Open Joint Stock Company
"MINSK MOTOR PLANT" Holding Managing Company"

Diesel engines
D-260.1S3A, D-260.2S3A, D-260.4S3A

OPERATION & MAINTENANCE MANUAL

Minsk 2013

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This Manual is intended for use by operators, drivers and engine mechanics of agricultural tractors, combine harvesters and agricultural machinery equipped with diesel engines D-260.1S3A, D-260.2S3A, D-260.4 S3A as well as by personnel of technical service centres and repair shops performing technical service and repair of said diesel engines.
This Operation & Maintenance Manual contains brief technical description, diesel engines operation and technical maintenance rules.
Eligible to diesel engines operation and technical maintenance rules are individuals with special training and those having read this Operation & Maintenance Manual.
Diesel engines and their components current repair may be done by mechanics familiar with their design, principle of operation, having general technical background according to 3-4 grades training programme.
Diagnostics and technical service of Common Rail fuel system must be done by specially trained personnel using specialised diagnostic equipment.
Diesel engines design implies long operation life without complete overhaul, provided the rules of operation, storage and timely technical service described in this Manual are observed.
Diesel engines exhaust gases contain substances harmful to human health (nitrogen oxides, carbon oxides, hydrocarbons, hard particles).
Applied in diesel engines design are technical solutions allowing to reduce the harmful substances impact on human health and environment, so unauthorized modification of the engines design, breaking the manufacturer settings, disregarding technical service periodicity is strictly forbidden.
The rooms where diesel engines are run must have purge-exhaust ventilation and the engine exhaust system must have an autonomous gas diversion duct from the engine silencer to the outside of the room.
Due to the engines continuous development, some of their assembly units and parts may be subject to modifications not indicated in this Operation & Maintenance Manual.

Customers' disregarding the rules and conditions of operation, technical service, transportation and storage contained in this Manual, breaking the manufacturer seals as well as using in current repair and technical service consumables (fuel and lubrication materials, assembly units and parts) from manufacturers not recommended for use by the OJSC "MMP" HMC" design documentation, engine design modification will stop the engine warranty validity.

Engine and (or) its components repair by the owner or other persons without participation of the manufacturer specialists or its authorized dealer centre in the event of the engine failure within the warranty period will make the engine or its components warranty invalid.

1. ENGINE DESCRIPTION AND OPERATION
1.1. Diesel engine description and operation
1.1.1 Diesel engine application
Diesel engines application, application environment and operation conditions are shown in table 1.
Table 1

Description	Engine model		
	D-260.1S3A	D-260.2S3A	D-260.4 S3A
Application	Wheeled tractors, 1,4; 2 drawbar categories		Forage harvesters and wheeled tractors, 3; 4 drawbar categories
Application environment	Areas with unlimited air exchange		
Climatic conditions of operation	Microclimatic regions with moderate climate. Air temperature values of operation conditions from + 40º C to - 45º C.* Microclimatic regions with both dry and humid tropical climate. Air temperature values of operation conditions from + 50º C to - 10º C.		

*- with diesel engine operation at the environment temperature lower than -25ºC the coarse fuel filter must be equipped with a fuel heater.

1.1.2 Technical specifications

Diesel engines technical specifications and operation parameters

Table 2

Parameters	Measurement unit	Engine model		
		D-260.1S3A	D-260.2S3A	D-260.4 S3A
		Values		
Diesel engine type		4-stroke, turbocharged with charge air cooling		
Fuel mixture method		Volumetric fuel mixture formation		
Number of cylinders	pcs	6		
Positioning of cylinders		In-line, vertical		
Swept volume	litres	7,12		
Firing sequence		1-5-3-6-2-4		
Crankshaft rotation direction per State Standard 22836-77 (from the fan side)		Right (clockwise)		
Bore	mm	110		
Stroke	mm	125		
Compression ratio (calculated)		17		
Permissible inclination angles at engine operation - - longitudinal - Transverse	degrees	20 20		
Operating output	kW	111,0	96,9	148,6
Rated speed	min	2100		
Specific fuel consumption at operating output	g/ kW/ hour	249,0		
Maximal torque	Nm	660,0	570,0	923,0
Speed at maximal torque, not less than	min	1600		
Engine mass without fuel, lubricants and coolant (with fan, alternator, starter and air cleaner)	kg	710		750
Average noise level. Not more than	dBA	97		98
General logarithmic levels of vibration velocity, not higher than				
а) vertically	dB	108,2		
б) horozontally		110,2		

1.1.2.2 Controlled engine parameters

Table 3

Parameters	Measure-ment unit	Engine model		
		D-260.1S3A	D-260.2S3A	D-260.4 S3A
		Value ± confidence limit (tolerance)		
Rated output	kW	116,0±2,0	100,0±2,0	156,0±3,0
Rated speed	min^{-1}	2100^{+40}_{-25}		
Specific fuel consumption at rated output	g/ kW/ hour	$240,0^{+12,0}_{-7,2}$		
Minimal stable idling speed	min^{-1}	800±50		
Maximal stable idling speed limited by regula-tor, not higher than	min^{-1}	2270		2270 (2250**)
Oil pressure in the main lubrication system line: -at rated speed -at minimal speed	MPa	0,28…0,45		
		0,10		0,16

Note:

** The parameters are reached after 60 hours of engine operation with the counter-pressure of not less than 150 kPa at a distance of 200 mm from the exhaust duct measured from the turbocharger flange with the engine brake switched off, the fuel temperature at the fuel system inlet between 38° C and 43° C and reference atmospheric conditions per UN EEC Rules No 24(03)/ 2nd Revision:*

-atmospheric pressure - 100 kPa

-water vapours pressure - 1 kPa

-air temperature - 25° C;

The parameters are calculated with formuli per State Standard 18509-88.

*** For combine harvester diesel engines*

1.1.2.3 Measuring means for determining the controlled parameters

Table 4

Measured parameter	Measurement unit	Measurement means	Measurement means basic absolute error limit	Note
Torque	Nm	Strain and torque strength measuring devices according to State Standard 15077-78	±0,005Мк max	For rated output calculation
Speed	min^{-1}	Electronic tachometers, ТЭСА type according to Technical Conditions 25-04.3663-78, State Standard 18303-72 ±0,005n rated, but not more than 10 min-1	±0,005n rated, but not more than 10 min-1	
Oil pressure in the lubrication system	MPa	Pressure gauges, compound gauges according to State Standards 2405-80 and 11161-84, pressure and depression measuring transducers according to State Standard 22520-85	±0,02	
Hourly fuel consumption	kg/ hour	Non-standard measuring means	±0,01Gт	For specific fuel consumption calculation

1.1.3 Diesel engine parts and components

Diesel engine consists of parts, assembly units and sets.

1.1.3.1 Basic D-260S3A diesel engine assembly units

Table 5

Assembly units and sets	
Cylinder block	Water catchment pipe
Cylinder heads mounting	Water pump mounting
Clutch mounting	Fan mounting
Turbocharger mounting	Tensioner mounting
Oil sump mounting	Gear pump mounting
Pump mounting	Compressor mounting
Heat exchanger mounting	Alternator mounting
Filter mounting	Starter motor mounting
Fuel equipment mounting	Drive and counter mounting
Oil ducts	Spare Parts, Tools & Accessories Kit

1.1.3.2 Key features of diesel engine models configurations

Table 6

Units, parts	Engine model		
	D-260.1S3A	D-260.2S3A	D-260.4S3A
	Unit, part designation and (or) its description		
Turbocharger	K27-61-08* "Turbo" (Czechia)		K27-542-01 "Turbo" (Czechia)
Compressor	Single cylinder air cooled, controlled * or not not available		
Gear pump	НШ-10 or НШ 14-3Л, or НШ 16-3Л*		
High-pressure fuel injection pump	CPN2.2 ("BOSCH", Germany)		
Electronic control unit	EDC7UC31 ("BOSCH", Germany)		
Injector	CRIN2 ("BOSCH", Germany)		
Fuel pre-filter	Type Preline PL 420 ("MANN-HUMMEL GMBH", Germany) ** (with water separator and manual priming pump) or similar filter by other manufacturers		
Fine fuel filter	Mann & Hummel WDK962/12 or WDK962/14 (Germany)		
Air filter	With paper filter elements **		
Oil filter	Non-separable, full flow, centrifugal, working on branch		
Fan and fan drive	Axle type		Unavailable **

Continuation of Table 6

Units, parts	Engine model		
	D-260.1S3A	D-260.2S3A	D-260.4S3A
	Unit, part designation and (or) its description		
Clutch	Friction type, dry, constantly closed-type, double-disk* or single disc or not available		Friction type, dry, constantly closed-type, double-disk
Alternator	AC, rated voltage 14V or 28V		
Starter	Rated voltage 24V***		
Start-up aids	Diesel engines are equipped with pin glow plugs with rated voltage of 23V and have locations for heat carriers inlet and outlet when a pre-start heater is installed		

Note

**- for tractor engines;*

***- to be installed by customer;*

****- to be installed by customer on the engines going to MTZ tractors;*

The D-260.1S3A diesel engine appearance is shown in Fig.1.

Spare Parts, Tools & Accessories Kit list - See Annex "B" to this Manual (Table B.1)

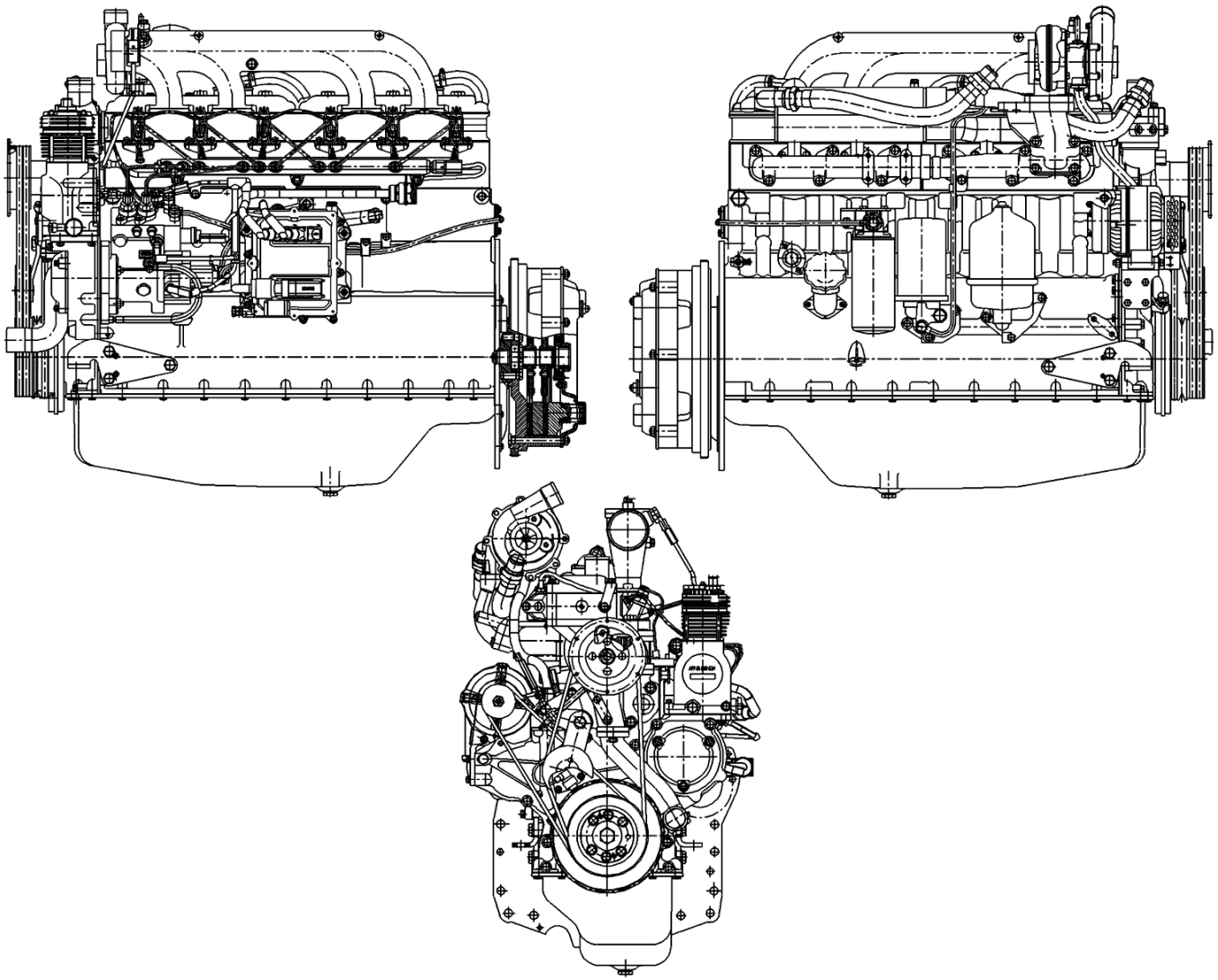

Fig.1 - Diesel engine D-260.1S3A

1.1.4 Design and operation

Engines D-260.1S3A, D-260.2S3A, D-260.4 S3A are 4-stroke internal combustion piston diesel engines with vertical cylinder positioning, direct fuel injection and ignition by compression.

The basic engine assembly units are: cylinder block, cylinder heads, pistons, connecting rods, crankshaft and flywheel.

To ensure high technical and economic characteristics the engines inlet systems use turbo charging with charge air intermediate cooling.

Using turbocharger with controlled air pressure in the charging device allows better engine pickup provided by higher torque values at low crankshaft speeds.

Engines equipped with "Common Rail" accumulator type fuel system show higher operational and fuel economy and conform to Tier-3A ecological parameters due to optimized operation process and minimization of transitional processes while changing the speed and load modes.

1.1.4.1 General information

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Using exhaust gas recirculation devices in the engines feed system also contributes to reaching the required ecological parameters, bringing changes into the mass charge contents entering the engine cylinders by way of partial deliver of exhaust gas.
To ensure engine start-up at low ambient temperatures, glow plugs are installed in the engine cylinder head, while fuel liquid heat exchanger ensures a faster reaching of the optimal oil temperature in the engine lubrication system and keeping it at the required level during the engine operation.

1.1.4.2 Diesel engine operation principle and its basic components interaction

A diesel engine operation principle, like with all other internal combustion engines, is transformation of heat energy of the fuel burning inside in the working cylinder to mechanical energy.
When a piston moves down at the intake stroke through the open inlet valve an air charge comes into the cylinder. When the inlet valve closes and the piston moves upwards the air compression takes place. At this the air temperature goes up sharply. In the end of the compression stroke fuel is delivered through an injector into the cylinder under high pressure. While being injected, fuel is finely sprayed, mixed with hot air in the cylinder and evapourated, thus making a fuel-air mixture.
The air-fuel mixture ignition during the diesel engine operation is achieved as a result of air compression to the extent of the air-fuel mixture self-ignition. The fuel is injected by injectors with fast operating electromagnetic valves. The moment of injection beginning and its duration are determined by the moment of beginning and duration of voltage supply to the electromagnetic valve by the Common Rail system Electronic Control Unit. The fuel-air mixture burning takes place at the moment of the piston starting to go down.
As soon as the fuel-air mixture is bunt down the process of cylinder expansion and cleaning begins through the exhaust valve.
Opening and closing of the intake and exhaust valves is coordinated by the gas distribution mechanism.
With the diesel engine operation start the turbocharger is actuated by the exhaust gas energy.
The diesel engine start is done by imparting rotation to the crankshaft by the electric starter via the flywheel mounted on the crankshaft flange.
The diesel engine cooling system water pump is drive is maintained from the belt of the pulley mounted on the crankshaft toe to the pulley mounted on the water pump shaft.
The A29.05.000 БЗА compressor drive and that of the gear pump is maintained by the toothed transmission of the distribution mechanism.

The transfer of energy (power) generated bythe diesel engine to the drive of tractor (agricultural machine) in which it is installed is done from the engine flywheel via the clutch.

1.1.4.3 Tools and accessories
To ensure the maintenance work on checking and adjusting the gap between the rocker striker and the valve end, done in the course of technical service, tools are attached according to the list in table B.2 of Annex B.

1.1.5 Diesel engine labelling
The brand tag of each engine fixed to the cylinder block bears the following data:
-manufacturer's name and its trade mark;
-engine model (modification);
-engine serial production number;

-inscription “Made in Belarus”in the English language .

The engines officially approved according to EEC UN Rules No 96(01), EEC UN Rules No 24(03), Revised Edition No 2 and Directives 2000/25/EC, 97/68/EC Stage IIIA bear the sign of official engine type approval.
The engines for which national certificates have issued for conformity to the rules of Belarus and other CIS countries bear the signs of conformity to the national certification systems of the countries where those certificates have been issued.
The official approval signs and the signs of conformity are located side by side with the brand tag or are depicted on it.
The engine transport marking is applied according to STATE STANDARD 14192. The marking method ensures its preservation for the period of the engine transportation, storage and operation life.

1.1.6 Packaging

With the engines transportation in closed carriages, containers or by trucks the engines are secured on wooden stands made to the manufacturer’s drawings. With shipping the engines in open type transport (trucks, trains) the engines are wrapped in polyethylene bags according to STATE STANDARD10354 and are secured on wooden stands.
The engines shipped in railway carriages to the regions with tropical climate are wrapped in polyethylene bags and placed in wooden cases; when shipped in sea containers - wrapped in polyethylene bags.

1.2 Description and operation of diesel engine components, mechanisms and devices

1.2.1 General information

Diesel engine is a complex unit consisting of a number of separate mechanisms, systems and devices made of parts and units. The engine structure is shown in Table 7.

Table 7

Diesel engine configuration			Units and parts making mechanisms, systems and devices
Housing			Cylinder block and suspension
Mechanisms	Gas distribution		Cylinder head. Valves and pushers
			Cylinder head covers, manifold and breathers
			Distribution mechanism
	Crank-and-slot		Pistons and conrods. Crankshaft and flywheel
Systems	Oiling		Oil sump
			Oil pump receiver and oil pump
			Heat exchanger
			Oil filter
			Centrifugal oil filter
			Turbocharger oil ducts
	Supply		Fuel piping and fuel equipment
			Coarse fuel filter
			Fine fuel filter
			Air cleaner and air duct
	Electronic fuel supply control		Electronic Control Unit, sensors and actuating mechanisms
	Cooling		Water catchment pipe and thermostats
			Water pump and tensioner
			Fan
Devices	Supercharging		Turbocharger
	EGR		EGR cooler
	Startup		Starter motor
			Glow plugs
	Drives	Electric equipment	Alternator
		Units	Compressor
			Gear pump
			Clutch

1.2.2 Description and operation

1.2.2.1 Cylinder block

Cylinder block is the main body part of the engine made as a cast iron monoblock. Placed in the monoblock bores are six removable liners made of special cast iron . Liners are fitted in the cylinder block along two centering zones.
Each liner is fixed by a collar in the upper zone while in the lower zone it is packed with two rubber rings placed in the cylinder block grooves.
Cooling liquid circulates between the cylinder block walls.
The cylinder block transverse dividers have pads for forming the crankshaft supports. Mounted on those pads are covers. The pads together with the covers shape beds for the main end bearings. The beds for the main bearing shells are bored with one installation complete with covers. It is not permissible to change the covers placing.
Cylinder block has a longitudinal oil channel from which oil is supplied to the crankshaft main end bearings along transverse channels and further to the camshaft ends and injectors for pistons cooling. The injectors for pistons cooling are installed in the cylinder block, in the upper section of the second, fourth and sixth crankshaft supports
The cylinder block water distribution channel has a floor for installation of liquid-oil heat exchanger. The oil supply and diversion from the heat exchanger goes via the channels in the block.
To stiffen the lower surface of the cylinder block it is shifted down to 80 mm relative to the crankshaft axis. A steel distribution shield and distribution cover are fixed to the front end of the cylinder block, to the rear end - a steel plate by which the engine is connected to tractor (machine) frame. Two brackets fixed on the cylinder block sides serve as the engine front support. The cylinder block bottom is covered by oil samp.

1.2.2.2 Cylinder heads

Cylinder heads are made of cast iron (one head for three cylinders)and are mutually exchangeable. The cylinder heads inner cavities have intake and exhaust channels closed by valves.
To divert heat from cylinder heads there are inner cavities where the cooling liquid circulates. The cylinder heads have insertable valve seats made of heat resistant and wear resistant alloy. Mounted on the cylinder heads are injectors (3 pieces for each head), racks, rocker axles with rockers, cylinder head covers and cover caps closing the valve mechanism. On the left side (from the fuel injection pump) there are 3 glow plugs for each head.
As a sealing between the cylinder heads and the block an asbestos-free gasket is placed. The holes for cylinder liners and oil channel are edged with pltae steel. From both sides of the gasket along the outer edge, as well as the edges of the holes located in the oiling system and liquid cooling areas

On both sides of the gasket, along the outer edge as well as the edges of the holes located in the lubrication and liquid cooling system channels, elastomeric sealant is applied by screen-relief method. When assembling a diesel engine, its cylinder holes are additionally lined with fluoroplastic rings.

1.2.2.3 Crank-and-rod mechanism

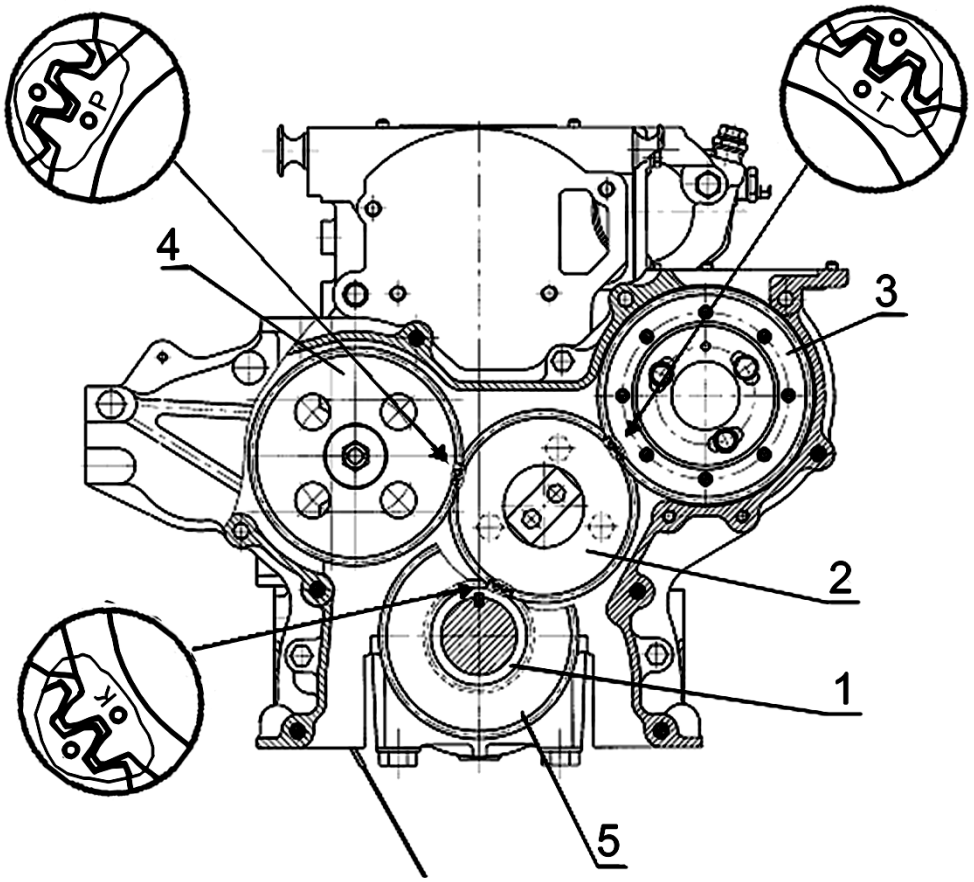
The main parts of the crank-and-rod mechanism are: crankshaft with main end and big end bearings, flywheel, pistons with piston rings, connection rods.
Crankshaft is made of steel, it has seven main end and six big end bearings.
To reduce the load derived from inertia on the bearings, removable counter balan-ces are mounted on the 1^{st}, 6^{th}, 7^{th} and 12^{th} crankshaft webs.
The crankshaft axial thrust is compensated by four bimetallic steel-aluminium semi- rings installed in the cylinder bores and the caps of the fourth main bearing. The crankshaft is inhanced by collars at the front and the rear. Mounted on the crankshaft front end are: gas distribution drive gear (crankshaft gear) and oil pump drive gear, water pump drive pulley, alternator. Installed on the shaft front end are: gas distribution drive gear (crankshaft gear) and oil pump drive gear, water pump drive pulley, alternator pulley, air conditioner compressor pulley (for tractors).
To reduce the crankshaft torsional vibrations, a silicon damper is mounted on the pulley hub.
Pistons are made of aluminium alloy. Ther is a combustion chamber in the piston bottom. Pistons have three groves in their upper parts, placed in the first two are compression rings, the third has an oil ring with an expansioner.
The piston pin is hollow made of chrome-nickel steel. The axial movement of the piston pin in the piston bosses is limited by stop rings.
Connection rod is an I-beam part made of steel. Pressed in the connection rod upper head is a bush. To oil the piston ring, there is a hole in the upper head of the connection rod and the bush.
The lower connection rod head bore for bearing shells is done in assembly with the cover. The connection rod and the cover bear the same serial numbers stamped on their surfaces. The connecting rod covers are not interchangeable. Apart from that, the connecting rods belong to different weight groups according to the mass of the upper and the lower heads. A group designation by mass is applied on the front surface of a connecting rod upper head. Installed in a diesel engine must be connecting rods of the same group. The main end and the big end bearing shells of the crankshaft are thin-walled made of bimetallic strips. As for the inner diameter, the bearing shells are made of two sizes according to the crankshaft necks specifications.
The flywheel is made of cast-iron, it is fixed to the crankshaft flange with bolts. A toothed rim of steel is pressed on the flywheel.

1.2.2.4 Gas distribution mechanism

Gas distribution mechanism consists of gears, camshaft, intake and exhaust valves as well as their mounting parts and a drive for: pushers, bars, rockers, adjustment screws with nuts, disks, keepers, springs, rocker axles and racks.
The camshaft has four supports, it gets rotated by the crankshaft via the distribution gears.

The pushers are made of steel, have spherical bottoms with a special cast-iron surfacing.
The camshaft lobes are made with a slight inclination allowing the pushers to rotate in the process of the engine operation.

The pushers bars are made of steel rods and the bar cups are hardened. The spherical portion coming inside the pusher and the bar cup are hardened.
The valve rockers are made of steel, they rock on the axle mounted in the racks.
The rocker axle is hollow, it has six radial holes for the rockers lubrication. The rockers motion along the axle is limited by spacer springs.
The intake and exhaust valves are made of heat-proof steel, they travel inside guiding bushes pressed in the cylinder heads. Each valve is closed by two springs: the outer and the inner, which are fixed on its stem with a disk and valve keepers.
Sealing collars installed on the vavs guding bushes prevent oil penetration into the diesel engine cylinders through the gaps between the valves stems and the guiding bushes.
The distribution gears are located in a housing formed by a distribution shield fxied to the cylinder block and by the distribution cover.
The synchronization of the crankshaft and camshaft rotation speed signals coming to an electronic fuel supply control unit and matched with the gas distribution mechanism operation is reached by installation of distribution gears according to the marks shown on Fig.2.

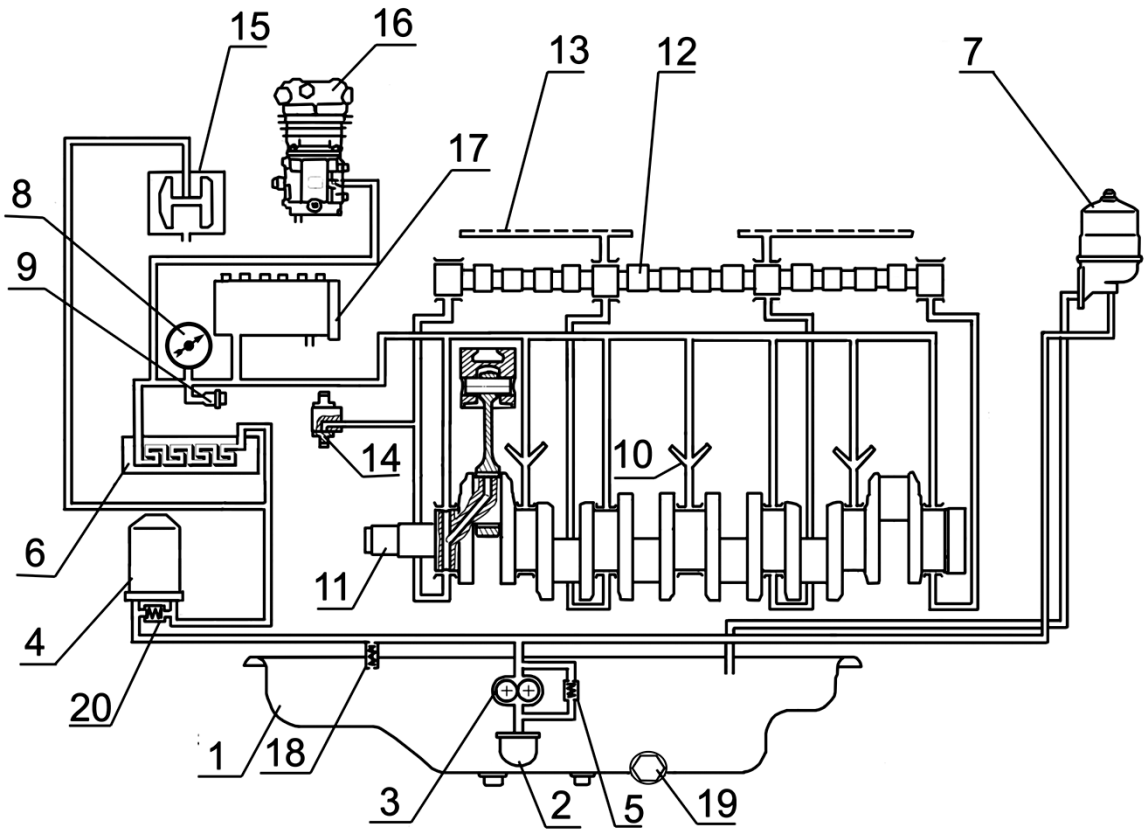


1-crankshaft gear; 2 - intermediate gear; 3- fuel injection pump drive gear; 4 – camshaft gear; 5- oil pump drive gear.

Fig.2- Distribution gears mounting diagram

1.2.2.5 Lubrication system
The diesel engine lubrication system, as shown on Fig.3, is a combined one: some parts are lubricated under pressure, other by spraying.

The crankshaft and camshaft bearings, the intermediate gear bush, the rockers bush, the pneumatic compressor crankshaft big end bearings, the turbocharger shaft bearing are lubricated under the pressure from the oil pump. The cylinder liners, pistons, piston pins, bars, pushers, camshaft lobes and fuel injection pump parts are lubricated by spraying.
The lubrication system consists of oil pump 3, oil filter with paper filter elements 4, centrifugal oil filter 7, liquid-oil heat exchanger 6.
Oil pump 3 is a gear type, single-section, fixed to the engine cylinder block by bolts. The oil pump is driven by a gear mounted on the crankshaft.
There is a by-pass valve 5 in the oil pump set for the pressure of 0,7…0,75 MPa. When the oil pressure exceeds mentioned these values the oil is by-passed from the discharge cavity to the suction cavity. The adjustment is done on a test-bench using adjustment washers.
The oil pump, via oil receiver 2, takes oil from oil sump 1 and via the channels in the cylinder block delivers oil to a full flow oil filter with a paper filter element, while some portion of the oil goes to a centrifugal oil filter for purification and subseguent sink into the oil sump.
Installed in the housing of filter 4 is an unadjustable safety valve18. It has been designed for keeping the oil pressure within 0,28...0,45MPa in the main oil duct. At the oil pressure exceeding 0,45MPa the safety valveopens and the redundant oil (oil reserve) is sunk into the engine oil sump via the protective valve.
The oil purified in oil filter 4 goes to liquid-oil heat exchanger integrated in the engine cylinder block. The filter element has a by-pass valve 20. In the event of overclogging of the paper filter element or at starting the engine with cool oil, when the filter element resistance goes over 0,13...0,17 MPa, the by-pass valve opens and the oil bypassing the filter paper is fed in the oil system. The by-pass valve is unadjustable.
From the liquid-oil heat exchanger, via the channels in the engine cylinder block, the cooled oil comes into the main oil duct from which, via the channels in the engine cylinder block, it is delivered to all of the main end crankshaft bearings and the camshaft supports.
From the second, fourth and sixth main end bearings, via injectors integrated in the cylinder block main end supports, the oil is delivered for pistons cooling.
From the main end bearings, via the channels in the crankshaft, oil comes for lubrication of the big end bearings.
From the first main end bearing, via special channels in the front cylinder block wall, the oil is delivered to intermediate gear bush 14 and further, via a channel in the distribution pump, it goes for lubrication of the parts of fuel injection pump 17.
The valvemechanism parts are lubricated by the oil coming from the second and the third camshaft supports via the channels in the cylinder block and cylinder heads, bores in the third and the fourth rocker racks into the inner cavity of the rocker axle and, through the holes, to the rocker bushes from which via a channel it comes to the adjustment screw and the bar.
The oil is delivered to bearing unit of of turbocharger 15 via a tube coonected at theoutlet of the oil filter with a paper filter element.
The oil is delivered to pneumatic compressor 16 via an oil duct connected at the heat exchanger outlet. The oil is sunk from the compressor into the engine oil sump.



1 - oil sump; 2 – oil receiver; 3 – oil pump; 4 – paper oil filter; 5 – by-pass valve; 6 – liquid-oil heat exchanger; 7 – centrifugal oil filter; 8 – oil pressure indicator; 9 – oil pressure alarm sensor; 10 – piston cooling injectors; 11 – crankshaft; 12 – camshaft; 13 – rocker axle oil channel; 14 – intermediate gear; 15 – turbocharger; 16 – compressor; 17 – high pressure fuel injection pump; 18 – safety valve19 – oil drainage plug; 20 – paper filter element by-pass valve.

