

## I. Formulation of tasks for research.

**Customer:** Ltd. "Altair" the Russian Federation, 303320, Orel region, Sverdlovsk district, p. Zmievka, Kirova d.42.

**Expert organization:** IP Gubanov Maksim Nikolaevich.

**Reason for work:** Contract for services.

**Purpose of the study:** Motor vehicle set disadvantages LAND ROVER

**Objectives of the study:** determine the cause of motor vehicle disadvantages LAND ROVER DISCOVERY 4, VIN

### Certificate of quality research.

1. The facts stated in the Opinion, true and correct reality.
2. Contained in the analysis and conclusions views belong to the skilled person and are strictly valid within the restrictive conditions and assumptions, which are part of the present findings.
3. The specialist has neither the present, not the expected interest in the object under study and act impartially and without prejudice to the parties involved. specialist remuneration does not depend on the final conclusions of the study, as well as those events that may occur as a result of the use by the Customer or by third parties of the findings of the Opinion.
4. The study suggested the absence of any hidden factors that influence the conclusions Conclusions.
5. The conclusion of the study contains a professional expert opinion on the conformity of damage the object being studied.
6. Initial and other data used by the expert in the preparation of the findings were obtained from trusted sources, and are considered reliable. However, the specialist can not guarantee their complete accuracy, so where possible on customer's request, reference is made to the source of information, unless otherwise provided by contract with the customer.
7. Specialist is not responsible for the legal description of the property rights to the object under study, the accuracy of which is taken from the customer's words.

### III. Manufacturing Expertise charged:

- **Gubanov Maksim Nikolaevich**, with higher education, academic degree "Candidate of Science" held training on specialty "expert technician"

entered in the register

ekspertovtehnikov Russian Ministry of Justice (the number in the register 461, the MAC protocol of the 11.02.2013 №2), held training on the expert specialties

confirmed "evidence of the right to self-production of legal expertise", issued by ANO "Inter-regional bureau of forensic examination and evaluation" №010, the experience of expert work from 2010.

Professional experience since 2004.

- **Pankov Oleg O.** with higher education in the specialty "Cars and automobile economy" held training on specialty "expert technician", entered in the register of expert technicians Russian Ministry of Justice (the number in the register 563, the MAC protocol from 11.03.2013 №3), the experience of expert work with 2013. Professional experience since 2011.

#### **IV. For permission to put questions to the experts:**

1. Is there a fault in the car LAND ROVER DISCOVERY 4, the state license plate E005HS57RUS?

2. **What is the cause of a fault in the car. Literature, used in the study:**

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19. Forensic Photography and video for experts - motor-vehicle (practical guide): Coruh YG Zamihovsky MI 2006.

## ===== STUDY

### terms

International and national standards, determined in accordance with the law binding the quality requirements set the terms and definitions used to define the parameters and quality parameters (states) of complex technical products, including vehicles, to the entire period of its existence, the so-called life cycle .

**Working condition** - state of the object at which it meets all the requirements of normative-technical and design documentation.

**fault condition** - state of the object at which he did not corresponds to at least one of the requirements of normative-technical and design documentation.

**usable state** - state of the object in which the value of all parameters characterizing the ability to perform specified functions, meet the requirements of normative-technical and design documentation.

**nonoperable condition** - state of the object, wherein the value of at least one parameter indicative of the ability to perform specified functions, not corresponds to with regulatory and technical or design documentation.

**Defect** - every single non-conformance to established requirements.

**Production (process) defect** - defect caused violation of the established manufacturing techniques (unit).

**disposable defect** - defect elimination is possible by maintenance or repair (the unit).

**Fatal flaw** - defects that the removal of technical it is impossible or not economically feasible and requires replacement (assembly) assembly.

**design defects** - defects caused by the violation of the established design codes (design).

**serious defect** - a defect that significantly affects the use of the product for its intended purpose and its longevity, but is not critical.

**latent defect** - defect to identify where in the regulatory documentation mandatory for this type of control does not provide for appropriate rules, methods and tools.

**The critical defect** - a defect which renders the use of products intended practically impossible or unacceptable.

**Renouncement** - failure or breakage (unit) during its operation due to incorrect operation, bad service (Repair) and / or structural and manufacturing defects. Exiting down (breaking) characterized by a deflection parameters (unit) from the standard in which it becomes unworkable.

