Design Of Intake Manifold for Single Cylinder Engine of Formula Student Race Car (Methodology)

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Abstract*— The objective of this paper is to optimize the Venturi to keep up a consistent mass stream rate and to maximize the delta weight after passing through the restrictor. This paper points to optimize the admissions complex of a equation SAE car competition. We are going to examine around plan & fabricating of admissions framework for 390CC motor. The 3-D printing innovation to fabricate the taking after parts: -Restrictor, Plenum, Runner As a result, in this approach the geometry has been updated to result in lessening of weight. Explanatory calculations are done to get most extreme mass stream rate and least weight drop over the restrictor. The complex is outlined with agreement to the SAE run the rule book which requires a restrictor of 20mm to be fitted in the admissions complex. The rules force the presentation of a restrictor in the admissions framework of the engine. The utilize of restrictor chokes the motor which diminishes its execution and control yield and thus require its determination and extemporization.

I. INTRODUCTION

The FSAE (Formula Society of Automotive Engineers) is a intrigue understudy made, equation car planning competition held at national and worldwide level. In this competition, understudies from different organizations /educate plan & construct a car. The driver of the car should to be one of the individuals of the group and subsequently it gets to be basic that the vehicle needs to be sensible and secure for the driver. The FSAE puts rules and restriction on the car. Occasion administration too gives in the rule book. Each group plans construct and tests the car based on a set of rules. There are shifting offices which are to be worked on for fabricating the vehicle. The admissions framework for the motor is one of the critical divisions to be worked on. The rules for admissions framework state that "a particular circular restrictor of 20 mm breadth must be set in between the throttle body and engine"

Displacement	373cc
Number of cylinders	1
Valves per cylinder	4
Maximum Power	43 bhp @ 9000 rpm
Maximum Torque	35 Nm @ 7000 rpm
Cooling system	Liquid Cooled
Engine Weight	172 KG

Table no. 1: Engine Specifiacations

II. RESEARCH METHODOLOGY

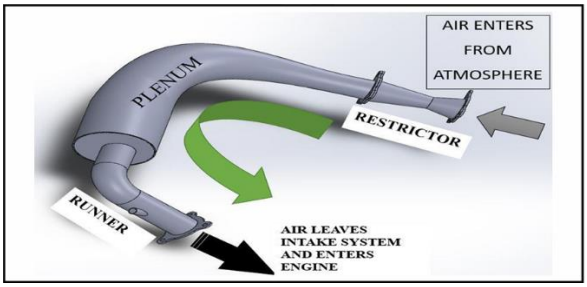

Fig no. 1: 3-D Model of Air Intake System

2.1 AIR FILTER

The objective of a high-performance air filter channel is sifting out flotsam and jetsam and clean, comparable to a ordinary channel. In any case, it should too adjust out filtration with a higher admissions of discuss. A high-performance air filter channel permits a vehicle to admissions additional discuss into the combustion chamber. That implies additional discuss is utilized for more proficient combustion of fuel. The component of an air filter permits a certain sum of wind current into the engine, so less resistance implies more discuss. A high-performance air filter has highly-efficient as compared to a typical air filter. High-performance air filter make a critical distinction in your vehicle's execution by expanding torque and drive. One test concluded a high-performance air filter expanded

drive by 2.6% and torque by 3.7%. There was too a 2-3% increment in increasing speed time with a execution air filter compared to a ordinary filter.

Fig no. 2 : Air Filter

2.2 THROTTLE

The throttle framework controls air, which is the key component of ignition. The throttle body temperature sensor serves to direct throttle weight basically. The direction of the air-fuel proportion and the throttle weight makes a difference in engine start to create fuel efficiency. When a driver presses on the gas pedal, wind current is controlled by the butterfly valve, which at that point triggers a sensor that sends a flag to the ECU, which prompts the throttle passage's opening to permit more discuss into the manifold. As a result, the sum of fuel infused from the injectors increments, expanding the engine's control yield. The vehicle's speed is expanded, and it moves faster. A throttle position sensor (TPS) is associated to the throttle plate shaft that transmits data to the ECU with respect to the throttle, i.e., if it is in a wide-open throttle (WOT) position, sit out of gear position, or in between the two.While in the sit still position, least wind stream is controlled by alterations and valves display in throttle bodies.Like engine parts, throttle bodies play nearly a comparable part as carburetors, an more seasoned innovation that mechanically directs airflow.

