AUTOMOBILE ENGINE TUNING

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Abstract. *Engine tuning is a complex process that should be carried out by qualified specialists. Incorrect tuning may lead to engine damage and negatively affect the performance of the car. In addition, it is necessary to comply with the legislation of Uzbekistan and traffic regulations during the tuning process.*

Keywords: *power increase, automotive electronics, suspension tuning, transmission tuning, brake system tuning, engine tuning.*

INTRODUCTION

An automobile engine is a device that propels the vehicle. Car engines can have two, three, four, or more cylinders, arranged either in a single row or in a "V" configuration. Among modern automobiles, the most common type is the **piston-type internal combustion engine**.According to their operating process, engines are divided into **two-stroke** and **four-stroke** types. Based on the method of fuel ignition, there are **carburetor engines**, in which the fuel mixture is ignited by a spark, and **diesel engines**, in which the fuel ignites spontaneously in the cylinder due to high compression.

In carburetor engines, the fuel mixture—composed of **gasoline vapors and air** prepared in the carburetor—is supplied to the cylinders. In diesel engines, **diesel fuel** is injected into the highly compressed air within the cylinders at high pressure. A modern automobile engine consists of the **cylinder block**, **crankshaft and connecting rod mechanism**, **valve timing system**, **cooling system**, **lubrication system**, **fuel supply system** (which prepares and delivers the mixture into the cylinders in carburetor engines or injects the fuel directly in diesel engines), and the **ignition system** (in carburetor engines). The power of modern passenger car engines ranges from **15 to 310 kW**, while that of truck engines can reach up to **220 kW**. In addition to piston engines, **rotary-piston** and **gas-turbine** engines are also used.

Engine tuning (from English ***"engine tuning"***) refers to a set of technical modifications aimed at changing and improving the operating characteristics of an automobile engine. It is carried out to replace the factory-installed engine with a newer and more powerful one. During such a tuning process, components like **pistons,**

connecting rods, and valves are replaced with improved versions. These modifications are intended to increase the engine's **power, torque, and speed**, as well as to **reduce fuel consumption**. In general, engine tuning is aimed at enhancing the **performance characteristics** of a vehicle. It is achieved by **modifying, improving, or replacing** certain parts of the factory engine.

The tuning process can affect both the **engine systems** and the **control electronics** of the vehicle.

RESEARCH METHODOLOGY

The main goals of engine tuning are as follows:

Increasing power: Enhancing the car's acceleration and its ability to reach higher speeds. This is particularly important for sports cars or vehicles participating in races. **Increasing torque:** Improving the engine's pulling force at low and medium speeds. This enhances the vehicle's traction characteristics and helps in carrying heavy loads. **Improving throttle response:** Increasing how quickly the engine responds when the gas pedal is pressed. This makes the vehicle easier to control and provides a more dynamic driving experience.**Optimizing fuel consumption:** Reducing the engine's fuel usage or improving its efficiency.**Extending engine lifespan:** Prolonging the life of the engine by upgrading internal components with improved parts.

Changing engine sound: Installing a sports exhaust system to modify the sound of the engine, making it more aggressive and sporty.**Meeting personal needs:** Adjusting the engine's characteristics to match the driver's individual preferences and driving style.

Engine tuning can provide the following advantages: **Increased speed and dynamics:** As a result of tuning, the vehicle's acceleration and dynamics can significantly improve, allowing the driver to enjoy a more thrilling driving experience. **Improved throttle response:** Enhancing how quickly the engine reacts helps make the car easier to control and gives the driver greater command over the vehicle.
Fuel efficiency: Certain types of tuning can help reduce fuel consumption, which makes long-distance travel more economical.

ANALYSIS AND RESULTS

Engine tuning allows the car owner to make their vehicle unique. The improved characteristics of the engine create an opportunity for greater driving enjoyment. Tuned cars serve as good preparation for participating in sports competitions.

Chip tuning: Optimization of engine performance by modifying the software of the Engine Control Unit (ECU). A car, being one of the most expensive purchases in life, may become boring over time. Such situations can be avoided through "chip tuning." This process is known by the mysterious and attractive term "chip tuning."

Most modern engines have the potential to increase power, which is intentionally limited by electronics. Manufacturers want their engines to serve for many years, so

they reduce the load. Cars with different configurations and, accordingly, different prices can be equipped with the same engine but with different power indicators. This, of course, is achieved through software.

Chip tuning – installing a new engine control program – depends on the programmer's skill. In addition, a car subjected to such an improvement automatically loses its warranty period. All complexity depends on choosing the right specialist and the quality of the new program.

There are several types of chip tuning according to the level of difficulty. The first includes only changing or improving existing software. The second requires removing environmental components – removing the catalytic converter and the EGR sensor – and adding performance to some components and assemblies. The third level is rebuilding the car "for sport," replacing the turbine and modifying everything in the system. However, the main factor is the program.

