management, Pune, India
anubhavpragesh@gmail.com
Abhishek Patil
Department Of Mechanical Engineering
Indira College Of Engineering And Management, Pune, India
gndptl@gmail.com
Prof.Snehal Sakhre
Department Of Mechanical Engineering
Indira College Of Engineering And Management, Pune, India
sne_hal@yahoo.co.in

***Abstract* — In order to increase energy efficiency of the vehicle powertrain, the innovative solutions in the construction of internal combustion engines, its aggregates, systems and equipment must be obtained. A trend that is prevalent today is widely known as downsizing. Namely, downsizing involves reducing of engine volume (consequently, its mass) and keeping or even increasing the power output compared to a reference IC engine in the same time. This trend of increasing energy efficiency is unthinkable without to use the supercharging systems. The most acceptable aspect supercharges the IC engines, in terms of energy efficiency is the use turbochargers that used exhaust gases which are producing in the combustion process in IC engines. Connecting turbochargers and IC engine is not feasible without knowing the turbochargers performance expressed in form of the compressor and turbine maps. Turbochargers performance testing is done on specialized development laboratories which are equipped with measuring elements necessary to simulate the working conditions prevailing in the real IC engines. Turbochargers testing methodology must be conducted in accordance with the recommendations of standards are defining testing regimes, measurement methodology and data analysis. Problem of creating a compressor map in accordance with standard requirements and guidelines of good engineering practice in this branch will be show in this paper. Special attention will be paid to the comprehension deviation of test results in the case of the use of test regimes that are not adapted to the requirements of standards.**

Keywords—Turbocharger, Turbine, Compressor

1.INTRODUCTION

In turbocharging, the turbocharger is being driven by a gas turbine using the energy in exhaust gases. The major parts of turbocharger are turbine wheel, turbine housing, turbo shaft, comp. wheel, comp. housing & bearing housing. A 4-stroke S.I. Engine is an engine that uses gasoline as fuel.
S.I..Engine is a spark ignited engine that is the combustion is carried out by spark ignition, it is achieved by installation of spark plug on cylinder head. A turbocharger uses the otherwise unused energy in the exhaust gases to drive a turbine directly connected by a co-axial shaft to a rotary compressor in the air intake system.

2.LITERATURE REVIEW

J. Cheong et. al., [2000] Power boosting technology of a High Speed Direct Injection (HSDI) Diesel engine without increasing the engine size had been developed along with the evolution of a fuel injection system and turbocharger. Most of the turbochargers used on HSDI Diesel engines had been a waste-gated type. That time, the Variable Geometry Turbocharger (VGT) with adjustable nozzle vanes was increasingly used, especially for a passenger car in European market. This study describes the first part of the experimental investigation that has been undertaken on the use of VGT, in order to improve full load performance of a prototype 2.5 litre DI Diesel engine, equipped with a common rail system and 4 valves per cylinder. The full load performance result with VGT was compared with the case of a mechanically controlled waste-gated turbocharger, so that the potential for a higher Brake Mean Effective Pressure (BMEP) was confirmed. Within the same limitation of a maximum cylinder pressure and exhaust smoke level, the low speed torque could be enhanced by about 44% at maximum. VGT is a device that can vary the flow area and flow angle between the turbine volute and rotor channel. Compared with a waste-gated turbocharger, it was possible not only to increase a boost pressure and charge air flow rate with VGT at low engine speeds, enabling a higher torque, but also to reduce fuel consumption at higher engine speeds, due to lower pumping losses with full utilization of the exhaust flow. With the use of the VGT, it was possible to increase the charge air mass by about 10 ~ 20 % at a low speed range. As a result of this, the exhaust smoke was reduced and the fuel consumption was improved with the same fuel delivery and start timing of injection.

Yashvir et. al., [2011] aimed at the work to increase the torque and power of the two-wheeler by supercharging the vehicle. For this purpose, LML freedom 125 cc was analysed for the work and certain parameters like torque, power, and specific fuel consumption vs rpm were calculated. The data calculated was used in software Engine Analyser for analysis purpose together with the data of supercharger. It can be seen that power and torque of the engine increases from 7 to 11 KW and 9 to 13 NM at 7500 and 9000 RPM respectively.