Fig.3 - Lubrication system diagram

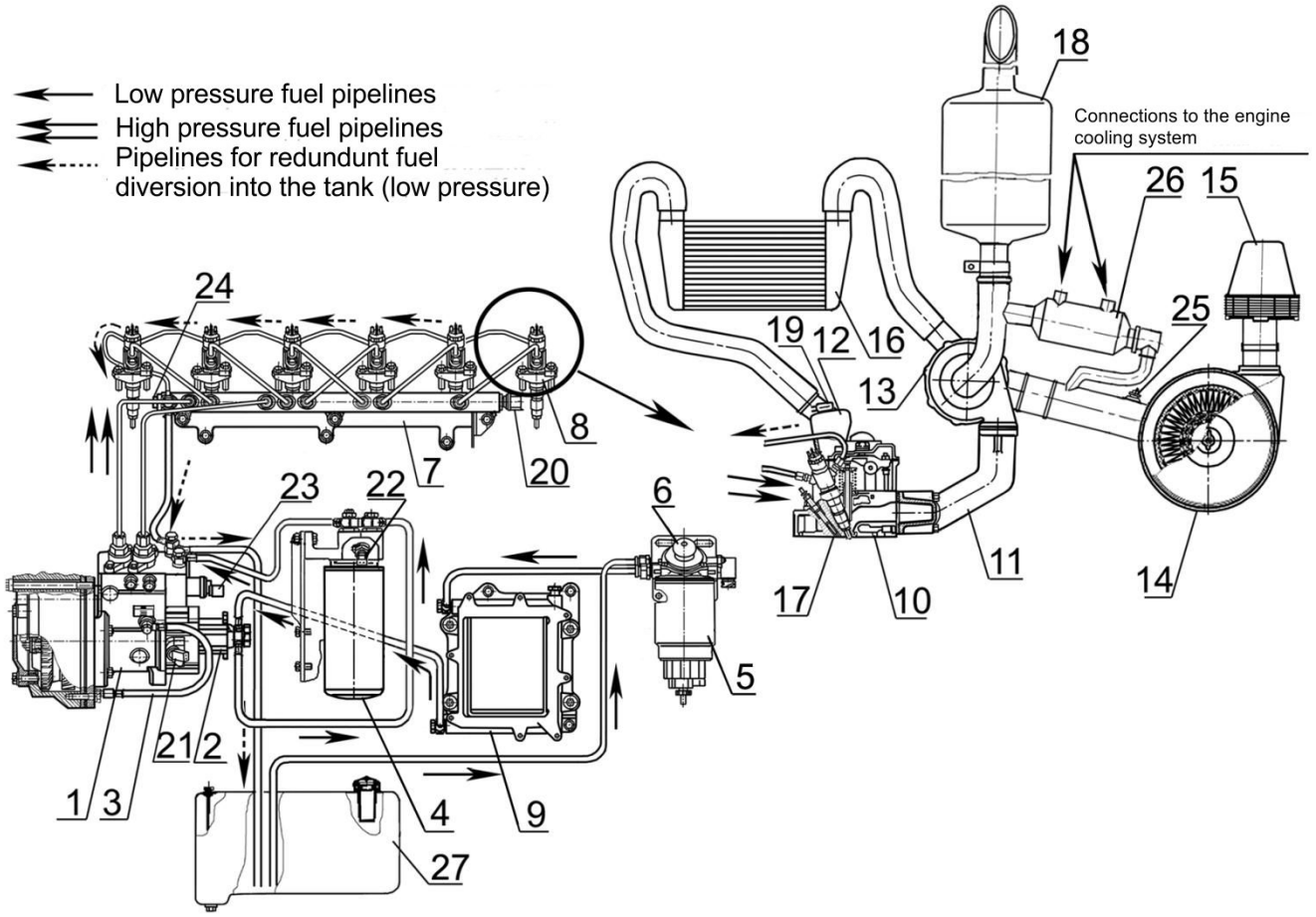
1.2.2.6 Power system

The diesel engine power system (Fig.4) according to engine builds shown in Table 6 consists of: Common RAIL accumulator type fuel supply system including high pressure fuel injection pump 1, injectors 8, high pressure fuel accumulator, operation environment condition sensors (fuel and air temperature and pressure, electromagnetic actuators (pressure regulator23), injectors electromagnetic valves), electronic unit for control and communication circuits, control and diagnostics board (in a tractor or an agricultural machine); low pressure pipelines; high pressure pipelines; intake manifold; exhaust manifold, recirculated gas cooler; turbocharger; fine fuel filter; fuel pre-filter*; air cleaner*; fuel tank; charge air cooler*; silencer*.*

Shown on the engine feed system diagram is a device for diesel engine startup aid under conditions of low ambient temperatures – glow plug.

The COMMON RAIL structural diagram (electric and hydraulic) is shown on Fig.5.

** - to be installed by customer.*



1 – high pressure fuel injection pump; 2 – Fuel feed pump (booster pump); 3 – oil duct; 4 – fine fuel filter; 5 – fuel pre-filter; 6 – hand fuel feed pump (priming pump); 7 – high pressure fuel accumulator; 8 – injector; 9 – electronic control unit radiator; 10 – cylinder head; 11 – exhaust manifold; 12 – intake manifold; 13 – turbocharger; 14 – air cleaner; 15 – monocylone; 16 – charge air cooler; 17 – glow plug; 18 – silencer; 19 – charge air temperature and pressure sensor; 20 – fuel high pressure sensor; 21 – camshaft angle sensor; 22 – fuel temperature and pressure sensor; 23 – pressure regulator; 24 – pressure limiting valve; 25 – air filter clog sensor; 26 – recirculated gas cooler: 27 – fuel tank.

* Sensors and actuating mechanisms location is shown on Fig.4a, Table 8.

Fig.4 - Diesel engines D-260.1S3A, D-260.2S3A, Д-260.4S3A power system diagram

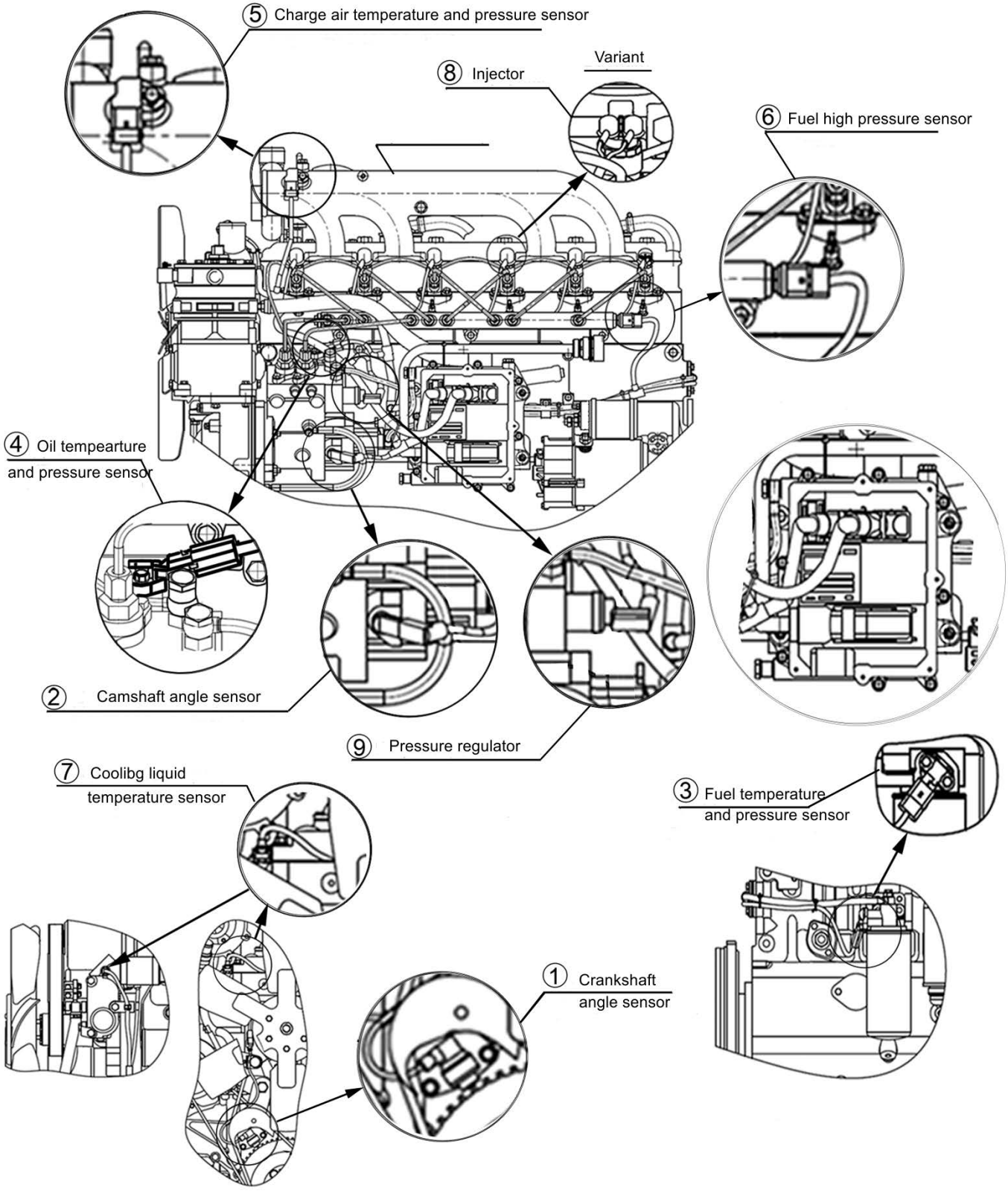
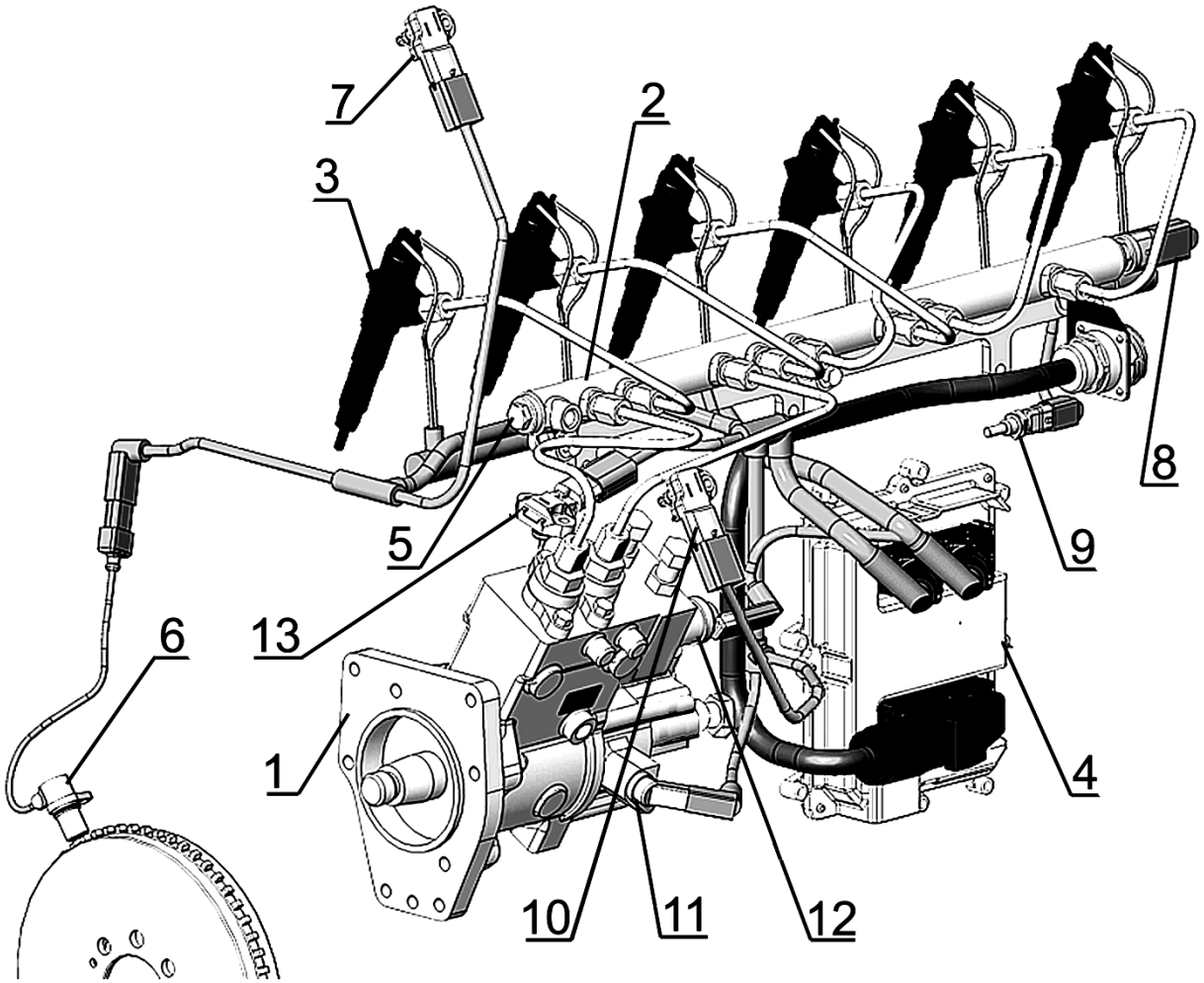


Fig.4*a* – Location of sensors and actuating mechanisms

Table 8

No	Sensor and actuating mechanism	Location
1	Crabkshaft angle sensor	Distribution cover
2	Camshaft angle sensor	High pressure fuel injection pump housing
3	Fuel temeperature and pressure sensor	Finr fuel filter housing
4	Oil temperature and pressure sensor	Heat exchanger
5	Charge air temperature and pressure sensor	Intake manifold
6	Fuel pressure sensor	Fuel high pressure accumulator
7	Cooling liquid temperature sensor	Thermostat housing
8	Injectors	Cylinder head
9	Pressure regulator	High pressure fuel injection pump



1- high pressure fuel injection pump; 2 – high pressure fuel accumulator; 3 – injector; 4 – Electronic Control Unit (ECU); 5 – pressure limiting valve; 6 – angle sensor; 7 – temperature and pressure sensor in the intake manifold; 8 – fuel high pressure sensor; 9 – cooling liquid temperature sensor; 10 – fuel temperaure and pressure sensor; 11 – angle sensor; 12 – pressure regulator; 13 – oil temperature and pressure sensor.

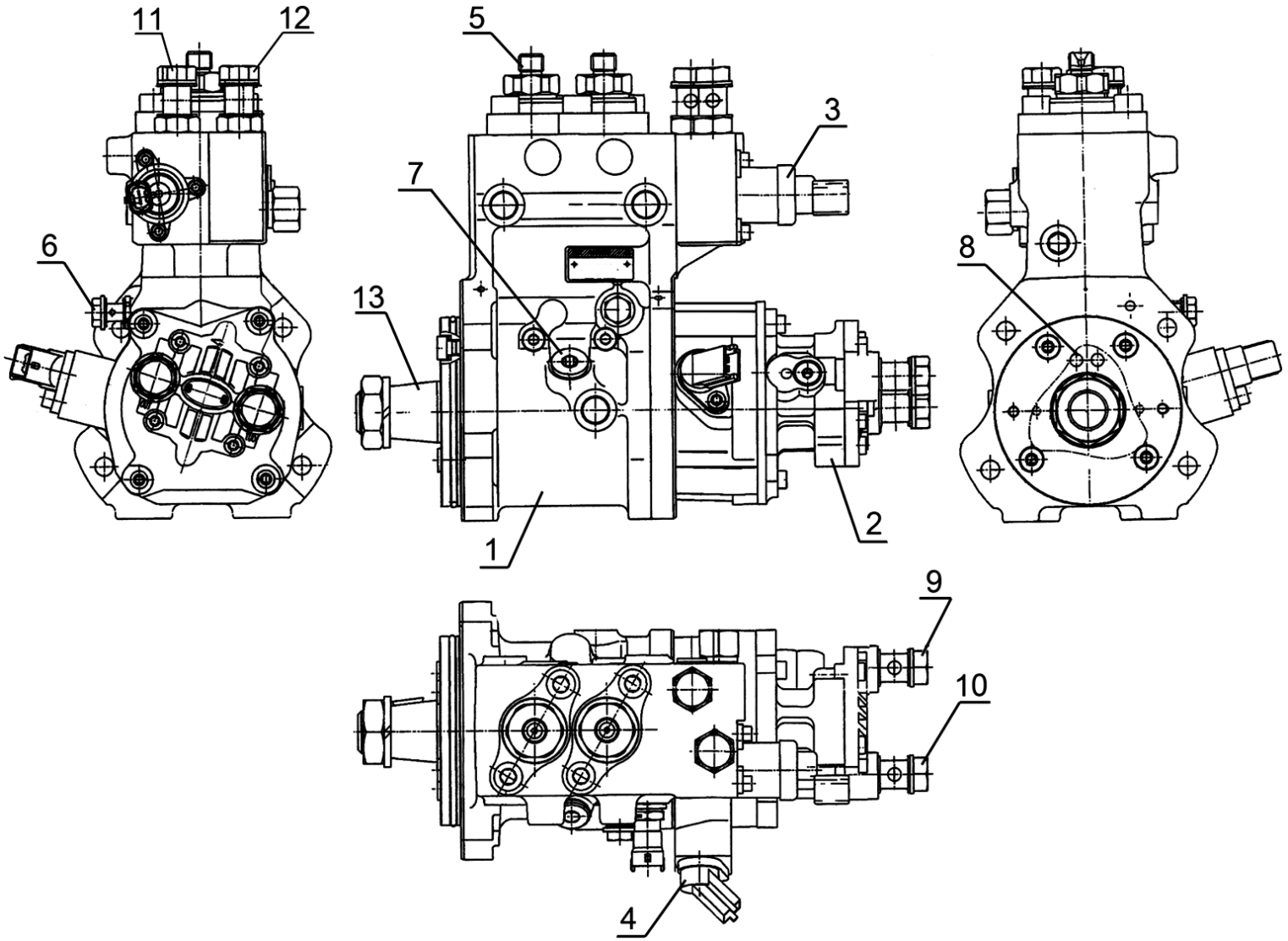
Fig.5 – CRS system structural diagram (electric and hydraulic)

1.2.2.6.1 High pressure fuel injection pump

Installed in diesel engines are High Pressure Fuel Injection Pumps (Fig. 6).
High pressure fuel injection pump (HPFIP)is designed to create fuel reserve, keeping and regulatingpressure in the fuel regulator.
Mounted on HPFIP are fuel priming pump 2 driven by camshaft 13 and pressure regulator 3.
Inside the HPFIP housing there are two plungers 3 (Fig.7) actuated by camshaft 2.
The camshaft, through a driver half-coupling is kinematic connection with the engine crankshaft through distribution gears.
The fuel having passed the coarse fuel filter with a moisture separator is further fed by the fuel priming pump to the HPFIP connector via the fine fuel filter under the pressure of 0,8...0,9 Mpa.
Under the influence of the created pumping pressure the fuel, via channel 5, comes into a plunger chamber.
The incoming camshaft moves the plunger up whilethe inley hole of the inlet channel is overlapped by valve 4 and with the further plunger rise the fuel is compressed in the plunger chamber.

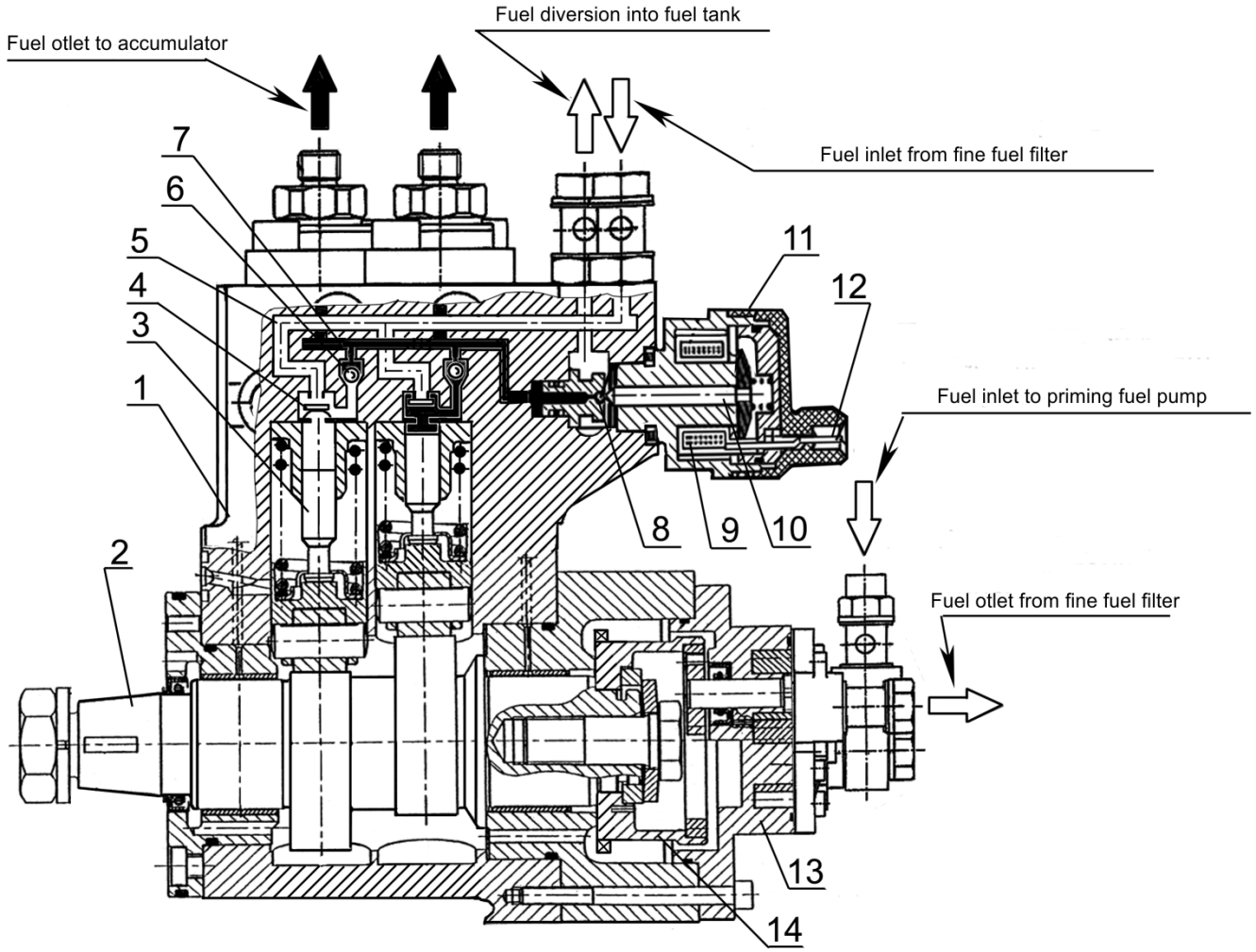
When the pressure reaches the level equal to that kept in the high pressure accumulator, valve 6 opens. The compressed fuel comes into the high pressure circuit.

The plunger delivers the fuel till it reaches its TDC (Top Dead Center), then the pressure goes down, the exhaust valve closes.
Since HPFIP has been designed for supply of large fuel amount, at the engine idle and at partial loads an excess of compressed fuel takes place which, via ball valve 8 of pressure regulator 11 and via the back runoff duct is returned into the fuel tank.
The pressure regulator sets the pressure in the high-pressure accumulator, depending on the engine load, speed and the engine thermal state.
With extremely high pressure in the accumulator the regulator valve opens and a portion of the fuel is diverted from the accumulator via the back runoff duct to the fuel tank.
The pressure regulator is mounted to the HPFIP housing with a flange. Armature 10 presses the ball of valve 8 to the valve keeper with the valve spring in order to disconnect the the high and the low pressure circuits.
The switched on electromagnet 9 moves armature 10 applying additional force for pressing the ball to the keeper.
The armature is all flushed by fuel which lubricates the friction surfaces and removes excessive heat. The working parts of the fuel pump are lubricated by oil coming from the diesel engine lubrication system. The from the fuel pump housing is drained into the engine oil sump. When a new pump is installed in an engine, it must be preli-minarily filled with oil for 200 cm^3
Oil is added through a special orifice, item 7 (Fig. 6).



1 – High pressure fuel injection pump; 2 – fuel priming pump (feed pump); 3 – pressure regulator; 4 – angle sensor; 5 – fuel diversion from the fuel accumulator connector; 6 – oil inlet connector; 7 – oil orifice plug; 8 – oil diversion holes; 9 – fuel inlet connector from the fuel pre-filter; 10 – fuel otlet connector to the fine fuel filter; 11 – fuel inlet conector from the fine fuel filter; 12– redundant fuel diversion into the fuel tank connector; 13 – camshaft.

Fig. 6 - High pressure fuel injection pump CPN2.2

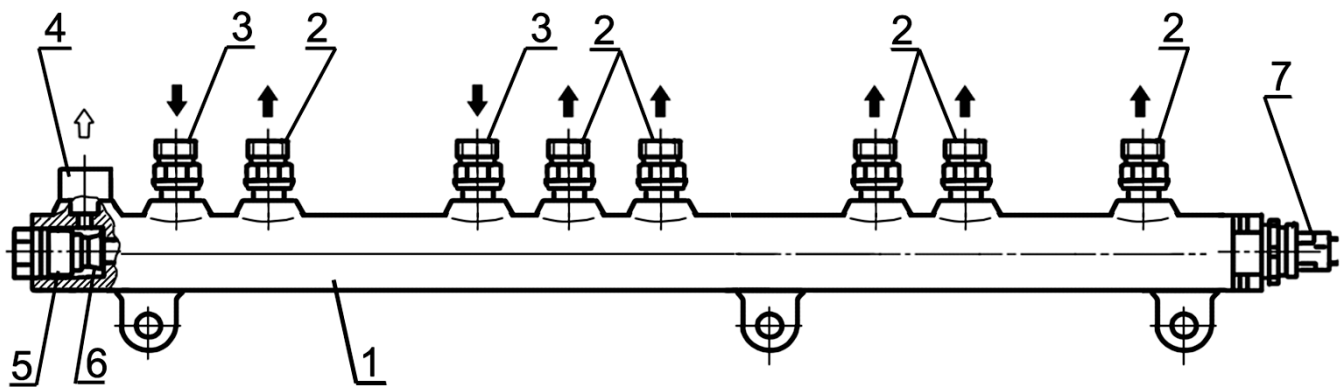


1- high pressure fuel injection pump housing; 2 – camshaft; 3 – plunger; 4 – intake valve; 5 – inlet channel; 6 - exhaust valve; 7 – outket channel; 8 – valve ball; 9 – electric magnet; 10 – armature; 11- pressure regulator; 12 - electric magnet terminals; 13 – fuel priming pump; 14 – fuel priming pump drive gear with a pulse rim.

Fig.7 – High pressure fuel pump schematic diagram.

1.2.2.6.2 High pressure fuel accumulator

High pressure fuel accumulator (Rail) is a volume storage of fuel under high pressure. Simultaneously, the accumulator smoothes pressure fluctuations that occur due to the pulsating flow of fuel from HPFIP, and also because of the injectors during injection due to nonsynchronous fuel pressure pulses coming from the HPFIP and consumed through the injectors as well as due to the multiple fuel mass excess in the accumulator working as a damper for small dose pressure pulses, the incoming and consumed ones.



1 – high pressure fuel accumulator; 2 – otlet connectors; 3 – inlet connector; 4 – back runoff connector; 5 – pressure limiting valve; 6 – valve core locking cone; 7 – fuel high pressure sensor.

Fig. 8 – High pressure fuel accumulator

Accumulator 1 has the shape of pipe at the ends of which are installed fuel pressure sensor 7 and pressure limiting valve 5. Along the pipe perimeter there are high pressure pipelines connectors 2, 3 and back runoff connector 4.

The fuel from HPFIP is directed via the high pressure duct to inlet connectors 3 of the accumulator. The fuel accumulator is coupled with the injectors by high pressure fuel pipings linked with the accumulator outlet connectors

The accumulator is permanently filled with fuel under high pressure. The pressure value is kept on a constant level and may be regulated by valve 5 (Fig. 8), depending on the engine operation parameters.

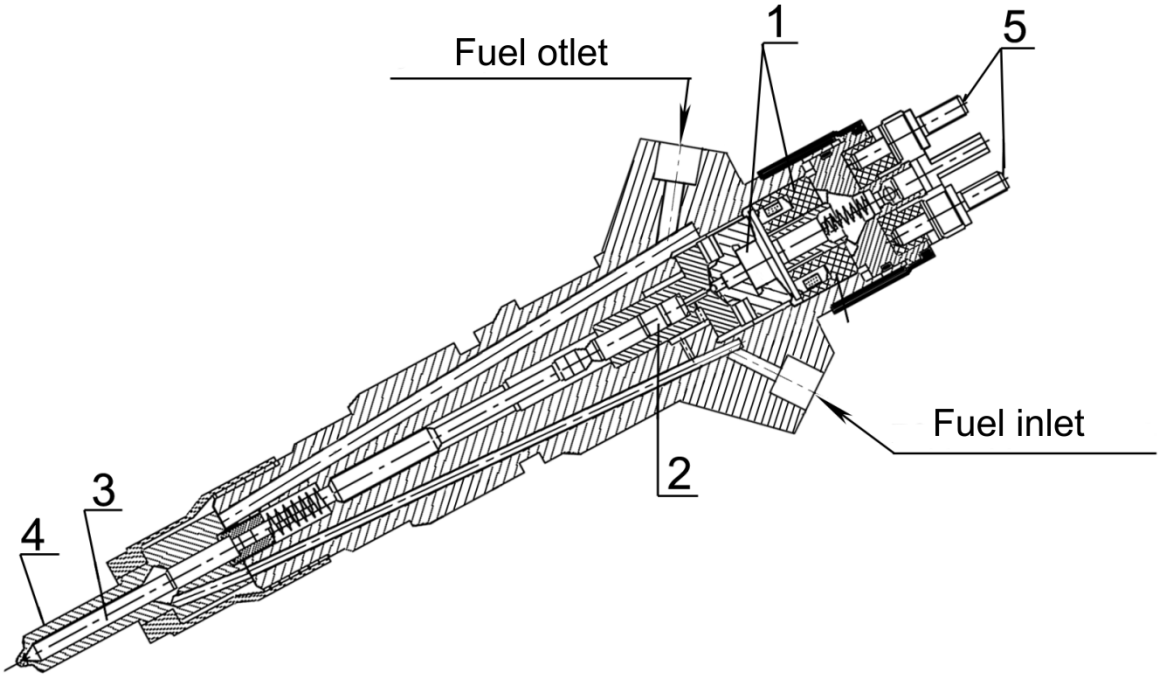
The pressure limiting valve keeps a definite pressure value in the accumulator working as a reducing (protective) valve. The valve housing on the accumulator side has a channel closed by valve core cone 6. A spring. A spring firmly presses the cone to the valve seat under normal operating pressure, so that the accumulator remains closed. In the event of the pressure in the accumulator exceeding the operating value, the cone moves away from the valve seat and the fuel being under high pressure is diverted to the back runoff duct. As a result the fuel pressure in the accumulator goes down.

1.2.2.6.3 Injector

Injector (Fig.9) is designed for deliverying fuel in the diesel engine cylinder and ensuring the necessary spraying.

Installed in the engines are CRIN2 injectors manufactured by"BOSCH" (Germany).

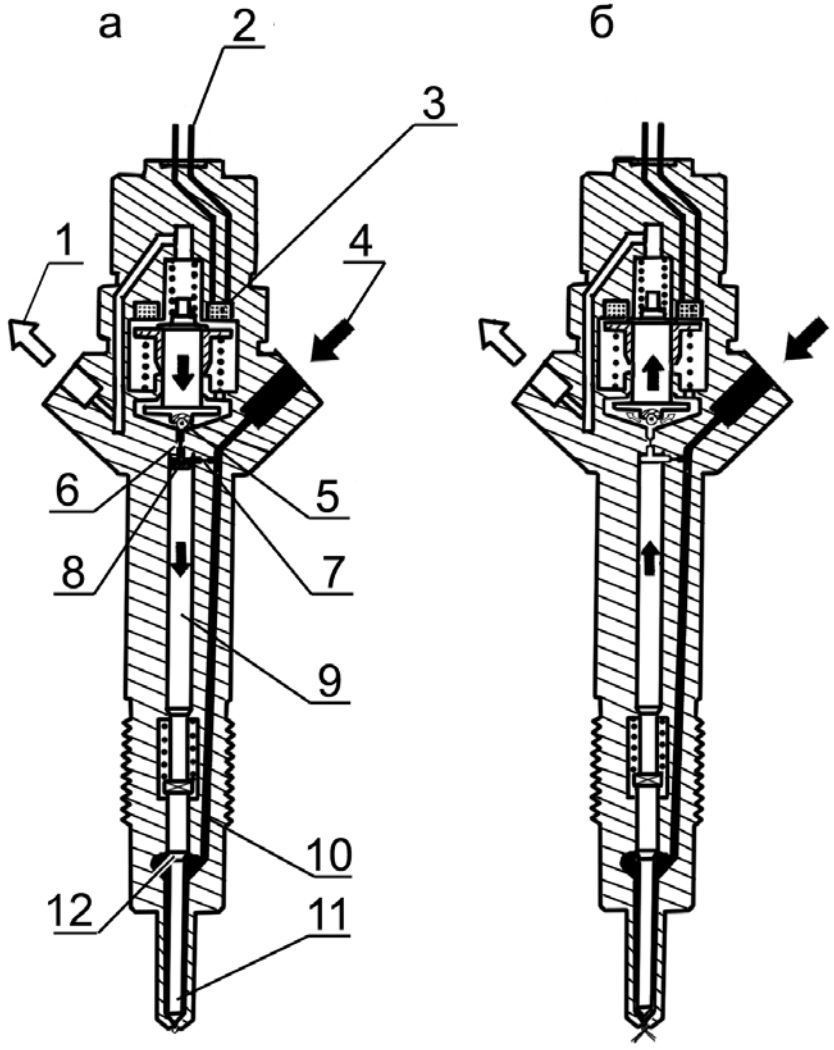
The required moment of the start of injection and the fuel supply amount are provide by the operation of the injector electromagnetic valve. The moment of the start of injection in the "angle-timing" coordinates is set by the diesel engine electronic control system.



1 – electromagnetic valve; 2 – controlling valve; 3 – atomizer needle; 4 – atomizer housing; 5 – electric terminals.

Fig. 9 – Injector

Forming of the injector control signals by ECU works based on reading the signals formed by the crankshaft and the HPFIP camshaft speed sensors (sensors 2 and 5, Fig.2, Annex Д), installed in a consistent relationship in a specific pattern.
The injectyor operation principle is shown on Fig.10.
The fuel is supplied along the high pressure pipeline via inlet channel 4 to the atomizer of injector 11 and also through a fuel supply throttle hole 7 – to the chamber of controlling valve 8. Through the fuel outlet throttle hole, which may be opened by the electromagnetic valve, the chamber is connected with back runoff duct 1.
With closed throttle hole 6 the hydraulis force acting from above on the controlling valve piston is higher the force of the fuel pressure on the atomizer needle cone underneath. As a result the needle is pressed to the atomizer seat and firmly closes the atomizer holes and the fuel cannot get in the combustion chamber.
When electromagnetic valve 3 triggers, the electromagnet armature is moved up opening throttle hole 6. Accordingly, reduced are both – the pressure in the controlling valve chamber and the hydraulic force applied on the controlling valve piston. By fuel pressure on the cone the atomizer needle moves away from the valver seat, so the fuel get in the cylinder combustion chamber through the atomizer holes. The controlling supply – an additional fuel amount meant for the needle rise which is further diverted to the fuel back runoff duct.



