

## **SYSTEM OF AUTOMOTIVE TECHNICAL SERVICING**

### **AUTOMOBILIŲ TECHNINĖS PRIEŽIŪROS SISTEMA**

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The automotive technical servicing system includes several kinds of technical activities, technical service, current repair and diagnostics. One of essential elements of the car technical service system is mileage in between servicing. During technical servicing oil is replaced, diagnostics and other servicing work planned by the car producers is performed.

The automobile producers increase the car mileage in between servicing following marketing trend. If for highly forced engines the mileage in between servicing is technically groundlessly increased, it can lead to essential decrease of resources of motors and other systems.

The aim of research is to determine influence of infrequent servicing of vehicle on vehicle service life. According to the results of the research infrequent technical servicing leads to premature decrease of the automobile's engine service life.

*Technical servicing, maintenance, oil change, service life.*

### **Introduction**

Experience of usage, costs of exploitation and technical condition of vehicle are well connected with technically and economically based system of technical servicing.

There are many technically based ways and theories about how to select the most important criteria's and determine right periodicity of vehicle servicing. In current conditions, automobile producers are adjusting periodicity of maintenance following marketing needs. Ignoring technically and scientifically based criteria's of determination of right periodicity of maintenance will shorten vehicle service life. Shorter automobile service life leads to higher expenses for its owners and larger footprint on natural recourses of our planet.

### **Purpose of research and objectives**

Most of owners and users of new vehicles regard maintenance operations and expenses as necessary evil to remain eligible for manufacturer's warranty

program. Customers, arriving at workshop for scheduled maintenance, often call it „warranty servicing”. Typical customer, whose vehicle is financed by leasing company by fixed terms, is not really interested of preserving vehicle’s technical condition in high level for period in future, when vehicle will no longer be at his possession. For such a customer, periodicity of maintenance, declared by manufacturer and based on marketing research method, is a good deal.

According to experience of companies, who use vehicles up to higher total mileage, for instance, 500 000 km, vehicle breakdown due to wear out of critical engine parts are becoming often issue. Objective of research is to determine optimal interval of engine oil change operation and its correspondence to information, publicized by manufacturer.

### **Test subjects and methodology of research**

Subjects of testing are samples of engine oil, collected from vehicles with different mileage form previous oil change. All test vehicles are Renault Scenic II, model year 2006, equipped with 1.9 liter Diesel engine, with total mileage varying from 62 000 to 135 000 km. Manufacture’s original oil and air filters were used for vehicle maintenance. Vehicles mainly were used in urban conditions. Two from five test vehicles were equipped with engine fitted with Diesel particle filter. All vehicles were equipped with Bosch second generation common rail Diesel injection, using CP3 type high pressure pump.

Engine oil used for engine lubrication was:

- Eurol Fluence 5W-30 for vehicles equipped with particle filter;
- Eurol Super Lite 5W-40 for other vehicles.

Eurol Fluence 5W-30 is certified according ACEA A1/B1; A5/B5 (07); C2 (08) and Renault RN0700 standards. Eurol Super Lite 5W-40 is certified according ACEA: A3/B4 (08) and Renault RN 070/ 0710 standards.

As oil tests are expensive, only 7 oil samples were taken. Samples were taken from automobiles, used by company “Rigas Taksometru Parks”, which is one of the biggest taxi operators in Latvia. Oil samples were sent for analysis to laboratory of oil producer Exxon-Mobil, located in Sweden. Research results are based on test results, provided by this laboratory. Oil was tested for its lubricating and protecting properties and for presence of impurities.

Results are comparison of parameters of new motor oil, key parameters publicized by oil producer and actual values of used motor oil. 7 samples are not enough for precise conclusions, but can show general trend and suggest necessity of further research in this direction.

### **System of vehicle technical servicing**

Experience of usage, costs of exploitation and technical condition of automobile are well connected with technically and economically based system of technical servicing.

## **Meaning of automotive servicing**

Any machine, mechanism and also automobile can be regarded as united framework of elements who operate together. In automobiles those elements of framework can be separate parts or systems, for instance engine, suspension, brakes and internal parts of those. Connections and operation of the elements of framework are determined and can be characterized by geometrical dimensions, mechanical, electrical, chemical and other values - the parameters.

Such numeric values – parameters characterize and determine capabilities of operation of entire machine or its systems.

Technical condition of the machine is characterized by set of parameters. Depending on working conditions, duration of use, maintenance and repair operations performed this set of parameters is changing.

To maintain technical condition of automobile at certain level, acceptable for user and state regulations, servicing is required.