Ghodke et. al., [2012] said that expectation in next coming years is CO2 emissions reduction for vehicles and demand for more driving comfort would be the challenges for the automobile industry. One approach to this problem is the reduction of the displacement of the combustion engine while maintaining the characteristics of large displacement engine. This method is often referred to using the term" downsizing" and requires the engine to be turbocharged and improve performance and torque. It has been demonstrated that a simple charging unit alone is not enough and it require more complex charging systems when emissions are stringent. The goals of developed in terms of the thermodynamics and operating of future passenger car viz increase in the power density of the engine, highest possible maximum torque at low engine speeds across the widest possible range of speeds, improvement of the driving response in transient operating condition like start up response and elasticity response, reduction of the primary energy consumption during testing and when driving on the road, observances of the future exhaust gas thresholds which mean a drastic reduction in the current emission levels. The latter goals can be reached through the use of smaller displacement engines. Engines with low engine displacement yield significant advantages in the test cycles with respect to fuel consumption and emissions, but the torque produced by small engine is pronouncedly less than that of a large displacement, naturally aspirated engine must be attained in terms of the steady state response and of the transient response. The author summarized review of advancements in turbocharger technology to meet the demand of high performance and low emission of passenger car vehicle application.

Shaaban et. al., [2012] said that turbocharger performance significantly affects the thermodynamic properties of the working fluid at engine boundaries and hence engine performance. Heat transfer takes place under all circumstances during turbocharger operation. This heat transfer affects the power produced by the turbine, the power consumed by the compressor, and the engine volumetric efficiency. Therefore, non-adiabatic turbocharger performance can restrict the engine charging process and hence engine performance. His research work investigated the effect of turbocharger non-adiabatic performance on the engine charging process and turbo lag. Two passenger car turbochargers were experimentally and theoretically investigated. The effect of turbine casing insulation was also explored. His investigation shows that thermal energy is transferred to the compressor under all circumstances. At high rotational speeds, thermal energy is first transferred to the compressor and latter from the compressor to the ambient. Therefore, the compressor appears to be "adiabatic" at high rotational speeds despite the complex heat transfer processes inside the compressor. A tangible effect of turbocharger non-adiabatic performance on the charging process is identified at turbocharger part load operation. The turbine power is the most affected operating parameter, followed by the engine volumetric efficiency. Insulating the turbine is recommended for reducing the turbine size and the turbo lag. Experimental data show 55% decrease of the turbine actual power at 60000 rpm due to thermal energy transfer from the turbine. The effect of thermal energy transfer from the turbine on turbine power decreases with increasing the turbine rotational speed at constant exhaust gas temperature at the turbine inlet. This decrease is due to the rapid increase in the turbine power with increasing the rotational speed relative to the amount of thermal energy transfer from the turbine.

Vishal et. al., [2012] examined the current and the future trends in the development of gasoline direct injection engine and attempts at identifying the turbocharger requirements for such systems. Predicted engine performance data from various reputable published sources were used to identify the air flow requirements and thus the turbocharger needs. A case study was considered by sizing an engine from the gathered brake mean effective pressure trends and its turbocharger requirements were simulated using a Cummins's Turbo Technologies developed software. The software uses a steady state energy balance between the required compressor work and the extracted turbine work. The findings of the simulation and the turbocharger matching were subsequently analysed. From the analysis of the simulation, it can be deduced that turbocharging the GDI engine offer considerable challenges to the air handling system. The report has shown that, for a wide operating speed range with a low speed peak torque, conventional turbocharger systems may not be sufficient. The parallel sequential turbocharger system provides a right solution for wide flow range and near constant pressure ratio demands. The control mechanism for the switch from the low speed turbocharger to the high speed one needs to be calibrated to ensure that during the transition, there is no loss of boost pressure and therefore loss of torque.

3. WORKING OF TURBOCHARGER

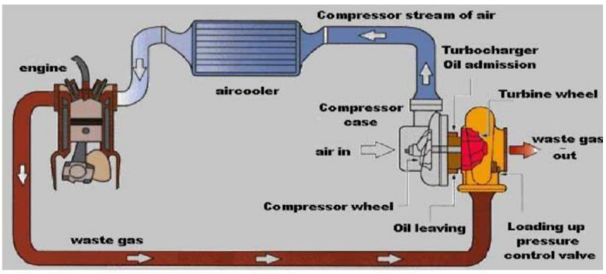
*A **turbocharger*** mainly consists of two main sections: the turbine and the compressor. The turbine consists of turbine wheel and the turbine housing whose purpose is to guide the exhaust gases into the turbine wheel. The kinetic energy of the exhaust gases gets converted into the mechanical after striking it on turbine blades. The exhaust outlet helps the exhaust gases to get exit from the turbine. The compressor wheel in ***turbocharger*** is attached to a turbine with the help of steel shaft and as the turbine turns the compressor wheel, it draws the high-velocity, low pressure air stream and convert it into high-pressure, low –velocity air stream. This compressed air is pushed into the engine with the more quantity of fuel and hence produce more power.