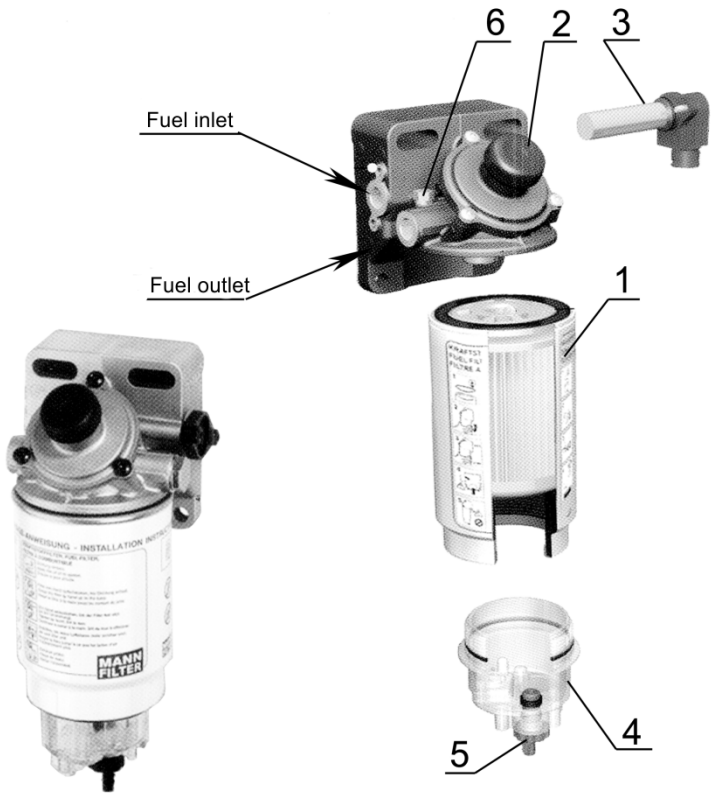
1 – fuel back runoff duct; 2 – electric terminals; 3 – electromagnetic valve; 4 – hofg pressure pipeline; 5 – valve ball; 6 – fuel outlet throttle hole; 7 – fuel inlet throttle hole; 8 – controlling valve chamber; 9 – valve controlling piston; 10 – fuel to atomizer inlet channel; 11 – needle and atomizer.

Fig. 10 – Injector schematic diagram

Apart from the controlling supply, there is fuel leakage through the atomizer needle and the controlling valve piston guide. All this fuel is diverted to the back runoff duct, to which all other injection system devices are connected, and gets back into the fuel tank. The amount of injected fuel is proportional to the time of the electromagnet valve being switched on and the pressure in the rail, and it does not depend either on the crankshaft speed or the HPFIP operation mode (time controlled injection).
When there is no electricity on the electromagnetic valve, the armature, by the force of the spring, is pressed down and valve ball 5 closes the throttle hole.
Upon closing the fuel outlet throttle hole the pressure in the controlling valve chamber reaches the same level with that in the accumulator. This increased pressure moves moves down the controlling valve piston together with the atomizer needle. When the needle is pressed firm to the atomizer seat and close its holes, injection stops.

1.2.2.6.4 Fuel pre-filter

Fuel pre-filter is designed for preliminary fuel cleaning from mechanic mixtures and water.
Fuel pre-filter is not included in the diesel engine and is installed in a tractor or an agricultural machine by customer. Because of the diesel engine HPFIP is not equipped with a hand fuel priming pump necessary for filling the fuel system without air, the filter design must contain a hand fuel priming pump.
Fig.11 shows a fuel pre-filter with a hand fuel priming pump "PreLine 420"recommended for tractor/agricultural machine.
The drainage of sediment from the filter is done through tap 5 located in the lower part of moisture separator 4. To open the tap, it is necessary to turn it (clockwise) in the moisture separator housing.



1 – Fuel pre-filter; 2 – hand fuel priming pump; 3 – fuel heater; 4 – moisture separator; 5 – water drainage tap; 6 – air outlet plug.

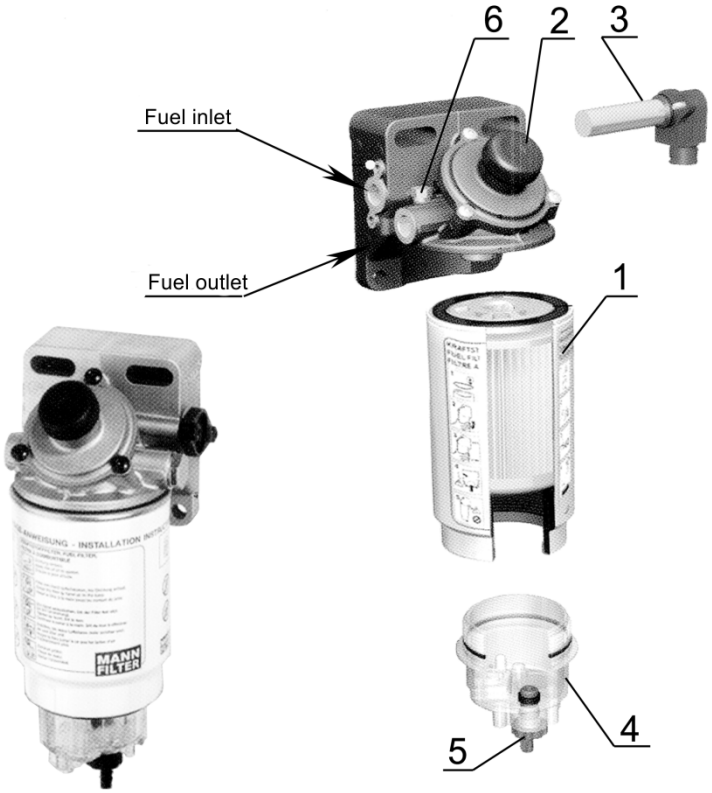
Fig. 11 – Fuel pre-filter «PreLine 420»

When using the diesel engine at ambient temperatures lower than -25ºC the filter housing must be equipped with fuel heater 3.

The heater voltage – 24V, output – 350 W. Connetction: + and mass. The heater operates independently, it is switched on and off automatically at temperatures lower than +5ºC. The heater may be purchased at the address:
127560 Moscow, 11A Konionkova Str.
Phone: +7 095 742 7976. Fax: +7 095 742 7988.
The heater No for orders 29 017 00202

1.2.2.6.5 Fine fuel filter

Fine fuel filter (Fig. 12) is designed for final fuel cleaning. It is unseparable. The fuel going through the paper filter element curtains gets cleaned from mechanic impurities. To remove the air from the engine power system it is necessary to follow the procedures outlined in item 3.2.10.



1 – filter housing; 2 – fine fuel filter “Mann & Hummel WDK962” (Germany).

Fig. 12 – Fine fuel filter

1.2.2.6.5 Air duct

Air duct consists of an air cleaner and a branch pipe connecting the air cleaner with the turbocharger, the charge air cooler and the intake manifold (Fig. 4). The dry type air cleaner with paper filter elements made of special highly porous cardboard serves for suction of air in the engine cylinders.

The air cleaner has three cleaning stages. The first stage is provided by a monocyclone, the second and the third – are the main and controlling filter elements.

Air, under the action of depression created by the diesel engine turbocharger, is cleaned from dust and comes into the turbocharger charging section from where it is delivered to the engine cylinders under the pressure through the charge air cooler.

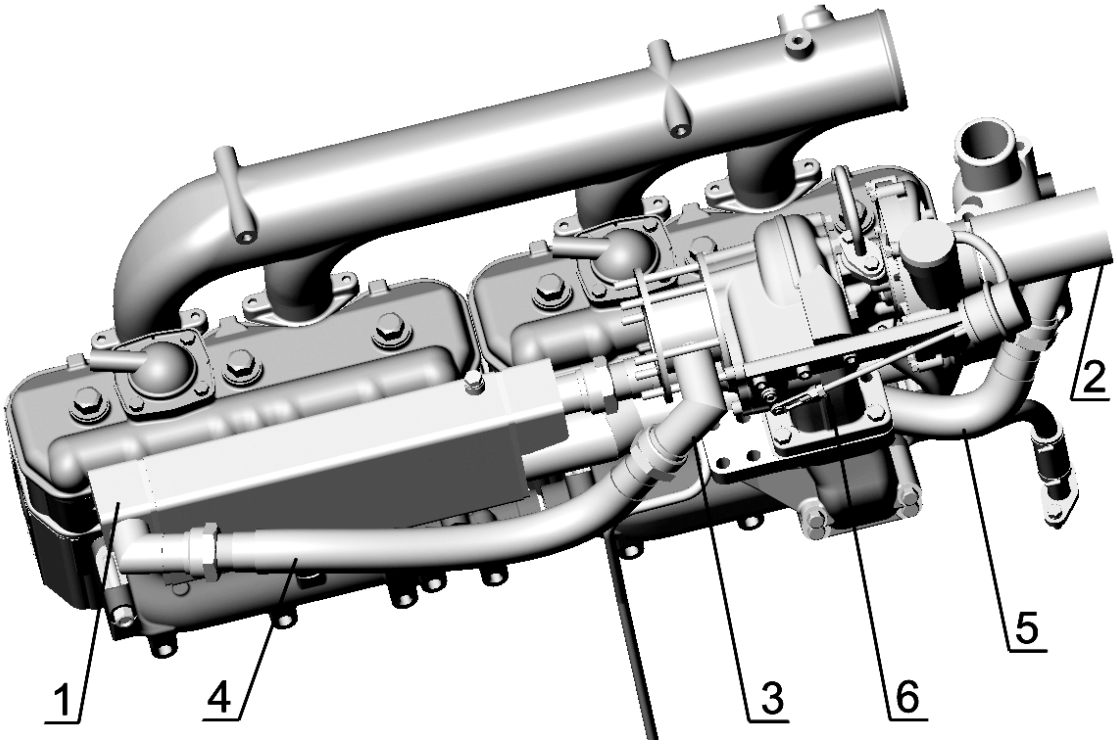
To control the air cleaner clogging condition and for determining the necessity of technical service there is an air filter clogging signal sensor installed in the diesel engine inlet duct. The air cleaner and the signal sensor are to be installed by customer.

As the air cleaner clogging grows the depression in the inlet pipeline grows and at reaching the value of 6,5 kPa the alarm sensor is triggered. With the alarm sensor triggered it is necessary to service the air cleaner.

1.2.2.6.6 Exhaust gas recirculation device

For the fuel mixture creation in the diesel engine cylinders the engine air charge supply design includes an exhaust gas recirculation device. Exhaust gas recirculation device serves for exhaust gas toxicity reduction and the engine fuel economy in partial modes of small frequency crankshaft rotation. The exhaust gas recirculation device (Fig. 13) consists of recirculated exhaust gas cooler 1 operating (EGR) operating on the principle of heat exchanger, mixer 2, recirculated exhaust gas inlet and outlet branch pipes.

The functioning of the device is maintained by delivery of a portion of exhaust gas from the exhaust manifold via the EGR cooler into the intake manifold, as a result of the natural difference between the exhaust gas pressure in front of the turbine and that of the charge air.
The presence of exhaust gases in the air charge coming to the engine cylinders provides froming of local zones in the combustion process allowing to reduce the amounts of nitrogene oxides. Afterburning of carbon monoxide and hydrocarbons also contributes to improving the eclological parameters of exhaust gas contents.

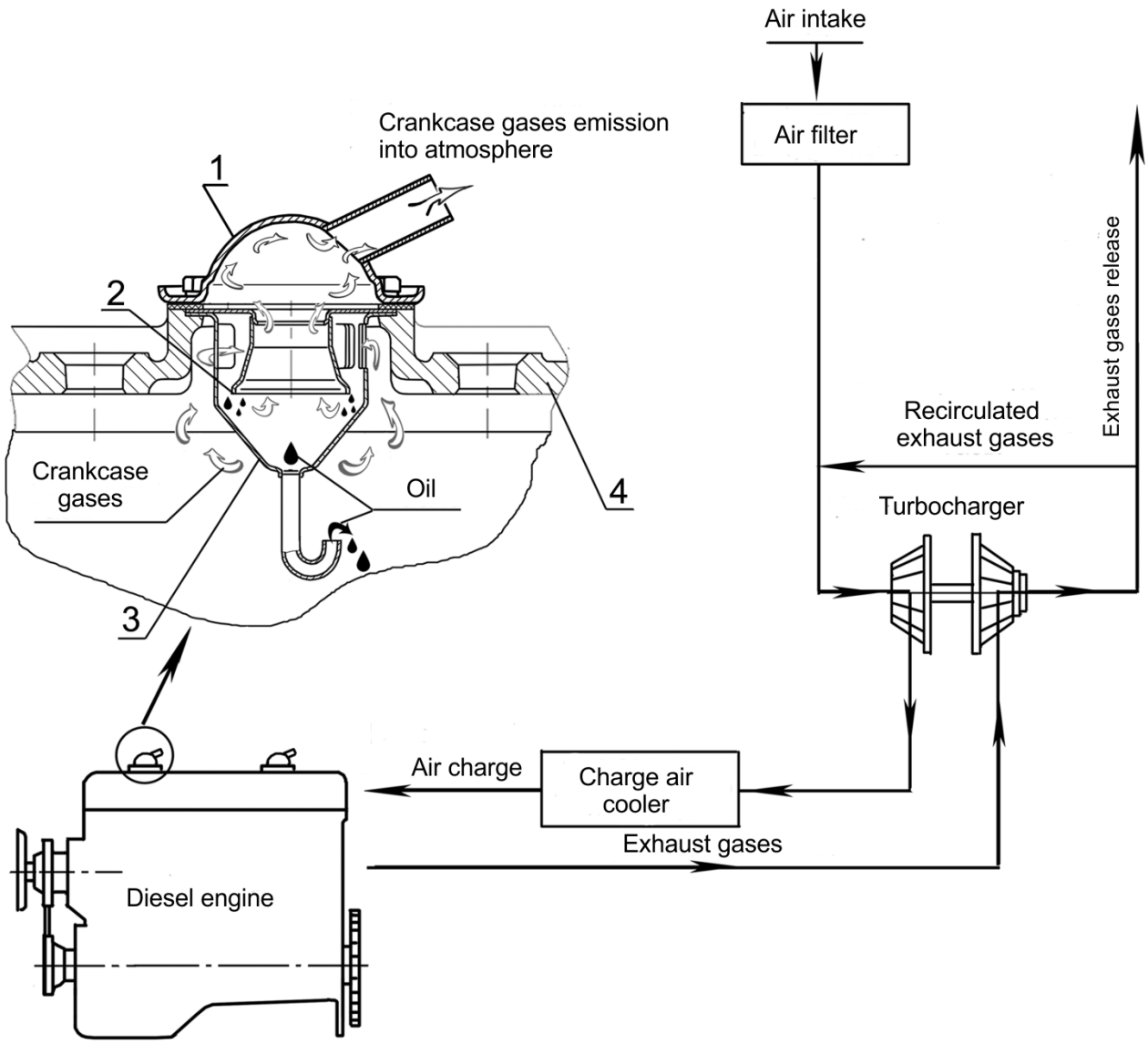


1 – recirculated exhaust gas cooler; 2* – mixer; 3 *– spacer; 4 – recirculated exhaust gas inlet branch pipe from turbocharger to EGR; 5 - recirculated exhaust gas inlet branch pipe from cooler to mixer; 6 – turbocharger.
* - the recirculated exhaust gas inlet and outlet elements design may be different with developers of tractors or agricultural machines for the reason proper fitting in a vehicle and must be approved with MMP.

Fig. 13 – Exhaust gas recirculation device

1.2.2.6.7 Diesel engine gas exchange system

The diesel engine gas exchange diagram together with breathers is shown on Fig.14. Breather is designed to prevent excessive pressure in the lubrication system created by the exhaust gas penetrating into the oil sump through the gas joints of the cylinder-piston group and oil injection into the atmosphere.
In the implemented gas exchange system the crankcase gases, via the channels in the cylinder block and the cylinder head, come into the cavity formed by the cylinder head cover and the cover cap. Breather housing 1 (Fig. 14) is mounted on cover cap 4 of the cylinder head. The crankcase gases rush through the slots of cup 6 into breather housing 1 under the influence of the pressure difference in the atmosphere and in the cavity of the cylinder head cover. Having got into the cup cavity, the crankcase gases expand and strike against oil deflector 2, lose their energy and cool down. As a resul,t a significant portion of the oil mist falls down as oil. The crankcase gases cleaned from oil then get into the atmosphere.



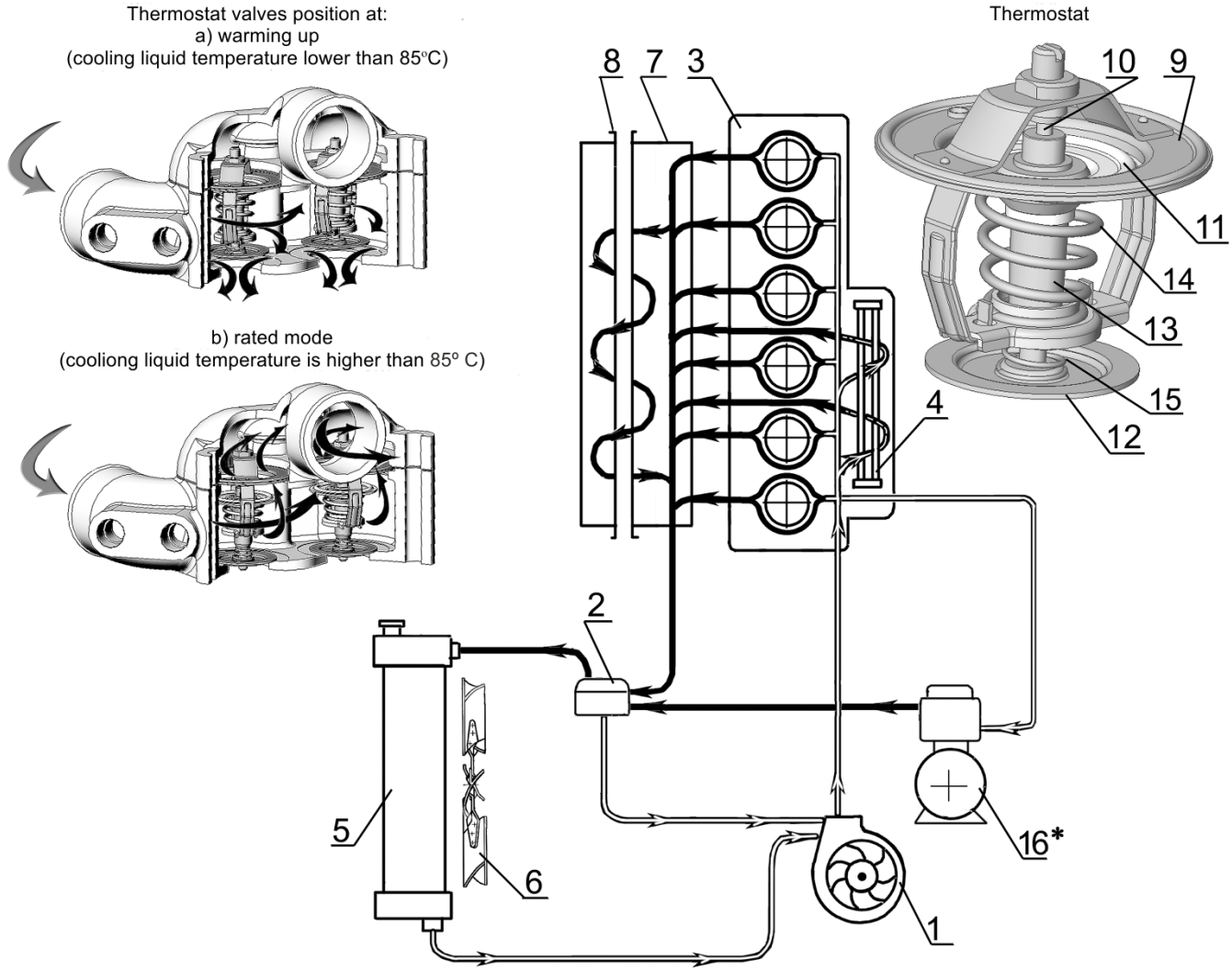
1 – breather housing; 2 – oil deflector; 3 – cup; 4 – cover cap

Fig.14 Diesel engine gas exchange diagram

1.2.2.7 Cooling system

Closed type cooling system (Fig.15) with forced circulation of cooling liquid from a centrifugal pump. The water pump is driven in rotation by a V-belt from the crankshaft pulley. Lubricant "Litol-24"is placed in the bearing cavity of the pump at the pump assembly. The bearing does not need lubrication in the process of use.

The cooling liquid temperature in the cooling system must be kept within 85º C - 95º C.



1 – water pump; 2 – thermostats; 3 – cylinder block; 4 – liquid-oil heat exchanger; 5– radiator; 6 – fan; 7 – recirculated exhaust gases cooler; 8 – recirculated gases inlet pipe; 9 – thermostat housing; 10 – piston; 11 – main valve; 12 – by-pass valce; 13 – thermal force element; 14 – valve spring; 15 – by-pass valve spring; 16 – compressor (for diesel engines with liquid cooled compressor)

Fig. 15 – Cooling system diagram.

For faster diesel engine warming up after start and automatic regulation of temperature mode at various loads and amvient temperatures two TC-107 thermostats are installed on the purging line.

Ther are two valves (the main 11 and bypass 12, Fig.15) in the thermostat housing and thermal force element 13, inside which there is piston 10

The thermal force element consists of housing (cylinder) filled with thermosensitive substance expanding with warming up. Fixed firm on the housing is the main valve. On the housing axis valve 12 is mounted, pressed by spring 15. Spring 14 is installed so that it firmly presses the main valve to the housing of thermostat 9.

After the engine start, before the cooling liquid warms up to +85°C, the main thermostat valves are closed. The cooling liquid from the cylinder head water outlet pipe, passing by the radiator, goes to the pump and once again gets back to the cylinder block.

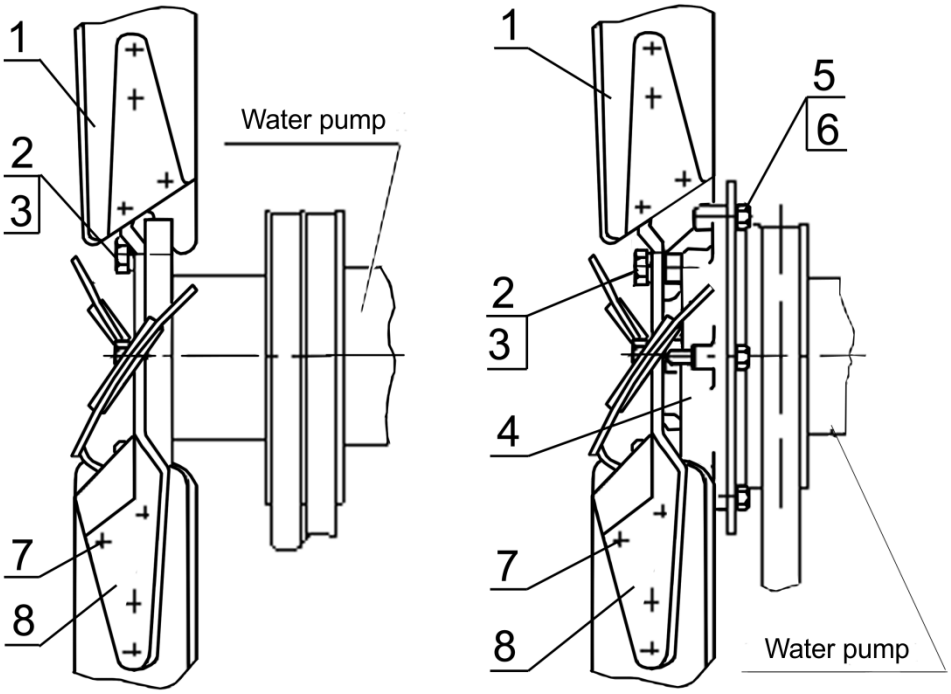
At the cooling liquid temperature over 85°C, the substance filling the thermosensitive element expanda and affects fixedly mounted piston 10, thus causing movement of the thermosensitive element with the main valve relative to the piston. With the force of movement exceeding the force created by valve 14, the main valve moves down thus creating a gap between the main valve and the thermostat hiusing, and the cooling liquid

then starts partially circulating through the radiator. When the cooling liquid temperature reaches +90°C, the main valve opens completely and the entire flow goes through the radiator. Simultaneously with the main valve movement, the bypass valve also moves down, shutting the channel of cooling liquid bypass to the water pump.

Installed in the engine is a water pump complete with a fan. The fan is fixed to the pulley.

On the diesel engine D-260.4S3A combine harvester modification, the water pump is installed without fan, since air supply to radiator is done by a fan installed in the combine harvester.

There are two options for fan installation: with a space plate and without it (Fig. 16). On some diesel engine modifications, instead of steel fan they may install a moulded plastic fan 245-1308040-А (Ø510 mm).



а – without space plate; **б – with space plate.**

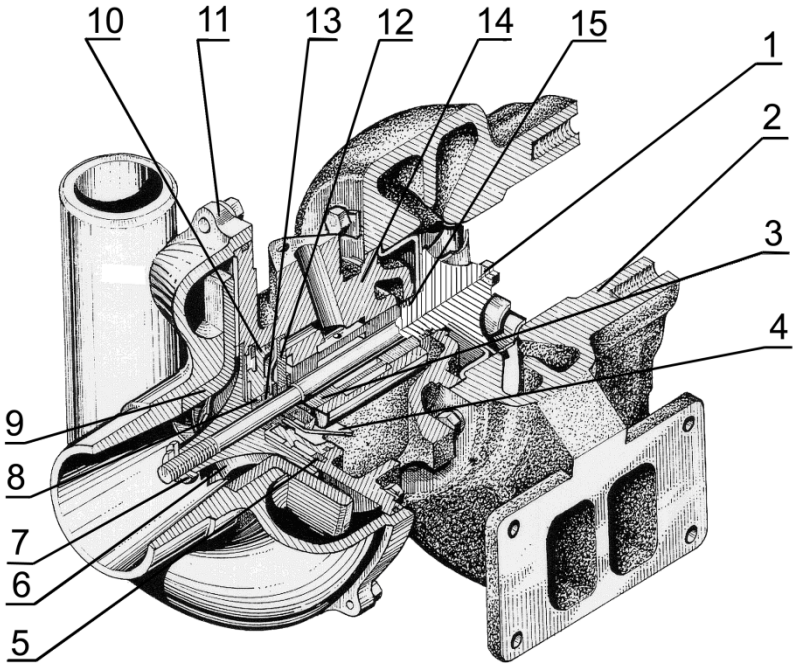
1-blade, 2-bolt, 3-washer, 4-space plate, 5-bolt, 6-washer, 7- rivet, 8-cross piece.

Fig. 16– Fan mounting

1.2.2.8 Supercharging device

1.2.2.8.1 Turbocharger

Installed in diesel engines D-260.1S3A, D-260.2S3A is an uncontrollable turbocharger (Fig.17a) using the energy of exhaust gases for charging air into the engine cylinders.
Turbocharger operation principle is as follows: the eaxhaust gases from the diesel engine cylinders get under pressure via the exhaust manifold into the turbine scroll channels. While expanding, the gases rotate the turbine wheel with a shaft on the other end of which a compressor wheel, via the air cleaner, sucks air in and delivers it under pressure into the diesel engine cylinders.
Turbocharger, according to Fig.10, is made on the principle: radial centrifugal turbine and centrifugal single-stage compressor with overhanging location of wheels relative to the supports.
The rotor speed, the charge air flow and pressure depend on the engine operation mode.



1 – turbine wheel with shaft; 2 – turbine housing; 3 - monobush; 4 – oil deflector; 5 – eccentric ring; 6 – compressor wheel; 7 – special nut; 8, 15 –sealing rings; 9 - diffuser; 10 - cover; 11 – compressor housing; 12 – thrust bearing; 13 – space bush; 14 – middle housing (bearings housing).

Fig. 17a – Uncontrolable turbocharger

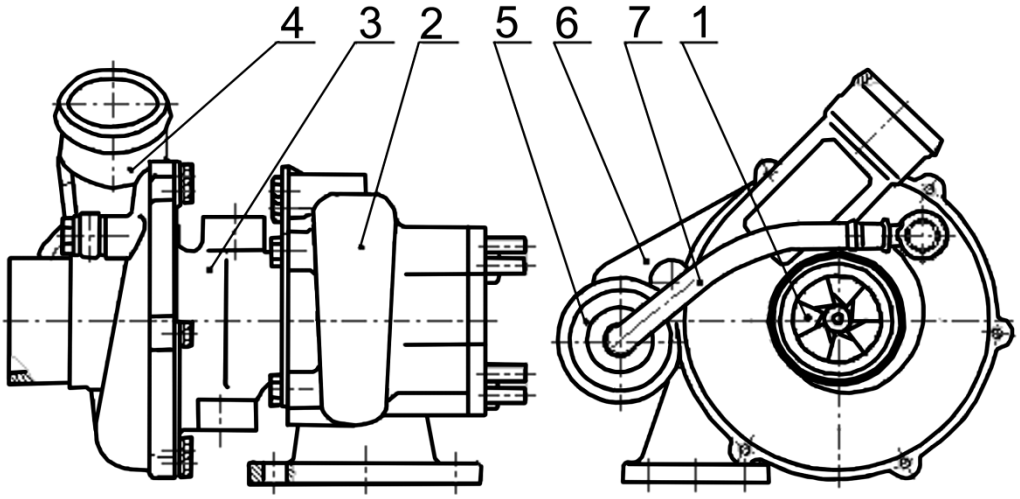
The housing of turbine 2 is made of high-strength cast iron. The turbine flow-through part for exhaust gases is fromed by the turbine housing and the turbine wheel.
Compressor housing 11 is made of alluminium alloy, its flow-through part is formed by the compressor housing and compressor wheel.
The turbine and compressor housings are fixed to bearings housing 14 made of high-strength cast iron.

Turbine whell 1 is cast of heat-proof alloy and welded to the rotor shaft.
Compressor wheel 6 is cast of alluminium alloy and is fixed to the rotor shaft with a special nut.
The rotor shaft rotates in a radial bearing made as a floating non-rotating monobush 3. The monobush is secured in the bearings housing by a fixer. The rotor axial motion is taken by thrust bearing 12.

The turbocharger bearings are lubricated and cooled by oil delivered through the pipe-line from a full-flow oil filter. Both the radial and the thrust bearings provide additional centrifugal oil cleaning. Oil then is drained into the oil sump through an oil diversion pipe.

On the compressor and turbine side there are gas-oil sealimgs – spring sealing rings 8 and 15, installed in the rotor groove. For efficiency raising, on the compressor side there os an oil deflector and a screen on the turbine side.

Installed in diesel engine D-260.4S3A is a controllable turbocharger (Fig. 17b).



1 – rotor; 2 – turbine housing; 3 – bearing housing; 4 – compressor housing; 5 – actuating mechanism; 6 - actuating mechanism bracket; 7 – air duct.

Fig. 17b - Controlable turbocharger.

Supercharging is regulated by diversion of a portion of exhaust gases past the turbine wheel at certain supercharge pressure values.

By design, turbocharger, as shown on Fig.17b consists of the following basic units: rotor 1, turbine housing 2, bearing housing 3, compressor housing 4, actuating mechanism 5, actuating mechanism bracket 6, air duct 7.

The rotor includes a shaft welded to the turbine wheel and the compressor wheel, oil sealing space bush, two washers and two sealing rings. The rotor rotates in the radial bearing, mounted in the bearing housing. The rotor axial motion is taken by the thrust bearing.

Incorporated in the controllable turbocharger housing is a bypass valve. With a controllable rod, the bypass valve lever is coupled with the actuating mechanism, in its turn linked with the compressoe outlet by the air duct.

The regulator setting to a ceratian pressure is done by adjusting the rod length.

The turbocharger actuating mechanism rod length within the operation period is not permissible.

The turbocharger bearings are lubricated and cooled by the oil coming through the diesel engine lubrication system pipeline. The oil is drained from the turbocharger into the engine oil sump.

The turbocharger disassembling and repair during the engine use is not permissible. When out of use, it should be done at a specialized repair shop.

1.2.2.9 Starting device

Diesel engines tarting device is an electric starter motor with rated voltage of 24V. Starter motor is a direct current electric motor with mixed excitation and a drive mechanism.
To facilitate startup at low ambient temperatures, all the engines are equipped with glow plugs with rated voltage of 23V and have heat carrier inlet and outlet locations for engine prestart heating systems, installed by customer in a tractor/ agricultural machine.
A tractor/ agricultural machine electric circuit diagram must include starter motor blocking after engine startup – starter motor switch-off upon the crankshaft speed reaching 900 min-1 to 1000 min-1 and inability to switch it on with the engine running.

1.2.2.10 Alternator and its drive

Installed in diesel engines are alternators serving as electric equipment power sources. Alternators have terminals for connection to circuits: «+» («B») – load and accumulator battery; «Д» («D») – starter motor blocking relay; «~» («W») - tachometer.
Alternator is used for accumulator battery recharging and direct current supply to electricity consumers installed in a tractor/ agricultural machine.
Alternator is driven by a V-belt on the crankshaft pulley.

1.2.2.11 Compressor and its drive

To drive pneumatic trailer brakes and tire inflation, diesel engines installed in tractors,combine harvesters, machine are equipped with a piston single stage compressor (Table 6).
Compressor А29.05.000БЗА is mounted on the distribution cover flange and is driven by the compressor and the distribution mechanism fuel pump drive gear.
With a diesel engine being used in agricultural work not requiring compressed air power, compressor А29.05.000БЗА must be switched off. It is not allowed to switch the compressor on with the engine running. Compressor А29.05.000БЗА is air cooled.

1.2.2.12 Gear pump and its drive

Hydroficated tractor or other vehicle control systems imply installation of НШ 14-3Л or НШ 16-3Л, or НШ-10 gear pump in diesel engines.
The gear pump is rotated by the engine distribution gears.

1.2.2.13 Clutch
Clutch is designed for torque transfer from the engine crankshaft to transmission and for short time diesel emgine disconnection from transmission, while the engine is running, to ensure bumpless shifting the gears and smooth vehicle pulling away.
Installed in diesel engines are friction type, dry, single disc or double-disk permanently-closed clutches as shown on Table 6.

1.2.3 Diesel engine labelling and sealing
Labelling and sealing of diesel engines manufactured by "MMP" is done according to the current manufacturer design documentation. Labelling of diesel engines big size parts – according to supplier companies' design documentation.

