There are following types of base:

- Mineral;
- Semi-synthetic;
- Synthetic;
- Hydrocracking.

Quantitative and qualitative composition of the additives is determined by each manufacturer individually, but gear oils must comply with the normative documents.

Gear oils are obtained by adding additives of various functional purpose or additive packages [3].

Detergent additives provide piston cleanliness and good mobility of the piston rings. Typically, in the oil combinations of different detergents are used which complement and improve the effectiveness of each other.

Depressant additives have good soluability in oils. They reduce the pour point and improve viscosity properties of oils.

Anticorrosion additives prevent and reduce corrosion in gear oils. They form a protective film on a metal surface. This film is catalytically inactive and is holds firmly on the surface.

Antiscoring additives prevent direct contact of metal surfaces at a very high load. This type of additive form very strong mono- or multimolecular film on the surface of the metal.

Viscosity additives help to keep the necessary viscosity at positive temperatures and don't have any negative influence at low temperatures.

Antifoam additives help to reduce foaming when they are used in transmission units. They also destroy already formed foam.

Antioxidant additives increase resistance to oxidation. When the engine works the oil undergos deep chemical transformations - oxidation, polymerization, and alkylation.

It is experimentally determined that by adding to a high viscosity index base of the package containing detergent, depressant, anticorrosion, antiscoring, viscosity, antifoam and antioxidant additives in total amount of 5-10%, they obtain the gear oil LUKOIL - TM-5 (API GL-5; SAE 85W90) with the following parameters [1]:

Quality parameters of gear oil LUKOIL - TM-5

Specification	Value
Kinematic viscosity at 100℃, mm^2/s	16,5
Pour point,℃, max	-25
Viscosity index, min	90
Flash point in o.c.,℃, max	180
Weight fraction of active elements, %, S/P, min	1,2/0,05

PEFERENCES

1. Каталог-справочник продукции ОАО «Лукойл». – М., 2002. – 108 с.
2. Топлива, смазочные материалы, технические жидкости. Ассортимент и применение : справ. / под ред. В.М. Школьникова. – Изд. 2-е. – М. : Техинформ, 1999. – 596 с.
3. Специальные технологии переработки природных энергоносителей : учеб.-метод. пособие / под ред. С.В. Покровская [и др.]. – Изд. 1-е. – Новополоцк : ПГУ, 2013. – 142 с.

UDC 629,331

DIAGNOSIS OF GEARBOXES AND MAIN GEARS

IGOR KONON
Polotsk State University, Belarus

Technical diagnosis is the process which determines the technical condition of the object to be diagnosed with certain accuracy. The result of the diagnosis is the conclusion about the technical condition of the vehicle including (if necessary) the place, the type and the cause of the fault. Diagnosis is used for routine maintenance, as well as for detecting defects in the maintenance.

The first task of technical diagnostics is the determination of technical condition, so that the vehicle status is to be related to one of the possible technical conditions.

Having established the fact of the efficiency loss, the failure or malfunction, the second problem started being solved: the search of the defects which have broken the condition and operation of the vehicle or caused malfunction.

The third task of the diagnosis is collecting initial data for forecasting the residual operation life or estimating the probability of failure-free operation of the vehicle during the monitoring period.

In addition, the use of the system itself arranges diagnosing operation, enables to create a computerized system for the collection of objective information on changing the current status of parts and assembly units as a function of operation time. It is important for the reliability assessment, design optimizing, improving the production technology and modes of vehicle operation .

Diagnosing transmissions and final drives aim at the detection and elimination of all possible problems arising from the operation of these units.

Transmission gear box and the main gear are essential elements of the transmission of the car, because it is through them that there is a transfer of a drive torque from the power unit to the drive wheels.

The principle of the gearbox comes down to the kinematic connection at different levels of the input and output shafts through various combinations of gears with different gear ratios.

Transmission mechanism is complicated with a large number of elements and therefore the number of possible faults in it is higher than those in the main gear. Each of the possible problems has their own characteristics.

The main gear is more simple in design, but the ladingt is substantially heavier on it. The purpose of the main transmission is to transfer the drive torque from the power unit and the gearbox to the driving wheels. Usually the main transmission is either an angle gearbox or a parallel-shaft reduction gear unit.

Malfunctions of the main transfer (table) are characterized by the run-out and sometimes gear teeth failure associated with the disturbance of the correct engagement and reducing the contact surface of the teeth.

