

## PREVENTIVE MAINTENANCE MANAGEMENT OF PASSENGERS CARS DRIVING IN THE TERRITORY OF THE REPUBLIC OF KOSOVO

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### ABSTRACT

*Preventive maintenance management enables the extension of the life expectancy of the vehicle equipment and significantly contributes in reducing of maintenance cost.*

*In this paper is analyzed necessary period for change of filters, respectively period of changing of the oil filter, air filter and fuel filter that are fitted in the passenger's cars by internal combustion engine. Criteria for determining of the period (passed kilometres of the vehicle) for changing the filters in the territory of the Republic of Kosovo are climatic condition, road state, average speed of the vehicles, fuel and oil quality, as well as level of air pollution. Also here is an investigation made for period of change of filters for some types of passenger's cars in auto services in Kosovo.*

*The paper presents real situation of preventive maintenance of the passenger's cars in territory of Kosovo and given conclusions will help drivers of passenger's cars and auto services to determine the optimal period for changing filters which will be best suits of exploitation conditions for passenger's cars to have better life expectancy of the engine.*

**Keywords:** Passengers cars, maintenance, filters, life expectancy, period, air pollution.

### 1. INTRODUCTION

A mechanical system to be technically in working condition, which means to work normally, it is essential to have quality maintenance. This is important especially in those systems that failures appear consistently and mechanical system is not able to work regularly. In order to prevent failures it is necessary a suitable maintenance. As a concrete case of mechanical systems are consider motor vehicles, which have found application in many fields such as in transport, agriculture, construction as well as in different branches of economy and industry.

Quality maintenance of motor vehicles represents an important stage of their life expectancy (service life). This life expectancy needs to be examined as a summary of all activities during the service life of systems, starting from the initial phase of exploitation until the end of period of using the passenger's cars.

Motor vehicles are one of the systems which are considered enough complexes, which consist from a large number of subsystems. The rapid development of the technology in vehicle has prevented the development of quality maintenance in the vehicle. These difficulties have influenced that vehicle maintenance to rank in the group of complex technical systems. This requires a development process and professional research of the maintenance systems in the vehicle and finding the necessary changes for improving vehicle maintenance.

As a conclusion of all of this, to have quality maintenance management should be focused on improving the life expectancy of the vehicles, vehicle safety, readiness of the vehicle and environmental protection [1].

## 2. INFLUENCE OF FILTERS IN LIFE EXPECTANCY OF THE VEHICLE'S ENGINE

Most of the vehicles experts believe the parts that have the greatest impact on the life expectancy of the engine are filters. Through regular changing of the filters which have a low cost but has impact in better life expectancy of the internal combustion engine. During driving the vehicle across different environments, the engine absorbs polluted air with dust which is very abrasive (wasting) and in most cases presents the main causes of wear of moving parts of the engine.

Therefore, taking in consideration the importance of changing the filters in the vehicles, following are made analysis for finding optimal period for changing the air filter, fuel filter, oil filter, motor oil as well as their influence on the life expectancy of engine.

### 2.1. The air filter

Practice demonstrates that even in clean environments, considerable amounts of abrasive particulate matter are found in air. Therefore, to prevent pollutants found in air is needed to install *the air filter* in intake manifold of engine. Air filter has influence in improving the life expectancy of the engine. Absorbing the air from engine has a lot impurity and is depended from climatic condition, road infrastructure, the level of air pollution, etc. These impurities should be stopped in air filter and do not allowed to enter in cylinder of the engine. If this impurity enters in cylinder of engine will cause serious damage in engine and will have impact in reducing life expectancy of the engine. In Figure 1 is shown air filter.

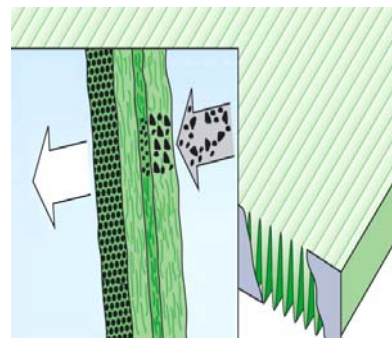


Figure 1. Air filter [2]

### 2.2. The oil filter

Lubrication system plays important role in vehicle engine. It is designed to deliver clean oil at the correct temperature and pressure to every moving part of engine. During operation process of the engine, oil should be polluted by carbon (during the burning process of fuel), dust, particular metal piece (from wear of moving engine parts) as well as water. All of these will cause increasing wear of moving part of the internal combustion engine. To prevent the wear of moving parts, engine should be equipped with an efficient oil filtration system. So, should be installed *the oil filter* to prevent wear of engine (Figure 2).