**Rejection reason** - the processes, events and conditions that have caused the occurrence of failure of the object.

**The consequences of failure** - phenomena, processes, events and conditions due to the occurrence of failure.

**production failure** - failure caused by imperfect or violation of the established manufacturing process or the repair facility that performs at the repair shop.

**operational failure** - failure resulting from a violation of the rules or conditions of operation.

**Wear** - the process of changing dimensions of the part as a result of separation from the surface of the material particles.

**Damage** - an event characterized by violation of serviceable condition while maintaining its functionality.

----- **Question №1** -----

Inspection within the above questions was carried out on the territory of "Autostadt Plus" at Voronezh, Leninsky Prospekt 156, 22.07.2016g. from 10-00 to 11-00, in the presence of a representative of the owner of the car Ltd. "Altair" and with the direct participation of service mechanics of "Autostadt Plus".

On the study, the experts presented the following object: vehicle car LAND ROVER DISCOVERY 4 ,.

In the study, an external inspection of the vehicle was conducted. Appearance of the car is shown in Fig. №1,2.

After comparing the records and registration data following actions were carried out on the vehicle:

Inspection of the vehicle instrument panel installed - run of the car at the time of the study can not be established, as produced engine disassembly and disconnected the battery, which does not allow to read the testimony of the instrument panel. vehicle mileage at the time of the study according to the preparation of documents for the repair of "Autostadt Plus" is 145 566 km. On Fig. №5 presented disassembled the engine and remove attachments of the test car, folded separately located within the service area of "Avtograd Plus".



Fig. № 5. dismantled and disassembled engine attachments of the test vehicle

Inspection of the engine revealed his shot partial disassembly, namely - Disassembling the timing, by performing the removal of the oil pan, crankshaft and pistons of the four cylinders were not removed and are located inside the cylinder block of Fig. №6.

Inspection and study of the bottom of the engine Fig. №6 revealed the following:

- on all four cylinders are present cooling nozzles;
- connecting rods and pistons have no breakage indication, all the pistons in the cylinders can be easily moved without shimming;
- engine block clean without traces of oil fumes.
- inspection of fusion antifreeze and oil indicates that they are correct and working condition. The presence of impurities is not revealed. The color and smell correspond to the working properties of process fluids. Mixing the oil and coolant is not set - the emulsion is absent.
- inspection of the oil filter revealed the presence of small chips in the filter element, indicating the presence in oil of small metal inclusions formed as a result of the wear process - mechanical friction.



Fig. № 6. disassembled, with removal of the pallet, the test car engine LAND ROVER DISCOVERY 4

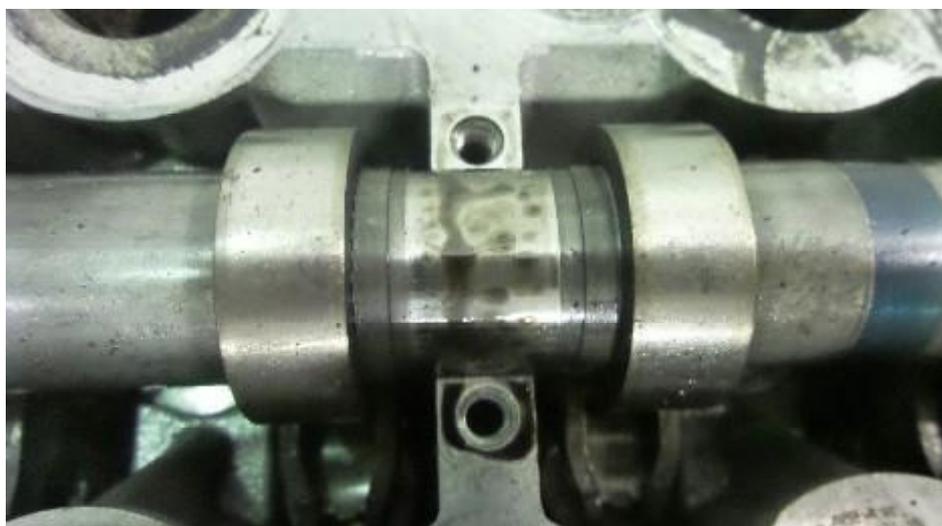


Fig. № 7. The cylinder head (one of two) of the motor vehicle investigated LAND ROVER at removing covers a cylinder head (Fig. №7) installed camshafts are properly installed and are in perfect condition, excessive friction traces in the form of scuffing and signs of overheating in the form annealing do not have. Valve mechanism without a trace faults. Condition Cylinder head gasket without gusts and traces of leaks.