2 APPROPRIATE USE

2.1 Operating restrictions

For long time and troubleless diesel engine operation, follow the basic conditions below:
- For proper"COMMON RAIL" electronic control system functionEng, the electronic Control Unit software must comply with the application of tractors/ agricultural machines where the engines are installed;
- Before putting a newly manufactured engine into operation under load, run it in according to article 2.3.4;
- At the beginning of a working shift, before the engine start check the oil level in the engine oil sump and that of the cooling liquid in the radiator or the expansion tank.
- After the engine start, before loading the engine, let it run for 2-3 minutes, first at the minimal idle speed with gradual increase to not more than 1600 min^{-1}. Full load of a cool engine is not allowed (the permissible oil pressure value for a not warmed up engine – not more than 0,8 MPa);
- At emergency engine idling (warming up, air pumping to the braking system cylinders etc.) it is necessary to keep the engine crabkshaft speed at not less than 1000 – 1200 min^{-1};
- During the engine running watch the controls indications:
- Engine operation with the oil pressure in the main oil duct lower than 0,1MPa is not permissible;
- The cooling liquid heating over 100°C is not permissible;
- In the event of the oil pressure or the cooling liquid temperature exceeding the said values the engine must be stopped;

- it is not permissible to keep the engine running under the cooling liquid temperature lower than 60°C, because in these conditions the non burnt fuel flushes the oil off the cylinder liner walls and gets the oil burning in the engine crankcase;
- the engine must not run longer than 1 minute under the full load and the speed lower than the speed corresponding to the maximal torque, so you should shift to the down gear;
- the engine operation in the range exceeding the maximal speed may lead to the engine damaging, so driving downhill use lower gear-box gears in combination with the vehicle service brake;
- do timely engine technical service according to section 3.1;
- to prevent the "COMMON RAIL" Electronic Control Unit (ECU) damage, while disconnecting harnesses or accumulator battery wires from it, as well as while replacing fuses, ignition and the mass switch must be off. The system disconnection, the system elements replacement must be done with the ignition switched off.
- do periodical check of the assembly units fixing, tighten the mountings;
- use only the fuel and oil grades recommended in this Manual;
- keep the diesel engine clean, do not allow leakage of fuel, oil and cooling liquid, uncleaned air sucking into the cylinders;
- doing repair and welding is allowed only with the accu,ulator battery terminals disconnected.

2.2 Diesel engine preparing for operation

2.2.1 Safety rules to be observed while preparing diesel engine for operation

Eligible for diesel engines preparation for operation are certified engine operators and drivers having been duly instructed on the operation safety and fire safety rules.
*Start working only after a detailed study of the engine design and operation procedures.While loading/ unloading the engine in transportation, clamp the lifting equipment slings only to the eye-bolts located on the engine (the slinging method is described in Annex **И**).*
Wkile doing the engine depreservation, follow the fire safety rules and the hygene rules working with chemicals, used rags and oil paper.
Do not allow dismantling protective shieldings implied by the diesel engine design.
While examining the engine visually, use a portable lamp with the voltage of not more than 24V.
The tools and appliances used in the engine preparation for operation must be well working, fit for the intended use and ensure safety in doing the job.
The location where the engine is prepared for operation must be equipped with fire extinction means.

2.2.2 Diesel engine, its assembly units and parts depreservation

Diese engines coming to consumers are preserved for shelf keeping from 6 months to 1 year period.
The particular preservation period is indicated in the engine passport.
The sequence of depreservation operations is shown in Table 9.

Table 9

No	Operations	Preservation period	
		1 year	6 months
Engine depreservation			
1	Uncover the engine.	+	-
2	Use diesel fuel to remove the preservation grease from the outer unpainted preserved surfaces of the diesel engine.	+	+
3	Remove plugs or polyethylene filming covering the exhaust manifold outer openings, intake manifold, thermostat housing, water pump branch pipe, turbocharger and breathers. Take the plugs out of the ECU radiator inlet connector and out of the redundant fuel diversion from HPFIP connector. Before installing the pipelines, remove the plugs from the hydraulic pump (Gear Pump) openings.	+	+
4	Drain the remnants of preservation oil through the engine crankcase drainage hole.	+	-
5	Drain the remnants of preservation solution from the cooling system through the drainage tap.	+	-
6	Get the engine ready for start. Fill the engine oil sump with clean sump.	+	-
7	Pump up the fuel supply system with the hand fuel feed pump, removing the air from the fuel system (See paragraph 3.2.10).	+	-
Assembly units and parts depreservation			
8	The diesel engine units and parts depreservation is done using a piece of rag soaked in white spirit (STATE STANDARD3134-78) with subsequent whipping dry.	+	+
9	The parts attached to the diesel engine are depreserved by jetting or dipping in a washing solution with subsequent hot drying: - the washing solution temperature: from 60° C to 80° C; - the hot drying temperature: from 70° C to 80° C.	+	+

2.2.3 Diesel engine additional equipment

When installed in a machine, diesel engine must be equipped with: fuel tank, cooling system radiator, fan, charge air cooler, air cleaner, electric divices and control devices.

The diesel engine design provides locations for heat carrier inlet and outlet from the pre-start heating system, which must be installed in a machine and used for the diesel engine pre-start heating at the ambient air temperature lower than - 20° C.

2.2.4 Filling the cooling system

The cooling system is filled by pouring the cooling system into the radiator or cooling liquid expansion tank (the liquid brand and amount of filling are indicated in a table of Annex A).

The engine start and running with unfilled cooling system is not permissible. To avoid boiler scale, it is not allowed to use water in the coling system.

At failures caused by the cooling liquid leakage short time use of water is permissible until the failure has been rectified.

2.2.5 Filling the engine with fuel and oil

Fill the engine fuel tank with fuel and the oil sump with motor oil. Use the fuel and oil brands matching the ambient air temperature at which the engine is operated. The recommended fuel and oil brands are indicated in a table in Annex A.
Using other fuel and oil brands may result in the engine early going out of operation, not meeting the ecology standards as well as in a difficult engine start in cold weather conditions.
The diesel fuel must be clean without any mechanical impurities, oil and water.
The lubrication materials must be clean and must not contain mechanical impurities and water.
Before fueling, a tractor or a combine harvester must be placed on a horizontal site.
Pour oil into the engine till the oil feeler rod upper mark. Start the engine and let it run for 5 minutes, let the oil drain for 10 minutes. Add up oil till the feeler rod upper mark.

2.2.6 Diesel engine controls and control devices

Diesel engine is controlled from the operator or driver locations. The engine controls and control devices mounting is done by the customer when installing the engine in a tractor/ agricultural machine.
The crankshaft speed is changed with a pedal, the signal of the pedal being moved is sent to the"COMMON RAL" power supply electronic unit by a pedal position sensor.
The glow plugs, the"COMMON RAL" power supply electronic unit and starter motor switching on is done by a 3-positional ignition lock.
With the ignition lock set in position I the glow plugs electric circuit switches on and the "COMMON RAL" power supply electronic unit, with the ignition key further turned to position II, switches on the starter motor electric circuit.
The glow plugs are controlled by a separate control unit independent from the "COMMON RAL" power supply electronic unit.
The lubrication system oil pressure sensor and pressure alarm sensor are installed in the heat exchanger cover.
The air cleaner impurity condition is controlled by the air filter clogging signalizer sensor serving switching a signal lamp on when the air filter gets clogged over the permissible extent.
The air cleaner impurity signalizer sensor is installed in the diesel engine inlet duct on the air cleaner outlet branch.
The crankshaft speed is controlled by tachometer. The signal comes to tachometer from the alternator AC terminal.
A diagnostic lamp and a diagnostic button are located on the dashboard.
The diesel engine controls are located on a tractor/ agricultural machine dashboard.

2.3 Diesel engine use

2.3.1 The order of diesel engine use by authorized technical personnel

Before starting a newengine or an engine that has not been operated for a long time do the following:

-check the oil level in the engine oil sump;

-check the cooling liquid level in the ngine cooling system;

-check if the fuel tank tap is open;

-fill the engine fuel system with fuel following the procedure described in paragraph 3.2.10 of this Manual.

Fuel drainage is done into a separate vessel.

2.3.2 Diesel ngine start

Set tractor/ agricultural machine gearbox lever to the neutral.

Turn the accumulator battery switch on.

Switch the glow plugs control unit and the"COMMON RAL" power supply electronic unit on by turning the ignition key to position I. At that, the glow plugs will set for heat-up.

Before the engine start make sure that the diagnostic lamp blinks after ignition switching on and fadesin not longer than 15 seconds.

The glow plugs heat-up time depends on the diesel engine temperature or it may be set fixed depending on the glow plugs control unit type. At switching on, a lamp on the dash-board lights up signalizing that the glow plugs are being heated up. Upon the glow plugs complet heat-up, the lamp fades commanded by the glow plugs control unit. As soon as the lamp fades, switch tractor/ machine clutch on. Turning the ingintion key to position II switch the starter motor on and start the engine. The plugs stay switched on for 180-240 seconds during the engine start process.

The diagnostic lamp must not light or blink after the engine start. In th event of the lamp lighting or blinking it will be necessary to perform the diesel engine control system diag-nostics (see paragraph 2.3.6).

Switch the clutch smmothly.

Heat the engine up to steady crankshaft rotating at 700-800 min^{-1} (2-3minutes), then let the engine run at higher speed gradually raising it up to 1600 min^{-1} untill the cooling liq-uid temperature reaches + 40º C.

The further engine heat-up till the cooling liquid temperature of +70° C is achieved with a vehicle moving at the lowest gear.

Using the engine to the full power is permissible only when the cooling liquid tempera-ture reaches + 70° C.

With the engine heated up, as well as in summer time, it is allowed to start the engine without prior glow plugs heating, turning the ignition key to position II and not keeping it in position I.

The starter motor continuous running must not exceed 15 seconds. If the diesel engine does not start, repeat start after 30-40 seconds. If the diesel engine does not start after three attempts, identify the fault and rectify it.

To make the engine start easier in the cold season (with the ambient temperature lower than -20° C), do the following:

- pump the fuel feed system up with the hand booster pump to remove air from the system;

- heat the engine up the pre-start cooling liquid heater;

- start the engine following the above described procedure.

At the engine cold start, white smoke may be coming out of the exhaust pipe for some time, which is not a fault as the engine is running overcooled. Do not heat up the air sucked in front of the air cleaner with open flames.
Do not start the engine by towing a tractor/ agricultural machine.

2.3.3 Diesel engine shutdown

Before the engine shutdown, let it run for 3-5 minutes, first at the medium, then at the maximal idle speed in order to reduce the cooling liquid and oil temperatures. Not observing this rule will cause the turvocharger going out of operation.
Stop the engine by turning the ignition lock key into "0" position. Disconnecting the vehicle mass from the accumulatory battery "plus" wire is not allowed within of not less than 1 minute after the engine ignition swutch-off and the engine shutdown.
Turn the accumulator battery switch off after the engine shutdown.

2.3.4 Diesel engine perationsl run-in

Diesel engine must be run-in for rubbing parts confrication before the engine going into operation. Diesel engine operation under full load without prior operational run-in is not allowed. Diesel engine operational run-in is done the engine final user.
As soon as the engine is ready for operation, start it and having made sure it works properly, begin the run-in.
Diesel engine running-in at the idle is done during 5 minutes with gradual raising the engine speed up to 1600 min^{-1}, then run the engine in under load for 30 hours.
The engines installed in tractors/ combine harvesters run-in under load is done while performing jobs not requiring tractive force, gradually raising the load from lower to higher gear.
With the engine run-in complete, perform the following technical maintenance:
- check and, if necessary, tighten the cylinder heads bolts;
- check and, if necessary, adjust the gap between the valves and rockers;
- clean the centrifugal oil filter rotor;
- replace the oil filter;
- replace the oil in the engine oil sump;
- pour the sediment out of the fuel pre-filter;
- check and, if necessary, adjust the drive belts tension;
- check and, if necessary, tighten the outer threaded connections.

! Exhaust gases at the oulet have the temperature of 600…800 °C, so the thermal damage to the exhaust manifold paintwork does not a signify disturbances in the engine workflow.

2.3.5 Diesel engine operation in winter conditions

Diesel engine operation is complicated at low ambient air temperatures. To ensure continuous and troublefree operation in the winter period, which start with the ambient temperatures lowering to +5° C and lower, get the engine ready for operation in the winter mode well in advance. For that purpose, do the scheduled technical maintenance, adding the seasonal technical service operations. A tractor engine compartment must have a

warmth keeping jacket and the diesel engine, if necessary, must have startup aid devices (pre-start heaters). Fill the cooling system with the cooling liquid according to Table A.1 (Annex A), check the accumulator battery condition, charge them, if necessary (the accumulator batteries must be fully charged).
With the battery not charged enough, the COMMON RAIL Electronic Control Unit blocks the engine start.
If in the summer period the customer has used cooling liquid non-frozing at low temperatures, it is necessary check it for frost resistance and replace, if necessary.
When getting over to the winter mode of operation, use the winter oil grades only and the fuels according to the Chemmatological Chart (Annex "A").
In the winter period, in case of the cooling systememergent filling with water after the engine not running for a lengthy time period, it is necessary to ensure the water drainage. Make sure that the water is drained completely and not staying frozen on the radiator and cylinder block taps. For this, clean the taps with a piece of wire. To do the water drainage faster, open the radiator fill orifice cap. Leave the taps open after the water drainage. With the subsequent cooling system fillings, close the taps as soon as the cooling liquid starts coming out of them.

2.3.6 Possible failures and troubleshooting

With a vehicle failures during its operation ("COMMON RAIL" diagnostic system lamp lighting up, blinking) it is necessary to diagnose "COMMON RAIL" system using the diagnostic lamp and the diagnostic button and rectify the discovered failures.
The diagnostic lamp blinking signifies a more serious fault than in case of its just lighting continuously.
To do the diagnostics, press the diagnostic button and keep it pressed for 2 seconds. With the button depressed, the lamp will "blink out" a 3-digital diesel engine error code coming as a series of flashes. It will look as follows:
- after depressing the diagnostic button – pause, a series of flashes after the pause (for example, with two flashes you mark the digit - 2), pause, a series of flashes after the pause (for example, with four flashes you mark the digit - 4), pause, a series of flashes after the pause (for example, with three flashes you mark the digit - 3), as a result, we have the error blink-code "243" (Oil pressure sensor).
With the next diagnostic button pressing, the diagnostic lamp will "blink out" the next failure blink-code. In this way all discovered faults are shown up. After showing up the last fault, the unit starts showing up the first identified.
The failures blink-codes explanation is given in Table 10.
Rectify the fault by the methods described in Table 10 and delete the fault record from the ECU memory in the following manner:

- switch ignition off and pause for one minute;
- press the diagnostic button and, keeping it pressed, switch ignition on;
- keep the diagnostic button pressed for 5-7 seconds after ignition switching on.

To make sure the fault has been rectified, test drive the vehicle. During such drive, the self-diagnostics check the system and stores still possibly remaining faults data in the memory again.

After the test drive, do the diagnostic fault blink-codes re-reading from the control unit memory. Now the error memory must be cleaned up, which means successful completion of repair.

If not all of the faults discovered by the diagnostic system have been fixed, you need to apply to a diagnostics station, even if the fault may not significantly affect the diesel engine operation, as it may cause deterioration of the engine ecology parameters.

Not all of the faults may be stored in the control unit memory. Therefore, during the engine operation pay attention to the engine gauges indications, exhaust gas colours, listen to the sounds of the engine running. Hearing unusual sounds, check the reason and rectify the fault. Being not able to rectify the fault, apply to a diagnostic station. Usually a diagnostic service station electronic database supports further search of faults.

The list of possible diesel engine faults in the process of operation and recommendations on the methods of their fixing are given below in Table 11.

Do checking of the engine operation failures in sections 1-4 of Table 11 after complete "COMMON RAIL" system check with a diagnostic device.

Blink-codes table

Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
Faults shown by diagnostic lamp lightup							
1	**1-1-1**	**P060B**	**3**	**520192**	Analogue-digital-analogue converter reference voltage exceeding the set limit.	Error discovered by analogue-digital-analogue converter watch function.	***Apply to service centre.***
		P060B	**4**		Analogue-digital-analogue converter reference voltage below the set limit.		
		P060B	**11**		Test pulse voltage exceeding the acceptable limits.		
		P060B	**2**		Sequence elaboration error by analogue-digital-analogue converter.		
2	**1-1-2**	**P0335**	**12**	**190**	Crankshaft speed sensor signal absent.	Crankshaft speed sensor circuit fault.	Check crankshaft speed sensor condition and connections. ***Apply to service centre.***
		P0336	**11**		Wrong crankshaft speed sensor.		

Note: *With regard to identification of the faults, the codes of which are given out by the diagnostic lamp lighting or stored in the Electronic Control Unit, with the codes identified by the full system diagnostics, but not shown in Table 10, customers will need to apply to a service centre.*

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
3	**1-1-3**	**P0340**	**12**	**636**	Camshaft speed sensor signal absent.	Camshaft speed sensor circuit fault.	Check camshaft speed sensor condition and connections. того вала. ***Apply to service centre.***
		P0341	**11**		Wrong camshaft speed sensor.		
4	**1-1-4**	**P0016**	**7**	**190**	Crankshaft and camshaft speed sensors signals mismatch.	Crankshaft and camshaft speed sensors signals mismatch.	Check camshaft and crankshaft speed sensors condition and connections. ***Apply to service centre.***
5	**1-1-5**	**P0607**	**2**	**523550**	Deviation between electronic time processor time and central processor timer.	Electronic time processor error.	***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
6	1-1-6	P1616	12	970	Fault of “Watchdog” cylinders shutdown module path.	Fault discovered at ECU initialization by the function of check of additional methods for cylinder control power stages shutdown.	***Apply to service centre.***
		P1617	3		Fault of path for cylinders shutdown by power stage voltage maximal limit function.		
		P1618	4		Fault of path for cylinders shutdown by power stage voltage minimal limit function.		
7	1-2-1	P0617	3	677	Power battery short circuit.	Starter motor relay power stage fault. High voltage.	Check starter motor condition and connections. ***Apply to service centre.***
		P0616	4		Short circuit to ground..		
8	1-2-1	P1638	3	677	Short circuit to power battery.	Starter motor relay power stage fault. Low voltage.	Check starter motor condition and connections. ***Apply to service centre.***
		P1639	4		Short circuit to ground.		
					Load resistance absent.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
9	**1-2-2**	**P2530**	**7**	**1041**	Terminal 50 is always closed	Terminal 50 circuit fault.	Check terminal 50 condition and connections. ***Apply to service centre.***
10	**1-2-3**	**P2533**	**12**	**158**	No signal from terminal 15.	Terminal 15 circuit fault.	Check terminal 15 condition and connections. ***Apply to service centre.***
11	**1-3-1**	**P0643**	**3**	**079**	Voltage beyond the set maximal limit.	Sensors power supply 1 voltage fault.	***Apply to service centre.***
		P0642	**4**		Voltage below the set minimal limit.		
12	**1-3-1**	**P0653**	**3**	**1080**	Voltage beyond the set maximal limit.	Sensors power supply 2 voltage fault.	***Apply to service centre.***
		P0652	**4**		Voltage below the set minimal limit.		
13	**1-3-1**	**P0699**	**3**	**523601**	Voltage beyond the set maximal limit.	Sensors power supply 3 voltage fault.	***Apply to service centre.***
		P0698	**4**		Voltage below the set minimal limit.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
14	1-3-1	P1640	3	520235	Voltage beyond the set maximal limit.	12V sensors voltage fault.	***Apply to service centre.***
		P1641	4		Voltage below the set minimal limit.		
15	1-3-2	P0687	3	1485	Short circuit to power battery.	Main relay circuit 2 fault (control unit).	Check the main relay condition and connections. ***Apply to service centre.***
		P0686	4		Short circuit to ground..		
16	1-3-2	P160E	3	2634	Short circuit to power battery.	Main relay circuit 1 fault (control unit).	Check the main relay condition and connections. ***Apply to service centre.***
17	1-3-2	P160F	4	2634	Short circuit to ground..	Main relay circuit 1 fault (control unit).	Check the main relay condition and connections. ***Apply to service centre.***
18	1-3-3	P0193	3	157	Voltage beyond the set maximal limit.	Rail fuel pressure sensor circuit fault.	Check the Rail fuel pressure sensor condition and connections. ***Apply to service centre.***
		P0192	4		Voltage below the set minimal limit.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
19	1-3-3	P0191	15	157	The Rail fuel pressure signal beyond the maximal permissible at signal mix check.	Rail fuel pressure valve fault, signal displacement check.	Check Rail fuel pressure sensor condition and connections. ***Apply to service centre.***
		P0191	17		The Rail fuel pressure signal below the minimal permissible at signal mix check.		
20	1-3-4	P100E	0	523470	Protective valve identified as open.	Rail fuel pressure safety valvefault.	***Apply to service centre.***
		P100F	11		Pressure jump in Rail requested.		
		P1010	7		Protective valve not opening after pressure jump in Rail.		
21	1-3-5	P0251	5	523615	No load resistance.	Fault in high pressure fuel injection pump doser pulse-width control power stage.	Check high pressure fuel injecttion pump doser condition and connections. ***Apply to service centre.***
		P0252	2		Excessive heat-up temperature.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
22	**1-3-5**	**P0254**	**3**	**523615**	Short circuit to power battery.	Fault in high pressure fuel injection pump doser pulse-width control power stage circuit.	Check high pressure fuel injection pump doser condition and connections. ***Apply to service centre.***
23	**1-3-5**	**P0253**	**4**	**523615**	Short circuit to ground..	Fault in high pressure fuel injection pump doser pulse-width control power stage circuit.	Check high pressure fuel injection pump doser condition and connections. ***Apply to service centre.***
24	**1-3-5**	**P025D**	**16**	**523615**	Signal voltage beyond the set maximal limit.	Fault in fuel injection pump doser analogue-digital-analogue converter control channel.	Check high pressure fuel injection pump doser condition and connections. ***Apply to service centre.***
		P025C	**18**		Signal voltage below the minimal set limit.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
25	**1-3-6**	**P1011**	**1**	**523470**	The number of safety valveopenings exceeding the number permissible by its tech specs.	Rail fuel pressure safety valve fault identified on the basis of its operation data.	***Apply to service centre.***
		P1012	**2**		The duration of safety valve openings exceeding the number permissible by its tech specs.		
		P1013	**4**		The number and duration of safety valve openings exceeding the number and duration permissible by its tech specs.		
26	**1-4-1**	**P0262**	**3**	**651**	Low side short circuit to battery.	Cylinder control power stage circuit fault, specific error, engine shutdown.	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
		P0263	**11**		Depending on settings.		
		P0261	**8**		Low side and High side short circuit.		
		P0263	**11**		Not classified error.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
27	1-4-1	P1213	11	51	Depending on the settings.	Fault in power stage control circuit of cylinder 1, specific warning.	Check engine cylinders injectors' connectors and cables condition. Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
		P1214	11		Depending on the settings.		
		P0201	12		No load resistance.		
		P1215	11		Depending on the settings.		
28	1-4-2	P0265	3	652	Low side short circuit to battery.	Fault in power stage control circuit of cylinder 2, specific error, engine shutdown	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
		P0266	11		Depending on the settings.		
		P0264	8		Low side and High side short circuit.		
		P0266	11		Not classified error.		
29	1-4-2	P1216	11	652	Depending on the settings.	Fault in power stage control circuit of cylinder 2, specific warning.	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
		P1217	11		Depending on the settings.		
		P0202	12		No load resistance.		
		P1218	11		Depending on the settings.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
30	1-4-3	P0268	3	653	Low side short circuit to battery.	Fault in power stage control circuit of cylinder 3, specific error, engine shutdown	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
		P0269	11		Depending on the settings.		
		P0267	8		Low side and High side short circuit.		
		P0269	11		Not classified error.		
31	1-4-3	P1219	11	653	Depending on the settings.	Fault in power stage control circuit of cylinder 3, specific warning.	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
		P121A	11		Depending on the settings.		
		P0203	12		No load resistance.		
		P1218	11		Depending on the settings.		
32	1-4-4	P0271	3	654	Low side short circuit to battery.	Fault in power stage control circuit of cylinder 4, specific error, engine shutdown	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
		P0272	11		Depending on the settings.		
		P0270	8		Low side and High side short circuit.		
		P0272	11		Not classified error.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
33	1-4-4	P121C	11	654	Depending on the settings.	Fault in power stage control circuit of cylinder 4, specific warning.	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
		P121D	11		Depending on the settings.		
		P0204	12		No load resistance.		
		P121E	11		Depending on the settings.		
34	1-4-5	P0274	3	655	Low side short circuit to battery.	Fault in power stage control circuit of cylinder 5, specific error, engine shutdown	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
		P0275	11		Depending on the settings.		
		P0273	8		Low side and High side short circuit.		
		P0275	11		Not classified error.		
35	1-4-5	P121F	11	655	Depending on the settings.	Fault in power stage control circuit of cylinder 5, specific warning.	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
		P1220	11		Depending on the settings.		
		P0205	12		No load resistance.		
		P1221	11		Depending on the settings.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
36	1-4-6	P0277	3	656	Low side short circuit to battery.	Fault in power stage control circuit of cylinder 6, specific error, engine shutdown	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
		P0278	11		Depending on the settings.		
		P0276	8		Low side and High side short circuit.		
		P0278	11		Not classified error.		
37	1-4-6	P1222	11	656	Depending on the settings.	Fault in power stage control circuit of cylinder 6, specific warning.	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
		P1223	11		Depending on the settings.		
		P0206	12		No load resistance.		
		P1224	11		Depending on the settings.		
38	1-5-1	P1203	3	52350	Short circuit.	Fault in injectors power stage control circuit Bank1, specific error, engine shutdown	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
		P1204	4		Low side short circuit to ground		
		P1205	11		Depending on the settings.		
		P1206	11		Not classified error.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
39	1-5-1	P1207	11	523351	Depending on the settings.	Fault in injectors power stage control circuit Bank1, specific warning, engine shutdown.	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
		P1208	11		Depending on the settings.		
		P1209	12		No load resistance.		
		P120A	11		Depending on the settings.		
40	1-5-2	P120B	3	523352	Short circuit.	Fault in injectors power stage control circuit Bank2, specific error, engine shutdown.	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
		P120C	4		Low side short circuit to ground		
		P120D	11		Depending on the settings.		
		P120E	11		Not classified error.		
41	1-5-2	P120F	11	523353	Depending on the settings.	Fault in injectors power stage control circuit Bank2, specific warning, engine shutdown.	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
		P1210	11		Depending on the settings.		
		P1211	12		No load resistance.		
		P1212	11		Depending on the settings.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
42	1-5-3	P062B	3	523354	Microchip CY33X, internal reload / loss of counter/ undervoltage.	Fault in injectors control power stage microchip ChipA, specific error, engine shutdown.	***Apply to service centre.***
		P062B	4		Microchip CY33X has no right to operation/ CY33X initialization error.		
		P062B	12		Microchip CY33X in check mode.		
		P062B	2		Communication blackout with microchip CY33X /check sum error/ reverse check error.		
43	1-5-3	P062B	3	523355	Microchip CY33X internal equality error.	Fault in injectors control power stage microchip ChipB, specific error, engine shutdown	***Apply to service centre.***
		P062B	4		Microchip CY33X error of internal software algorithm.		
		P062B	12		Microchip CY33X check of inv. YSEL during ON failed		
		P062B	2		Microchip CY33X exceeding wait time, at least for one cylinder.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
44	1-5-4	P1225	12	520226	The number of working cylinders is less than the minimal set limit.	The number of working cylinders is less than the minimal set limit, engine shut-down	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
		P0000	255		Not used.		
		P0000	255		Not used.		
		P0000	255		Not used.		
45	2-1-2	P1018	7	95	Fine fuel filter clogged.	Fine fuel filter clogged.	Replace fine fuel filter.
46	2-1-3	P1015	3	95	Voltage beyond the set maximal limit.	Fault in fine duel filter clog sensor circuit.	Check fine fuel filter clog sensor condition and connection. ***Apply to service centre.***
47	2-1-3	P1016	4	95	Voltage below the set minimal limit.	Fault in fine duel filter clog sensor circuit.	Check fine fuel filter clog sensor condition and connection. ***Apply to service centre.***
48	2-1-3	P1017	2	95	Implausible fine fuel filter clog sensor signal.	Fault in fine duel filter clog sensor circuit.	Check fine fuel filter clog sensor condition and connection. ***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
49	2-2-1	P0123	3	91	Voltage beyond the set maximal limit.	Fault in sensor 1 of gas pedal position.	Check gas pedal position sensors condition and connections. ***Apply to service centre.***
		P0122	4		Voltage below the set minimal limit.		
		P2135	2		Lost plausibility with sensor 2 of throttle position.		
50	2-2-1	P0223	3	9	Voltage beyond the set maximal limit.	Fault in sensor 2 of gas pedal position.	Check gas pedal position sensors condition and connections. ***Apply to service centre.***
		P0222	4		Voltage below the set minimal limit.		
		P2135	2		Lost plausibility with sensor 1 of throttle position.		
51	2-2-2	P0704	12	98	Defective clutch state signal via CAN.	Error discovered by clutch condition signal diagnostics function.	Check gas pedal position sensors condition and connections. Check CAN line connection to other CANs.
		P0704	2		Implausible clutch sensor signal.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
52	2-2-3	P0571	12	597	Brake pedal sensor faulty signal.	Fault in Brake pedal sensor circuit.	Check brake pedal position sensor condition and connection. ***Apply to service centre.***
		P0504	2		Brake pedal sensor implausible signal.		
53	2-2-3	P0504	2	597	Faulty brake sensor.	Fault in brake pedal position sensor circuit with one sensor used.	Check brake pedal position sensor condition and connection. ***Apply to service centre.***
54	2-2-3	P0504	2	597	Cruise control function disabled till brake pedal position sensor functioning check.	Error signal meaning disabling cruise control function till brake pedal position sensor functioning check.	Press the brake pedal. If the error keeps on, check brake pedal position sensor condition and connec-tion. ***Apply to service centre.***
55	2-2-3	P0504	2	597	Cruise control function disabled till brake pedal position sensor functioning check. The diagnostic lamp is on.	Error signal for diagnostic lamp switch-on meaning disabling cruise control function till brake pedal position sensor functioning check.	Press the brake pedal. If the error keeps on, check brake pedal position sensor condition and connec-tion. ***Apply to service centre.***
56	2-2-9	P0741	255	776	Implausible hydraulic transformer turbine wheel speed indication.	Error in determining hydraulic transformer turbine wheel speed.	You may continue driving. ***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
57	2-3-1	P0238	0	102	Voltage beyond the maximal physical limit.	Fault in charge pressure sensor circuit, physical limit check.	Check charge pressure sensor condition and connection. ***Apply to service centre.***
		P0237	1		Voltage below the minimal physical limit.		
58	2-3-1	P0238	3	102	Voltage beyond the set maximal limit.	Fault in charge pressure sensor circuit.	Check charge pressure sensor condition and connection. ***Apply to service centre.***
		P0237	4		Voltage below the set minimal limit.		
		P0235	12		Implausible CAN signal value.		
		P0236	2		Implausible signal.		
59	2-3-2	P2229	3	08	Voltage beyond the set maximal limit.	Fault in atmospheric pressure sensor circuit (*control unit in-built sensor*).	Check sensor condition and connection. ***Apply to service centre.***
		P2228	4		Voltage below the set minimal limit.		
		P0000	12		Implausible CAN signal value.		
		P2227	2		Plausibility lost with charge pressure sensor.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
60	2-3-2	P2229	0	108	Voltage beyond the maximal physical limit.	Fault in atmospheric pressure sensor circuit, physical limit check.	Check atmospheric pressure sensor condition and connection. ***Apply to service centre.***
		P2228	1		Voltage below the minimal physical limit.		
61	2-3-3	P0098	3	05	Voltage beyond the maximal limit.	Fault in air temperature sensor circuit.	Check air temperature sensor condition and connection. ***Apply to service centre.***
		P0097	4		Voltage below the minimal limit.		
		P0099	12		Faulty signal via CAN.		
62	2-3-3	P0098	0	105	Voltage beyond the maximal physical limit.	Fault in the incoming air temperature sensor circuit, physical limit check	Check incoming air temperature sensor condition and connection. ***Apply to service centre.***
		P0097	1		Voltage below the minimal physical limit.		
63	2-4-1	P0118	3	110	Voltage beyond the set maximal limit.	Fault in cooling liquid temperature sensor circuit.	Check cooling liquid temperature sensor condition and connection. ***Apply to service centre.***
		P0117	4		Voltage below the set minimal limit.		
		P0115	12		Faulty CAN signal.		
		P0116	2		No plausibility between oil temperature and cooling liquid temperature sensors indications.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
64	2-4-1	P0118	0	110	Voltage beyond the maximal physical limit.	Fault in cooling liquid temperature sensor circuit.	Check cooling liquid temperature sensor condition and connection. ***Apply to service centre.***
		P0117	1		Voltage below the minimal physical limit.		
65	2-4-2	P163A	5		Cooling liquid temperature beyond the maximal permissible.	Cooling liquid overheating.	
66	2-4-3	P0523	3	100	Voltage beyond the set maximal limit.	Fualt in oil pressor sensor circuit.	Check oil pressor sensor conditiona and connection. ***Apply to service centre.***
		P0522	4		Voltage below the set minimal limit.		
		P0520	12		Faulty signal from sensor or via CAN.		
		P0521	2		Implausible signal, oil pressure too high.		
67	2-4-3	P0524	17	100	Implausible signal, oil pressure too low.	Oil pressor sensor signal error, too low oil pressure.	Check oil pressor sensor conditiona and connection. ***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
68	2-4-4	P0198	3	175	Voltage beyond the set maximal limit.	Fault in oil temperature sensor circuit.	Check oil temperature sensor condition and connection. ***Apply to service centre.***
		P0197	4		Voltage below the set minimal limit.		
		P0195	12		Faulty signal via CAN.		
		P100D	2		Implausibility between oil temperature sensor and cooling liquid temperature sensor indications.		
69	2-4-4	P0196	17	175	Implausibel signal, too high oil temperature.	Oil temperature sensor signal error, too high oil temperature.	Check oil temperature sensor condition and connection. ***Apply to service centre.***
70	2-5-1	P1011	16	523613	Excessive maximal positive fuel pressure in Rail deviation.	High pressure fuel pump doser control mode disruption.	Check high pressure and low pressure hydraulic curcuits condition and connections. ***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
71	**2-5-2**	**P1012**	**15**	**523613**	Overshoot of maximal positive fuel pressure in Rail deviation at fuel pump set flow rate overshoot.	Disruption of high pressure fuel pump doser control mode.	Check high pressure and low pressure hydraulic curcuits components condition and connections. ***Apply to service centre.***
72	**2-5-3**	**P0087**	**4**	**523613**	Fuel pressure in Rail lower than the minimal set limit.	Disruption of high pressure fuel pump doser control mode.	Check high pressure and low pressure hydraulic curcuits components condition and connections. ***Apply to service centre.***
73	**2-5-3**	**P0088**	**3**	**523613**	Fuel pressure in Rail higher than the set maximal limit.	Disruption of high pressure fuel pump doser control mode.	Check high pressure and low pressure hydraulic curcuits components condition and connections. ***Apply to service centre.***
74	**2-5-4**	**P1013**	**17**	**523613**	Overshoot of maximal negative fuel pressure in Rail deviation at fuel pump doser minimal flow rate.	Disruption of high pressure fuel pump doser control mode.	Check high pressure and low pressure hydraulic curcuits components condition and connections. ***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
75	**2-5-4**	**P1019**	**5**	**523613**	Overshoot of maximal positive fuel pressure in Rail deviation at fuel pump set flow rate	Disruption of high pressure fuel pump doser control mode.	Check high pressure and low pressure hydraulic curcuits components condition and connections. ***Apply to service centre.***
76	**2-5-5**	**P1014**	**2**	**523613**	Implausible set value of fuel pump doser at fuel pump excessive flow rate mode.	Disruption of high pressure fuel pump doser control mode.	Check high pressure and low pressure hydraulic curcuits components condition and connections. ***Apply to service centre.***
77	**2-5-6**	**P1018**	**7**	**523613**	Fuel pump doser filtered electric current lower than the minimal permissible electric current.	Disruption of high pressure fuel pump doser control mode.	Check high pressure and low pressure hydraulic curcuits components condition and connections. ***Apply to service centre.***
78	**2-5-7**	**P101A**	**18**	**523613**	Pressure differentials in Rail higher than expexted.	Disruption of high pressure fuel pump doser control mode.	Check high pressure and low pressure hydraulic curcuits components condition and connections. ***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
79	**2-5-8**	**P101B**	**1**	**523613**	Fuel pump flow rate at the engine idle exceeding the set maximal value.	Disruption of high pressure fuel pump doser control mode.	Check high pressure and low pressure hydraulic curcuits components condition and connections. ***Apply to service centre.***
80	**2-6-1**	**P0607**	**14**	**520222**	ECU restart has taken place.	ECU restart stored as protective.	***Apply to service centre.***
81	**2-6-1**	**P0607**	**14**	**520222**	ECU restart has taken place.	ECU restart shown in the error memory.	***Apply to service centre.***
82	**2-6-2**	**P1613**	**16**	**1108**	Injectors excitation time exceeding the level set in the watch function.	Error registered by ECU operation watch function.	***Apply to service centre.***
83	**2-6-2**	**P1614**	**15**	**520228**	Implausibility between the engine speed calculated by the watch function and the main programme.	Error registered by ECU operation watch function using the engine independent speed calculation.	***Apply to service centre.***
84	**2-6-3**	**P060A**	**11**	**523617**	Disruption of communication with the ECU “CJ940” module.	Disruption of communication with ECU power stages controlled with SPI.	***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
85	**2-6-3**	**P1607**	**3**	**523612**	Internal power voltage beyond the maximal limit.	CJ940 module maximal power voltage limit error.	***Apply to service centre.***
86	**2-6-3**	**P1608**	**4**	**523612**	Internal power voltage below the minimal limit.	CJ940 module minimal power voltage limit error.	***Apply to service centre.***
87	**2-6-4**	**P060C**	**2**	**523420**	Impluasible operation of controller or Watchdog system or the system must shut down.	The function of monitoring communication between Watchdog of CY310 and controller. Used for reverse system shutdown by means of the engine coordinator function.	***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
88	**3-1-1**	**P0478**	**3**	**1074**	Short circuit to power battery/ Excessive heat-up temperature.	Short circuit to battery in exhaust flap control circuit power stage.	Check exhaust flap condition and connection. ***Apply to service centre.***
89	**3-1-1**	**P0477**	**4**		Short circuit to ground..	Short circuit to ground in exhaust flap control circuit power stage.	Check exhaust flap condition and connection. ***Apply to service centre.***
90	**3-1-1**	**P0476**	**12**		No load resistance.	Broken circuit or unpermissible temperature in exhaust flap control circuit power stage.	Check exhaust flap condition and connection. ***Apply to service centre.***
		P0476	**2**		Excessive heat-up temperature.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
91	3-2-4	**P0501**	**0**	**84**	Vehicle speed shown by speed signal beyond the vehicle set maximal speed.	Failure of vehicle speed measurement, path 1.	Check vehicle speed sensor condition and connection. Check connection to tachograph. Check CAN line connection to other CAN devices. ***Apply to service centre.***
		P0500	**12**		Faulty vehicle speed signal caused by faulty ECU hardware.		
		P0501	**2**		Impluasible vehicle speed with regard to the injected fuel amount and the engine speed.		
92	3-2-4	**P2158**	**3**	**1624**	Signal voltage beyond the set maximal limit.	Failure of vehicle speed measurement, path 2.	Check vehicle speed sensor condition and connection. Check connection to tachograph. Check CAN line connection to other CAN devices. ***Apply to service centre.***
		P2160	**4**		Signal voltage below the set minimal limit.		
		P2157	**12**		Faulty vehicle speed signal received via CAN.		
		P2159	**255**		Implausible vehicle speed signal voltage.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
93	3-2-4	P1511	3	645	Speed signal pulse width bigger than the set maximal limit.	Failure of vehicle speed measurement, path 3.	Check connection to tacho-graph. ***Apply to service centre.***
		P1512	4		Speed signal pulse width smaller than the set minimal limit.		
		P1513	12		Faulty vehicle speed signal frequency caused by faulty ECU hardware.		
94	3-2-5	P0050	3	1072	Short circuit to power battery.	Fault in engine brake decompression throttle power stage circuit.	Check engine brake decompression throttle condition and connection. ***Apply to service centre.***
		P004F	4		Short circuit to ground..		
		P0661	255		No load resistance.		
		P0662	255		Excessive heat-up temperature.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
95	3-2-6	P0629	3	520231	Short circuit to power battery.	Fault in electric fuel priming pump control power stage circuit.	Check electric fuel priming pump condition and connection. ***Apply to service centre.***
		P0628	4		Short circuit to ground..		
		P0627	12		No load recistance.		
		P062A	2		Excessive heat-up temperature.		
96	3-2-8	P2106	11	1653	Engine technical parameters limitation mode enabled.	Engine technical parameters limitation mode enabled.	***Apply to service centre.***
97	4-1-1	U0029	12	639	Absence of CAN A bus.	Absence of CAN A bus.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
98	4-1-2	U0038	12	1231	Absence of CAN B bus.	Absence of CAN B bus.	Check CAN line connection to other CAN devices. ***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
99	**4-1-3**	**U0047**	**12**	**1235**	Absence of CAN C bus.	Absence of CAN C bus.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
100	**4-1-4**	**P0607**	**12**	**523600**	SPI communication disrupted between central processor and watch unit.	SPI communication disrupted between central processor and watch unit.	***Apply to service centre.***
101	**4-2-1**	**U1104**	**11**	**523605**	Wait time elapsing for TSC1-AE CAN messages when the engine speed/torque correction mode is enabled.	TSC1-AE CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
		U1105	**12**		Wait time elapsing for TSC1-AE CAN messages when the engine speed/torque correction mode is disabled.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
102	**4-2-1**	**U1106**	**11**	**523606**	Wait time elapsing for TSC1-AR CAN message when the engine speed/torque correction mode is enabled.	TSC1-AR CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
		U1107	**12**		Wait time elapsing for TSC1-AR CAN message when the engine speed/torque correction mode is disabled.		
103	**4-2-2**	**U1108**	**11**	**523607**	Wait time elapsing for TSC1-DE CAN message when the engine speed/torque correction mode is enabled.	Ошибка TSC1-DE CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
		U1109	**12**		Wait time elapsing for TSC1-DE CAN message when the engine speed/torque correction mode is disabled.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
104	**4-2-2**	**U110A**	**11**	**523608**	Wait time elapsing for TSC1-DR CAN message, when the engine speed/torque correction mode is enabled.	TSC1-DR CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
		U110B	**12**		Wait time elapsing for TSC1-DR CAN message, when the engine speed/torque correction mode is disabled.		
105	**4-2-3**	**U110C**	**3**	**520218**	Wait time elapsing for TSC1-PE CAN message, when the engine speed/torque correction mode is enabled.	TSC1-PE CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
		U110D	**4**		Wait time elapsing for TSC1-PE CAN message, when the engine speed/torque correction mode is disabled.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
106	**4-2-4**	**U110E**	**11**	**898**	Wait time elapsing for TSC1-TE CAN message, when the engine speed/torque correction mode is enabled.	TSC1-TE CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
		U110F	**12**		Wait time elapsing for TSC1-TE CAN message, when the engine speed/torque correction mode is disabled.		
107	**4-2-4**	**U113A**	**11**	**520**	Wait time elapsing for TSC1-TR CAN message, when the engine speed/torque correction mode is enabled.	TSC1-TR CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
		U113B	**12**		Wait time elapsing for TSC1-TR CAN message, when the engine speed/torque correction mode is disabled.		
108	**4-2-5**	**U1110**	**3**	**520219**	Wait time elapsing for TSC1-VE CAN message, when the engine speed/torque correction mode is enabled.	TSC1-VE CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
		U1111	**12**		Wait time elapsing for TSC1-VE CAN message, when the engine speed/torque correction mode is disabled.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
109	**4-2-5**	**U1112**	**3**	**520220**	Wait time elapsing for TSC1-VR CAN message, when the engine speed/torque correction mode is enabled.	TSC1-VR CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
		U1113	**12**		Wait time elapsing for TSC1-VR CAN message, when the engine speed/torque correction mode is disabled.		
110	**4-3-1**	**U0001**	**12**	**523500**	Wait time elapsing for sent to CAN messages.	Sent to CAN messages error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
111	**4-3-4**	**U0158**	**255**	**520210**	Wait time elapsing for DashDspl CAN message	DashDspl CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
112	**4-3-5**	**U1115**	**12**	**520238**	Wait time elapsing for WSI CAN message	WSI CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
113	**4-4-1**	**P0000**	**12**	**520211**	Wait time elapsing for EBC1 CAN message	EBC1 CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
114	**4-4-2**	**U1100**	**3**	**520212**	Wait time elapsing for ERC1DR CAN message	ERC1DR CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
115	**4-4-3**	**U0103**	**12**	**520213**	Wait time elapsing for ETC1 CAN message	ETC1 CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
116	**4-4-5**	**U0104**	**12**	**523218**	CAN errors killing function disabled and wait time elapsing for RxCCVS CAN message	RxCCVS CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
117	**4-4-6**	**U0157**	**12**	**523222**	Wait time elapsing for TCO1 CAN message	TCO1 CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
Faults not shown by diagnostic lamp lightup							
118	**1-1-4**	**P0008**	**12**	**90**	Backup mode enabled.	The engine start and operation performed by camshaft speed sensor only.	Check camshaft speed sensor condition and connection. ***Apply to service centre.***
119	**1-2-4**	**P0563**	**3**	**68**	Voltage beyond the set maximal limit.	Unpermissible voltage of power supply battery.	Check power supply battery condition and connection. ***Apply to service centre.***
		P0562	**4**		Voltage below the set minimal limit.		
120	**1-2-5**	**P1007**	**2**	**20236**	Implausible field appearance.	FMTC_trq2qBas_MAP field contains not strictly monotonous curves of cyclic fuel feed dependence on torque at engine set speed.	***Apply to service centre.***
121	**1-5-5**	**P1300**	**16**	**20225**	Number of injections limited by charge coordinator load balance.	Limeted number of injections.	You may continue driving. ***Apply to service centre.***
		P1301	**15**		Number of injections limited by high pressure fiel injection pump quantitative balance.		
		P1302	**11**		Number of injections limited by software settings.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
122	**2-1-1**	**P2269**	**11**	**97**	Sensor showing water in fuel concentration beyond permissible.	Discovered water in fuel concentration is beyond permissible.	Replace fuel.
123	**2-1-6**	**P1008**	**3**	**520207**	Short circuit to power battery.	Fault in fuel filter electric heating element circuit.	Check fuel filter electric heating element condition and connection. ***Apply to service centre.***
		P1009	**4**		Short circuit to ground..		
124	**2-2-5**	**P2299**	**7**	**91**	Implausibel gas pedal signal.	Error registered by gas pedal and brake pedal work plausibility function.	Check gas and brake pedals position sensors condition and connection. ***Apply to service centre.***
125	**2-2-6**	**P0219**	**15**	**533**	Crankshaft maximal permitted speed overshoot discovered.	Crankshaft maximal permitted speed overshoot.	If the overshoot is caused by incorrect switch from the upper gear to the lower with the engine still working right, you may continue driving. ***If the engine speeds up spontaneously, all by itself, do not start the engine! Apply to service centre urgently!***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
126	**2-2-8**	**P0856**	**2**	**520199**	Physically implausible request from Resistance Moment Control System Unit.	Error of Resistance Moment Control System Unit.	Check Resistance Moment Control System Unit condition and connection. Check CAN line connection to other CAN devices. ***Apply to service centre.***
127	**2-3-4**	**P0113**	**3**	**172**	Voltage beyond the set maximal limit.	Fault of incoming air temperature sensor circuit in air mass consumption meter.	Check sensor condition and connection. ***Apply to service centre.***
		P0112	**4**		Voltage below the set minimal limit.		
128	**2-3-4**	**P0101**	**3**	**132**	Air mass consumption meter signal voltage beyond set limit.	Error registered by air mass consumption meter standard voltage initial deviation plausibility check function.	Check air mass consumption meter condition and connection. ***Apply to service centre.***
		P0101	**4**		Air mass consumption meter signal voltage below set limit.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
129	2-3-4	P0103	3	5201193	Air mass consumption meter coefficient beyond set limit.	Error registered by air mass consumption meter signal sensitivity deviation plausibility check function.	Check air mass consumption meter condition and connections. ***Apply to service centre.***
		P0102	4		Air mass consumption meter coefficient below set limit.		
130	2-3-4	P0103	3	132	Mass air consumption registered beyond set limit.	Error registered by air mass consumption meter signal boundary check function.	Check air mass consumption meter condition and connections. ***Apply to service centre.***
		P0102	4		Registered mass air consumption below set limit.		
131	2-3-5	P0073	0	171	Voltage beyond maximal physical limit.	Error in ambient air temperature sensor circuit, physical limit check	Check ambient air temperature sensor condition and connection. ***Apply to service centre.***
		P0072	1		Voltage below minimal physical limit.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
132	**2-4-5**	**P0116**	**2**	**520198**	Minimal cooling liquid temperature not achieved within the set time limit.	Error registered by cooling liquid temperature sensor absolute plausibility check function.	Check cooling liquid temperature sensor condition and connection. ***Apply to service centre.***
133	**2-4-5**	**P0116**	**2**	**520198**	Minimal rise of cooling liquid temperature not achieved within the set time limit.	Error registered by cooling liquid temperature sensor dynamis plausibility check function.	Check cooling liquid temperature sensor condition and connection. ***Apply to service centre.***
134	**2-6-1**	**P0607**	**14**	**520222**	Electronic Unit retstart has taken place.	Electronic Unit retstart by unknown reason.	***Apply to service centre.***
135	**2-6-5**	**P062F**	**4**	**630**	Error during the last reading operation.	Fault of Electrically Deletable Programmable Permanent Memory Device.	***Apply to service centre.***
		P062F	**12**		Error during the last record operation.		
		P062F	**2**		Deafualt value used.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
136	3-1-3	P0647	3	1351	Short circuit to power battery.	Fault in conditioner control power stage circuit.	Check conditioner state and connection. ***Apply to service centre.***
		P0646	4		Short circuit to ground..		
		P0645	12		No load resistance.		
		P0645	2		Excessive heat-up temperature.		
137	3-2-1	P0542	3	729	Short circuit to power battery.	Fault in air pre-heat power stage circuit.	Check air pre-heat device condition and connection. ***Apply to service centre.***
		P0541	4		Short circuit to ground..		
138	3-2-2	P0540	7	676	Faulty multi-signal	Air pre-heat permanently on.	Check air pre-heat device condition and connection. ***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
139	3-2-3	P1020	3	729	Power supply battery voltage change beyond set maximal limit at air pre-heat device switch-on.	Error registered by air pre-heat switch-on check function.	Check air pre-heat device condition and connection. ***Apply to service centre.***
		P1021	4		Power supply battery voltage change below set minimal limit at air pre-heat device switch-on.		
140	3-2-3	P1022	3	730	Power supply battery voltage change beyond set maximal limit at air pre-heat device switch-off.	Error registered by air pre-heat switch-off check function.	Check air pre-heat device condition and connection. ***Apply to service centre.***
		P1023	4		Power supply battery voltage change below set minimal limit at air pre-heat device switch-on.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
141	**3-3-1**	**P1619**	**3**	**624**	Short circuit to power battery.	Fault in diagnostic lamp control system power stage circuit.	Check system diagnostic lamp condition and connection. ***Apply to service centre.***
		P161A	**4**		Short circuit to ground..		
		P161B	**12**		No load resistance.		
		P161C	**2**		Excessive heat-up temperature.		
142	**3-3-3**	**P0650**	**3**	**1213**	Short circuit to power battery.	Fault in failure indication lamp control power stage circuit.	Check failure indication lamp condition and connection. ***Apply to service centre.***
		P0650	**4**		Short circuit to ground..		
		P0650	**12**		No load resistance.		
		P0650	**2**		Excessive heat-up temperature.		
143	**3-3-4**	**P162F**	**3**	**624**	Short circuit to power battery.	Fault in warning lamp control power stage circuit.	Check warning lamp condition and connection. ***Apply to service centre.***
		P1630	**4**		Short circuit to ground..		
		P1631	**12**		No load resistance.		
		P1632	**2**		Excessive heat-up temperature.		