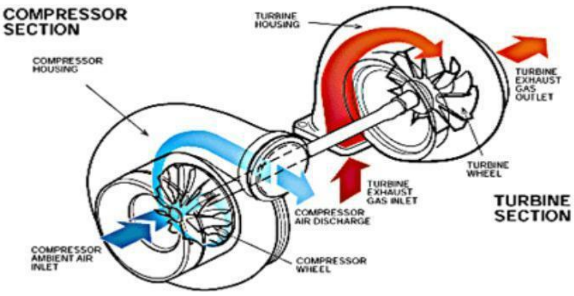
Since the power a piston engine can produce is directly dependent upon the mass of air it can ingest, the purpose of forced induction (turbo-supercharging and supercharging) is to increase the inlet manifold pressure and density so as to make the cylinders ingest a greater mass of air during each intake stroke. A supercharger is an air compressor driven directly by the engine crankshaft, and as such, consumes some of the power produced by the combustion of fuel, thereby increasing BSFC and engine wear for a given amount of produced power. A turbocharger consists of a turbine and a compressor on a shared shaft. The turbine converts heat to rotational force, which is in turn used to drive the compressor. The compressor draws in ambient air and pumps it in to the intake manifold at increased pressure, resulting in a greater mass of air entering the cylinders on each intake stroke. The output of the engine exhaust gas is given to the input of the turbine blades, so that the pressurized air produced. This power, the alternate power must be much more convenient in availability and usage. The next important reason for the search of effective, unadulterated power are to save the surrounding environments including men, machine and material of both the existing and the next fourth generation from pollution, the cause for many harmful happenings and to reach the saturation point.

A turbocharger is a small radial fan pump driven by the energy of the exhaust gases of an engine. A turbocharger consists of a turbine and a compressor on a shared shaft. The turbine converts exhaust to rotational force, which is in turn used to drive the compressor. The compressor draws in ambient air and pumps it in to the intake manifold at increased pressure, resulting in a greater mass of air entering the cylinders on each intake stroke.

4. Connect turbo air inlet with hoes pipe with bike air cleaner.
5. Now connect carburettor with air cleaner & with engine.

4. LOCATION OF TURBOCHARGER





5. INSTALLATION OF TURBOCHARGER

Steps for installation

1. Connect the turbo inlet with engine exhaust port with the help of stud nut & welding.
2. The turbine shaft is connected to a compressor, which draws in combustion air, compresses it, and then supplies it to the engine.
3. Now connect air filter with turbo compressor section.
6. Connect silencer with waste gate from where the waste gas will flow.

6. ADVANTAGES

-More power compared to the same size naturally aspirated engine.

-Better thermal efficiency over naturally aspirated engine and super charged engine, because the engine exhaust is being used to do the useful work which otherwise would have been wasted.

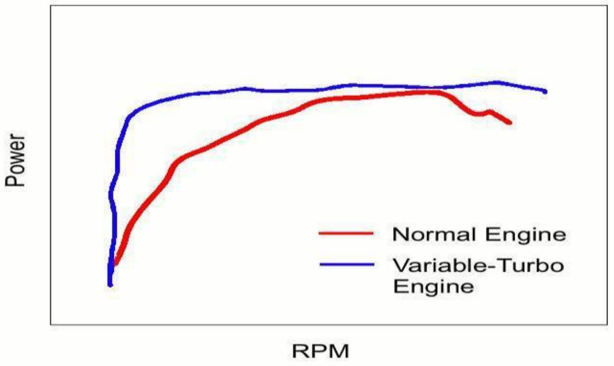
-Better Fuel Economy by the way of more power and torque from the same sized engine. A century of development and refinement for the last century the SI engine has been developed and used widely in automobiles. High speed obtained.

-Better average obtained.

-Eco-friendly

7. EXPECTED RESULT

After using turbocharger in KTM 390 rc engine the following parameters changes in power. Due to introduction of turbocharger in engine there will be increase in power. Initially the power range between 40 to 43 HP . After instalment of turbocharger its increase in the range of 43 to 60 HP . Maximum power is up to 60 HP.



8.CONCLUSION

Due to low speed of operation and less power in agricultural tractor, turbocharger is used not supercharger for more power generation and to operate it higher altitude. Turbo-charging a tractor engine is an acceptable method of increasing its performance if carried out within manufacturers' specifications. Lower engine operating temperatures result which can be beneficial. Since the engine lubricating oil is subjected to high temperatures as it passes through the turbocharger the correct oil must be used as specified for turbocharged engines.

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