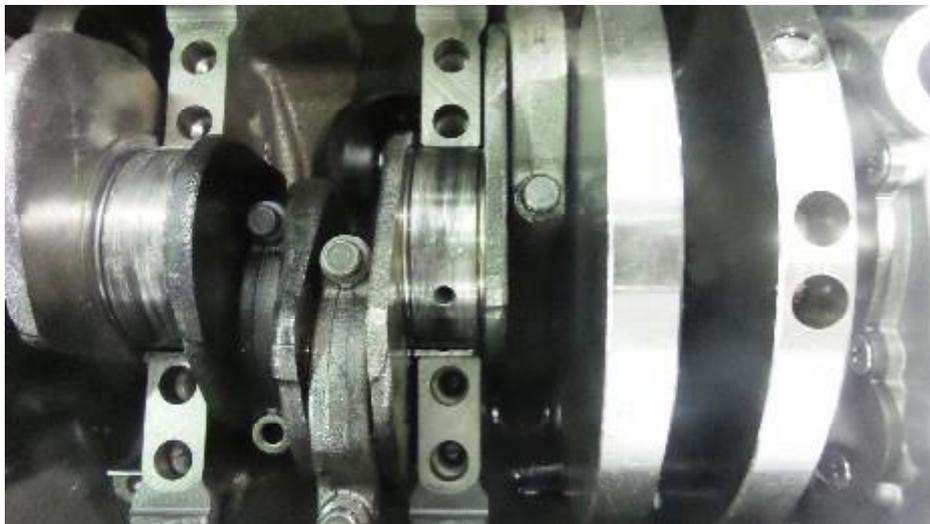


Fig. № 8. Native neck engine inserts the test vehicle LAND ROVER DISCOVERY 4, VIN  
decapping main journals of the crankshaft and inspection of their indigenous inserts revealed traces of  
increased friction in the form of burrs and deformations with  
partial destruction of the inserts Fig. №8;



Fig. № 9. The connecting rod is welded by friction liner motor vehicle investigated LAND

inspection rod liners also revealed traces of increased friction and wear in the form of burrs and deformations. Identified as well as traces of overheating annealing and welding by friction of a connecting rod

inserts Fig. №9.

----- Question №2 -----

For a more thorough study of the state of connecting rod and piston group it produced lifting crankshaft.