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
144	3-3-5	P0649	3	520194	Short circuit to power battery.	Fault in adjustable speed limit lamp circuit.	Check lamp condition and connection. ***Apply to service centre.***
		P0649	4		Short circuit to ground..		
		P0649	5		No load resistance.		
		P0649	2		Excessive heat-up temperature.		
145	3-4-1	P0564	2	596	Non-operable switched combination.	Fault in cruise control device actuating mechanism circuit.	Check cruise control device (control unit) condition and connection. ***Apply to service centre.***
146	3-4-3	P2530	8	1041	Button sticking or permanently pressed in.	Fault in engine control backup start button circuit.	Check engine control backup start button. ***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
147	3-4-4	P1000	3	1192	Signal voltage beyond set maximal limit.	Fault in charge compressor regulator control analogue-digital-analogue converter channel.	Check charge compressor regulator condition and connection. ***Apply to service centre.***
		P1001	4		Signal voltage be;ow set minimal limit.		
		P1002	12		Faulty sugnal.		
148	4-1-5	U0113	4	520214	Wait time elapsing for EngGsFlowRt CAN message	EngGsFlowRt CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
149	4-1-6	U1101	3	520215	Wait time elapsing for HRVD CAN message	HRVD CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
150	4-1-7	U1114	3	520237	Wait time elapsing for TimeDate CAN message	TimeDate CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
151	4-4-4	U0156	3	520216	Wait time elapsing for RxAMCON CAN message	RxAMCON CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
152	**4-5-1**	**U1102**	**12**	**523604**	Wait time elapsing for RxEng-Temp2 CAN message	RxEngTemp2 CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
153	**4-5-2**	**U1103**	**3**	**520217**	Wait time elapsing for TF CAN message	TF CAN message error.	Check CAN line connection to other CAN devices. ***Apply to service centre.***
154	**4-6-1**	**U0434**	**2**	**523618**	SPN received via CAN-message coinsides with SPN in unit SPN 1.	DM1DCU CAN message error, SPN 1 unit.	***Apply to service centre.***
155	**4-6-2**	**U0435**	**2**	**523619**	SPN received via CAN-message coinsides with SPN in unit SPN 2.	DM1DCU CAN message error, SPN 2 unit.	***Apply to service centre.***
156	**4-6-3**	**U0436**	**2**	**523620**	SPN received via CAN-message coinsides with SPN in unit SPN 3.	DM1DCU CAN message error, SPN 3 unit.	***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
157	**4-6-4**	**U0437**	**2**	**523621**	SPN received via CAN-message coinsides with SPN in unit SPN 4.	DM1DCU CAN message error, SPN 4 unit.	***Apply to service centre.***
158	**4-6-5**	**U0438**	**2**	**523622**	SPN received via CAN-message coinsides with SPN in unit SPN 5.	DM1DCU CAN message error, SPN 5 unit.	***Apply to service centre.***
159	**4-6-6**	**U0439**	**3**	**523623**	Wait time elapsing for DM1DCU CAN message	DM1DCU CAN message error.	***Apply to service centre.***
160	**5-1-1**	**P0301**	**3**	**1323**	Number of flashes skips recognized beyond set limit.	Error registered by flashes skips control function in cylinder 1.	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
161	**5-1-2**	**P0302**	**3**	**1324**	Number of flashes skips recognized beyond set limit.	Error registered by flashes skips control function in cylinder 2.	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
162	**5-1-3**	**P0303**	**3**	**1325**	Number of flashes skips recognized beyond set limit.	Error registered by flashes skips control function in cylinder 3.	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
163	**5-1-5**	**P0300**	**3**	**1322**	Number of flashes skips recognized beyond set limit.	Error registered by flashes skips control function in several cylinders.	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
164	**5-2-2**	**P160C**	**20**	**520223**	Rail inner pressure control functions disabled during testing.	Error signal meaning high pressure circuit testing in process.	
165	**5-3-1**	**P0304**	**3**	**1326**	Number of flashes skips recognized beyond set limit.	Error registered by flashes skips control function in cylinder 4.	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***

Continuation of Table 10

No	Blink-code	R-code	FMI	SPN	Fault type	Fault description	Fix method
166	**5-3-2**	**P0305**	**3**	**1327**	Number of flashes skips recognized beyond set limit.	Error registered by flashes skips control function in cylinder 5.	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***
167	**5-3-3**	**P0306**	**3**	**1328**	Number of flashes skips recognized beyond set limit.	Error registered by flashes skips control function in cylinder 6.	Check engine cylinders injectors' connectors and cables condition. ***Apply to service centre.***

Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
1.Engine start issues	
1.1 Engine does not start	
1.1.1 Check if there is fuel in the tank and is it conforms to the appropriate grade.	Fill the fuel tank.
1.1.2 Check the starter motor and its control circuits.	Do the necessary repair.
1.1.3 Check the low pressure circuit.	
- check the correctness of low pressure circuit connections;	Do the necessary repair.
- check hoses and connectors for leakage;	
- check fuel filter condition and conformity;	Replace filter by the appropriate.
- make sure there is no water in the diesel fuel inside the coarse fuel filter cup;	Clean the fuel filter from water pouring it out by opening the tap.
- make sure there is no air in the fuel;	Remove air from the low pressure circuit (See Manual, item 3.2.10).
1.1.4 Check the high pressure circuit for leakage.	Do the necessary repair.
1.1.5 Check the electric circuit.	
- check the accumulator battery charging;	Do the necessary repair. or replace accumulator battery.
- check the fuses;	Do the necessary repair.
- check the “ground” wire;	Replace the “ground” wire.
1.1.6 Check the engine parameters	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do ”KTS – Bosch’ standard testing.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device.	Do diagnostics and necessary repair.
1.1.7 Check the intake system	
- check for air leakage/ suction;	Do the necessary repair.
- check the air filter condition.	Replace the air filter.

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
- check the intake manifold for clogging.	Clean the intake manifold.

1.1.8 Check the glow plugs reliability.	Replace the glow plugs or the glow plugs control unit.
1.1.9 Check the harness condition (breaking or short circuit).	Do the necessary repair.
1.1.10 Check the compression level in cylunders.	Do the necessary repair.
1.1.11 Check the injectors	
- launch injector check cycle by the appropriate standard testing command in the "KTS – Bosch" diagnostic device.	Follow the instructions in the "KTS – Bosch" diagnostic device software. ***(Testing and repair at a specialized workshop)***
1.1.12 Check the high pressure fuel injection pump	
- launch high pressure fuel injection pump check cycle by the appropriate standard testing command in the "KTS – Bosch" diagnostic device;	Follow the instructions in the "KTS – Bosch" diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check the low pressure circuit operability; - check the high pressure circuit for leakage.	Do the necessary repair.
1.1.13 Checking the Control Unit	
- check the Control Unit plug-and-socket fixtures.	Fix plug-and-sockets.
1.2 Engine is started with effort or starts and then shuts down	
1.2.1 Check if there is fuel in the tank and is it conforms to the appropriate grade.	Fill the fuel tank.
1.2.2 Check the low pressure circuit.	
- check the correctness of connections in the low pressure circuit.	Do the necessary repair.
- check the hoses and pipe connectors for leakage.	Do the necessary repair.
- check fuel filter condition and conformity.	Replace filter by the appropriate.
- make sure there is no water in the diesel fuel inside the coarse fuel filter cup.	Clean the fuel filter from water pouring it out by opening the tap.

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
- make sure there is no air in the fuel.	Remove air from the low pressure circuit (See Manual, item 3.2.10)
1.2.3 Check the high pressure circuit for leakage.	Do the necessary repair.
1.2.4 Check the electric circuit.	
- check the accumulator battery charging;	Do the necessary repair. or replace the accumulator battery.

- check the fuses;	Do the necessary repair.
- check the «ground wire».	Replace the «ground wire».
1.2.5 Check the intake system.	
- Check for air leakage/ suction;	Do the necessary repair.
- Check the air filter condition;	Replace the air filter by new one.
- check the intake manifold for clogging.	Clean the intake manifold.
1.2.6 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do ”KTS – Bosch’ standard testing.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device.	Do diagnostics and the necessary repair.
1.2.7 Check the glow plugs opeartion reliability.	Replace the glow plugs or the glow plugs control unit.
1.2.8 Check the harness condition for breaking or short circuit.	Do the necessary repair.
1.2.9 Check the injectors.	
- launch injector check cycle by the appropriate standard testing command in the “KTS – Bosch” diagnostic device.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
1.2.10 Check compression level in the cylinders.	Do the necessary repair.
1.2.11 Control Unit check.	
- check the Control Unit plug-and-socket fixtures.	Fix plug-and-sockets.

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
1.3 Hot engine is started with effort	
1.3.1 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do ”KTS – Bosch’ standard testing.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device.	Do diagnostics and the necessary repair.
1.3.2 Check the low pressure circuit.	
- check the correctness of connections in the low pressure circuit;	Do the necessary repair.
- check the hoses and pipe connectors for leakage;	
- check the fuel filter condition and conformity;	Replace filter by the appropri-

	ate.
- make sure there is no water in the fuel inside the coarse fuel filter cup;	Clean the fuel filter from water pouring it out by opening the tap.
- make sure there is no air in the fuel.	Remove air from the low pressure circuit (See Manual, item 3.2.10)
1.3.3 Check the injectors.	
- launch injector check cycle by the appropriate standard testing command in the "KTS – Bosch" diagnostic device.	Follow the instructions in the "KTS – Bosch" diagnostic device software. ***(Testing and repair at a specialized workshop)***
1.3.4 Check the intake system.	
- Check for air leakage/ suction;	Do the necessary repair.
- Check the air filter condition;	Replace the air filter by new one.
- check the intake manifold for clogging.	Clean the intake manifold.
1.3.5 Check compression level in the cylinders.	Do the necessary repair.
1.3.6 Check the harness (broken or kinked).	Do the necessary repair.
1.3.7 Control Unit check.	
- check the Control Unit plug-and-socket fixtures.	Fix plug-and-sockets.

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
2. Unstable engine operation at idle	
2.1 Unstable speed at idle	
2.1.1 Check the low pressure circuit.	
- check the correctness of connections in the low pressure circuit;	Do the necessary repair.
- check the hoses and pipe connectors for leakage;	
- check the fuel filter condition and conformity;	Replace filter by the appropriate.
- make sure there is no water in the fuel inside the coarse fuel filter cup;	Clean the fuel filter from water pouring it out by opening the tap.
- make sure there is no air in the fuel.	Remove air from the low pressure circuit (See Manual, item 3.2.10)
2.1.2 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do "KTS – Bosch" standard testing.	Follow the instructions in the "KTS – Bosch" diagnostic device software. ***(Testing and repair at a specialized workshop)***

- check electricity consumers condition with the diagnostic device.	Do diagnostics and the necessary repair.
2.1.3 Check the harness condition for breaking or short circuit.	Do the necessary repair.
2.1.4 Check the high pressure circuit for leakage.	Do the necessary repair.
2.1.5 Check compression level in the cylinders.	Do the necessary repair.
2.1.6 Check the injectors.	
- launch injector check cycle by the appropriate standard testing command in the “KTS – Bosch” diagnostic device.	Follow the instructions in the “KTS – Bosch” diagnostic device software. (***Testing and repair at a specialized workshop***)
2.1.7 Check the high pressure fuel injection pump	
- launch high pressure fuel injection pump check cycle by the appropriate standard testing command in the “KTS – Bosch” diagnostic device.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
- check the high pressure circuit operability ; - check the high pressure circuit for leakage.	Do the necessary repair.
2.2 Idle spped too low or too high.	
2.2.1 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do ”KTS – Bosch’ standard testing.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device. системы CRS	Do diagnostics and the necessary repair.
2.2.2 Check the electric circuit.	
- check the accumulator battery charging;	Do the necessary repair or replace the accumulator battery.
- check the fuses.	Do the necessary repair.
- check the «ground» wire.	Replace the «ground wire».
2.2.3 Check the clutch adjustment correctness.	Do the necessary repair.
2.2.4 Check the harness condition for breaking or short circuit.	Do the necessary repair.
2.2.5 Control Unit check.	
- check the Control Unit plug-and-socket fixtures.	Fix plug-and-sockets.
3 Engine behavior at vehicle moving	
3.1 Unstable engine operation at speed up/ slow down	
3.1.1 Check the engine parameters.	

- check for faults in the COMMON RAIL injection system using the diagnostic device; do ”KTS – Bosch’ standard testing.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device. системы CRS	Do diagnostics and the necessary repair.
3.1.2 Check the intake system.	
- Check for air leakage/ suction;	Do the necessary repair.

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
- Check the air filter condition;	Replace the air filter by new one.
- check the intake manifold for clogging.	Clean the intake manifold.
3.1.3 Check the harness condition for breaking or short circuit.	Do the necessary repair.
3.1.4 Check the injectors.	
- launch injector check cycle by the appropriate standard testing command in the “KTS – Bosch” diagnostic device.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
3.1.5 Control Unit check.	
- check the Control Unit plug-and-socket fixtures.	Fix plug-and-sockets.
3.2 Failures during acceleration and clutch switch-on	
3.2.1 Check the intake system.	
- Check for air leakage/ suction;	Do the necessary repair.
- Check the air filter condition;	Replace the air filter by new one.
- check the intake manifold for clogging.	Clean the intake manifold.
3.2.2 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do ”KTS – Bosch’ standard testing.	Follow "KTS – Bosch" device diagnostic software instructions. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device. системы CRS	Do diagnostics and the necessary repair.
3.2.3 Check the turbocharger operability.	See Manual, Annex Ж.
3.2.4 Check the low pressure circuit.	
- check the correctness of connections in the low pressure circuit;	Do the necessary repair.
- check the hoses and pipe connectors for leakage;	
- check the fuel filter condition and conformity;	Replace filter by the appropri-

	ate.

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
- make sure there is no water in the fuel inside the coarse fuel filter cup;	Clean the fuel filter from water pouring it out by opening the tap.
- make sure there is no air in the fuel.	Remove air from the low pressure circuit (See Manual, item 3.2.10)
3.2.5 Check compression level in the cylinders.	Do the necessary repair.
3.2.6 Check the high pressure circuit for leakage.	Do the necessary repair.
3.2.7 Check the injectors.	
- launch injector check cycle by the appropriate standard testing command in the “KTS – Bosch” diagnostic device.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
3.2.8 Control Unit check.	
- check the Control Unit plug-and-socket fixtures.	Fix plug-and-sockets.
3.3 Engine shutdown	
3.3.1 Check if there is fuel in the fuel tank.	Fill the fuel tank.
3.3.2 Check the low pressure circuit.	
- check the correctness of connections in the low pressure circuit;	Do the necessary repair.
- check the hoses and pipe connectors for leakage;	
- check the fuel filter condition and conformity;	Replace filter by the appropriate.
- make sure there is no water in the fuel inside the coarse fuel filter cup;	Clean the fuel filter from water pouring it out by opening the tap.
- make sure there is no air in the fuel.	Remove air from the low pressure circuit (See Manual, item 3.2.10)
3.3.3 Check the high pressure circuit for leakage.	Do the necessary repair.
3.3.4 Check the electric circuit.	
- check the accumulator battery charging;	Do the necessary repair. Or replace the accumulator battery.
- check the «ground wire» .	Do the necessary repair.
- check the «ground» wire.	Replace the «ground wire».

Continuation of Table 11

Fault ***Outward fault demonstration***

Fault identification algorythm	Fix method
3.3.5 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do ”KTS – Bosch” standard testing.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device.	Do diagnostics and the necessary repair.
3.3.6 Check the intake system.	
- Check for air leakage/ suction;	Do the necessary repair.
- Check the air filter condition;	Replace the air filter by new one.
- check the intake manifold for clogging.	Clean the intake manifold.
3.3.7 Check the harness (broken or kinked) .	Do the necessary repair.
3.3.8 Check the high pressure fuel injection pump	
- launch high pressure fuel injection pump check cycle by the appropriate standard testing command in the “KTS – Bosch” diagnostic device.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check the high pressure circuit operability ; - check the high pressure circuit for leakage.	Do the necessary repair.
3.3.9 Control Unit check.	
- check the Control Unit plug-and-socket fixtures.	Fix plug-and-sockets.
3.4 Engine running unevenly (unstable operation of the engine during acceleration / deceleration and overload)	
3.4.1 Check if there is fuel in the fuel tank.	Fill the fuel tank.
3.4.2 Check the low pressure circuit.	
- check the correctness of connections in the low pressure circuit;	Do the necessary repair.
- check the hoses and pipe connectors for leakage;	
- check the fuel filter condition and conformity;	Replace filter by the appropriate.
- make sure there is no water in the fuel inside the coarse fuel filter cup;	Clean the fuel filter from water pouring it out by opening the tap.