High-quality and professional software is written for large companies after dozens of weeks of tests and trials. Professional racing cars have the opportunity to finalize their software on site. That is, it is not just a factory setting with small changes, but a real author's ecosystem that can even operate in administrator mode.

Thus, high-quality chip tuning that delivers results rather than problems later can be expensive. It must be a program created for a specific engine and, in most cases, for a specific type of gasoline or diesel fuel at a specialized fueling station.

Air Filter Replacement: Steps for replacing an air filter:

Step 1: Open the engine compartment cover and locate the air filter. The air filter is usually positioned on the left side of the engine compartment, above the left front wheel. It appears as a square black plastic box with the filter element installed inside. Around the case cover, there are four clips that seal the air intake pipe and secure the plastic housing over the air filter. The structure of the clips is relatively simple. To fully lift the air filter cover, slowly raise the two metal clips upward. Some models also use screws to secure the air filter. In that case, you need to select a suitable screwdriver to remove the screw on the air filter box, then open the plastic housing to see the air filter inside.

Step 2: Remove the air filter element and check how much dust it contains. You can gently tap the end surface of the filter element or use compressed air to clean the dust from the inside out. If inspection shows that the air filter is seriously clogged, it must be replaced with a new one. When comparing the old and new filters, it can be seen that the paper of the old filter has turned black. This happens because a large amount of dust accumulates in the paper fibers. Too much dust inevitably reduces the airflow, resulting in poor engine performance and lower power efficiency. Therefore, regularly replacing the air filter helps maintain the engine's power characteristics.

Step 3: After cleaning or replacing the air filter, thoroughly clean the air filter box. Usually, a large amount of dust accumulates under the air filter, which is often the cause of reduced engine power.

Step 4: When installing a new air filter, pay attention to the plastic part protruding on the right side under the air filter, which is designed to prevent incorrect installation. When installing the air filter, the plastic layer must be inserted into the slot of the filter holder to ensure correct placement.

Installing or upgrading a turbine: Increasing engine power by installing or improving a turbocharger. A **turbine** (from French ***turbinus*** – "whirl") is a primary engine that converts the kinetic energy of a working medium—steam, gas, or water—into mechanical work. The working element is the **rotor**. The flow of the working medium acts on the rotor blades, causing it to rotate.

CONCLUSION AND RECOMMENDATIONS

There are active and reactive types of turbines, as well as single- and multi-stage ones. Stationary steam and gas turbines are used to drive **electric generators (turbogenerators)**, **centrifugal compressors**, **air-blowing devices (turbochargers, air boosters)**, and **fuel and oil pumps (turbopumps)**.

In transportation, steam and gas turbines are used as **main engines on ships**. Gas turbines are also used as **aircraft engines** (turboprop and turbojet types), and in some cases, when high power is required, as **locomotive engines (gas-turbine locomotives)** or in **special-purpose vehicles**.

Hydraulic turbines are used in **hydroelectric power stations** to drive electric generators (hydrogenerators). Due to their **efficiency, compactness, reliability, and ability to produce high power**, turbines have replaced **piston steam engines** in the energy sector.

Replacing internal engine components: Replacing pistons, shafts, bearings, and other internal parts of the engine with lighter and stronger ones. The engine temperature can become very high, which may lead to **overheating and melting**. Rubber seals, triangular belts, tires, and other components exposed to excessive heat tend to **age prematurely**, reducing performance and lifespan. Starters, generators, regulators, and other electrical devices can **burn out or fail** due to overheating. Therefore, the vehicle's system must maintain an appropriate temperature. Excessive overheating also causes engine oil to deteriorate quickly.

List of References

1. "Rules on Labor Protection When Working with Paint and Varnish Materials", approved by the Order of the Minister of Labor and Social Protection of the Population of the Republic of Uzbekistan No. 23-B, dated April 24, 2013. "Collection of Legislative Documents of the Republic of Uzbekistan" 2013, No. 19, Article 246.

2. Matkarimov K.J., Mahmudov B.J., Norqulov A.A. “Materials Used in Automobiles.” Tashkent:” Talqin” Publishing House, 2012 – 304 p.
3. Matkarimov K.J., Mahmudov B.J., Norqulov A.A. *Materials Used in Automobiles.* Tashkent: Noshir Publishing House, 2017 – 388 p.
4. A.A. Maxmudov, H.A. Ne’matov. *Journal of Effective Learning and Sustainable Innovation*, Vol. 3, No. 2 (2025), February, pp. 306–311.
5. A.A. Maxmudov. “The Role of the Transport and Logistics System in Increasing Economic Potential.” “Journal of Engineering and Economics”, November 2024, No. 4.
6. A.A. Maxmudov, H.A. Ne’matov. “The Concept, Types, and Classification of Auto Tuning.” “Journal of Engineering and Economics”, April 2025, No. 4.