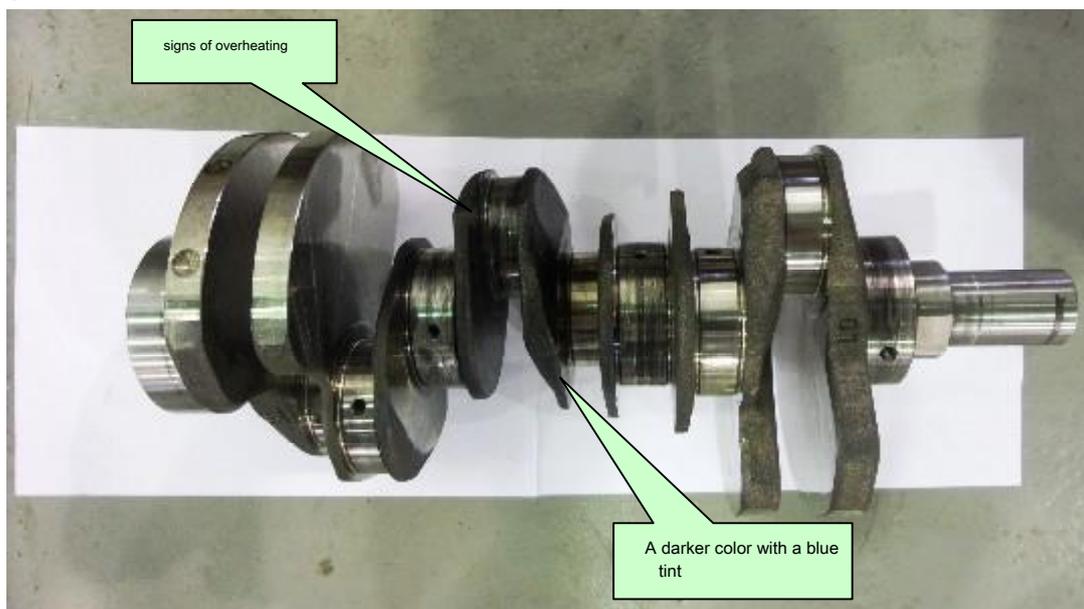


Fig. № 10. Visual inspection of the test vehicle engine crankshaft LAND ROVER DISCOVERY 4, VIN

Crankshaft (Fig №11.) - is part of an internal combustion engine which converts the reciprocating motion of the pistons into torque. Apparatus crankshaft include cheeks, crankpins and counterweights, a shank flange. The support of the crankshaft - the root of the neck. In the test six-cylinder engine crankshaft with four pillars. The crankshaft must be durable, have low weight, balanced, have a precise processing. On the crankshaft during operation to bending and twisting forces. That there was no premature failure pair

between the crankpins and cheeks made slightly rounded. If the engine is operating normally, the indigenous and crankshaft connecting rod gradually wear out, as well as sliding bearings. Thus, in the chambers of the internal combustion engine after ignition of the injected fuel there are formed gas, which expands, pushing the pistons. Those, in turn, have an impact on the rods attached to them via the kinematic pair (bronze bushing and the pin, the finest space between them is filled with oil, is fed through the hole in the sleeve). The connecting rod bearing through the bottom head is connected to the neck of the knee, located on the shaft, and each piston movement, thus cranking the entire engine crankshaft. To torque it was transferred to the transmission without attenuation, each crank journal bearing covers a special crankshaft consisting of two halves mounted within the crankcase covers. In the latter cells are provided for rotating the knee, with holes for the connecting rods at the top and an oil pan at the bottom. Between the cells, the number of bearing journals, bearings are arranged, each of the rolling elements instead of on the inner side a groove for oil. Crankshaft of the engine, as a rule, one-piece structural component, so the right to call him the part. The shaft is made from steel by forging or cast iron by casting. instead of each rolling element on the inner side a groove for oil. Crankshaft of the engine, as a rule, one-piece structural component, so the right to call him the part. The shaft is made from steel by forging or cast iron by casting. instead of each rolling element on the inner side a groove for oil. Crankshaft of the engine, as a rule, one-piece structural component, so the right to call him the part. The shaft is made from steel by forging or cast iron by casting.

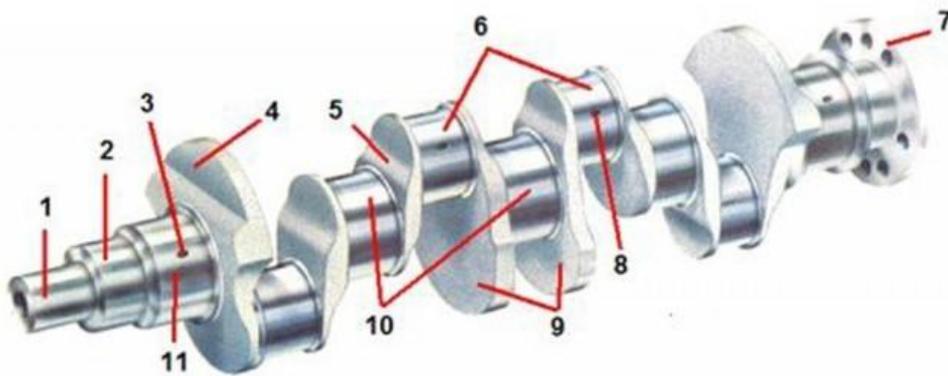


Fig. № 11. Driving the internal combustion engine crankshaft device.

1. Sock of the crankshaft;
2. The seat sprockets (gears) driving the camshaft;
3. The oil feed hole to radical neck;
4. Counterweight;
5. Cheek;
6. Crankpin;
7. The flange of the flywheel;
8. The oil feed hole to the crankpin;
9. counterweights;
10. Main journals;
- eleven. Radical neck thrust bearing.