Servicing operations can be divided in two main groups. One group of operations is meant for maintaining of automobile's technical condition, the other one is for restoring it. For this reason all set of operations meant for providing certain level of technical condition can be separated in two main groups – maintenance and repair operations.

Maintenance is preventive action; it is conducted according to schedule, when certain mileage or length of usage is reached.

The purpose of maintenance:

- to maintain automobile in working condition and acceptable external state;
- to ensure safe and economical operation of automobile;
- to provide compliance to state regulations;
- to reduce intensity of change of technical properties;
- to preventively discover defects and prevent them.

Purpose of repair operations is to restore technical condition to certain level and normal, uninterrupted operation of automobile.

Repair operations are normally conducted when there is a need for it.

## **Periodicity of maintenance**

Periodicity of maintenance is mileage or length of usage between two following maintenance services.

Two main methods exist for maintenance operations:

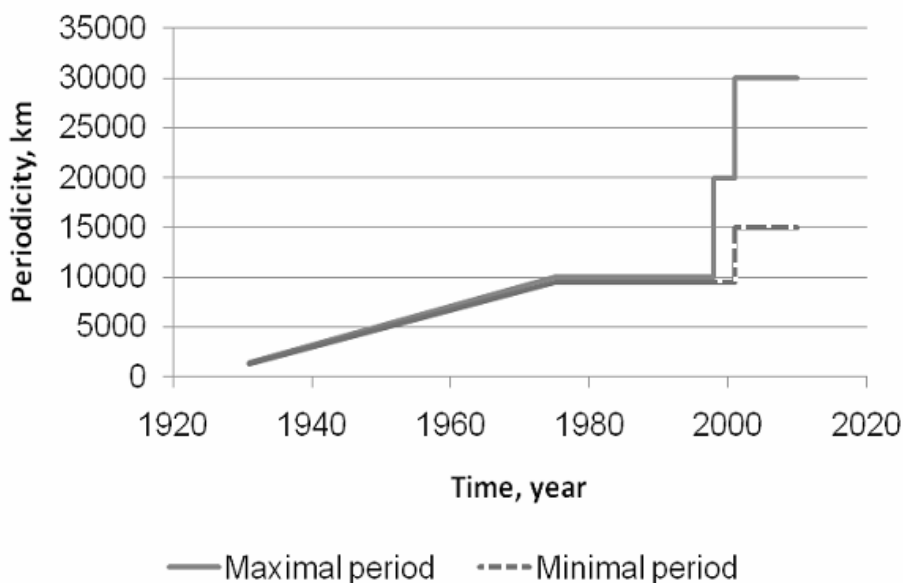
- restoring of automobile's technical condition after certain period;
- restoring of automobile's technical condition according results of diagnostic tests.

Many ways of determination of right periodicity of maintenance exist, for instance:

- method of analogy according to prototype;
- analytical methods, based on experiments and collected data;
- methods based imitation of processes;
- methods, based on marketing researches.

As maintenance at its basic level is technological operation, technologically based normative must be given a priority above others. On contrary, most of carmakers use declared figures of maintenance periodicity as marketing tool.

Evolution of maintenance periodicity of Renault passenger vehicles is shown on figure 1.



**Fig. 1.** Evolution of maintenance periodicity of Renault passenger vehicles

**Pav. 1.** Lengvųjų automobilių Renault techninių priežiūrų evoliucija

Manufacturer of automobiles is not really interested in extended use of their products. When product life cycle is coming to end, it makes room for new products.

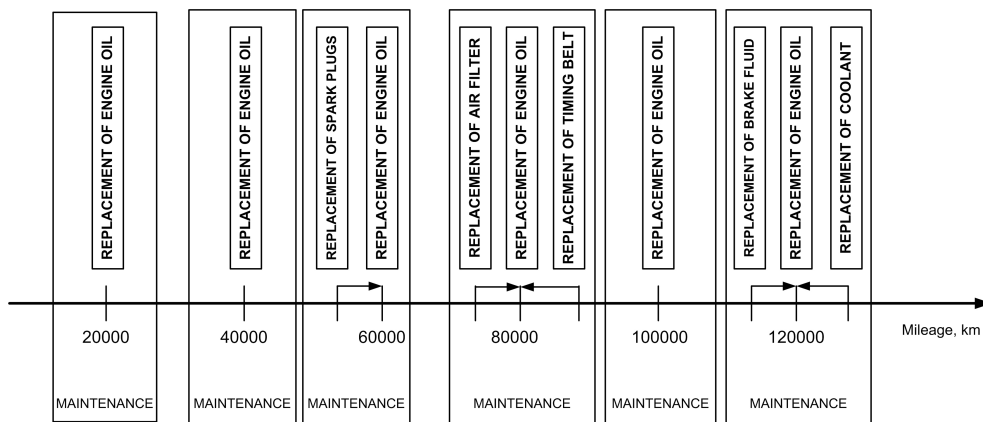
Service life of modern automobiles in Latvia is normally up to 300 000 km. Older vehicles demand many repairs to stay in acceptable technical condition. A price of spare parts and labor makes total repair costs close to market value of automobile in question. For instance, replacement engine for automobile Renault Kangoo, model year 2004, equipped with 1.5 Diesel engine cost 3800 EUR, but market value of such a vehicle today is 3000 EUR, and decreases by every day.