The characteristics and the corresponding malfunctions in gearboxes and main gears

characteristics	malfunctions
Gearbox	
Noise in the neutral position	bearing run-out of the drive shaft; low oil level in a box
Noise in the gear	wear and deformation of the locking device; worn synchronizer sleeve; weakening of the threaded joint in the gearbox fixture; incomplete clutch
Operation noise in a gearbox	bearing run-out Worn synchronizer sleeve; low oil level in a box
Difficulty in switching the gear	worn synchronizer sleeve; gear wear; low oil level in a box; worn or damaged shift shaft; loose or damaged cable (thrust) drive; incomplete clutch
unintentional gear disengagement	weakening of the threaded joint in the gearbox fixture; grabbing the rope (traction) of the drive; worn synchronizer sleeve; splines worn synchromesh clutches; gear wear; worn-out shift shaft; worn-out shift fork; run-out of the layshaft bearing
Leaking oil	weakening of the threaded joint in the gearbox fixture; worn-out filler blocks
Main gear	
The noise during operation of the main gear	worn-out pinion gears; improper adjustment of the pinion gears; no oil in the crankcase
Increased heating of the oil in the reducing unit	continuous operation under heavy lading ; insufficient oil level; tough bearings tightening
Leaking oil	weakening of the threaded joint in the gearbox fixture; worn-out filler blocks

The reason for this is the significant lading acting on the main transmission, which causes an elastic deformation of the shafts and bearings, reducing their preload and the appearance of gaps in the bearings (especially the driving gear). Bearing deformation and their misalignment causes axial displacement of the adjusting gear,the violation of their alignment and, consequently, increased run-out and noise during their operation.

As can be seen from the table, all possible faults are determined by ear (noise), tactually (heating) or visually (oil leakage). However, it should be noted that these methods are subjective and have a low level of reliability.

For more accurate and continuous monitoring of the gear-box and the main gear it is reasonable to use special stand-alone systems on a car that will monitor specific performance characteristics of the aggregates on a car.

Noise while operating. Noises associated with the worn-out pinion gears at early stages may be not audible to humans, and therefore it makes sense to implement the system for measuring noise into the construction of gearboxes and final drive.

Such system will detect the increased noise at early stages, which will serve as a signal to check the details of transmissions and final drives, and will prevent tough wear and carry out adjustment or reconditioning work to extend the service life.

Increased heat-up. The Increased heat-up of the transmission gear box and the main gears may be due to the insufficient level of the oil in the crankcase. The same tough heat- up occurs when there is a run-out or or incorrect adjustment of gear system.

To carry out continuous monitoring of the temperature of the oil in the crankcase of transmission gear boxes and final drives it is advisable to use transmission oil temperature sensors.

The use of autonomous systems to control transmission oil temperature and noise level in the gear system will allow the driver to monitor the status of transmission units in the real-time mode immediately during operation.

The deviation from the regulatory parameters of the sensors will serve as a signal for checking on the presence of the defects in aggregates , and their timely fixing will significantly extend the service life of the units as a whole and individual elements in particular.

UDC 610.658.

ASSESSMENT OF COMPLEX RISK IN MAIN PIPELINE TRANSPORT

VLADISLAVA KOVRIZHNYKH, ALIAKSEI VARONIN
Polotsk State University, Belarus

In this article was given a description of new method of complex risk assessment in the main pipeline transport. At the stage of structure analysis was proposed to use the methodology of functional modeling. At the stage of risk assessment at functioning of pipeline transport was shown practicability to use the logical-probabilistic calculus. At the stage of getting local probabilities of dangerous events was suggested to apply the method of expert evaluations.

The main pipeline transport is attributed to hazardous industrial facilities. In this connection it is necessary to systematically evaluate the safety of main pipelines. Considering that security is one of the quality indicators the methodological basis for risk management mechanisms may become the methodology of quality management from the position of the ISO 9000 series.

A systematic approach to the mechanism of evaluation, analysis, decision-making in relation to the effectiveness of risk management involves the identification of sources of risk, finding of communication functions between the resulting risk and local sources, quantitative risk assessment and decision on the need for measures to reduce risk.

In the context of the assigned task an identification procedure can be carried out by the various methods. The problem of identification and description of the processes which influence the activity of the enterprise of the main pipeline transport can be solved with use of a method of modeling. In this case it is convenient to use methodology of functional modeling of structure of processes IDEF0 which allows using the process and system approaches at drawing up model of activity of the enterprise of the main pipeline transport.

At process of building a model it is necessary to remember that the result of pipeline transportation service is provided not only by production processes but also by processes that ensure controlled conditions for its implementation. An important aspect in the activity of pipeline transport system is also the priority of information resources over all other resources as the primary control actions on further physical actions. In addition another feature is that at functioning of pipeline transport the process of safety evaluation and assessment of the state of objects has a separate agent who is not part of the organization which carries out activity.

The correct functional operation of pipeline transport which includes the processes of various categories, relationships and resources is the objective evidence that it was identified all sources of risks, clearly defined the structure of private risks. This together will allow building a reliable evaluation model.

Taking into account the specific features of functioning of pipeline transport as an integrated activity on the structure and interaction of its constituent processes it was identified three integrated sources of risk: risk of management, technological risk and risk of analysis.