The test engine was developed in close cooperation with Peugeot and Citroen companies to install it on a number of models of these companies. The interaction was very compact, balanced and effective

powerplant. Indicators of power and torque of the engine allowed to place it in a sturdy chassis Discovery 4 and still get good performance acceleration, maximum speed and fuel consumption.

### Discovery 4 engine failure

The compactness of the power unit has played a key role in the breakdown statistics of this particular engine. Experts can repair noticed that often the failure of the crankshaft in the area of the second or third main journal. Having carefully considered the breaking point came to the conclusion that these breakdowns - a consequence of combat engineers of the small size and light weight of the engine. The short length of the crankshaft - a narrow and crankpins, and it is the high load on the inserts. Narrow cheeks of the crankshaft through which pass yet drilling the oil supply - a high torsional loads on the crankshaft during operation and stress concentration at the narrowest section. As a result, the engine, due to the action on it of high torsional oscillations during operation has two drawbacks:

#### 1. Cranking the crankshaft inserts.

##### 2. Damage to the crankshaft.

Removing and thorough inspection of the crankshaft in the presence of faults and fractures of the crankshaft results has not given. Crankshaft visual whole.

In turn, all of defective root bushings and the inserts 2 and the connecting rod 5 the cylinder.

Indigenous damaged liners all (Fig №13,14.) - being worn their inner part and the outer, which is adjacent to the block and closures of wear and scuffing does not except the liner third crank journal. Insert a third crank journal (which is attached to the cylinder block) has a strong wear of the inner surface and the part where the locking is completely split off Fig. №15. There is a deformation (flattening) of indigenous inserts Fig. №14,15 in consequence of shock. Cranking, in consequence of fracture of the insert part (split off the part where the liner disposed locking), led to a shift of the insert and partial overlapping oil supplying channel to the crankpin of the second cylinder Fig. №15, lowering oil pressure and as a result the oil starvation insert rod Fig. №15. The result of oil starvation crank liner was welded it to the connecting rod Fig. №9 and engine seizure. The cheeks of the crankshaft in the region of 2 and 5 cylinders are dark blue hue Fig. №10, indicating that they overheat due to friction.

