FINITE ELEMENT ANALYSIS OF EXHAUST MANIFOLD IN DIFFERENT METALS

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ABSTRACT

The Exhaust manifold in the engines is an important component which has a considerable effect on the performance of the I.C engine. The exhaust manifold operates under high temperature and pressure conditions. Their design usually has to be performed by trial and error through many experiments and analyses. Therefore, an automated design optimization would reduce technical, schedule, and cost risks for new engine developments. This paper deals with the various factors that are to be considered in the design of the exhaust manifold. It tries to explain the effect of various factors during the Finite Element Analysis.

Keywords— Exhaust manifold, Analysis, Automated design optimization

1. Introduction

The exhaust manifold is the first part of the vehicle's exhaust system. It connects to our car's engine and records running engine's emissions. The exhaust manifold receives the air-fuel mixture from multiple cylinders of the vehicle engine. Collect the air-fuel mixture from each cylinder regardless of whether it has four, six, or eight cylinders. The exhaust manifold not only accepts all burned engine gas, but also uses very high temperatures to completely burn unused or incompletely burned gas. The manifold has the first oxygen sensor in the exhaust system to check the amount of oxygen entering the system. The oxygen sensor monitors the amount of oxygen and instructs the fuel injection system to increase or decrease the amount of oxygen in the mixture used to power the engine. Basically, the exhaust manifold acts as a funnel and is used to collect all the emissions of the engine (the number of cylinders in the vehicle). When they are in one place and burned completely, the manifold directs the emissions to the rest of the exhaust system. (6)

Working principle of exhaust manifold explains that it is designed to avoid overlapping of exhaust strokes, as far as possible, thus keeping the backpressure to a minimum. This is often done by dividing the exhaust manifold into two or more branches so that two cylinders will not exhaust into the same branch at the same time. (4)

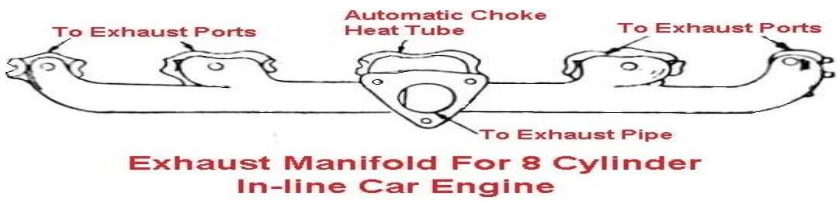

Figure 1: Exhaust Manifold for 8 cylinder In line Car Engine

2. Basic description of the used Solid works software

Solid Works is an incorporated CAD/CAE machine, offering unified and interconnected surroundings for layout, for structural and dynamic analyses, for records control of engineered products. It becomes evolved in 1993 and on the grounds that 1997 has been a change emblem of French organization Dassault Systems. Solid Works is understood to be a number of the maximum broadly used preferred software's for 3-D designing. [11-15]

The machine carries modules for making ready technical documentation, kinematic, dynamic, thermal and energy evaluation of systems, glide simulation techniques, layout of particular product (sheet steel products, mildew products, etc.) and so on. Based on a multifunctional interface, SW has a parametric, 100% associative and hybrid modeller. The massive software program libraries offer a whole lot of parametric 3-Dcomponents, geared up to be carried out with inside the model. [11-13];

Solid Works permits becoming member of diverse components collectively and growing unique systems and mechanisms. It permits status quo of complicated mechanical relations, checking the assemblies for interference, collisions and alignment of the components. Solid Works imports/exports documents to AutoCAD, Draft Sight (an unfastened product evolved with the aid of using Dassault Systems) and a few different famous software program products. [19]