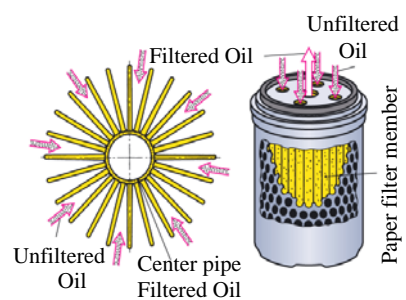


Figure 2. Oil filter [2]

A good oil filter should be able to stop the penetration of very small materials and at the same time don't prevent the flow of oil through the filter and flows in oil channels of the engine.

### 2.3. The fuel filter

For normal operation of the engine, the fuel supply system plays crucial role. Significant part of the fuel supply system is also *the fuel filter* (Figure 3).

The primary task of the fuel filter is to stop the various impurities in fuel and prevent them not to move in sensitive parts of feeding system of engine.

Feeding system it is completely closed system and presentation of any fault, observed through the decrease or increase of pressure (when the filter is blocked by impurities) in fuel supply system.

Impurities in fuel are the main cause of filter blocking. Such problem is very difficult to isolate, so the vehicle engine should be supplied with quality fuel and fuel filter change as often as possible.

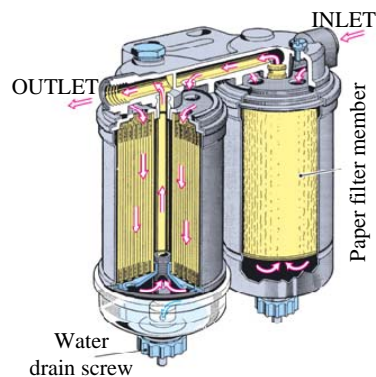


Figure 3. Fuel filter [2]

## 3. THE PERIOD OF CHANGING OF FILTERS IN PASSENGERS CARS THAT ARE BEING DRIVEN IN KOSOVO

In this section, are analyzed and are given recommendations on necessary period for changing the filters and motor oil for internal combustion engine, always based on the operation conditions of passenger's cars that are driving in territory of the Republic of Kosovo.

### 3.1. Determining the required period for changing filters and motor oil

Determining the optimal period for changing filters and motor oil is one of the challenges that facing every day auto services in Kosovo. These difficulties are due to different operation conditions because passenger's cars are being driven in different areas (e.g. area with variable climatic condition, poor road infrastructure, etc.) that make it difficult determining optimal time to changes the filters.

In Table 1 are given the actual and recommended period for changing filters and motor oil for passenger's cars that are being driven in Kosovo. Setting the period to change the filters and motor oil are obtained from analysis of data for approximately 25 000 vehicles manufactured after 2000 and that are being driven in Kosovo during the period January 2011 until October 2011.

Table 1. Actual and recommended period for changing filters and motor oil for passenger's cars that are being driven in Kosovo

Changing of the	Average of actual changing of filter and motor oil	Recommendation for changing of filter and motor oil
<i>Oil filter</i>	14.500 km	5000 km
<i>Air filter</i>	15.540 km	5000 km
<i>Fuel filter</i>	18.500 km	5000 km
<i>Motor oil</i>	11.100 km	5000 km

From Table 1 is easy to conclude the recommended period for changing of the filters and motor oil for passenger's cars that are being driven in Kosovo is smaller than current situation. Vehicle manufacturers usually provide two recommendations period for preventive maintenance, such as for the normal and heavy driving conditions. One of the vehicle manufacturers such as Land Rover gives these recommendations [3].

Manufacturers recommend that maintenance should be performed after every 5000 *km* (driving in heavy conditions), if the passenger's cars will be used in these conditions [3]:

- Frequent starting and stopping,
- Driving in dusty conditions,
- Climate variation condition from  $-25^{\circ}\text{C}$  up to  $+25^{\circ}\text{C}$ ,
- Frequent short trip,
- Extensive idling,
- Engine most of the time work in small number of rotation, etc.

These types of driving conditions, in adequate way respond to the conditions of Kosovo, therefore, recommended that the period of change of filters to be realized after passenger's cars pass 5000 *km*.

A large number of factors have contributed to reduce the period of changing filters and motor oil in Kosovo, such as: poor quality of motor oil, fuel, road infrastructure as well as environmental pollution (dust) which is 3 up to 10 times higher than allowed by International Standards [1]. Starting from a study done by the Institute of Public Health of Kosovo conducted in 2009 for air pollution, has resulted that particular matter (particles suspended) in some cases is 18 times greater than the maximum permitted by laws.