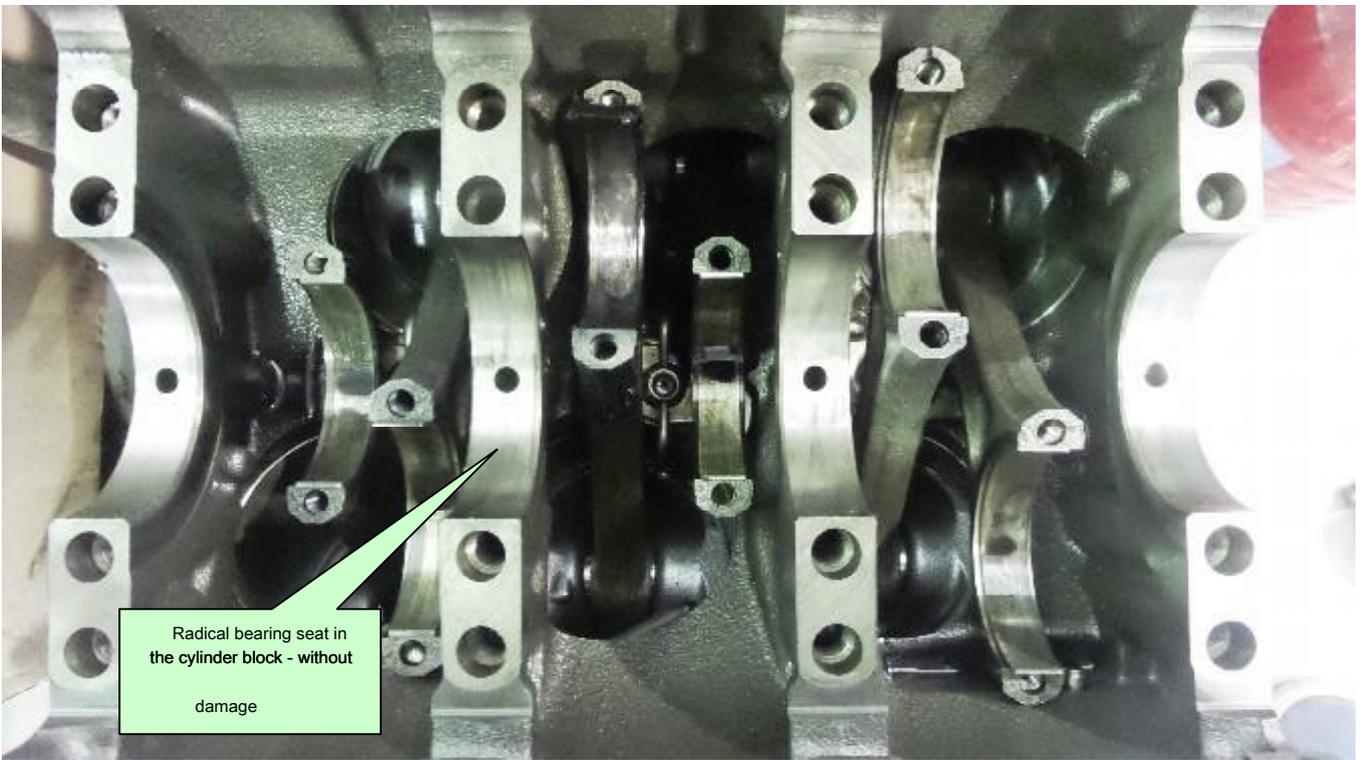


Fig. Number 12. Status of indigenous necks after removing the crankshaft of the test engine car LAND ROVER