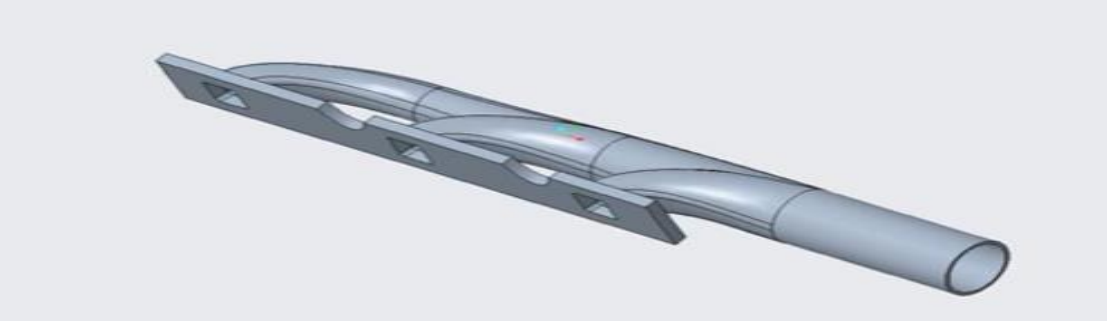

Figure 2: complete model of exhaust manifold using solid works 2013

3. Selection of material

6063 is an aluminium alloy, with magnesium and silicon as the alloying elements. The standard controlling its composition is maintained by The Aluminum Association. It has generally good mechanical properties and is heat treatable and weldable. 6063 has an ultimate tensile strength of at least 140 MPa (20,000 psi) in thicknesses up to 13 millimetres (0.5 in), and 130 MPa (19,000 psi) from 13 mm (0.5 in) thick, and yield strength of at least 97 MPa. It has elongation of 8%.

4. Result obtained

The Aluminium 6063 proves that it is suited to manufacture the exhaust manifold. Hence It is purely done by own through Solid Works software.

Figure 3: Aluminum 6063

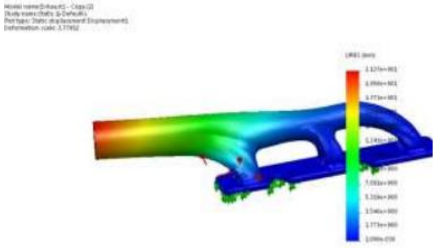

Figure4: Displacement for Al6063

5. Conclusion

Solid Works grades with Cast iron, Stainless steel 304, Aluminum 6063 was successfully designed via Solid Works software. Test results revealed that grade Aluminum 6063 enhances the mechanical properties of the project. There is a decrement of mechanical properties like density, maximum pressure, elastic modulus, tensile strength, yield strength one by-one which is shown in results and discussion chapter. So the Aluminum 6063 proves that it is suited to manufacture the exhaust manifold. Hence It is purely done by own through Solid Works software.

6. References

1) S.S.Borole, Design Modification and Analysis Of Engine Exhaust Manifold. Proceeding: Volume: 03 Issue: 09 | Sep-2016.

2) Vishal M. Shrivastav. Design and Analysis of Exhaust System for the Two Wheeler using FEA. Proceeding: Volume: 05 Issue: 06 | June-2018.

3) Alessandra Nigro. Fluid dynamic investigation of innovative intake strategies for multivalve internal combustion engines. Proceeding: S0020-7403(17)30441-1.

4) Hung-Hsiao Liu a. Modeling and design of air-side manifolds and measurement on an industrial 5-kW hydrogen fuel cell stack.

5) D. Tutunea. The computational fluid dynamics (CFD) study of fluid dynamics performances of a resistance muffler. Proceeding: Issue 4, Volume 7, 2013.

6) Cristiana Delpretea. Multiaxial damage assessment and life estimation: application to an automotive exhaust manifold. Proceeding: 2 (2010) 725–734).

7) Vignesh.G. CFD Analysis Of Exhaust Manifold Of Multi- Cylinder SI Engine. Proceeding: Vol 7 Issue 4 April - 2019 3221 5687, (P) 3221 568X.

8) Balesh Babali. CFD Analysis of Exhaust Manifold of A Multi-Cylinder Engine. Proceeding: ISSN 2348-117X Volume 6, Issue 8.

9) Mehmet Bulut. CFD Analysis of Exhaust Manifold for Different Designs. Proceeding: e-ISSN: 2587-1110.

10) Andreas Fabricius. Premature Grade 91 failures — worldwide plant operational experiences