Fig no. 3: Throttle Body

2.3 RESTRICTOR

The Admissions restrictor is a component commanded by the rules of the FSAE competition, in which all the discuss entering the IC Engine must go through this 20mm breadth hole. There are two types of disobedient which can be utilized as restrictor 1.Orifice plates 2.Venturi tubes. The Opening plate is a basic rectangular plate with a gap penetrated in it. The Venturi tube is a tube having a meeting and separating area with a throat segment of circular shape interfacing the both. The choice of restrictor to be utilized is laid out in underneath comparison. A restrictor is a gadget introduced at the admissions of an IC engine to constrain its control. In FSAE

competition the run the rules is given to constrain the control of the engine.

Orifice plate	Venturi tube
The coefficient of discharge is between 0.58 to 0.65.	The coefficient of discharge is between 0.95 to 0.975.
The cost of manufacturing is cheaper.	The cost of manufacturing is high.
On a scale of high to low the pressure loss is medium.	On a scale of high to low the pressure loss is low.
The Process of manufacturing is easy as there is just a hole to be drilled on a plate.	The Process of manufacturing is difficult as there is a conical profile to be made.

Table no. 2: Comparison of Orifice plate and Venturi tube

2.4 PLENUM

It is utilized as an discuss supply. The weight of the discuss which diminished in the restrictor increments in plenum. The plenum shape and volume is chosen on the premise of ricardo computer program comes about. Plenum encourages the dissemination of discuss and fuel blend into the barrel. The weight inside the complex should to be more prominent than that in the barrels. the essential work of the plenum is to create the above-mentioned tall weight. Plenum is planned concurring to Slam hypothesis, which states that a slam discuss admissions is any admissions plan which employments the energetic discuss weight made by vehicle movement to increment the inactive discuss weight interior of the admissions complex on an inside combustion engine , hence permitting a more noteworthy mass stream through the motor and subsequently expanding motor power.

For optimizing plenum shape, the temporal CFD examination is done. Four distinctive plenum shapes were considered, which were vertical barrel, cone shaped shape, sine wave molded and circular shape and comes about of their examination were compared to select best plenum shape. Indeed in spite of the fact that point of examination was to choose plenum shape as it were, total admissions framework was taken for examination with fitting boundary conditions connected at both closes. Channel boundary condition was 1 atm weight and outlet condition was changing weight. It was connected in the frame of weight profile.

2.5 RUNNER

The runner of an admissions framework is the essential tuning instrument for adjusting volumetric effectiveness. Changing the length of the runner is as a rule the easiest approach with a given engine plan, with the cross sectional zone, and hence breadth, as of now known premise based on the barrel head cross sectional region earlier to the valve. Changing the runner length moreover has the advantage of being boundlessly movable, where the distance across is constrained to accessible pipe distances across unless more costly fabricating forms such as machining or fast prototyping are utilized. For these reasons, runner length alteration is commonsense and the premise for experimentation. As the cylinder moves towards the foot dead center, suction of discuss takes put into the engine frame the runner. When the channel valve closes, the discuss waves hitting the closed valve reflect back to runner making acoustic waves in the runner. The ideal length of the runner offer assistance those reflected waves to reflect back into the motor at the appropriate timing of the valve opening.

CONCLUSION

For a single cylinder engine, non variable length intake framework Runner length & Plenum volume are most imperative variables for ideal plan of intake framework. Intake complex is a exceptionally pivotal portion for the motor as we have seen its significance talked about over, and all the plan contemplations are made concurring to the SAE run the rule book. The plan of plenum and runner is of significance for a single cylinder motorbike (KTM duke 390) engine. The restrictor having settled throat breadth as 20mm is optimized with the offer assistance of legitimate combination of merged and unique points such that the weight drop over the restrictor is minimum.

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