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# Design and Fabrication of Laser Operated Measurement of Head Valve Seat in Diesel Engine

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***Abstract:*** ***The project deals with the problem that arises in recon department, which deals with dismantling and assembly of old engines bought by customer consisting of various type of engine such as, H-series, P15 engines and Neptune engines. One of the areas of our work has been highlighted in this report and has been carried out in detail. Mainly H-Series and P15 reuse engine in production line and thereby increase quality and productivity of engine. Increase the accuracy of valve seat measurement by using laser operated measurement system to find the head valve seat height of diesel engines and finally this will result in increase of profit.***

## I. INTRODUCTION

In recent days, the air pollution caused due to vehicles which could be a major problem in feature. The researchers concentrated in the air pollution sources from vehicles and found the important interference. The major causes of the pollution caused by vehicles is due to the old nature of the engines. The most impactful component of engine resulting in major emission is the cylinder head. Further, the in-appropriate valve seating in the cylinder head causes more emission in the engine.

In order to control the valve seating, we have to identify the unevenness of the height of the valve seats in the engine. A laser operated system has been designed to measure and detect the unevenness of cylinder head assembly by measuring the height. In an internal combustion engine, the cylinder head (often informally abbreviated to just head) sits above the cylinders on top of the cylinder block. The head covers the block in the top of the cylinder forming the combustion chamber. This joint sealed by a head gasket. In most of engines, the head also provides space for the passages that feed air and fuel to the cylinder, and that allow the exhaust to escape. The head can also be a placed to mount the valves, spark plugs, and fuel injectors. By replacing these uneven heads in the cylinder block with proper even shaped the combustion will be improved result in the reduction of emissions.