A very important fact should be noted that the average speed of driving of the passenger's cars in town Prishtina is approximately 15 *km/h* which affects the engine of the vehicle, it will work more hours and will pass fewer kilometers [1]. In these circumstances of driving of the vehicles it is necessary to become the most frequent change of filters and motor oil.

Recommended period for changing of the fuel filter is based on the fact that in most cases in market you can find poor quality of fuel and another argument is that most of the passenger's cars, are driven with minimum amount of fuel in the tank. A research conducted in some points for supply with fuel carried out during 2011 [1] shows that over 80 % of drivers, his vehicle supply with amount of fuel around 10.00 € which is equivalent from 7.5 to 8.5 liters. Therefore, this research has found that over 80 % of vehicles are driven with fuel tank filled with less than 10 % of total capacity; this means that vehicles, driven with minimum amount of fuel in the tank.

When the amount of fuel in the tank is minimal, the space above the fuel is filled with air. As is known, air contains a small amount of moisture and this moisture of air condenses inside of the fuel tank, especially at low temperatures. The amount of condensed water can cause corrosion on the metal tank and will mix with fuel tank, causing reduction in the efficiency and life expectancy of the fuel feeding system of engine.

Another reason to keep full tank is that corrosion formed from the air humidity tends to move to the bottom of the tank by forming a layer by sediment. Thus sediment formed at the bottom of the tank and other impurities can be not absorbed from the pump if they have enough fuel, but if the fuel level in tank will be very low, the supply of engine with fuel will be from bottom of the tank and fuel mixed with dirt causes the reduction of performance of the fuel feeding system of engine, filter blocking, pipes blocking, damage of the injectors, etc. Some tanks have installed a filter that prevents these impurities to enter in feeding system of engine, but if the cars are driven continuously with an empty tank filter may be blocked.

### **3.2. Factors that impact in wear of the vehicle's engine**

Studies have shown that in the most cases, defects of the engine are as a result of wear of motion parts. To prevent the wear of the engine, it is necessary to continually make improvements in the filtration system. Practice shown, that the life expectancy of the engines is in function of the purity of air entering in the combustion chamber [1].

The engine wear is very complex to analyse because it is depended from many factors such are [1, 4]:

- Forms of pollutants,
- Size of the pollutants,
- Type of pollutants,
- Concentration of pollutants,
- Vehicle operation conditions,
- Road infrastructure,
- Engine load conditions,
- Performance of filters (air, oil as well as fuel filters), etc.

For a better life expectancy of the engine is required to be adequate protection from abrasive pollutants that may enter in the combustion chamber through the suction manifold.

### 3.3. Investigation of changing filters of the passenger's cars in territory of Kosovo

The following diagrams, present current situation of the changing the filters for about 25 000 investigated vehicles in Kosovo for various types such are: VW, Mercedes, Audi, Land Rover, and other vehicles. These types of the vehicles are the mostly present in Kosovo. Investigations are carried out for period January – October 2011 through auto services given in reference [5].

In Figure 4 is showing the total number and percentage of the changing filters in auto services in Kosovo [5] for all types of investigated vehicles.

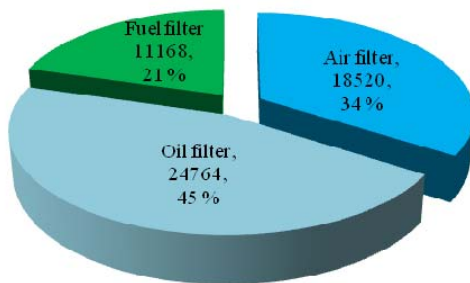


Figure 4. Diagram of situation for changing filters for all types of investigated cars

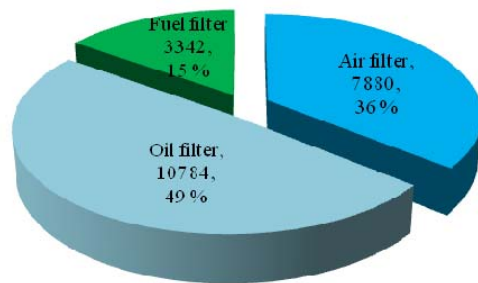


Figure 5. Diagram of situation for changing filters for VW passenger's cars

In Figure 5, Figure 6, Figure 7, Figure 8 and Figure 9 are presented the number and percentage of the changing filters for passenger's cars such are: VW, Mercedes, Audi, Land Rover and some other types of passenger's cars in auto services in Kosovo mentioned in reference [5]. As seen from presented diagrams, change of the filters are not carried out according to the manufacturer's recommendations.