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
- make sure there is no air in the fuel.	Remove air from the low pressure circuit (See Manual, item 3.2.10)
3.4.3 Check the engine parameters.	
- check for faults in the COMMON RAIL injection sys-	Follow the instructions in the

tem using the diagnostic device; do ”KTS – Bosch’ standard testing.	“KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device.	Do diagnostics and the necessary repair.
3.4.4 Check the harness condition for breaking or short circuit.	Do the necessary repair.
3.4.5 Check compression level in the cylinders.	Do the necessary repair.
3.4.6 Check the clearances in the valve drive.	Adjust the clearances in the valves drive.
3.4.7 Check the high pressure fuel injection pump	
- launch high pressure fuel injection pump check cycle by the appropriate standard testing command in the “KTS – Bosch” diagnostic device.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check the high pressure circuit operability ; - check the high pressure circuit for leakage.	Do the necessary repair.
3.4.8 Control Unit check.	
- check the Control Unit plug-and-socket fixtures.	Fix plug-and-sockets.
3.5 Insufficient power	
3.5.1 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do ”KTS – Bosch’ standard testing.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device.	Do diagnostics and the necessary repair.
3.5.2 Check the intake system.	
- Check for air leakage/ suction;	Do the necessary repair.

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
- Check the air filter condition;	Replace the air filter by new one.
- check the intake manifold for clogging.	Clean the intake manifold.
3.5.3 Check the engine oil level.	Add oil to the necessary level.
3.5.4 Check the turbocharger operability.	See Manual, Annex E.
3.5.5 Check the low pressure circuit.	
- check the correctness of connections in the low pressure circuit;	Do the necessary repair.
- check the hoses and pipe connectors for leakage;	
- check the fuel filter condition and conformity;	Replace filter by the appropri-

	ate.
- make sure there is no water in the fuel inside the coarse fuel filter cup;	Clean the fuel filter from water pouring it out by opening the tap.
- make sure there is no air in the fuel.	Remove air from the low pressure circuit (See Manual, item 3.2.10)
3.5.6 Check the injectors.	
- launch injector check cycle by the appropriate standard testing command in the "KTS – Bosch" diagnostic device.	Follow the instructions in the "KTS – Bosch" diagnostic device software. ***(Testing and repair at a specialized workshop)***
3.5.7 Check compression level in the cylinders.	Do the necessary repair.
3.5.8 Check the clearances in the valve drive.	Adjust the clearances in the valves drive.
3.6 Power too high	
3.6.1 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do "KTS – Bosch" standard testing.	Follow the instructions in the "KTS – Bosch" diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device.	Do diagnostics and the necessary repair.

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
3.6.2 Check the intake system.	
- Check for air leakage/ suction;	Do the necessary repair.
- Check the air filter condition;	Replace the air filter by new one.
- check the intake manifold for clogging.	Clean the intake manifold.
3.6.3 Check oil consumption.	At oil consumption too high do the necessary repair.
3.6.4 Check the injectors.	
- launch injector check cycle by the appropriate standard testing command in the "KTS – Bosch" diagnostic device.	Follow the instructions in the "KTS – Bosch" diagnostic device software. ***(Testing and repair at a specialized workshop)***
3.6.5 Control Unit check.	
- check the Control Unit plug-and-socket fixtures.	Fix plug-and-sockets.

3.7 Excessive fuel consumption	
3.7.1 Check the low pressure circuit.	
- check the correctness of connections in the low pressure circuit;	Do the necessary repair.
- check the hoses and pipe connectors for leakage;	
- check the fuel filter condition and conformity;	Replace filter by the appropriate.
- make sure there is no water in the fuel inside the coarse fuel filter cup;	Clean the fuel filter from water pouring it out by opening the tap.
- make sure there is no air in the fuel.	Remove air from the low pressure circuit (See Manual, item 3.2.10)
3.7.2 Leakage in the fuel temperature sensor.	Replace the fuel temperature sensor.
3.7.3 Check the injectors.	
- launch injector check cycle by the appropriate standard testing command in the “KTS – Bosch” diagnostic device.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
3.7.4 Check the high pressure circuit for leakage.	Do the necessary repair.
3.7.5 Check the intake system.	
- Check for air leakage/ suction;	Do the necessary repair.
- Check the air filter condition;	Replace the air filter by new one.
- check the intake manifold for clogging.	Clean the intake manifold.
3.7.6 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do ”KTS – Bosch’ standard testing.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device.	Do diagnostics and the necessary repair.
3.7.7 Check the engine oil level.	Add oil to the necessary level.
3.7.8 Check the turbocharger operability.	See Manual, Annex E.
3.7.9 Check compression level in the cylinders.	Do the necessary repair.
3.7.10 Control Unit check.	
- check the Control Unit plug-and-socket fixtures.	Fix plug-and-sockets.
3.8 Super high engine speed at pedal release or shifting the gears	
3.8.1 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do ”KTS – Bosch’ standard testing.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device.	Do diagnostics and the necessary repair.
3.8.2 Check the harness condition for breaking or short circuit.	Do the necessary repair.
3.8.3 Check the clutch adjustment correctness.	Do the necessary repair.

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
3.8.4 Check the turbocharger operability.	See Manual, Annex Ж.
3.8.5 Check the injectors.	
- launch injector check cycle by the appropriate standard testing command in the “KTS – Bosch” diagnostic de-	Follow the instructions in the “KTS – Bosch” diagnostic de-

vice.	vice software. (***Testing and repair at a specialized workshop***)
3.8.6 Control Unit check.	
- check the Control Unit plug-and-socket fixtures.	Fix plug-and-sockets.
3.9 Engine stalls when accelerated	
3.9.1 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do ”KTS – Bosch’ standard testing.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device.	Do diagnostics and the necessary repair.
3.9.2 Check the intake system.	
- Check for air leakage/ suction;	Do the necessary repair.
- Check the air filter condition;	Replace the air filter by new one.
- check the intake manifold for clogging.	Clean the intake manifold.
3.9.3 Check the low pressure circuit.	
- check the correctness of connections in the low pressure circuit;	Do the necessary repair.
- check the hoses and pipe connectors for leakage;	
- check the fuel filter condition and conformity;	Replace filter by the appropriate.
- make sure there is no water in the fuel inside the coarse fuel filter cup;	Clean the fuel filter from water pouring it out by opening the tap.

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
- make sure there is no air in the fuel.	Remove air from the low pressure circuit (See Manual, item 3.2.10)
3.9.4 Check the clutch adjustment correctness.	Do the necessary repair.
3.9.5 Check the harness condition for breaking or short circuit.	Do the necessary repair.
Fault identification algorythm	Fix method
3.9.6 Control Unit check.	
- check the Control Unit plug-and-socket fixtures.	Fix plug-and-sockets.

3.10 Engine does not stop	
3.10.1 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do ”KTS – Bosch’ standard testing.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device.	Do diagnostics and the necessary repair.
4 Noise, smellx or smoke	
4.1 Knocking or noise in the engine	
4.1.1 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do ”KTS – Bosch’ standard testing.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device. системы CRS	Do diagnostics and the necessary repair.
4.1.2 Check the intake system.	
- Check for air leakage/ suction;	Do the necessary repair.
- Check the air filter condition;	Replace the air filter by new one.
- check the intake manifold for clogging.	Clean the intake manifold.
4.1.3 Check compression level in the cylinders.	Do the necessary repair.

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
4.1.4 Check the low pressure circuit.	
- check the correctness of connections in the low pressure circuit;	Do the necessary repair.
- check the hoses and pipe connectors for leakage;	
- check the fuel filter condition and conformity;	Replace filter by the appropriate.
- make sure there is no water in the fuel inside the coarse fuel filter cup;	Clean the fuel filter from water pouring it out by opening the tap.
- make sure there is no air in the fuel.	Remove air from the low pressure circuit (See Manual, item 3.2.10)
4.1.5 Check the injectors.	
- launch injector check cycle by the appropriate standard testing command in the “KTS – Bosch” diagnostic	Follow the instructions in the “KTS – Bosch” diagnostic de-

device.	vice software. ***(Testing and repair at a specialized workshop)***
4.2 Intermittent noise	
4.2.1 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do ”KTS – Bosch” standard testing.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device.	Do diagnostics and the necessary repair.
4.2.2 Check the harness (broken or kinked) .	Do the necessary repair.
4.2.3 Control Unit check.	
- check the Control Unit plug-and-socket fixtures.	Fix plug-and-sockets.
4.3 Various mechanical noise	
4.3.1 Make sure that the injectors don’t rattle (discharge through the injectors).	Do the necessary repair.
4.3.2 Fuel pipes holders broken or absent.	Do the necessary repair.

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
4.3.3 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do ”KTS – Bosch” standard testing.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device.	Do diagnostics and the necessary repair.
4.3.4 Check the intake system.	
- Check for air leakage/ suction;	Do the necessary repair.
- Check the air filter condition;	Replace the air filter by new one.
- check the intake manifold for clogging.	Clean the intake manifold.
4.3.5 Check the injectors.	
- launch injector check cycle by the appropriate standard testing command in the “KTS – Bosch” diagnostic device.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
4.3.6 Check the clutch adjustment correctness.	Do the necessary repair.

4.3.7 Check the turbocharger operability.	See Manual, Annex E.
4.3.8 Check the clearances in the valve drive.	Adjust the clearances in the valves drive.
Exhaust gas smell	
4.4.1 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do ”KTS – Bosch’ standard testing.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
- check electricity consumers condition with the diagnostic device.	Do diagnostics and the necessary repair.
4.4.2 Check the intake system.	
- Check for air leakage/ suction;	Do the necessary repair.

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
- Check the air filter condition;	Replace the air filter by new one.
- check the intake manifold for clogging.	Clean the intake manifold.
4.4.3 Check oil consumption.	At oil consumption too high do the necessary repair.
4.4.4 Check the turbocharger operability.	See Manual, Annex Ж.
4.4.5 Check the engine oil level.	Add oil to the necessary level.
4.4.6 Check the injectors.	
- launch injector check cycle by the appropriate standard testing command in the “KTS – Bosch” diagnostic device.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
4.4.7 Control Unit check.	
- check the Control Unit plug-and-socket fixtures.	Fix plug-and-sockets.
Diesel fuel smell	
4.5.1 Check the low pressure circuit.	
- check the correctness of connections in the low pressure circuit;	Do the necessary repair.
- check the hoses and pipe connectors for leakage;	
- check the fuel filter condition and conformity;	Replace filter by the appropriate.
- make sure there is no water in the fuel inside the coarse fuel filter cup;	Clean the fuel filter from water pouring it out by opening the tap.

- make sure there is no air in the fuel.	Remove air from the low pressure circuit (See Manual, item 3.2.10)
4.5.2 Leakage in the fuel temperature sensor.	Replace the fuel temperature sensor. or резиновое уплотнительное кольцо

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
4.5.3 Check the injectors.	
- launch injector check cycle by the appropriate standard testing command in the “KTS – Bosch” diagnostic device.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
4.5.4 Check the high pressure circuit for leakage.	Do the necessary repair.
4.6 Blue, white or black smoke	
4.6.1 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do ”KTS – Bosch’ standard testing.	Follow the instructions in the “KTS – Bosch” diagnostic device software. ***(Testing and repair at a specialized workshop)***
4.6.2 Check the intake system.	
- Check for air leakage/ suction;	Do the necessary repair.
- Check the air filter condition;	Replace the air filter by new one.
- check the intake manifold for clogging.	Clean the intake manifold.
4.6.3 Check the engine oil level.	Add oil to the oil gauge upper mark.
4.6.4 Check the low pressure circuit.	
- check the correctness of connections in the low pressure circuit;	Do the necessary repair.
- check the hoses and pipe connectors for leakage;	
- check the fuel filter condition and conformity;	Replace filter by the appropriate.
- make sure there is no water in the fuel inside the coarse fuel filter cup;	Clean the fuel filter from water pouring it out by opening the tap.
- make sure there is no air in the fuel.	Remove air from the low pressure circuit (See Manual, item

	3.2.10)

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
4.6.5 Check oil consumption.	At oil consumption too high do the necessary repair.
4.6.6 Check compression level in the cylinders.	Do the necessary repair.
4.6.7 Check the injectors.	
- launch injector check cycle by the appropriate standard testing command in the "KTS – Bosch" diagnostic device.	Follow the instructions in the "KTS – Bosch" diagnostic device software. ***(Testing and repair at a specialized workshop)***
4.7 Blue, white or black smoke when accelerated	
4.7.1 Check the engine parameters.	
- check for faults in the COMMON RAIL injection system using the diagnostic device; do "KTS – Bosch" standard testing.	Follow the instructions in the "KTS – Bosch" diagnostic device software. ***(Testing and repair at a specialized workshop)***
4.7.2 Check the intake system.	
- Check for air leakage/ suction;	Do the necessary repair.
- Check the air filter condition;	Replace the air filter by new one.
- check the intake manifold for clogging.	Clean the intake manifold.
4.7.3 Check the low pressure circuit.	
- check the correctness of connections in the low pressure circuit;	Do the necessary repair.
- check the hoses and pipe connectors for leakage;	
- check the fuel filter condition and conformity;	Replace filter by the appropriate.
- make sure there is no water in the fuel inside the coarse fuel filter cup;	Clean the fuel filter from water pouring it out by opening the tap.
- make sure there is no air in the fuel.	Remove air from the low pressure circuit (See Manual, item 3.2.10)

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
4.7.4 Check the engine oil level.	Add oil to the oil gauge upper mark.
4.7.5 Check the turbocharger operability.	See Manual, Annex Ж.
4.7.6 Check oil consumption.	At oil consumption too high do the necessary repair.
4.7.7 Check compression level in the cylinders.	Do the necessary repair.
4.7.8 Check the high pressure circuit for leakage.	Do the necessary repair.
4.7.9 Check the harness (broken or kinked) .	Do the necessary repair.
4.7.10 Check the injectors.	
- launch injector check cycle by the appropriate standard testing command in the "KTS – Bosch" diagnostic device.	Follow the instructions in the "KTS – Bosch" diagnostic device software. ***(Testing and repair at a specialized workshop)***
4.7.11 Control Unit check.	
- check the Control Unit plug-and-socket fixtures.	Fix plug-and-sockets.
Engine overheating	
5.1 Not enough cooling liquid in the cooling system.	Add cooling liquid in the radiator to the normal level.
5.2 Radiator dirty outside.	Clean the radiator.
5.3 The thermostat valve not opening to the full.	Replace the thermostat.
5.4 Insufficient fan belt tension.	Tighten the belt.
5.5 Fan belt and pulleys oiling.	Dismantle the belt, remove oil stains from the belt and the pulleys surface.
6 Oil pressure lower than permissible in hot engine	
6.1.1 Check for faults in the COMMON RAIL injection system using the diagnostic device; do "KTS – Bosch" standard testing.	Follow the instructions in the "KTS – Bosch" diagnostic device software. ***(Testing and repair at a specialized workshop)***

Continuation of Table 11

Fault Outward fault demonstration	
Fault identification algorythm	Fix method
6.1.2 Faulty pressure sensor or indicator (backup devices).	Replace pressure sensor or indicator, if necessary, after checking the oil pressure with a set of check devices.

6.2 Oil pipelines connections hermeticity lost	Identify the area of lost hermiticity and restore it. ee
6.3 Faulty oil pump	Identify the fault and rectify it.
6.4 Oil level in the engine oil sump lower than permissible.	Add oil to the oil feeler rod upper mark.
6.5 Extreme wear in interfacings: crankshaft necks – bearing shells (main end and big end)	Rectifu the fault.
6.6 Safety valve in the oil filter housing jammed	Clense the valve and the valve channel in the filter housing.
6.7 Clogged oil filter	Replace the filter.
7 Turbocharger - See Annex Ж	
8 Starter motor	
8.1 The engine crankshaft not rotating or rotating too slowly at the starter motor switch-on	
8.1.1 Weak accumulator battery terminals tightening or wires ends oxidated.	Clean the wires ends and tighten the terminals.
8.1.2 Accumulator battery discharged.	Charge the acumulator battery.
8.1.3 Collector and brushes dirty.	Clean collector and brushes.
8.1.4 Bad brushes contact with collector. Brushes wear.	Dismantle the starter motor, clean the collector, eliminate the brushes loosing or replace them with new ones.
8.1.5 Contact bolts and contact plate surfaces burnt in the starter motor relay.	Clean the starter motor contacts or mount the contact bolts in the cover seats, turning them 180° around the axis, and mount the conact plate with the reverse side.

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
8.1.6 Starter notor faild.	Replace starter notor.
8.2 Starter motor staying switched in after the engine start	
8.2.1 Contact plate welded to the starter motor relay contact bolts or contacts welded in the starter motor control circuit relay.	Stop the engine, disconnect the battery and do as decribed in item 8.1.5 or replace the starter motor control circuit relay.
8.3 Starter motor armature rotating fast not moving the engine crankshaft	
8.3.1 Flywheel rim teeth broken.	Replace the flywheel rim.
8.3.2 Starter notor faild.	Replace starter notor.
8.4 Starter motor relay interruptions (switches the starter motor on and then immediately switches it off).	
8.4.1 Relay holding coil broken.	Replace the relay.
8.4.2 Accumulator battery discharged.	Charge the accumulator battery.
8.5 Drive gear systematically not engaging the flywheel rim at the relay normal operation.	
8.5.1 Toothed flywheel rim back-off area end wear.	Back the flywheel rim teeth off or replace the flywheel rim.
8.5.2 Drive gear sticking due to the lack or poor quality lubrication.	Remove old lubrication from the drive and the shaft, apply new lubrication ЦИАТИМ-201/203/221.
8.5.3 Drive gear teeth back-off area end wear.	Back the teeth off or replace the dirive.
9 Alternator	
9.1 Ammeter (voltmeter) does not show the charge after starting the diesel engine, and then for the entire duration of its running	
9.1.1 Positive terminal wire broken or bridged to the alternator housing.	Disconnect the rectifier, solder and insulate the place of the break. Insulate the damaged location. ***(Repair at a specialized workshop)***

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
9.1.2 Field coil circuit broken.	Disassemble the alternator. Solder or insulate the damaged place or replace the coil, if it is impossible to rectify the fault. ***(Repair at a specialized workshop)***
9.1.3 One of the stator phases bridging to the alternator housing.	Replace the stator. ***(Repair at a specialized workshop)***
9.1.4 Power rectifier terminals short-circuiting or forward and reverse polarity diodes damaged.	Replace the rectifying device. ***(Repair at a specialized workshop)***
9.1.5 Faulty voltage regulator.	Replace the voltage regulator. ***(Repair at a specialized workshop)***
9.1.6 Bad brushes contact with collector. Brushes wear.	Clean the collector, eliminate the brushes loosing or replace them with new ones.
9.2 Alternator does not generate full power	
9.2.1 Regulator lead broken.	Solder and insulate the damaged place. ***(Repair at a specialized workshop)***
9.2.2 One of the stator phases broken.	Replace the stator. ***(Repair at a specialized workshop)***
9.2.3 Stator winding turn-to-turn short circuit.	Replace the stator. ***(Repair at a specialized workshop)***
9.2.4 Field coil winding turn-to-turn short circuit.	Replace the field coil. (***Repair at a specialized workshop)***
9.2.5 One of the power rectifier diodes faulty.	Replace the power rectifier. ***(Repair at a specialized workshop)***

Continuation of Table 11

Fault ***Outward fault demonstration***	
Fault identification algorythm	Fix method
9.3 Accumulator battery recharging systematically	
9.3.1 Faulty voltage regulator.	Replace the voltage regulator. ***(Repair at a specialized workshop)***
9.3.2 Voltage regulator bridging to “III” lead housing.	Insulate the damaged place. ***(Repair at a specialized workshop)***
9.4 Alternator noise	
9.4.1 Drive belt slipping or excessive tensioning.	Adjust the drive belt tension-

	ing.

2.3.7 Safety measures with engine appropriate use

To ensure safe work and avoid accidents during engine operation and technical maintenance, observe the following rules:

- Begin working only after proper study of the diesel engine design and operation and maintenance rules;

- Do not operate vehicles with faulty engines;

- Do not run the engine in a closed room with poor ventilation;

- Do engine maintenance and rectify failures with the engine not running and at cooling liquid temperature in the cooling system not over 60°C;

- To avoid face and hands burn, when removing the radiator orifice cap on a hot engine, use gloves or a piece of cloth;

- Mount and dismantle the engine using slings run through the eyes located on the engine (the slinging scheme according to Annex "И");

- Do not us eopen fire for the engine fuel pipelines and oil sump heating in the cold season of the year;

- Make sure there are no flammable materials near the engine exhaust manifold, turbocharger and silencer;

- Do engine fueling and oiling using special appliances and observing the fire safety rules.

- When draining the fuel system (or purging), pour the fuel only into a separate vessel

- Do not heat the sucked in air by open fire in front of the air cleaner;

- Do not start the engine with the cooling system not filled with the cooling liquid;

- After engine shutdown, switch the accumulator batteries off, but not earlier than 1 minute after ignition switch-off and engine shutdown.

The rooms where engines are run must be equipped with influx/exhaust ventilation, while the engine exhaust system must be equipped with an independent gas diversion line ensuring forced exhaust gas diversion from the engine silencer to the outside of the room.

2.4 Operation in extreme conditions

In the event of an accident, immediately stop the engine, switching off the fuel supply by the ignition lock or emergency stop button, if available.

In emergency situations, when flame appears on the engine, pour sand on the flames, cover them with a tarpaulin cloth or other thick canvas. Use carbon acid fire extinguisher. Do not pour water on the burining flame.

In the event of spontaneous acceleration of a tractor/ agricultural machine with a gear on, or spontaneous engine acceleration, shut the engine down using the ingintion lock or emergency stop button, if available.

In such cases the tractor/ agricultural machine must be towed to the place of repair, rigidly hitched ***without starting the engine****.*

All measures for stopping the engine uncontrolled operation must be taken promptly in order to prevent the engine final failure.

3 MAINTENANCE
3.1 Diesel engine maintenance

3.1.1 General instructions

Diesel engine maintenance is done for the purpose of keeping it properly functioning in the process of operation.
Not observing the scheduled periodicity or low quality maintenance significantly shorten its operation life, lead to the increasing failures, bring down the engine power, ecology parameters and result in more costs for its operation.
Engine operation without the regular technical maintenance is not permissible.
The deviation from the scheduled engine maintenance periodicity is acceptable only within the limit of ±10%.
The records on the scheduled routine maintenance (except for those relating to the Annual Technical Maintenance) must be enetered in a tractor/ machine/ combine harvester log-book.
While performing technical maintenance before a lengthy storage period or Technical Maintenance-3, the engine must undergo diagnostics in order to determine a necessity of repair or repair type – current or overhaul repair.
All malfunctions discovered in the course of maintenance must be eliminated. Maintenance operations linked with assembly units disassembling must be performed in closed rooms to prevent dust and dirt getting into the diesel engine assembly units cavities.

For correct and safe diesel engine operation, maintenance within the engine warranty period is recommende at the manufacturer service centers specified at: www.po-mmz.minsk.by.

3.1.1.1 ***Technical maintenance types and periodicity***

Technical maintenance types and periodicity are shown in Table 12.

Table 12

Maintenance type	*Diesel engine use*	
	All year round	*Сезонное*
	Periodicity or operation hours	
1 Maintenance before operation run-in	Before new diesel engine putting into operation or that of over-hauled. According to the instructions in items 2.2.2 – 2.2.5.	
2 Maintenance after operation run-in	Before new diesel engine putting into operation or that of over-hauled. According to the instructions in item п.2.3.4	
3 Monthly maintenace (MM)	*8-10*	
4 1st Maintenance (TM-1)	*125*	
5 2nd Maintenance (TM-2)	*500*	
6 3rd Maintenance (TM-3)	*1000*	

7 Seasonal maintenance while transferring from the autumn-winter (TM-AW) or the spring-summer (TM-SS) operation periods.	-	Done simultaneously with the routine scheduled maintenance (TM-1, TM-2, TM-3)
8 Maintenance for a short-time storage (10 days – 1 month) preparation.	According to item 3.1.5.1 and section 5.	
9 Maintenance for a long-time storage preparation.	According to item 3.1.5.2 and section 5.	
10 Maintenance during a long-time storage.	According to item 3.1.5.2 and section 5.	
11 Maintenance before the operation season (TM-Э)	According to item 3.1.1.1.1	

Maintenance cycle (not including MM, TM-AW and TM-SS) when installed in tractor/ machine, combine harvester will be: TM-1 » 2TM-1 » TM-1 » TM-2 » TM-1 » 2TM-1 » TM-1 » TM-3 » TM-1 »2TM-1 » TM-1 » TM-2 » TM-1 » 2TM-1 » TM-1 » 2TM-3.

3.1.1.1.1 Diesel engine maintenance before combine harvester operation season (TM-Э)

Take the engine back from dead storage as described in item 3.1.6.2
Mount back in place the parts and units kept separately during the dead storage.
Adjust the drive belts tension.
Check hermeticity of all air cleaner and inlet duct couplings.

3.1.1.2 Maintenance staff and requirements to it.

Table 13

Maintenance type	Maintenance staff and staff skills
MM	Driver, operator, or engine mechanic of a tractor, combine harvester or a machine where the diesel engine is installed.
TM-1; 2TM-1; TM-2; SS; AW	3-4 class locksmith having general technical training according to the locksmith training program, familiar with the D-260S3A engine and its modifications design and operation principles; opearator, driver or engine mechanic of a tractor, combine harvester or a machine where the diesel engine is installed
TM-3; 2TM-3	4–5 class engine mechanic or fixer and 3–4 class locksmith, having general technical training according to the locksmith training program, familiar with the D-260S3A engine and its modifications design and operation principles or engine mechanic of a tractor, combine harvester or a machine where the diesel engine is installed, skilled specialist for diagnostics and maintenance of the COMMON RAIL fuel management system.

3.1.1.3 Requirements to diesel engine before maintenance

An engine meant for maintenance must undergo technical examination with the purpose of finding the locations of fuel and oil leakage, which are difficult to discover after the engine wash. After the technical examination the engine must be cleaned and washed.
The quality of washing to a great extent affects the engine troublfree operation and the engine parts and units durability. Improper cleaning may reduce the engine operation life by 20 – 30 % and more. Washing the engine, it is not permissible to send direct water flow on the CRS electronic control system sensors plugs-and-sockets, ECU and harnesses plugs-and-sockets.
To do some adjustment work during the maintenance, the diesel engine must be heated up to the necessary temperature mode specified in this Manual.
Technical maintenance must be commenced only after visual examination and proper tightening of loosened fixtures. Upon maintenance completion, the engine, as part of a machine, is sent to the storage site or for fuelling for continuation of the scheduled work.
The basic and backup fuel and oil materials list is given in Table A.1 (Annex "A").

3.1.2 Safety measures

To ensure safe operation and avoid accidents during the engine maintenance, observe the following rules:
- eligible to the engine washing are persons having been theoretically and practically instructed;
- using ungrounded washing equipment or that having a pump electric motor not set to "0" is not permissible.
- washing is not permissible outside specially equipped locations ensuring ecological safety;
- do not run the engine in a closed room with poor ventilation;
- maintenance and faults elimination must be done with the engine not running;
- to avoid face and hands burn, when removing the radiator orifice cap on a hot engine, use gloves or a piece of cloth
- the appliances used in maintenance must be in a proper working condition;
- the tools must be in a proper working condition and of the relevant sizes;
- for visual inspection, use portable light sources with the voltage of not higher than 12V;
- draining fuel out of the coarse and fine fuel filters when removing the sediment, filling the fuel system (purging) must be done only into a vessel;
- drain oil and storage mixtures only into a vessel;
- do not allow fuel and oil materials spill on the working site;
- the working place for maintenance must be equipped with fire extinguishing means.

3.1.3 Maintenance procedures

3.1.3.1 Scope of work at scheduled maintenance types

Table 14

Work description	Maintenance type							
	MM	TM-1	2TM-1	TM-2	TM-3	2TM-3	SS	AW
1 Check oil level in the engine sump.	+	+	+	+	+			
2 Check the cooling liquid level in the cooling system.	+	+	+	+	+			
3 Clean the alternator from dust with compressed air.	+	+	+	+	+	+		
4** Pour sediment out of the fuel pre-filter.		See Notes						
5 Check the belts tension.		+	+	+	+	+		
6 Check the air cleaner for clogging (filter elements condition).		+	+					

Continuation of Table 14

Work description	Maintenance type							
	MM	TM-1	2TM-1	TM-2	TM-3	2TM-3	SS	AW
7 Service the gas exchange system components.			+	+				
8* Clean the centrifugal oil filter rotor.			+	+	+	+		
9* Replace the oil filter.			+	+	+	+		
10* Replace oil in the engine oil sump.			+	+	+	+		
11 Check hermeticity of all air cleaner and inlet duct couplings.				+	+	+		
12 Tighten the cylinder head bolts.					+	+		
13 Check the clearance between the valves and rockers.				+	+	+		
14 Wash the engine breathers.						+		
15** Replace the coarse fuel filter.		See Notes						
16*** Replace the fine fuel filter.		See Notes						
17 Service the air cleaner.				+	+	+		
18 Replace the air cleaner main filter element.					+	+		
19 **** Do the “COMMON RAIL” system overall service.		See Notes						
20 Check the engine starter motor condition (brushes, collector, springs, terminals etc.).						+		
21 Wash the cooling system.						+		

22 Replace the winter oil by the summer oil in the engine sump.				+				
23 Set the alternator seasonal voltage adjustment screw (if available) to the "Л" position (summer).				+				
24 Replace the summer oil by the winter oil in the engine sump.				+				

Continuation of Table 14

Work description	Maintenance type							
	MM	TM-1	2TM-1	TM-2	TM-3	2TM-3	SS	AW
25 Set the alternator seasonal voltage adjustment screw (if available) to the "З" position (winter).								+

* - diesel engines installed in combine harvesters require centrifugal oil filter rotor cleaning, replacement of oil filter and oil in the engine oil sump every 125 operation hours.
** - the TM periodicity is set in the relevant tractor/ machine Oeration & Maintenance Manuals.
*** - fine fuel filter replacement is done every 600 diesel engine operation hours or as recommende by the “COMMON RAIL” diagnostics.
**** - maintenance is done every 3 000 engine operation hours at special “COMMON RAIL” system service centers.

3.1.4 Checking the engine operation condition

The engine operation condition is checked by way of technical diagnostics.
The diagnostics are done at: engine putting to long-time storage at TM-3, after scheduled operations hours between maintenances and while checking the engine repair quality.
Those doing TM-3 must possess equipment for resource technical diagnostics or use a mobile diagnostics machine.
Before engine diagnostics the following preparation work must be done: examine the engine visually, clean it from dust and dirt, wash the engine and intervew the engine operator on its functioning.
With any information on the engine parts and units wear extreme wear, such as: crankshaft bearings distruction detected by knocking during operation, damage or serious defects of cylinder block, the engine must be sent to overhaul.
Diagnosting of some units, devices and systems is done with the use of generalized indicators of technical condition (output, oil pressure, water temperature, specific fuel consumption, amount of gas penetrating the engine crankcase) with which you may estimate the condition of pistons, piston rings, cylinder liners and crank mechanism.
Before testing the engine it is necessary to: check the units mounting, service (clean) the air cleaner; replace the fuel fine filter, check the turbocharger; check and adjust the drive belts tension, gas exchange mechanism valves, check and, if necessary, restore the oil level in the engine and fuel pump sumps, check the cooling liquid in the radiator, check fuel

in the fuel tank. With that job done and rectifying the discovered faults, you may begin the diagnostics.

The diesel engine controllable parameters – according to item 1.1.2.2, Table 3.
Measurement means for determining the engine controllable parameters – according to item 1.1.2.3, Table 4.
Upon the diesel engine warranty period expiration, it is permissible to determine the engine output by the non-braking method. The non-braking method allows to determine the output and fuel economy by the effective fuel consumption. At that, there is no necessity to dismantle the engine from the machine.
When testing the engine with the non-braking method, connect a КИ-8955 or КИ-8940 type fuel consumption meter to the low pressure fuel system and mount a КИ-5653 type load imitator on the air intake pipe. Connect piezometer to the air supply system inlet branch.
The engine is started and heated up to the normal heat condition and, at set modes, determine the effective fuel consumption by which the engine output is finally determined.
If necessary, to estimate the technical condition of parts and units (beraing units, belt drives, shafts) not having generalized indicators they use the size parameters (gaps, clearances, lifts), try the parts and units or visually inspect them. All faults discovered by technical diagnostics must be rectified by current repair or overhaul.

3.1.5 Proofing (reproofing) for storage

Depending on diesel engines scope of delivery agreed in contracts with customers, the engines are proofed for storage from 6 months to one year periods. The particular proofing period is specified in an engine passport.
With the engine storage period exceeding that in the passport, it must undergo reproofing. Engine reproofing after a 6 months storage must be done for a one year period. Repeated reproofing under a 6 months standard is not permissible.
Enegine proofing as part of a tractor/machine for a short storage period (10 days to 1 month) is done as described in item 3.1.5.1.
Enegine proofing as part of a tractor/machine for a long storage period (over 1 month) as well as reproofing for over 6 months is done as described in item 3.1.5.2.
It should be noted that after the engine start depreservation of its inner cavities, cooling and fuel supply systems takes place.
3.1.5.1 Engine proofing before short storage
Drain motor oil from from the engine oil sump into suitable vessel at the ambient temperature and the engine parts temperature not higher than 60ºC.
Put and screw the oil drainage plug into the oil sump tray.
Fill the oil sump with motor oil to the appropriate level as recommended by the Chemmotological Chart (Annex "A").
Fill the fuel tank with the recommended fuel (Annex "A").
Let the engine run without load for 2 minutes at 1200 min^{-1}.
Do not drain the oil from the oiling system and the fuel from the engine power system after the engine shutdown.
Check the air cleaner and, if necessary, service it.

If frosty weather is expected during the engine storage period, check the cooling liquid for conformity to the required frost resistance and, if necessary, replace it. If needed, add cooling liquid up to the expansion tank mark.
Clean the outside of the engine (except for electrical parts) with fuel and compressed air. Cover with polyethylene film STATE STANDARD 10354-82 and tie up the air cleaner inlet branch, silencer outlet branch and the engine breathers with string ШЛ 4,0 (0,25) Н1 «б» STATE STANDARD17308-88.