Typical user of new car is not very interested in preserving vehicle's technical condition in highest level. In most cases vehicle is financed by leasing company, on terms that include fixed period of use and maximum mileage up to 100 000 km. First user and financing company are not concerned about details, how much longer after that lease period is over, vehicle will in usable state. It is in automobile servicing business best interests to maintain vehicle's technical condition in appropriate level and prolong automobile's service life.

To reach that goal, management of automobile workshops can follow steps:

- find the best servicing methods, periodicity of operations, materials and spare parts for maintenance operations;
- offer individually adjusted maintenance program for each customer;
- convince the customers that special maintenance will ensure trouble free use of vehicles and have economical advantages.

Maintenance program of modern automobile usually is based on periodicity of main operation – engine oil change. Periodicity of other operations, for instance air filter replacement is dependent on main operation. Typical grouping of maintenance operations is shown on figure 2.



**Fig. 2.** Maintenance operation grouping

**Pav. 2.** Techninės priežiūros darbų suskirstymas

To evaluate chosen interval of engine oil change operation, oil have to be chemically analyzed. Results of tests of engine oil Eurol Super Lite 5W40, used on vehicle Renault Scenic II equipped with 1.9l Diesel engine (F9Q 812) are shown in table 1.

**Table 1.** Results of engine oil tests 1.**1 lentelė.** Variklio alyvos bandymų rezultatai 1.

Parameter	Result			
Engine life, km	-	130000.00	135000.00	100000.00
Oil life, km	0.00	10000.00	15000.00	20000.00
Viscosity at 100°C, cSt	14.60	14.20	19.20**	14.60
Viscosity at 40°C, cSt	86.00	86.00	120.00**	91.00
Temperature of flash	>180.00°C	>180.00°C	>180.00°C	>180.00°C
TBN, mgKOH/g	10.00	8.80	6.20	3.70**
H <sub>2</sub> O, %	0.06	0.07	0.17	0.11
Silicon, ppm	3.00	6.00	47.00**	44.00**
Sodium, ppm	10.00	13.00	9.00	5.00
Boron, ppm	1.00	6.00	23.00	33.00
Insoluble's, %	<0.20	0.86	2.25**	1.53
Iron, ppm	2.00	48.00	613.00**	217.00**
Aluminum, ppm	1.00	5.00	62.00**	21.00
Chromium, ppm	<1.00	2.00	10.00	7.00
Molybdenum, ppm	<1.00	5.00	27.00	23.00
Copper, ppm	<1.00	5.00	23.00	8.00
Lead, ppm	<1.00	1.00	71.00**	11.0
Tin, ppm	<1.00	<1.00	15.00	1.00
Nickel, ppm	<1.00	1.00	16.00	8.00
Silver, ppm	<1.00	<1.00	<1.00	<1.00
Manganese, ppm	<1.00	1.00	5.00	2.00
<b>Conclusion of Laboratory</b>	<b>Suitable for further use</b>	<b>Suitable for further use</b>	<b>Oil change recommended</b>	<b>Oil change recommended</b>

Results of tests of engine oil Eurol Fluence 5W30, used on vehicle Renault Scenic II equipped with 1.9l Diesel engine and Diesel particle filter (F9Q 804) are shown in table 2.