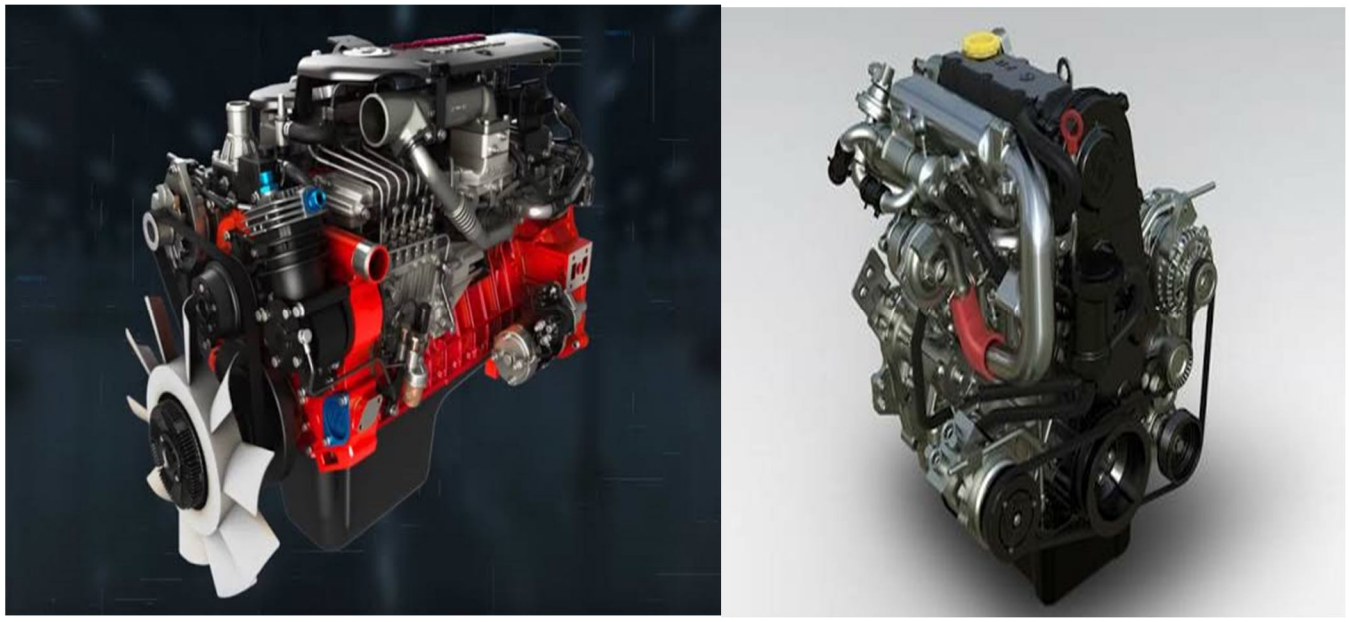

Fig.1. H-series and p15 diesel engines

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*A. Valve Seat Height*

Inlet valve 0.050– 0.350 mm

Exhaust valve 0.40-0. 70 mm

Fig.2.Engine cylinder head

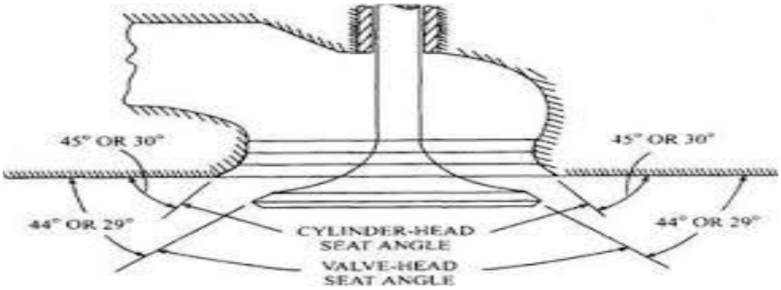


Fig.3.Valve and valve seat

## II. LITERATURE SURVEY

The literature is related to valve seat arrangement in cylinder block and cylinder head were reviewed as follows

*A. Establishment Of An Installation Process Of A Valve Seat To A Cylinder Head Using The CAE Technique*

K.W.LEE et.al, have done and analysis related to the project Establishment of an installation process of a valve seat to a cylinder head using the cae technique. Valve seats press-fitted in the cylinder head function to hold exhaust gas inside the ignition chamber and to transfer heat to the coolant moving in the water jacket of the head. The press-fitting of the valve seats to the head at ambient temperature has been widely spread out due to its many advantages over pressing with frozen valve seats or with a heated head. The benefits include lower equipment costs, lower running costs, and fewer installation faults during the press-fitting. Nevertheless, a systematic approach for pressing at ambient temperature (ATP; ambient temperature press-fitting) has not been studied and analyzed to date. A technique to check the reliability of the press-fitting by measuring hoop strain inside the valve seat and the FEM procedure to simulate ATP is developed in this study. The FEM procedure of ATP developed here exhibits a concurrence with experimental results. Utilizing the DOE (Design of Experiments) technique, we determined the effects of various geometric parameters and the optimal shapes of the valve seat and cylinder head. The optimal shapes have been successfully applied in an actual engine and verified in a running-engine test. A simulation procedure for press tight-fitting at ambient temperature has been developed based on the FEM method, and it exhibits a concurrence with experimental results. The effects of each geometric parameter were revealed and the shapes of the valve seat and cylinder head were optimized using the DOE (Design of Experiment) technique. The optimal shape was successfully applied in a real engine and the results of this study have been transferred to other gasoline and diesel engines of the HMC.

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*B. Experimental Analysis of Valve and Valve Seats Wear in Gases (CNG) Fuelled Engine*

ROHIT T et.al., have done and analysis related to valve seat wear in the engines.when CNG, LPG, and other gas fuels were used for combustion in vehicles' engines, a large degree of valve seat wear was observed and it was difficult to provide the same wear resistance as that of petrol (gasoline) & Diesel fuel engines. Therefore, valve seat wears in gas fuel engines need to examine. These parts related to the engine valve timing. Now the most of the company in engine manufacturing, found field related problem of valve and valve seat in gas engine. So most observed problem is valve and valve seat wear. In R&D department, durability is one of the ways to find the problem of valve and valve seat before the field related problem will face. In durability, the engine is test at approximately condition that of the vehicle, in engine test bed. So this paper gives material as per various parameters like Temperature. Mach inability, weld ability, Cost, availability is studied for valve & valve seat in gas fuel engine.

*C. Optimization of Process Parameter in Seat Hard facing Process for an I C Engine Valves*

MADHU.G et.al., carried out research to optimize the process parameters in seat hard facing process used to deposit cobalt based super alloy having higher wear, corrosion and heat resistance in an I C engine valves. The detailed study of operation, equipment & materials are done to find the root causes of the problem. Quality control tools such as pare to diagram, cause and effect diagram are used for the suggestions & modifications to overcome the defects like stellite deposition overflow, head melt, non uniform stellite merging, stellite unfill on seat and blowholes on the seat portion of the I C engine valves.