3.1.5.2 Engine proofing (reproofing) before long storage

Fill the cooling system with proofing solution (thickened aqueous sodium chromate) of the following composition (g/l):
Drain the cooling liquid from the the cooling system and wash with pure soft water under pressure.
- glycerine STATE STANDARD 6823-77 - 800;
- potassium dichromate STATE STANDARD 4220-75 - 30…50;
- soda ash STATE STANDARD 5100-85 - 6…10;
- drinking water STATE STANDARD 2874-82 - 140…165
(to prepare the solution, Preliminarily dissolve soda in warm water and introduce it to the proofing solution when cooled down).
Start the engine and let it run till the temperature goes up to 60...80 (ºC).
Drain motor oil from the engine oil sump into a suitable vessel at the ambient temperature and the engine parts temperature not higher than 60ºC.
Remove and utilize the oil filter. Clean the centrifugal oil filter rotor. Mount and screw the oil drainage plug in to the oil sump tray.
Install a new oil filter.
Pour washing proofing oil "Белакор АН-Т ТУ (TECH. CONDITIONS) Belarus 03535026.291-97" into the oil sump or motor oil recommended for the engine (Annex "A") with 15…25% of additive "АКОР-1 STATE STANDARD 15171-78". Add additive "АКОР-1" to the motor oil in a few doses with vigorous stirring until a homogenious mixture. The mixture homogeneity is characterized by the absence of black or dark brown stains in the mixture flushes coming down from the stiring rod.
Before using the "Белакор АН-Т" oil, it is necessary to thoroughly stir it. The "Белакор АН-Т" should not be heated (in the winter season, with the oil thickening, it is allowable to heat it up to 80°C).
Drain fuel from the fuel tank.
Pour enough clean diesel fuel, Standard "СТБ 1658-2006", "F" grade, and let the engine run for 10 minutes.
(If it is not convenient to drain the fuel from the tank, use a portable vessel filled with recommended fuel).
Drain fuel from the engine power system, remove the fuel filters (coarse and fine) and utilize them.
Fill the new filters with diesel fuel, Standard "СТБ 1658-2006", "F" grade, and install them on the engine. Fill (purge) the engine power system with fuel according to item 3.2.10. Start the engine and let it run for five minutes. The engine stable running will show that th engine power system is filled up.
Stop the engine and let it cool down. Then disconnect the low pressure fuel pipelines:
-the inlet from the coarse fuel filter to the ECU radiator;
-diverting the redundant fuel the HPFIP into the fuel tank;

and carefully plug them in order to keep the fuel in the system.
Drain the proofing solution from the engine cooling system.
Drain the proofing oil from the oil sump, mount and tighten the oil drainage plug.
Dismantle, service and store the accumulator battery following the instructions the of tractor/machine Operation & Maintenance Manual.
Clean the engine outside (except for electrical parts) with fuel and compressed air.
Proofing of the fuel system parts and units (fuel pipelines, rail, fuel filters, injectors, fuel pump, ECU radiator) is done with the diesel fuel proofing solution recommended for the engine (Annex А) with 5…10% of the "АКОР-1" additive.
(Add additive "АКОР-1" to the diesel fuel in a few doses with vigorous stirring until a homogenious mixture. The mixture homogeneity is characterized by the absence of black or dark brown stains in the mixture flushes coming down from the stiring rod).
Disconnect the compressor air diverting pipe and pour 4-6 grams of proofing oil into the compressor cylinder.
Mount the air inlet pipe. Switch the compressor on (applies to single-cylinder compressors).
Cover the engine with polyethylene film STATE STANDARD 10354-82 and tie up the air cleaner inlet branch, silencer outlet branch and the engine breathers with string ШЛ 4,0 (0,25) Н1 «б» STATE STANDARD17308-88.
Protect the engine with weather resistant tarpuline spreading it in a way allowing air access.
The proofed engine must be periodically checked. Should you discover any signs of corrosion, you will have to undertake the appropriate measures in order to prevent the engine parts damage
Applies to the engines meant for proofing with keeping separate from tractor/machine, to do additionally:
Wipe with a napkin and apply the "Белакор АН-Т" oil or proofing oil on the flywheel gasket face (if the clutch is not there), hydraulic pumps (gear-pumps) gasket faces, clutch pressure disk slits, turbocharger outlet hole flange connector (applies to the engines without outlet branch/pipe).
Cover the outer openings of exhaust manifold, intake manifold, thermostat housing, water pump branch, turbocharger, engine breathers with polyethylene film STATE STANDARD 10354-82 and tie up with string ШЛ 4,0 (0,25) Н1 «б» STATE STANDARD 17308-88.
Cover the starter motor and the air cleaner monocyclone with polyethylene bags and wind with sticky polyethylene tape STATE STANDARD20477-86 or tie up with string ШЛ 4,0 (0,25) Н1 «б» STATE STANDARD 17308-88.

3.1.6 Engine preparation for putting into operation after return from storage

3.1.6.1 Engine return from short storage
Remove the inlet and outlet branches and engine breathers protective packaging.
Check the cooling liquid and oil levels.
Fill (purge) the engine fuel supply system according to item 3.2.10.
Check and, if necessary, charge the accumulator battery.
Start the engine.

3.1.6.2 Engine return from long storage
Remove the inlet and outlet branches and engine breathers protective packaging.

Remove the plugs from the inlet and outlet fuel pipelines and connect the pipelines according to their normal position.
Using the diesel fuel, remove the proofing oil from the engine outer proofed surfaces.
Fill the oil sump with motor oil according to the Chemmatological Chart (Annex "A") up to the appropriate level. Fill (purge) the engine fuel supply system with fuel according to item 3.2.10.
Close all drainage taps and fill the engine cooling system with colling liquid of the recommended type according to the Chemmatological Chart (Annex "A") up to the appropriate level.
Install and connect the accumulator battery. Charge the battery, if necessary.
Disconnect the inlet oil pipeline from the turbocharger central bearings housing. Preliminarily, oil the bearings pouring oil into the orifice up to the flange level.
Connect the inlet oil pipeline using a new gasket, tighten the inlet oil pipeline flange bolts.
Start the engine.
Heat the engine up to the normal operation temperature and diagnose it for error codes according to item 2.3.6.

3.2 Diesel engine and its components maintenance

3.2.1 Checking the cooling liquid level in the cooling system

The cooling liquid level in the cooling system must be checked every worlin shift before the engine statrt.
Remove the radiator cap and check the cooling liquid level, which must be reaching the orifice upper face. Do not allow the cooling liquid level lower than 40 mm from the orifice upper face.

3.2.2 Cooling system maintenance and washing

The cooling system must be filled with low freezing cooling liquid.
Watch the cooling liquid temperature, the normal operation temperature must stay within 80-100℃. At the temperature rise over the normal, check the cooling liquid level in the radiator, the radiator hermeticity and the fan belt tension.
When necessary, but at least every 2 000 diesel engine operation hours, wash the cooling system. Washing the cooling system use a 50-60 soda ash per 1 litre of water solution.
The cooling system washing is done in the following order:
- pour in 2 litres of kerosene and fill the system with the ready solution;
- start the engine and let it run 8-10 hours, after that drain the solution and wash the cooling system with pure water.

3.2.3 Checking oil level in the engine oil sump

Checking oil level in the engine oil sump must be done every working shift before the engine start with an oil level feeler rod located on the engine cylinder block. The oil level must stay between oil feeler rod lower and upper marks as shown on Fig.18. This check must be done not earlier than 3-5 minutes after the engine shutdown, when all of the oil is down in the oil sump. It is not permissible to keep the oil level less than the lower mark and higher than the upper mark of the oil feeler rod.

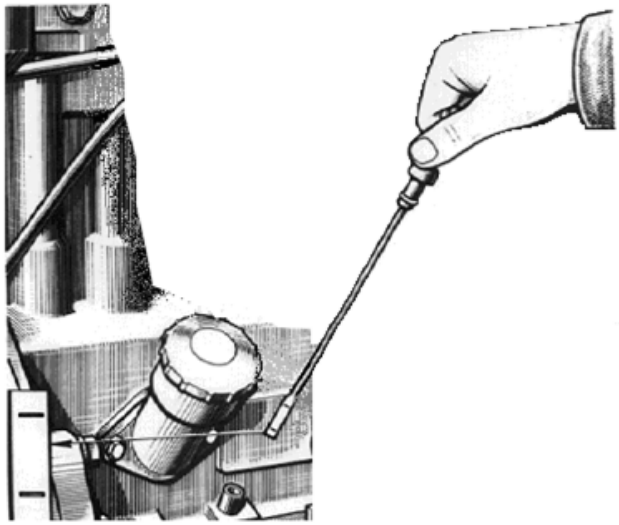


Fig. 18- Checking oil level in the engine oil sump.

3.2.4 Replacing oil in the engine oil sump

Oil in the diesel engine oil sump must be replaced after every 250 operation hours and in case of using lower quality analogous oils or fuel with highsulphur contents – after every 125 operation hours.

Drain used oil only from a heated engine. To drain the used oil, screw out the oil sump plug. A soon as all of the oil is out screw the plug back in place. Pour new oil through the oil filling branch up to the oil gauge upper mark. Fill the oil sump only with the oil recommended by this Manual, according to the season of operation.

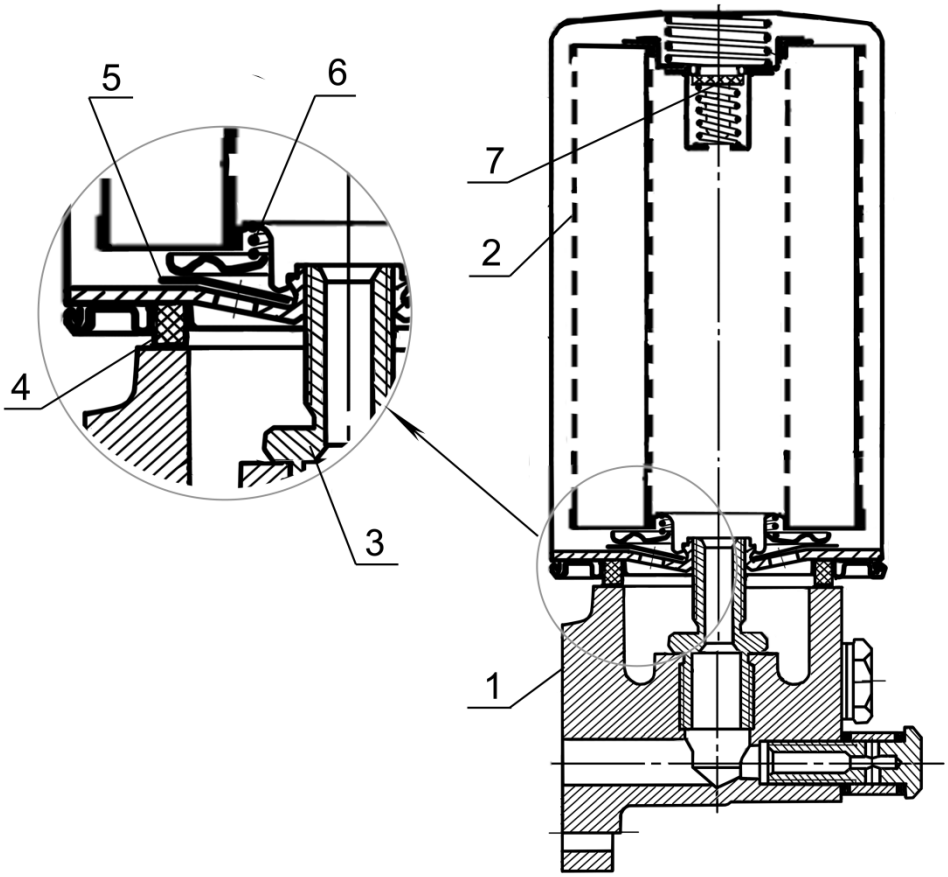
3.2.5 Replacing he oil filter Replacing he oil filter

Oil filter must be replaced after every 10 thousand of vehicle run or upon the results of the "COMMON RAIL" system diagnostics, as shown on Fig.19, in the following order:

- unscrew filter ФМ 037-1012005 from connector 3 using a special spanner or other tools available;

- screw a new ФМ 037-1012005 (OJSC «Avtoagregat», Livny, Russia) filter on the connector. When mounting the filter on the connector, apply motor oil on gasket 4. As soon as the gasket touches the housing base surface of filter 1, screw the filter further for 3-4 turns. The filter on housing mounting must be done with hands only.

In the future, order oil filter ФМ 037-1012005 at: 303858, Russia, the Oriol Region, Livny, 2a Industrialnaya Street, OJSC "Avtoagregat".



1 – filter housing; 2 – filter; 3 – connector; 4 – filter gasket; 5 – anti-drainage valve; 6 – spring; 7 – by-pass valve.

Fig. 19 – Oil filter

3.2.6 Cleaning the centrifugal oil filter rotor

Cleaning the centrifugal oil filter rotor is done simultaneously with oil replacement in the engine oil sump.

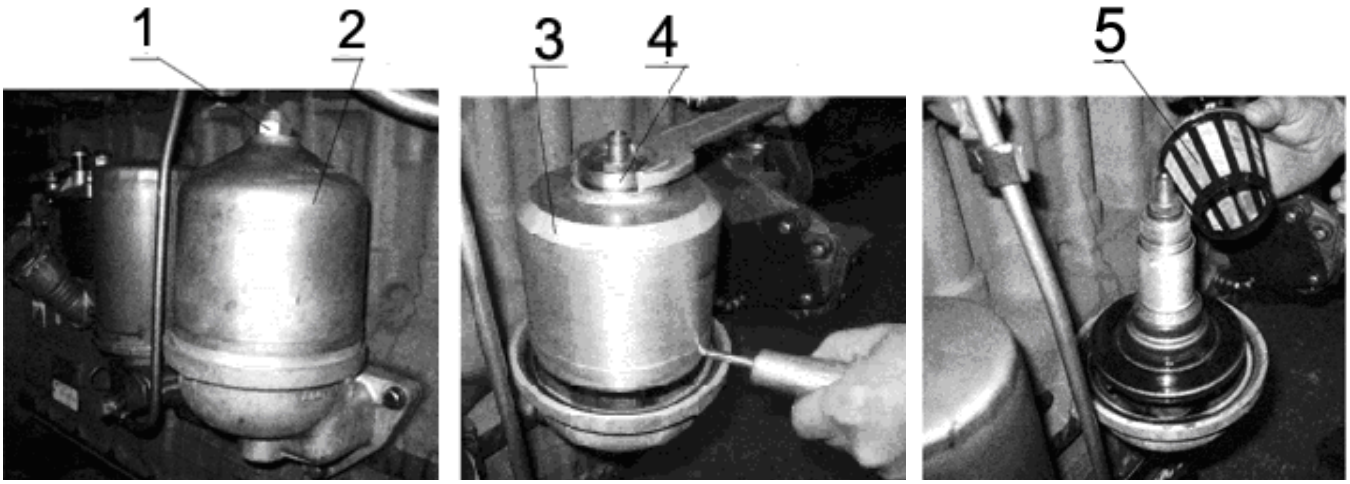
As shown on Fig. 20, unscrew nut 1 of the centrifugal oil filter cap 2 mounting and remove it. Check for presence of the balance mark in the rotor housing cup (put the mark, if it is not there). Lock the rotor from turning, for that purpose put a screw driver or a rod between the filter housing and the rotor bottom and, turning nut 4of the rotor cup mounting with a spanner, remove rotor cup 3.

Check the rotor filtering screen 5 condition, clean and wash it, if necessary.

Using a non-metalic scraper, remove the sediments from the rotor cup inner walls.

Before assemblying the cup with the rotor housing, apply motor oil on the rubber sealing ring. Align the balancing marks on the cup and the rotor housing. The cup mounting nut should be screw with little effort until complete cup fitting on the rotor. After assemblying, the rotor must rotate freely without jamming with a move by hand.

Put the centrifugal oil filter cap back in place and screw the cap nut at 35...50 N·m.



1–nut; 2-cap; 3-cup; 4-special nut; 5-filtering screen

Fig. 20 – Cleaning the centrifugal oil filter rotor.

3.2.7 Sediment removal from fuel pre-filter

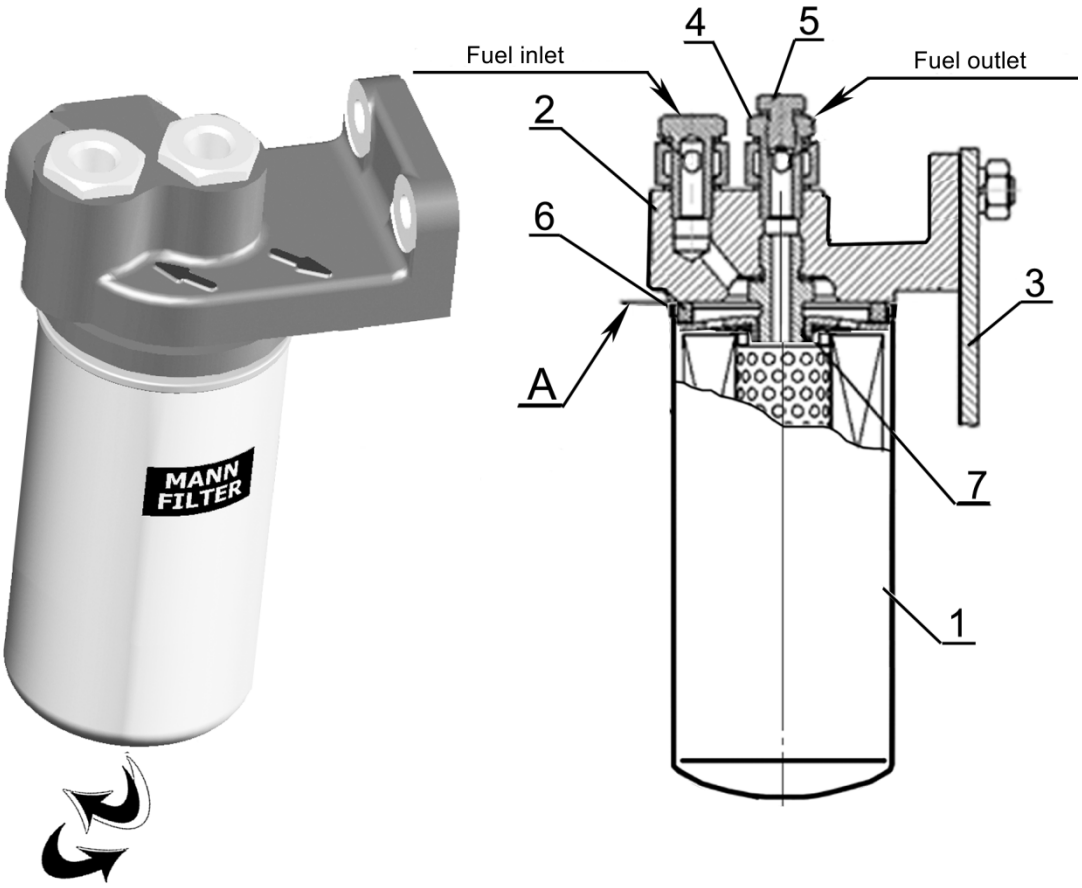
See tractor/ machine Operation & Maintenance Manual.

3.2.8 Fuel pre-filter replacement Replacing fuel pre-filter

See tractor/ machine Operation & Maintenance Manual.
Fill the system with fuel after filter assembly.

3.2.9 Replacing fine fuel filter

Fine fuel filter service life depends on the purity of the fuel used.
Fine fuel filter is replaced after every 6oo hours of operation or upon the results of the "COMMON RAIL" system diagnostics as shown on Fig.21, for that purpose:
- unscrew filter 1 from connector 7 in housing 2 and replace it by a new filter Mann & Hummel WDK962 shippedassembled together with gasket 6, which must be preliminarily oiled with motor oil;
- as soon as gasket 6 touches mounting surface "A" on housing 2, further screw the filter in by ¾ of a turn. At that, the filter must be screwd further by hand only;
- open the fuel tank tap and fill the sytem with fuel as described in item 3.2.10.



1 – filter Mann & Hummel WDK962; 2 – filter housing; 3 – bracket; 4 – connector; 5 – plug (for letting out air); 6 – gasket; 7 – connector.

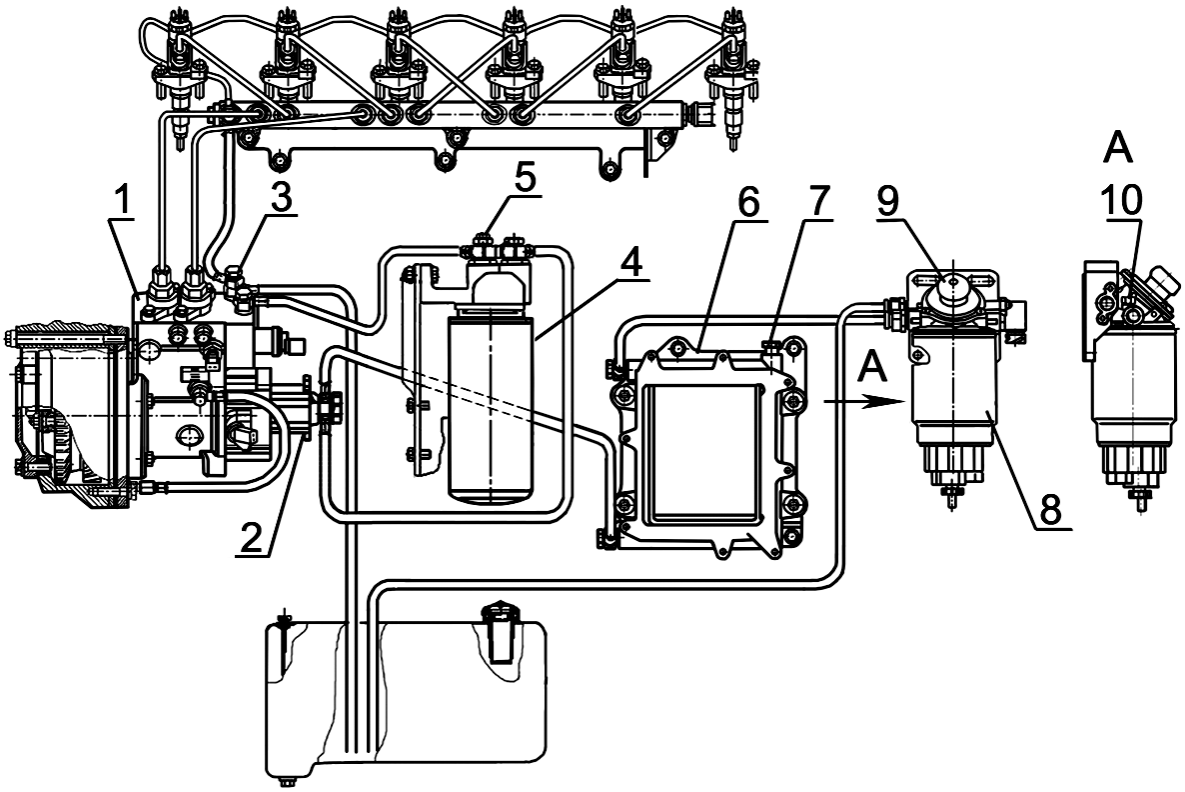
Fig. 21- Replacing fine fuel filter.

3.2.10 Filling the fuel system Filling the fuel system

To fill the fuel system, it is necessary to remove air from it (purge the system). For that purpose:

Unscrew plug 5 (Fig. 22) located on the fine fuel filter outlet connector mounting bolt by 2-3 turns.Purge the system with booster (priming) pump 9 located on fuel coarse filter housing 8, screw plug 5 in (torque – 7…8 Nm) when you see fuel coming out without air bubbles.

Unscrew turn-elbow 3 bolt of the fuel drainage pipelines mounting on HPFIP housing 1 by 2…3 turns and continue purging by the booster pump until you see fuel coming out without air bubbles. Screw bolt 7 (torque 3…4 Nm).



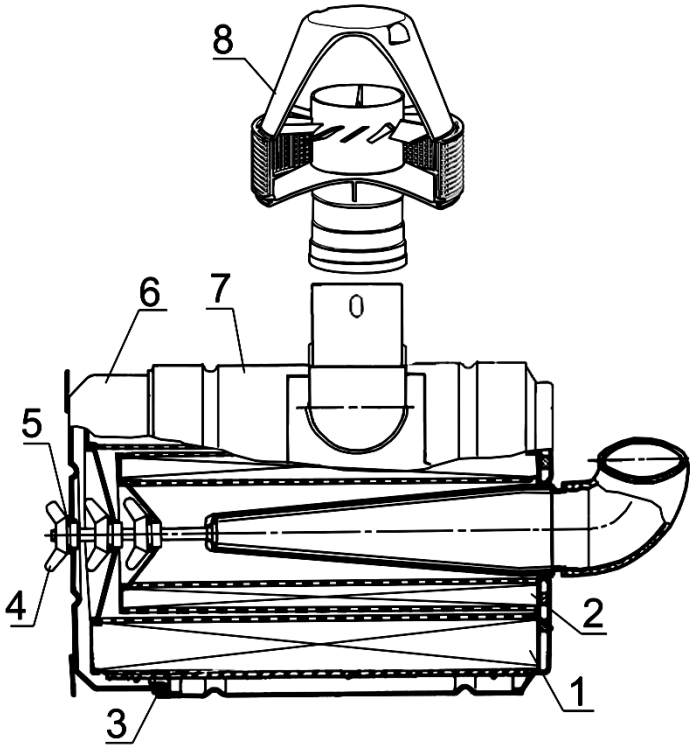
1- High pressure fuel injection pump; 2 – fuel priming pump; 3 – drainage pipelines turn-elbow bolt drainage pipelines turn-elbow bolt; 4 – fine fuel filter; 5 – plug; 6 – ECU radiator; 7 – air outlet plug; 8 – coarse fuel filter; 9 – hand booster pump; 10- air outlet plug;

Fig. 22 - Removing air from the fuel system

Switching over to the "winter" or "summer" operation period and, therefore, changing the type of fue, to speed up the fuel system filling, use all available plugs for letting air out and do step-by-step air removal through plugs 10, 7, 5 and turn-elbow bolt 3.

3.2.11 Servicing the air cleaner

Servicing the air cleaner with a papter filterelement made of special highly porous cardboard is done after every 500 engine operation hours or, if necessary, by the indication of the clogging signalizer. Servicing the air cleaner includes purging of the main filter element, which retains dust coming into the air cleaner. The control filter element clogging says for damage of the main filter element (paper curtain broken, bottoms coming off). In this case it is necessary to purge the control filter element and replace the main one.
Servicing the air cleaner as shown on Fig.20 is done in the following order:
- remove the monocyclone; clean the screen, the swirler and the monocyclone outlet holes from dust and dirt;
- remove tray 6;
- remove main filter element 1.
It is not recommended to take control filter element 2 out of the housing.
Blow the main filter element with compressed air, first the inside and then the outside unitll complete dust removal. To avoid the paper curtain breaking, the compressed air pressure should not exceed 0,2-0,3MPa.



1 – main filter element; 2 – control filter element; 3 – gasket; 4 – wing-nut; 5 – ring; 6 – tray; 7 – housing, 8 - monocyclone

Fig. 23 - Air cleaner

Air flow must be directed at an angle relative to the filter element surface. When serviced, the filter element must be protected from mechanical damage and oiling.
It is not permissible to purge the filter element with exhaust gases or wash it with diesel fuel.
Clean the inlet pipe, the air cleaner housing and tray inner surfaces from dust and dirt.
Before assemblying the air cleaner, check the sealing rings condition.
When assemblying, make sure the filter elements are correctly installed in the housing and properly tighten the wing-nut by hand.
3.2.12 Checking the air cleaner and the inlet duct connections hermeticity

Checking the hermeticity of the air cleaner and the inlet duct connections is done during ТМ-2. To check the hermeticity use device КИ-4870 ГОСНИТИ. With this device unavailable, check the hermeticity visually.

3.2.13 Washing the engine breathers

The engine breathers must be washed with diesel fuel after every 2 000 hours of engine operation. To do that, remove the breathers housings, take the breathers out of the cylinder heads cover caps, wash them and purge with compressed air. Put the breathers and breathers housings back in place.

3.2.14 Tightening the cylinder heads mounting bolts

The cylinder heads mounting bolts tightening is done after every 1 000 operation hours on a hot engine in the following order:

- remove the caps and the cylinder heads covers;

- remover the rocker axles together with the rockers and the brackets;

- using a dynamometric spanner tighen all of the cylinder heads mounting bolts, preliminarily having loosened them by 1/6 of a turn in thre stages:

while installing cylinder heads gaskets 714-63-09 (260-1003020): torques 1) 50±10 N·m, 2) 170±10 N·m, 3) 240±10 N·m.

while installing cylinder heads gaskets 719-73-08 (263-1003020): torques 1) 50±10 N·m, 2) 190±10 N·m, 3) 260+10 N·m.

The sequence of tightening is shown on Fig.24.

After tightening the cylinder heads mounting bolts, put the rocker axles back in place and adjust the gap between the rockers and the valves as described in item 3.2.15. Put the cylinder heads covers and the covers caps back in place.

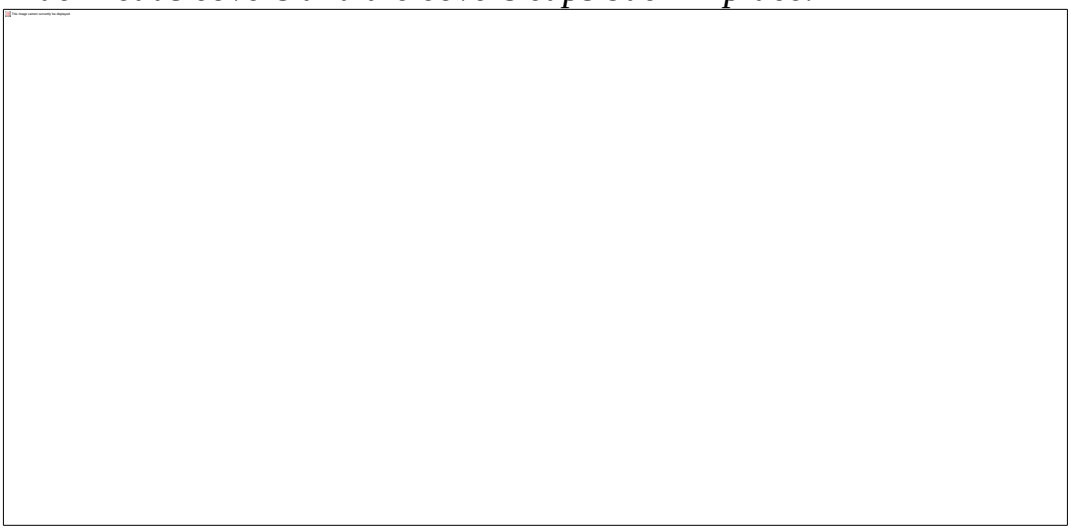


Fig. 24- Sequence of cylinder heads mounting bolts tightening

3.2.15 Checking the gaps between the valves and the rockers

Checking and adjusting the gaps between the valves and the rockers is done after every 500 operation hours preceded by checking of the cylinder heads mounting bolts tightening or, if necessary, on a cold engine (the water and oil temperature must not exceed 60ºC).

The gap between the valve stems ends and the rocker strikers must stay within $0{,}25^{+0{,}05}_{-0{,}10}$ *mm for intake valves and* $0{,}45^{+0{,}05}_{-0{,}10}$ *mm foe exhaust valves.*

When adjusting the gap between a valve stem end and a rocker striker on a cold engine keep to:

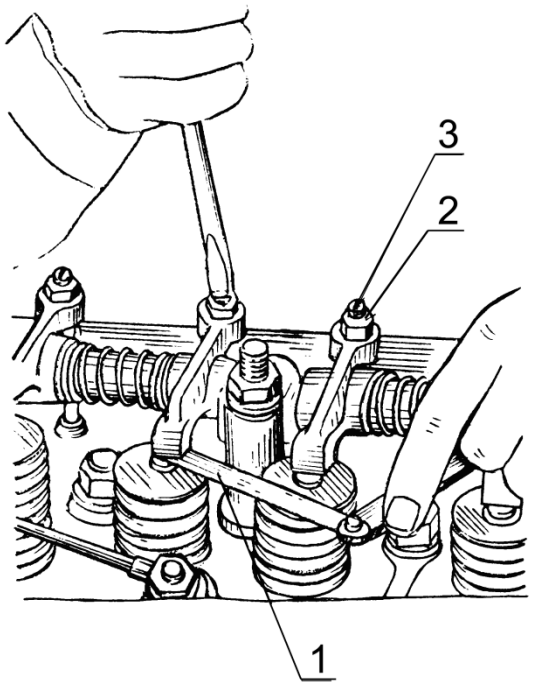
- intake valves - $0{,}25^{-0{,}05}$ *mm;*

- exhaust valves - $0{,}45^{-0{,}05}$ *mm;*

Do adjustment in the following order:

- remove the cylinder heads cover caps and check the rocker axles brackets mounting bolts tightening;

- rotate the crankshaft till the first cylinder valves overshoot (the first cylinder intake valve starts opening and the exaust valve ends closing);
- adjust the gaps of the third, fifth, seventh, tenth, eleventh and twelveth valves (counting from the fan), then rotate the crankshaft by one turn setting the overshoot in the sixth cylinder and adjust the gaps of the first, second, fourth, sixth, eighth and nineth valves.
To adjust the gaps, loosen locknut 2 of adjustment screw 3 as shown on Fig.25 and, screwing or unscrewing the screw, set the required gap per feeler rod 1 between the rocker striker and the valve stem end.
Having set the gap, tighten the locknut and check the gap with the feeler rod again turning the bar. Adjustment finished, put the cylinder heads cover caps back in place.
The valves may be adjusted also in each cylinder when the piston is in the top dead center. To do that, turn the crankshaft till the first cylinder piston reaches the top dead center corresponding to the end of the compression stroke (the setting pin indicator on the gas distribution gears cover and the TDC mark on the torsional vibrations damper housing scale coincide) and adjust the first cylinder valves gap.
Rotate the crankshaft by 1/3 of a turn and adjust the gaps of the fifth cylinder valves. At that, the valves gaps must be adjusted in the order corresponding to the cylinders firing order(1-5-3-6-2-4) with rotating the crankshaft by 1/3 of a turn clockwise.



1 – feeler rod; 2- locknut; 3 – adjustment screw

Fig. 25 – Adjusting the valves gaps

3.2.16 The "COMMON RAIL" system maintenance

The "COMMON RAIL" system maintenance is done at specialized service centers by the specialists of the"COMMON RAIL"system specialized service centers.
Replacement of injectors after the "COMMON RAIL" system testing is done taking into account an injector and a nozzle labeling applied in the locations shown on Fig.26.
Replacing an injector or a nozzle without using special equipment and specially trained staff, as well as within the warranty period, is not permissible. Replacing an injector nozzle during the warranty period may be done only by a BOSCH service center or by a BOSCH authorized workshop.