**Table 2.** Results of engine oil tests 2.

**2 lentelė.** Variklio alyvos bandymų rezultatai 2.

Parameter	Result		
Engine life, km	-	70000.00	62000.00
Oil life, km	0.00	10000.00	20000.00
Viscosity at 100°C, cSt	11.9	8.00**	9.00**
Viscosity at 40°C, cSt	67.00	41.00**	48.00**
Temperature of flash	>180.00°C	>170.00°C**	>170.00°C**
Fuel, %	<2.00	12.00**	9.00**
TBN, mgKOH/g	7.30	3.90**	3.00**
H <sub>2</sub> O, %	0.05	0.08	0.05
Silicon, ppm	4.00	31.00**	62.00**
Sodium, ppm	7.00	7.00	7.00
Boron, ppm	70.00	46.00	43.00
Insoluble's, %	<0.20	0.90	1.43
Iron, ppm	1.00	108.00	197.00**
Aluminum, ppm	1.00	7.00	12.00
Chromium, ppm	<1.00	2.00	6.00
Molybdenum, ppm	<1.00	7.00	9.00
Copper, ppm	<1.00	17.00	18.00
Lead, ppm	<1.00	12.00	16.00
Tin, ppm	<1.00	<1.00	1.00
Nickel, ppm	<1.00	2.00	3.00
Silver, ppm	<1.00	<1.00	<1.00
Manganese, ppm	<1.00	1.00	2.00
<b>Conclusion of Laboratory</b>	<b>Suitable for further use</b>	<b>Oil change recommended</b>	<b>Oil change recommended</b>

Main parameters, determining suitability for further use of motor oil are:

- temperature of flash;

- viscosity;
- presence of water;
- Total Base Number;
- amount of insoluble's.

Considering high costs of engine oil analysis, only 7 samples were tested, two of them were new oil. Number of test samples is not enough for reasonable exclude of influence of random values on results.

Anyway, the result shows stable trend – decrease of Total Base Number depending on mileage of oil.

Total Base Number characterizes ability of engine oil to neutralize acids, which are forming during process of combustion. If value of TBN is below 4 mgKOH/g, engine oil is no longer protecting engine of influence of those acids.

Other key parameters also are changing its values, making oil unsuitable for further use.

Results of test show that engine oil of Diesel engine without particle filter is suitable for use up to mileage of 12 000 km. In case of engine, equipped with particle filter, even 10 000 km is too long mileage between oil changes. Main difference is excessive use of fuel, during regeneration phase of particle filter. During that phase, some amount of fuel is getting in to engine oil and changing its characteristics. For tested engines, another brand of oil should be selected, or periodicity of maintenance should be changed.

### Conclusions

1. Periodicity of maintenance, advised by automobile manufacturer, is serving marketing purposes.
2. Technically groundlessly increased periodicity of maintenance can lead to shorter service life of automobile.
3. Shorter automobile service life leads to higher expenses for its owners and larger footprint on natural recourses of our planet.
4. To determine optimal periodicity of oil change, chemical analysis of engine oil is recommended.

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## AUTOMOBILIU TECHNINĒS PRIEŽIŪROS SISTEMA

### Reziუმэ

Automobilu tehninio serviso sistema apima keletu tehnines veiklos ruisiu: tehnini servisu, einamu remontu ir diagnostiku. Vienas is esminiu automobilu tehninio serviso elementu yra nuvaziuotas atstumas tarp tehniniu prieziuru. Atliekant tehnini servisu keiciama alyva, vykdoma diagnostika ir kiti automobilio gamintojo numatyti serviso darbai.

Sekdami marketingo tendencijomis, gamintojai didina automobilio nuvaziuota atstuma tarp serviso darbu. Jeigu forsuotiems varikliams nuvaziuotas atstumas tarp serviso darbu padidinamas techniskai nepagrirstai, tai gali privesti prie motoresurso sumazejimo. Tyrimu tikslas yra nustatyti automobilu nedažno aptarnavimo itaka automobilio motoresursui. Pagal tyrimo rezultatus nedažnas techninis servisas veda prie paankstinto variklio susidavejimo.

*Tehnis servisas, prieziura, tepalo keitimas, darbo laikas.*

Марис Гаилис

## СИСТЕМА ТЕХНИЧЕСКОГО ОБСЛУЖИВАНИЕ АВТОМОБИЛЕЙ

### Резюме

Система сервиса автомобилей включает несколько сортов технических аспектов: технический сервис, текущий ремонт, диагностику. Пробег между техническими осмотрами является одним из существенных элементов системы технического сервиса автомобилей. Во время технического сервиса меняется масла и производится диагностика, выполняется другие сервисные работы предусмотренные изготовителем.

Следуя тенденциям маркетинга, изготовители увеличивает пробег автомобиля между сервисными осмотрами. Необоснованно увеличивая

пробег автомобиля между сервисными осмотрами с форсированными двигателями, может привести к уменьшению мотто ресурса.

Целью исследования является определение влияния увеличенного пробега между обслуживанием автомобиля на мотто ресурс. Анализ результатов исследования указывает на повышения износа двигателя при увеличении интервалов между техническими осмотрами.

*Технический сервис, обслуживание, замена масла, рабочее время.*