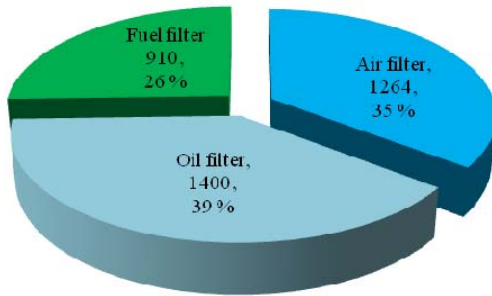


Figure 6. Diagram of situation for changing filters for Mercedes passenger's cars

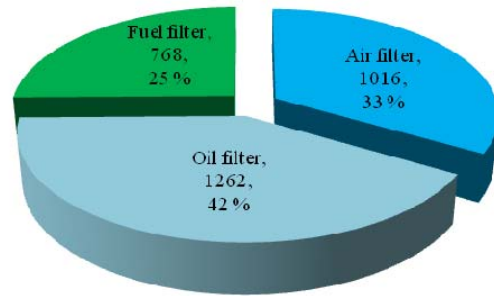


Figure 7. Diagram of situation for changing filters for Audi passenger's cars

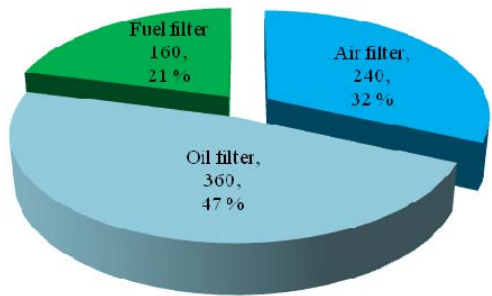


Figure 8. Diagram of situation for changing filters for Land Rover passenger's cars

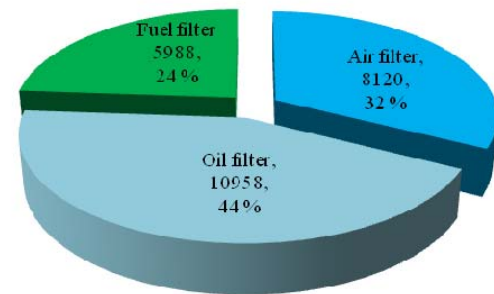


Figure 9. Diagram of situation for changing filters for other types of the passenger's cars

Vehicle's driver primary attention was paid only in changing of oil filters which is in percentage 99.06 % of the investigated vehicle. Second care is dedicated on the changing of the air filters which is 74.08 %, while, changing of fuel filter is only 44.67 %.

Therefore can be concluded that, it is worrying fact regarding changing the filters, which can be seen that air filters have a smaller substitute than oil filters, while based on the recommendations of manufacturers, air filter should be replaced at the same time with oil filter or more often. This is based on the fact that the air filter is exposed to most dust and dirt in the air.

Another important fact from the above diagram shows that the fuel filter has less percentage of change than air and oil filters, this difference would be justified if the quality of fuel will be high (in accordance with International Standards). As we know the quality of fuel in Kosovo is not considered as a high quality and vehicle drivers drive their vehicles with minimal amount of fuel in the tank. Based on these arguments we can conclude that this change is not regular and does not comply with the manufacturer's recommendations and presents a permanent risk to damage the fuel feeding system of the engine. This justified that devices of feeding system of engine worked with a high precision, so it is recommended to change the fuel filter in same time with oil filter and air filter.

#### 4. CONCLUSIONS

Starting from investigation made in this paper for analysing the period of changing of filters and motor oil for passenger's cars driven in territory of Republic of Kosovo, we can conclude that:

- The recommended period for changing the filters and motor oil for territory of Kosovo is much smaller than the current period,
- Analyses of investigated data, shown that the changing of filters is not in accordance with manufacturer's recommendation and will present permanent risk for reduction of life expectancy of the vehicle engine and
- Vehicle's driver pays more attention to changing the oil filter with a percentage of 99.06 %, compared to air filter with 74.08 % and fuel filter with 44.67 %.

This research carried out in the paper is a good suggestion for auto services in Kosovo and so on and we recommend that the current situation should be changed. So, for the preventive maintenance to be changed: motor oil, oil filter and air filter while fuel filter after second preventive maintenance of course this will be in consideration during summer season, while during winter season, we recommend all filters to be changed at the same time.

#### 5. REFERENCES

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