*D. Improving the processing accuracy of the valve seats of internal combustion engines using diagnostic measurements*

D T SAFAROV et.al., have done research based on the results of measurements, immediately follow the suggestions for improvement. As a result, management effectiveness has sharply increased, as well as the required time for planning and corrective actions. Effective use of control charts is possible only for the indicator with the simplest internal technological structure, or on condition that the embedded technological components of the indicator are negligible or only one known cause predominates. In the case where the equipment is worn out and the structure of the technological indicator is developed, the direct application of control charts or other statistical methods for improving the quality of products is rendered ineffective.

*E. Sliding Wear Study On The Valve-Seat Insert Contact*

EDGAR E et.al., have done research related to sliding wear of valve seat. The aim of this work was to investigate the sliding wear coefficient k, using an experimental sliding wear study on the valve-seat insert contact. Commercial inlet valve and seat inserts were used as test specimens. The tests were performed at room temperature and at 200˚C, using test duration of 72,000 cycles and 18,000 cycles, respectively, and both in dry sliding conditions. A load of 5 N, an average speed of 22 mm/s and sliding distance of 2.2 mm were used for all tests. The sliding wear coefficients were calculated using experimental and analytical methods. The wear volume was higher in the tests at 200˚C both in valve and seat insert specimens. The principal wear mechanisms observed in valve specimen were oxidation and abrasion. Valve specimens made of martens tic low alloy steel were put in frictional sliding tests against seat insert specimens made of cast tool steel.

1) The experimental procedure employed in this work, for the materials used, provides reliable results in wear volumes and sliding wear coefficients.
2) The wear volume was higher in the tests at 200˚C, both in valve specimens and seat insert specimens.

*F. Overview of Failure Trend of Inlet & Exhaust Valve*

YUVRAJ K et.al., have done research related to failure in valves. Diesel engine consists of number of vital components, which perform various functions and are subjected to different forces, thermal loadings and stresses. Inlet & Exhaust valves are most important components of the diesel engine. The function of Inlet valve is to provide path for desired air flow to combustion chamber.

Function of Exhaust valve is to provide opening, to pass burnt gases through the cylinder. The opening and closing of inlet and exhaust valve is controlled by valve mechanism during the engine operation. Valves are subjected to thermal loading because of high temperature and pressure developed inside the cylinder.

This paper focuses on failure trend of inlet and exhaust valve. Failures take place of inlet and exhaust valve in different manners due to fatigue, thermal loading, wear, corrosion and erosion which leads to loss of mechanical properties of material and engine performance etc.

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*G. Technical Challenges in Shifting from BS IV to BS VI Automotive Emissions Norms by 2020 in India*

DEVENDRA VASHIST et.al., have reviewed literature related to challenges in shifting from BS IV to BS VI automotive emissions norms by 2020 in india Automotive vehicles emit several exhaust gases and pollutants. The largest part of these gases consists of nitrogen (N2), water vapour (H2O) and carbon dioxide (CO2) these are not toxic. Harmful gases i.e. carbon monoxide (CO) produced because of incomplete combustion, nitrogen oxides (NOx) generated at high temperatures, hydrocarbons (HC) obtained from un burnt fuel, particulate matter (PM, mostly soot) and oxides of sulphur (SOx) due to sulphur content in fuel, are referred as pollutants. India's Emission Standard were formulated in 1991 has reached today to direct transition to BS VI from BS IV norms. This decision to leapfrog fuel standards has managed to disrupt oil and auto Industry. In this paper challenges faced by these industries for this transition based on technical understanding are discussed. For diesel engines diesel particulate filter for moving to BS V and Selective Catalytic Reduction for BS VI is critically analyzed. For S.I engines technologies that are likely to be commercialized which will help vehicles to comply with BS VI norms are explained.

## III. PROBLEM IDENTIFICATION

*A.* In the old engines the valve seating in the 6 and 4 cylinder engine block head will be damaged .So that improper fuel and air ratio will occur by valve seating arrangement in H-series and p15 engine.

*B.* To find and rectify the variations in height of valve seat arrangement in header block of the engine.

*C.* To design and fabricate the equipment by using the laser for identifying for both 4 and 6 cylinder head.