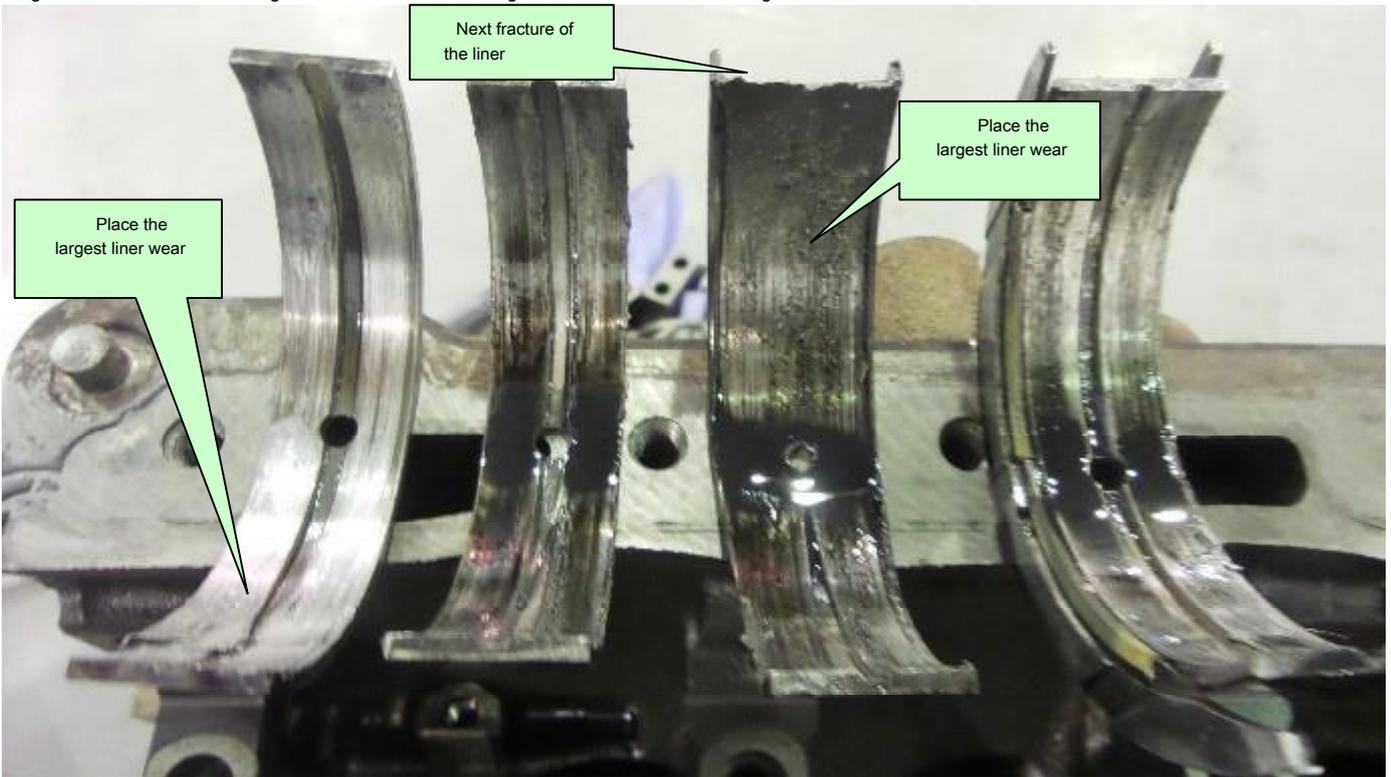


Fig. № 13. Condition root bushings after removal of the test vehicle the crankshaft of the engine LAND



Fig. Number 14. Status of indigenous inserts after removing the crankshaft of the engine of the test vehicle LAND ROVER DISCOVERY 4,

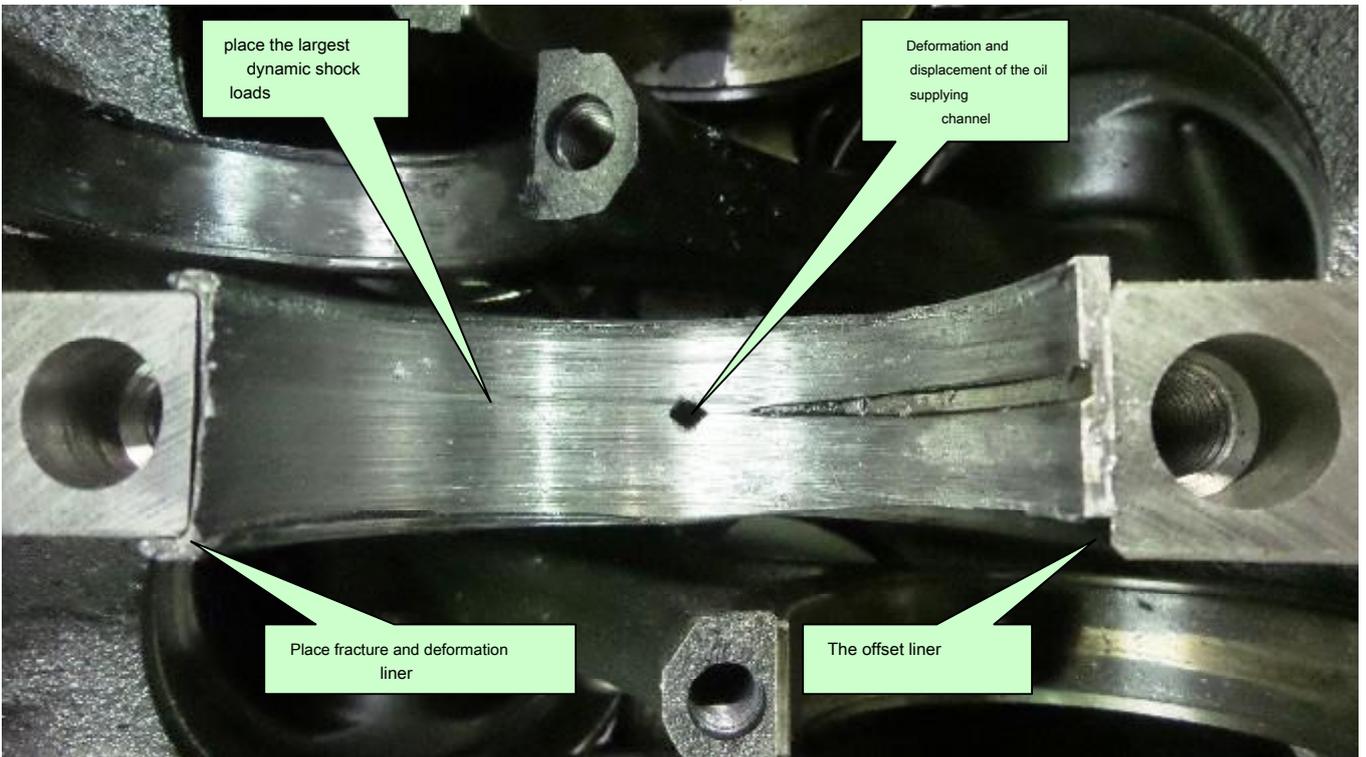


Fig. № 15. Root insert after removal of the test vehicle the crankshaft of the engine LAND ROVER