## IV. EXPERIMENTAL SETUP

1) *Option 1:* Dial gauges are used for checking flatness of the surfaces; parallelism of bar and rods; and detecting small differences if any in linear measurement of identical objects. A dial gauge is also used for measuring concentricity of round objects. These are available in inches as well as in mm. Inch dial gauge of 0.001"measuring accuracy is in general use ,but gauges are available up to the accuracy of 0.0001".the commonly used metric dial gauges as an accuracy of 0.01mm. Till now they are using gauge meter to measure the height of valve seat which is very difficult for the persons who don't know to use it, so that many problems are occurred.
2) *Option 2:* Laser measurement sensors are often used for height measurement. Height measurement encompasses a variety of non-contact applications where different laser measurements sensors are used to measure the top height position of target that pass beneath a sensor.

*A. CMOS type Micro laser Distance Sensor HG-C*

This type of laser possible to perform highly precise Measurements in the order of 1/100 mm 0.0003 in. The existing adjustable range reflective sensors cannot achieve such accuracy.

*B. Compact and Light-weight*

The HG-C series is the smallest CMOS laser sensor in industry. W20*H44*D25mm W0.787*H1. 732*D.984 in,35g approx.(without cable)

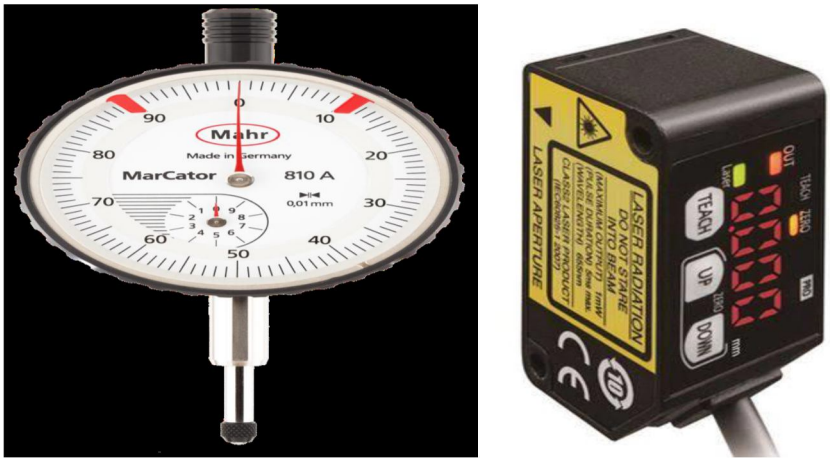


Fig .4.dial gauge and CMOS laser

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Design and modelling

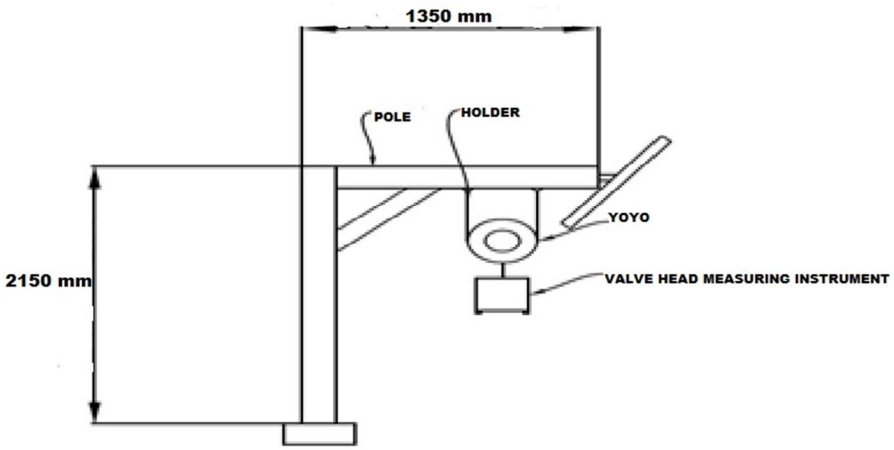


Fig.5.side view of measuring instrument

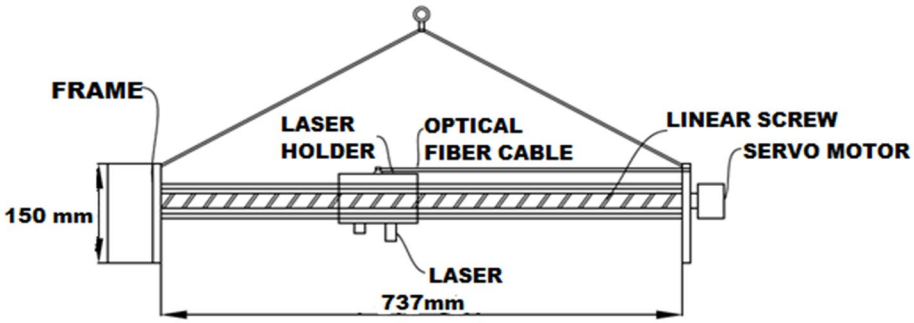


Fig.6.front view of measuring instrument

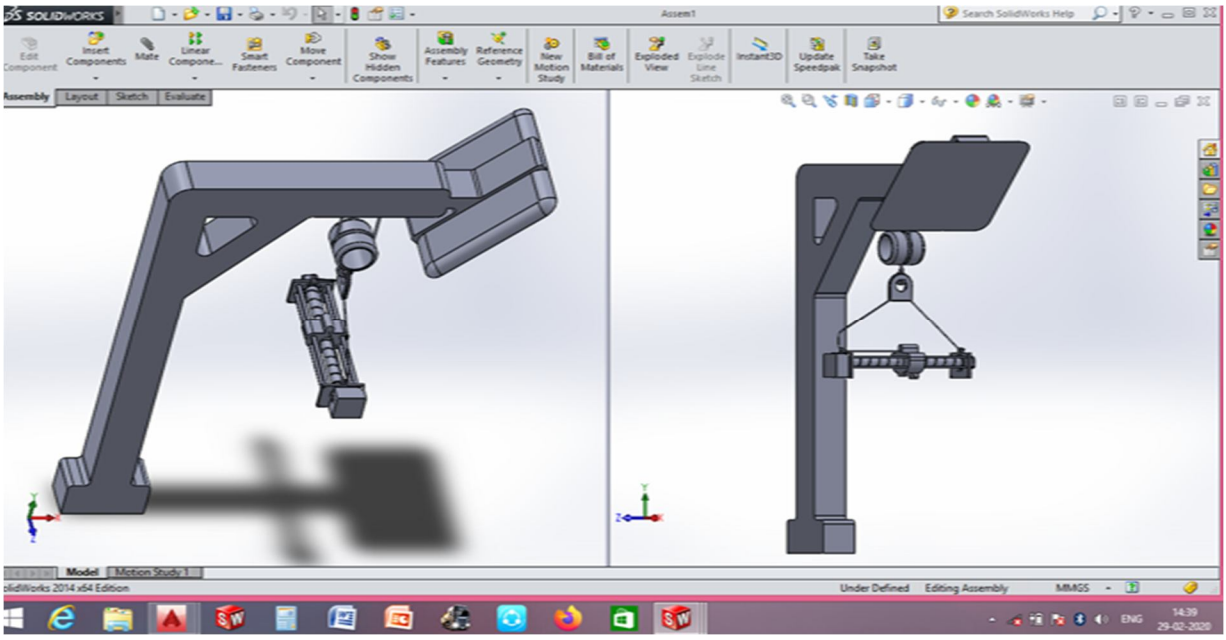

Fig.7. 3D modelling of measuring instrument

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*C. Parts Of Valve Seat Measuring Instrument*

Pole, holder(hook), yoyo, display, frame, optical fiber, laser, servo motor, inear screw, hanging cable, feedback system.

1) *Display:* Display is used to show the readings of head valve seat.
2) *Optical Fiber:* It is used to transfer the data in very high speed.
3) *Laser:* It is used to measure the height of valve seat.
4) *Servo Motor:* A powered mechanism producing motion or force at a higher level of energy than the input leve .In this project it's help to rotate the linear screw.
5) *Linear Screw:* It is used to move the laser in linear direction.
6) *Feedback System:* It helps to give the accuracy of the rotation.

*D. Recommendation*

1) Quality
2) Cost
3) Delivery
4) Morale
5) Safety
6) Environment

## V. ANALYSIS

The design is reduce time of valve seat measuring compared to dial gauge.

| CMOS type micro laser distance sensor HG-C measurement | Dial gauge measurement |
|---|---|
| High accuracy | Low accuracy |
| Less errors will be occurred | Many errors will be occurred |
| Less time to take measure | More time to take measure |

*A. Dial Gauge Measurement*

1hour = 15 H-series engines valve height measured
1hour = 20 P 15 engines valve height measured

*B. CMOS type Micro laser Distance Sensor HG-C Measurement*

1 hour = 45 H-series engines valve height measured
1 hour = 50 H-series engines valve height measured

## VI. CONCLUSION

Thus, the facility improvement in Recon is done. H-series diesel engine cylinder valve seat measuring instrument are designed successfully and also, standard operating procedure for BS IV P15 Bosch engine testing have been recorded.