The absence of traces of oil starvation in the cylinder head indicates the operating state of the oil pump, since the disruption in the form of a pressure drop in the oil system leads primarily to oil starvation in the most remote points, and that the plane of cam sliding in the cylinder head, and as indicated above camshafts are properly installed and are in perfect condition, excessive friction traces in the form of scuffing and signs of overheating as a discolouration has not.

Investigation oil system indicates the presence of swarf in the filter element, which indicates the operation of the engine at the time of chip formation, since only the damaged element of the engine are inserts, and consequently are a source of formation chips liners.

An important factor for correct operation of the engine is the quality of the oil used. If oil is used which does not meet the requirements of the manufacturer, it is possible to be premature wear. In the case of low-quality oil affects all internal engine components. This study indicates selective wear - inserts all indigenous and connecting rod bearings of cylinders 2 and 5 were subjected to increased wear and destruction, and all other elements of the engine are in good condition. This fact suggests that the operation of the test vehicle used high-quality oil and the cause of the malfunction could not serve as the use of low-quality oil.

### CONCLUSIONS

Studies indicate the following:

- inspection of the oil filter revealed the presence of small chips in the filter element, indicating the presence in oil of small metal inclusions formed as a result of wear during mechanical friction;
- decapping main journals of the crankshaft and inspection of their indigenous inserts revealed traces of increased friction in the form of burrs and deformations with the partial destruction of the inserts;
- inspection rod liners also revealed traces of slip cylinders 5 and 2 in the form of burrs and deformations. Identified as well as traces of overheating annealing and welding by friction liner rod of the second cylinder.
- radical loose all damaged - and worn their inner part and the outer, which is adjacent to the block and closures of wear and scuffing does not except the liner third crank journal. Insert a third crank journal (which is attached to the cylinder block) has a strong wear of the inner surface and the part where the locking is completely split off. There is a deformation (flattening) radical loose leaves in consequence of shock loads. In consequence of the destruction of part of the insert (split off the part where the liner disposed locking) resulted in a shift of the insert and partial overlapping oil supplying channel to the crankpin of the second cylinder, lowering oil pressure and as a consequence oil starvation rod insert. The result of oil starvation crank liner was welded it to the connecting rod and engine seizure.

**Based on the findings and lessons learned, we answer the questions put to the experts:**

**Question 1: "Is there a fault in the car LAND ROVER DISCOVERY 4,".**

Vehicle LAND ROVER DISCOVERY 4, to be in inoperable state due to engine failure. The following defects are revealed:

- presence in oil of small metal inclusions formed by the process of mechanical friction;
- scuffing and discolourations on and crankpins of the crankshaft, the crankshaft traces overheating (buccal) in the region of the cylinder 2 and 5;
- welding by friction liner rod of the second cylinder.
- all indigenous damaged liners, the worn out portion of the internal and external, which is adjacent to the block and closures of wear and scuffing does not except the liner third crank journal. Insert a third crank journal (which is attached to the cylinder block) has a strong wear of the inner surface and the part where the locking is completely split off. There is a deformation (flattening) radical loose leaves in consequence of shock loads.

**Question 2: "What is the cause of a fault in the car LAND ROVER DISCOVERY 4,**

The short length of the crankshaft, and consequently narrow and crankpins result in high loads on the liners. Narrow cheeks of the crankshaft through which pass yet drilling the oil supply lead to high torsional loads on the crankshaft during operation and the stress concentration at the narrowest section. As a result of the engine, in consequence of the action on it of high torsional oscillations perenagruzhaet radical loose, causing them to rotate. In the test engine was a displacement of the insert with its indigenous partial destruction (split off the part where the liner disposed locking). The displacement in turn led to the partial overlapping of oil supplying to the channel crankpin second cylinder. overlap oil supplying channel result was a drop in oil pressure, and as a consequence of oil starvation rod liner.

**experts:**

**Wrasse MN  
Pankow OO**

**APPLICATIONS**