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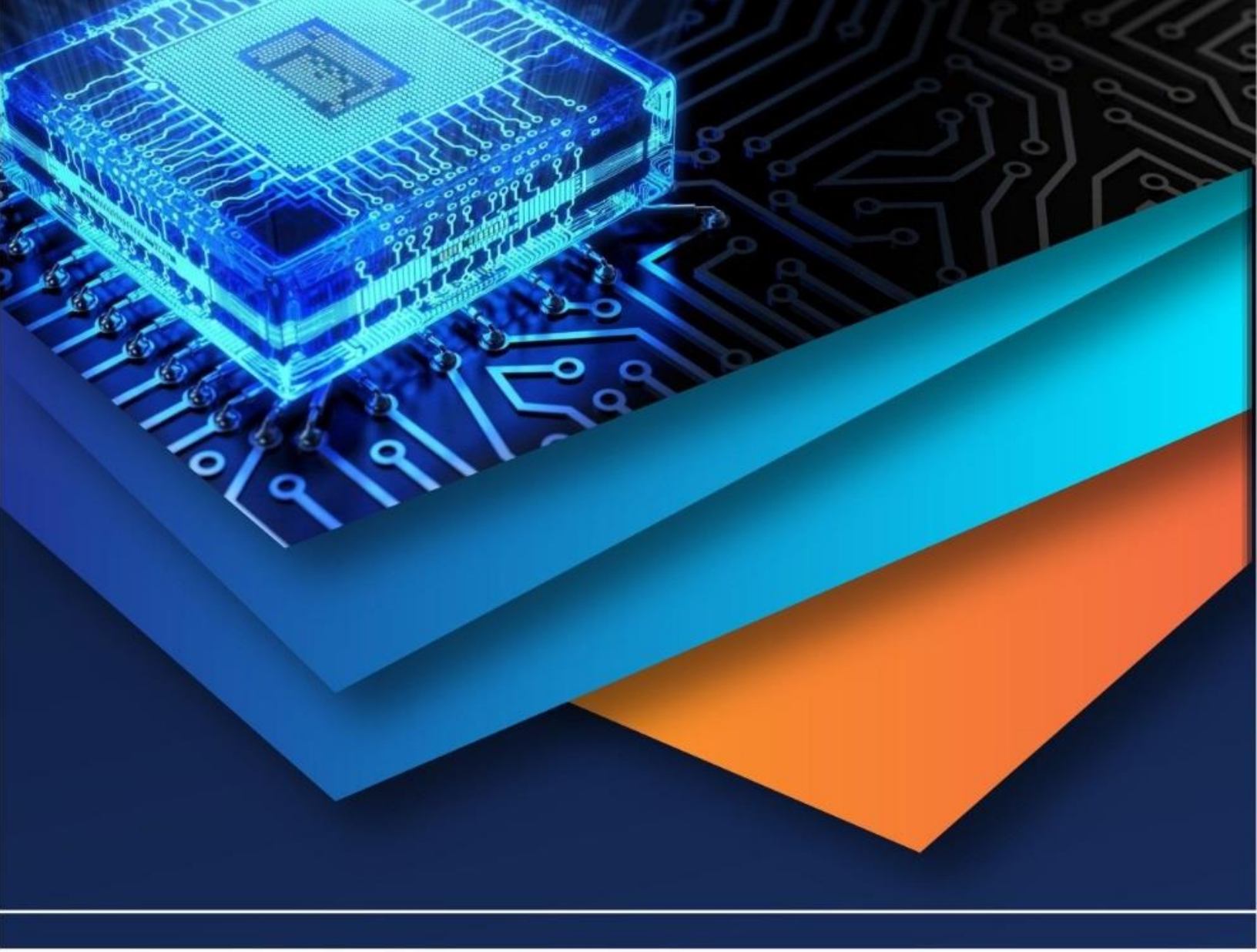

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