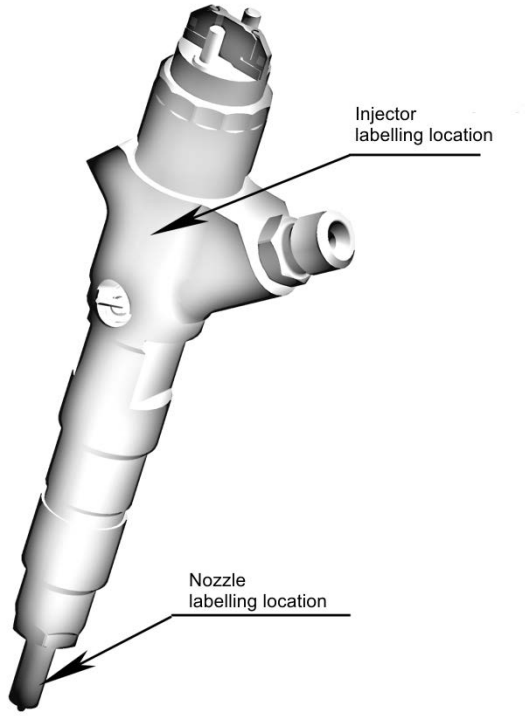


Fig. 26 - Injector

3.2.17 Alternator maintenance

There is no need in the alternator special maintenance during the engine operation. Seasonal alternator voltage "winter-summer" adjustment is done with a "winter-summer" adjustment screw (if available) located on the alternator rear wall.
Diesel engines may be equipped with alternators with automatic "winter-summer" voltage adjustment. With that, the "winter-summer" adjustment screw is not there.
Make sure the alternator mounting and that of the alternator wiring are reliable and keep the alternator outer surface and terminals clean.
The alternator operability is checked with a voltage meter or with a control lamp and an ammeter located on a vehicle dashboard. With the alternator operable, a control lamp lights up at the mass switch-on before the engine start. After the engine start and at the engine running at the middle speed the control lamp fades away, the voltage metter arrow must stay in the green zone and the ammeter must show some charge current the value of which goes down as the battery charge is restored.

3.2.18 Checking the belts tension

Checking the belts tension is done after every 125 engine operation hours.
The alternator belt tension is considered normal, if its deflection on the branch "crankshaft pulley-alternator pulley" stays within 13 mm to 18 mm when pressed with a force of 40±2 N. To adjust the belt tension, loosen the alternator mounting. Adjust the belt tension turning the alternator housing. Tighten the alternator plate mounting bolt and the alternator mounting bolt nuts.

The water pump drive belt (D-260.1S3A, D-260.2S3A, D-260.4S3A) deflection must stay within 9…18 mm when the branch "water pump pulley-crankshaft pulley" is pressed on with the force of 39,2±2,0 N.

3.2.19 Checking the starter motor condition

Checking the starter motor condition is done after every 1 000 engine operation hours in the following manner:
- check the mounting bolts tightening, if necessary, tighten them;
- clean the ends of the wires leading to the starter motor terminals and the accumulator battery and tighten their mountings.
The preventive examination and servicing must be done after every 2 000 engine operation hours.
Remove the cover from the collector side and check the brush-collector unit condition. The coolector working surface must be smooth and should not contain any stains of considerable burn. If the collector is dirty or has stains of considerable burn, wipe it with a clean napkin soaked in gasoline. If it is impossible to remove dirt or stains of burn by wiping, clean the collector with a piece of small grained sand paper. With stains of considerable burn not going off with wiping use a machine tool for cleaning the collector.
The brushes must freely travel inside the holders and be firmly pressed to the collector. In case of the brushes extreme wear as well as with considerable cleavage replace them by new ones. Blow the brush-collector unit and the cover with compressed air on the collector side.
Check the starter notor relay contact system condition. With considerable burn, clean the contact bolts and the contact plate with a piece of sand paper or a file removing the unevenness caused by burn, but not damaging the copper bolts contact surfaces flatness. With the contact plate and bolts extreme wear, turn the contact plate over and the contact bolts for 180°. Check smoothness of the drive travel along the armature shaft. At the relay switch-on/ switch-off the drive must travel along the armature shaft slits without jamming. Remove dirty thick grease from the inner surfaces of the drive guiding bush (slit and smooth) brought from the crankcase, which prevents smooth drive axial motion in the shaft slits at the gear engagement with the flywheel toothed rim. Spread a thin layer of ЦИАТИМ-221 (ЦИАТИМ-203, ЦИАТИМ-201) grease on the cleaned surfaces.
Do visual check of the drive gear and thrust washers condition. The gap between the gear ends and thrust washers at a switched-on position must stay within 2...4 mm.

3.2.20 Turbocharger maintenance

Turbochrger does not require special maintenance during operation, partial or complete disassemblying is not permissible. Partial or complete disassemblying as well as repair are permissible after the turbocharger dismantling from the engine and only by a specialized company. The turbocharger long lasting and reliable operation depends on observation of the rules of periodicity of the engine oiling and air cleaning systems maintenance, the type of oil recommended by the manufacturer, oil pressure checking in the oiling system, timely replacement of or cleaning of air and oil filters. Damaged oil supply and drainage pipelines and air pipelines to the turbochargery must be replaced immediately. When replacing the turbocharger, pour pure oil in the oil inlet orifice up to the flange level, and do not use sealants when mounting the pipelines gaskets.

3.2.21 Compressor maintenance

Compressor does not require special maintenance during operation. If found faulty, the compressor must be sent to a specialized workshop where skilled specialists will identify the fault cause and rectify it.

3.2.22 Maintenance of gas exchange system components with EGR device

To ensure the D-260S3A engine stable power and economy parameters within the operation life, maintenance of the charge air cooler (CAC) must be done after every 250 engine operation hours (2TM-1) and that of the EGR cooler after every 500 engine operation hours (TM-2).

Technical maintenance includes cleaning from asphalt-tar formations by plunging and keeping in dissolving-emulsifying agent with the subsequent rinsing in synthetic washing agent.

Washing agents and modes of parts cleaning from asphalt-tar formations

Washing agents	**Working concentration, g/l, %**	**Solution temperature, °C**	**Duration, min**
Dissolving-emulsifying agent: Labomid-203 ТУ (Tech. Conditions) 38-10738	20-30	80-90	30-40
Rinsing agents: Labomid-102 ТУ (Tech. Conditions) 38-10738 or Temp 100Д ТУ (Tech. Conditions) 38-40843	5±0,1	80±5	10-15

It is permissible to use glycocoll ethers Dowanol PnB or Dowanol PnP manufactured by Dow Europe GmbH for CAC and EGR cooler cleaning by way of plunging and keeping in the cleaning agent within 30 minutes. Then let the ether flow down from the inner cavites and keep the cleaned parts plunged in synthetic washing agent for windows or kitchen washing agent for 30….90 minutes. Let the washing agent go flow down.

** - to save on consumables, it is permissible to pour the agents into the cleaned cavities.*

4 CURRENT REPAIR

4.1 Engine current repair

4.1.1 General instructions

Engine current repair is done to ensure or restore the engine operability and it implies replacement or rehabilitation of particular engine parts. Current repair is done with the engine failures (malfunctions) or damage, which may not be eliminated by adjust in technical maintenance.

The signs for necessity of engine current repair are: rise of fuel consumption, increased oil burn, oil pressure dropdown, deterioration of the engine start ability.
Fauly components at current repair may be replaced by new ones, provided the other engine parts still have considerable operation resource.
It is necessary to do current repair keeping the belonging of the rehabilitated components to the particular engine. With this method the engine parts and units remaining life is preserved to the most extent, because there is no need in increased bedding in and, with that, there is no excessive wear of parts and couplings functional without rehabilitation.
Current repair must be done by skilled technician staff familiar with the design and operation of D-260S3A diesel engine and its modifications.
Installed on the engine for preliminary technical condition diagnostics during the engine operation are: oiling system oil pressure indicator sensor and alarm pressure signalizer sensor located in the heat exchanger cover; cooling liquid temperature indicator sensor and cooling liquid alarm temperature indicator sensor located in the thermostats housing.
The air cleaner clogging extent is controlled by the air filter clogging signalizer sensor which activates the signal lamp at the air filter clogging over the permissible.
The control devices showing the sensors information are located on tractor/combine harvester/machine dashboard.
The list of the diesel engine component possible failures and damage and conditions of their elimination by current repair are given in Table 15.

Table 15

Engine component	Failures and damage to be eliminated by current repair in the conditions of:	
	Company workshops	Specialized repair companies
Turbocharger	-	All failures and damage
"COMMON RAIL" system units	-	All failures and damage
Cylinder head	Loss of valves hermeticity	Wear of valves guiding holes inner surfaces; valve seat extreme wear; head-to-block surface buckling; cracks; threaded holes damage
Cylinder liner-piston	Reduction or loss of the gas connection sealing ability	-
Water pump	All failures and damage	-
Cebtrifugal oil filter	-	All failures and damage
Oil pump	-	Reduction of productivity
Gear pump	-	Reduction of productivity
Clutch	-	All failures and damage
Compressor		Reduction of productivity
Starter motor	Errosive starter motor relay contact couple wear; collector beushes wear	Coils windings short circuit; coils windings insulation damage; bearings wear; drive failure

4.1.2 Safety measures

Eligible to do current repair are workers with special training having certificates confirming their skills, properly instructed for operation safety measures, fire safety etc.
Dismantling of faulty parts and units is done only with the engine not running.
When examining the engine use a portable lamp with the voltage of not more than 24V.
Fuel and oil drainage must be done into a sepaeate vessel. Fuel and oil spilt on the floor mst be frist covered with sand or wooden chips and then taken away from the working place.
Using lifting appliances make sure the handled components are securely clamped. The lifting appliances must bear labeling with the indication of their lifting capacity. Using lofting appliances with weight exceeding their lifting capacity and moving cargos over other people is not permissible. It is not permissible to pile large parts and units one on another thus creating a hazard situation.
Do parts and units washing in a specially equipped for that purpose place. Working with not grounded equipment and the fuel pump electric motor not set to "0" is not permissible.
Disassembling and assemblying small parts and units is done on workbenches, large parts and units – on special benches.
Tools and appliances used must be kept in proper condition. Pulling (extracting) appliances must not contain cracks, kinked rods or damaged threading. It is not permissible to use worn out or bad tools and appliances. The working tools must be of the proper sizing. It is not permissible to use bad conditions spanners or spanners with deformed gaps.
To check holes coincidence, it is necessary to use a mandre,l a pinchbar or a bolt, but not hands.
Using a drilling or a rough-grinding machine pneumatic tools, follow the established safety rules.
Using electric tools, take the necessary safety precautions: use tools only with proper insulation, do the tools housings grounding, use individual protective means.
The working place must be equipped with the necessary fire extinguishing appliances.

4.2 Engine components current repair

Description of failures, their possibles causes and instructions on elimination of failures consequences are given in Table 16.

Table 16

Description of failures and damage consequences	Possible causes	Instructions on identifying the consequences of failures and damage of assembly units	Instructions on elimination of the consequences of failures and damage
Engine			
1 Blue smoke coming out of the exhaust pipe.	1.1 Oil in the combustion chamber burning because of the piston rings wear.	1.1; 2.1 Keep control of oil burning by adding oil at MM; pay attention to the oil colour change intensity during operation period.	1.1 Replace piston rings (item 4.2.1)
2 Difficult engine start. Low speed-up dynamics at fuel supply increase. Blue smoke coming out of the exhaust pipe.	2.1 Oil in the combustion chamber. The cause: the absence of hermeticity in the combustion chamber at the valves disks placing in the valves seats.	As per the oil replacement procedure. By the exclusion method, do the engine failures identification and those of the turbocharger as described in the table (Annex “E”).	Remove the cylinder heads from the engine and do the valves bedding-in (item 4.2.2).
Water pump			
3. Cooling liquid leakage through the drainage hole.	3.1 End sealing wear.	3.1 Control the cooling liquid level in the cooling system at MM.	Remove the water pump from the engine, disassemble the pump (item 4.2.3).

Continuation of Table 16

Description of failures and damage consequences	Possible causes	Instructions on identifying the consequences of failures and damage of assembly units	Instructions on elimination of the consequences of failures and damage
	3.2 Bearing unit wear.	3.1.1 Visually examine the water pump on a running engine after the engine start during heating up. 3.2 Press on the pump pulley with the engine not running and check the radial backlash in the bearing unit.	Replace the water pump gland. Replace the bearings, water pump housing (if necessary).
4. No cooling liquid circulation in the cooling system.	Impeller turns over without fixing on the pump shaft.	Checking the engine cooling system temperature condition by the temperature indicator shows sharp cooling liquid temperature rise.	Remove the water pump from the engine, disassemble the water pump (item 4.2.3). Replace the water pump impeller and/or shaft.

4.2.1 General instructions on piston rings replacement

Remove the cylinder head and the oil sump from the engine. Move the piston down to the bottom dead center (BDC), turning the engine flywheel by hand. Clean the cylinder liner upper section from carbon not allowing the carbon particles drop into the cylinder. It is not permissible to use steel scraper that may damage the liner "mirror".

Unscrew the connecting rod cover nuts, remove the cover and take the piston assembled with the connecting rod out of the cylinder. The piston with the connecting rod must be taken out upwards in the direction of the head mounting.

Mounted on each engine piston, as shown on Fig.27, is an upper trapezoidal compression ring, a conical compression ring and a box-type oil ring with a spring expander.

The compression rings on the end surface at the lock bear marking "вверх" and "TOP", which must face the piston bottom when installed. The oil ring expansioner junction must not coincide with the ring lock.

Position the piston rings locks at equal distances on the circumference.

Insert the piston with the connecting rod into the cylinder, mount the connecting rod cover.

To avoid the piston rings breaking while installing the piston with the connecting rod in the cylinder, use a mandrel for pressing the rings.

The tightening torque for the connecting rod cover nuts is specified in the Table of Annex "Г".

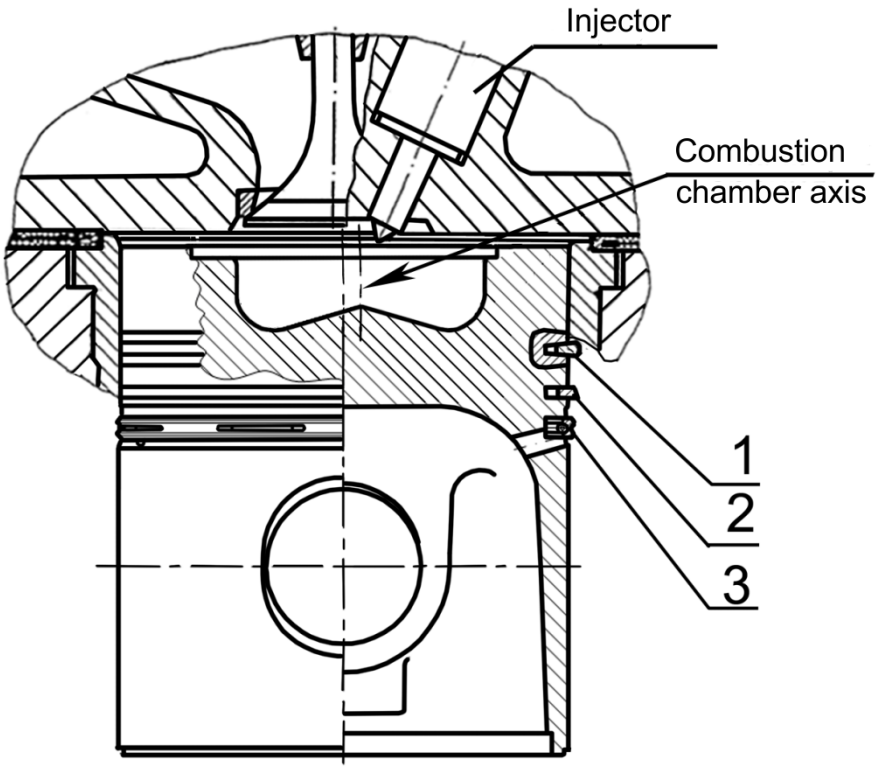


Fig. 27- Piston rings mounting

4.2.2 General instructions on the valves grinding

Unscrew the rocker axle brackets nuts and dismantle the rocker axle with the springs and the rockers.

Unscrew the head mounting bolts, remove the head.

Remove the valve keepers, the valve springs disk, the valve springs, the valve spring washers, remove the sealing collar from the valve guiding bush.

The valves should be grinded with special machine tools of "ОПР-1841А" type or on "OP-6687M" benches. Apply paste on the valves faces or cylinder head seats faces made of one of the following compositions:

- boron carbide M 40 - 10%; microcorundum M 20 - 90%;

- granular electrocorundum M14 - 87%; parafin - 13%;

Mix the composition with diesel fuel till a sour cream condition. To raise the composition quality, it is recommended to add oleic or stearic fat acid.

Continue the valves grinding until you see a continuous foggy belt on the valve face and the valve seat face, not less than 1,5 mm wide. The belt breakings or scratches are not acceptable. The belt's width varioation is permissible within 0,5 mm.

Wash the head and the valves after grinding.

When assemblying the head apply motor oil on the valve stems.

The valves grinding may be done manually with locksmith appliances, but this operation labour efforts grow considerably.

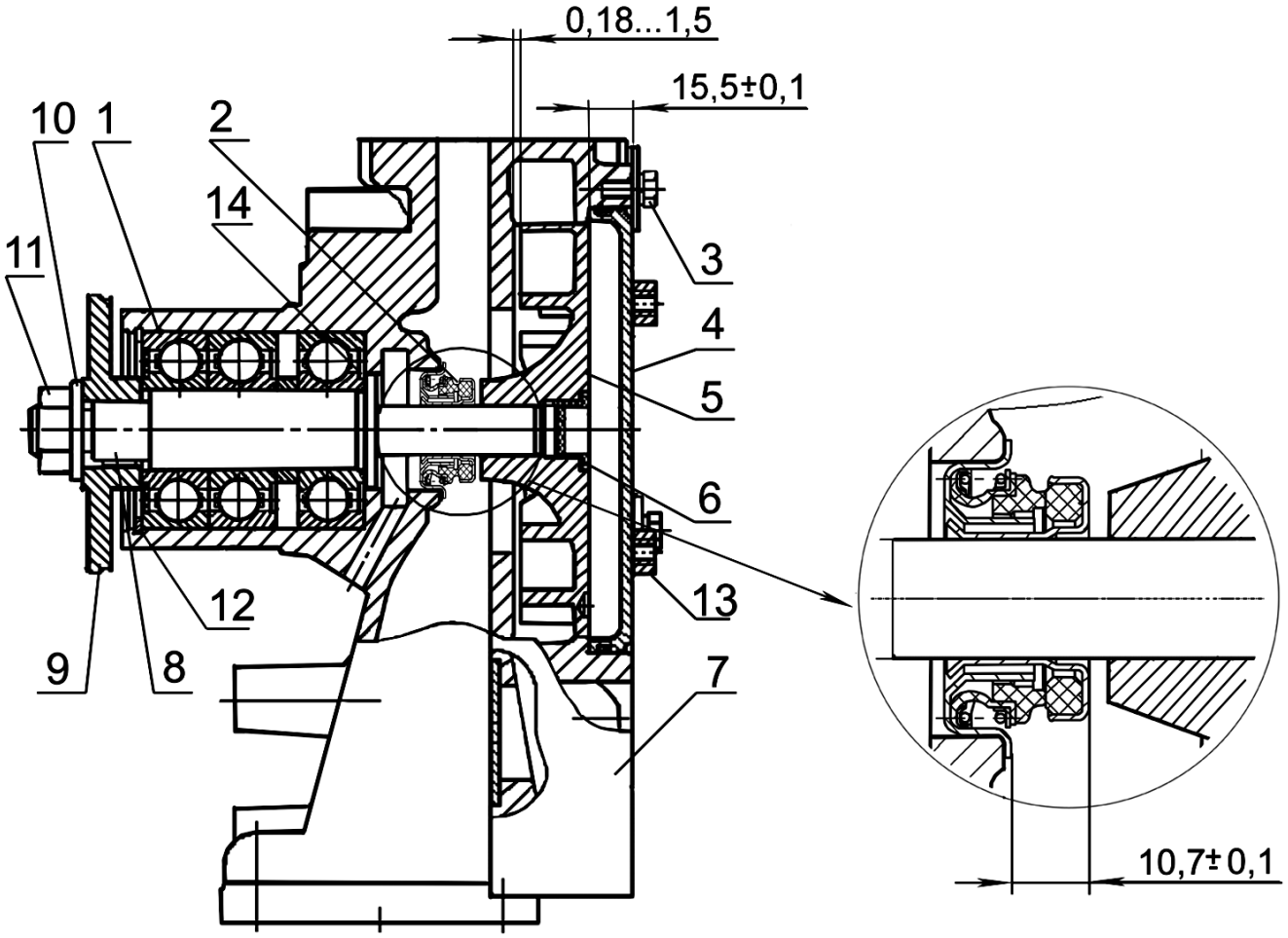
4.2.3 General instructions on water pump disassembly and assembly

4.2.3.1 Water pump disassembly

Unscrew bolts 2 (Fig. 16) of the fan mounting.
Mount a fixer on pulley 9 (Fig.28) end surface, similar to that shown on Fig.29, with the mounting holes coordinates corresponding to the holes coordinates on the pump pulley. Holding the pulley by the fixer lever, unscrew nut 11(Fig. 28). Remove pulley 9 using a puller. Take the key out of the slit on the pump shaft and stop ring 12 fixing the bearings block in the water pump housing.
Unscrew three 3 bolts of the water pump cover. Remove the water pump cover using two dismantling pieces 13 (thread M8) located on the cover end. Remove plug 6 installed in the impeller end.
Press the shaft with bearings out of the water pump housing. The pressing out direction – to pulley mounting side. Press the bearings out of the shaft.
Press the gland out of the pump housing.
Check the parts for defects.

4.2.3.2 Water pump assembly.

Mount thrust ring 14 on the pump shaft, press the bearings in. Fill the bearings and bearings cavities with 45g of Litol 24-МЛи 4/12-3 lubricant. Press the shaft with bearings into the pump housing. Mount ring 12 stopping the bearings unit.
Mount the pump pulley, washer and nut. Tighten the nut with 120…140N·m torque.
Using the mandrel (Fig. 30) press water pump sealing 2 with the inner housing on the water pump shaft and simultaneously press with the sealing outer housing into the water pump housing till the sealing housing flange thrust to the water pump gasket surface. The mandrel design must ensure the inner sealing housing pressing so that the inner housing end surface stays at 10,7±0,1 mm away from the sealing outer housing.
Press the impeller on the shaft till the pump shaft end coincides with the impeller bore end surface ensuring 15,5±0,1mm from the pump housing end to the impeller end surface.
Mount a plug in the impeller end. Mount the water pump cover providing horizontal positioning of the dismantling bosses located on the cover. Fix the cover with three bolts putting on them spring and flat washers. The bolts must be tightened with 4,5…10 N·m torque. Mount the water pump on the engine.



1-bearing; 2-water pump sealing; 3-bolt; 4-cover; 5-impeller; 6-plug; 7-housing; 8-pump shaft; 9-pulley; 10-washer; 11-nut; 12-lock ring; 13 – dismantle element; 14 – thrust ring

Fig. 28 – Water pump

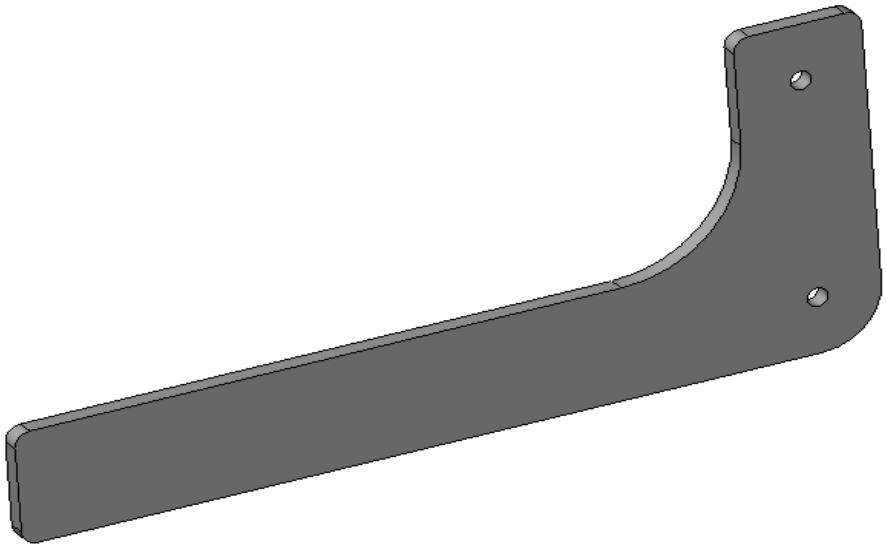


Fig. 29- Water pump pulley fixer

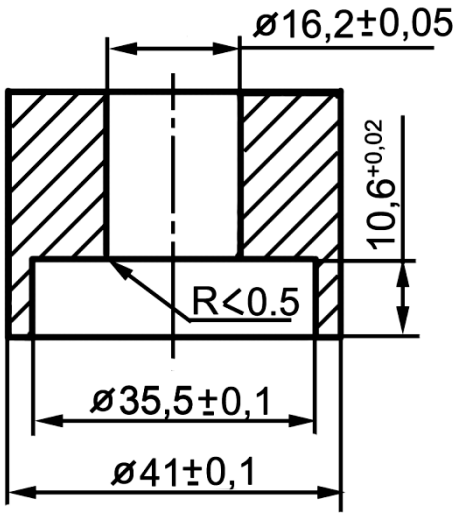


Fig. 30- Mandrel for the water pump sealing pressing in (main design dimensions).

5 STORAGE

To ensure operability of the diesel engines, saving materials and monetary funds for their repair and preparation to operation, one should strictly observe the regulations of diesel engine storage at off hours.

Regardless of the season, diesel engines must be kept in full conformity with GOST 7751-85. At long-term storing, the vehicle with installed diesel engine should be place in closed premise or under the awing.

Preparation of the diesel engine for storage must be finished not later than 10 days as of the date of completion of vehicle operation.

Fulfill the following works when preparing the diesel engine for long-term storage:

- clean diesel engine from dust and dirt;
- drain the cooling fluid from the cooling system;
- drain oil from the diesel engine crankcase, fuel pump housing;
- lay up the diesel engine for a year period in accordance with item 3.1.5.2

When keeping the vehicle under the awning or at the open area, dismantle and hand over the generator and the starter to the warehouse. Cover starter installation place with a lid.

Diesel engines dismantled from the vehicles or supplied as a spare parts must be stored conservated indoors on special supports. It is forbidden to store storage batteries, acids, salts, alkali and other agents able to provoke metal corrosion.

At short-term storing of the vehicle at the open area or under the awning, do the following:

- clean the diesel engine from the dust and dirt;
- wrap exhaust pipe and air cleaner connecting pipe with waxed paper or polyethylene film.

Prior to putting the vehicle into operation, replace the filtering cell of the oil filter and do all preparatory works in accordance with instruction of chapter 2.2

In case of a long period of storage (over one month) of a tractor, combine harvester, machine with an engine installed it is necessary to place the machine in a room or under a shed. It is permissible to store tractors, combine harvesters, machines on open sites with compulsory proofing and hermetization.

The diesel engine preaparation for storage must be completed in not less than 10 days following the engine operation stop.

Preparing an engine for storage, do what is described in item 3.1.5.2 of this Manual.

When storing a tractor, combine harvester, machine under a shed or on an open site, dismantle the alternator and the starter motor from the engine and keep them in a storage room. Put a cover on the alternator and the starter motor installation places. The engines removed from tractors, combine harvesters, machines or coming up as spare parts sets must be stored in a closed room secured on special stands. It is not permissible to store

accumulator batteries, acids, salts, alkkalines and other chemicles able to cause metal corrosion together with the engines.
At short period storage (from 10 days to one month) of a tractor, combine harvester, machine on an open site or under a shed do as described in item 3.1.5.1 of this Manual.
Before a tractor, combine harvester, machine putting into operation do the preparation work as described in item 3.1.6.1 or 3.1.6.2.

6 TRANSPORTATION

When transporting diesel engines, external openings must be closed with stopper plugs.
Diesel engine transportation must guarantee its protection against moisture and mechanical damages under storage conditions 2C of GOST 15150-69.

Diesel engine stowage and fixing during transportation in closed railway cars must meet the requirements of "Technical conditions of loading and fixing cargos", Ministry of Communications, 1969, as well as "Regulations of cargo transportation", Publishing house " Transport", Moscow, 1977.

Loading, stowage, fixing, covering and unloading during engine transportation by truck must meet "Regulations of cargo transportation by motor transport" adopted by the Ministry of Automobile Transport of the Russian Federation on July 30, 1971.

7 RECYCLING

The diesel engine does not contain substances posing hazard to human life, health and environment.

While recycling diesel engine after service life expiry, it is necessary to do as follows:

- drain oil from the lubrication system and send it for re-processing in the established order;
- drain cooling liquid from the cooling system (if is was used during the diesel engine operation) and place it in the reservoirs designed for storing;
- make complete dismantling of the diesel engine into parts, sorting them out by groups of steel, cast-iron, aluminum, ferrous and precious metals, resins and plastics and send them for reprocessing in the established order.

When carrying out maintenance works and routine maintenance works of the diesel engine, parts and assembly units subject to replacement should be sent for reprocessing, assembly units must be dismantled into parts and sorted out by materials.

Annex "A" (reference)
Chemmotological chart
Table A.1

No	Assembly unit (functionally finished device, mechanism, friction couple) name, index	Quantity of assembly units in a product, pcs	Fuels and lubricants names and grades				Mass (volume) of fuels and lubricants filled in a product at replacement (adding) , kg (dm^3)	Fuels and lubricants replacement (adding) periodicity, hours	Notes
			Main	Substitution	Back-up	Foreign			
1	Fuel tank	1	Diesel fuel, the technical conditions of which conform to "СТБ 1658-2006" with sulphur contents not more than 50 mg/kg (0,005%) of the grade (for moderate climate) or class (for arctic and cold climate) according to ambient temperatures in the engine operation region.	Not available	Not Available	Diesel fuel , the technical conditions of which conform to EN 590:2004 with sulphur contents not more than 50 mg/kg (0,005%)			According to Directive 2004/26/EC and EEC UN Rules № 96 (02) (Stage IIIA), it is permissible to use fuels with sulphur contents up to 0,3 g/kg (0,03 %)

Note:

For **moderate climatic zones,** it is recommended to use **fuel grades** at ambient temperatures (C°):

Temperature (C°) **up to** (not lower than)	+5	0	-5	-10	-15	-20
Fuel grade	**A**	**B**	**C**	**D**	**E**	**F**

For **arctic and cold climate** it is recommended to use **fuel classes** at ambient temperatures (C°):

Temperature (C°) **up to** (not lower than)	-20	-26	-32	-38	-44
Fuel class	**0**	**1**	**2**	**3**	**4**

Seasonal use of diesel fuels in the Republic of Belarus, depending on ambient temperatures.

Summer period		**Winter period**
Grade B	**Grade C**	**Grade F**
Down to 0° C (not lower than)	Down to -5° C (not lower than)	Down to -20° C (not lower than)
From May 1 to September 30 (5 months) – according to agreement with the customer.	From April to October 30 (7 months)	From November 1 to March 31 (5 months)

Continuation of Table A.1

Номер позиции	Assembly unit (functionally finished device, mechanism, friction couple) name, index	Quantity of assembly units in a product, pcs	Fuels and lubricants names and grades				Mass (volume) of fuels and lubricants filled in a product at replacement (adding) , kg (dm^3)	Fuels and lubricants replacement (adding) periodicity, hours	Notes
			Main	Substitution	Back-up	Foreign			
2	Oil sump*	1	In summer (stable ambient air temperature beyond + 5º C)				16 (18)**	250	**Using motor oils depending on operation conditions:** a) summer (+5 ˚C and higher) –SAE 30; SAE 10W-40 (30); SAE 15W-40 (30); SAE 20W-40 (30) b) winter (-10 ˚C and higher) – SAE 20; SAE 10W-40 (30) c) winter (-20 ˚C and higher) – SAE 10W-20 (30, 40 SAE 5W-30 (40)); d) winter (below -20˚C) – SAE 5W-30 (40); SAE 0W-30 (40)
			Motor oil «Lukoil Avangard Extra» SAE 10W-40	Not available	Not available	Motor oils Liqui Moly Super Leichtlauf SAE 10W-40, BP Visco 3000 SAE 10W-40, Shell Helix Plus SAE 10W-40, Elf Competition SX SAE 10W-40, Agip 2000 GPX SAE 10W-40, Esso Utra Oil X SAE 10W-40, Mobil Super Formula SAE 10W-40			
			In winter (stable ambient air temperature below - 5º C)						
			Motor oil «Lukoil Avangard Ultra» SAE 5W-40	Not available	Not available	Motor oils Liqui Moly Diesel Synthoil SAE 5W-40, Ethyl Hitec 5909, Castrol TXT Softec Plus, Elf Synthese SAE 5W-40, Esso Ultron SAE 5W-40, Shell Helix Ultra SAE 5W-40, Mobil 1 Rally Formula SAE 5W-40			

* All motor oils specified in this Chemmotological Chart must conform toclasses CH-4, CI-4 under API and E4-99 classifications, 5-02 under ACEA classification

**- oil mass (volume) is checked more accurately by adding oil when filling up to the upper mark of the feeler rod.м

End of Table A.1

No	Assembly unit (functionally finished device, mechanism, friction couple) name, index	Quantity of assembly units in a product, pcs	Fuels and lubricants names and grades				Mass (volume) of fuels and lubricants filled in a product at replacement (adding) , kg (dm^3)	Fuels and lubricants replacement (adding) periodicity, hours	Notes
			Main	Substitution	Back-up	Foreign			
3	High pressure fuel injection pump*	1	Motor oil the same as in the engine				0,17 (0,2)		
4	Water pump (bearings cavity)	1	Grease “Litol-24-МЛ$_и$4/12-3” STATE STANDARD 21150-87	Not available		Shell Retinax EP, Shell Retinax HD	0,045 (0,05)	One-time	Done by the manufacturer. No further lubrication is needed in operation.

5	Cooling system volume (without radiator and connecting branches)	1	Low freezing cooling liquid «Tosol Dzerzhinsky TC-40» (down to -40ºC), «Tosol Dzerzhinsky TC-65» (down to -65ºC) ТУ (TECH. CONDITIONS) 2422-050-36732629-2003 manufactured by LLC «Tosol Sintez», Dzerzhinsk, Russia Low freezing cooling liquid ОЖ-40 (down to -40ºC) STATE STANDARD 28084-89 manufactured by OJSC «Lesokhimik», Borisov, Belarus Low freezing cooling liquid «Sibur Premium» ОЖ-40 (down to -40ºC), ОЖ-65 (down to -65ºC) ТУ (TECH. CONDITIONS) 2422-054-52470175-2006 manufactured by OJSC «Sibur Neftekhim», Dzerzhinsk, Russia Low freezing cooling liquid «Tasol-АМП40» (down to -40°C) ТУ (TECH. CONDITIONS) BY 101083712.009-2005 manufactured by RUE «Gomelkhimtorg», Gomel, Belarus Low freezing cooling liquid «CoolStandart» (down to -40°C) ТУ (TECH. CONDITIONS)2422-002-13331543-2004 manufactured by OJSC «Tekhnoform», Klimovsk, Russia	Cooling liquid ОЖ-40 (down to -40ºC) ОЖ-65 (down to -65ºC) STATE STANDARD 28084-89	Not available	MIL-F-5559 (BS 150) (USA) FL-3 Sort S-735 (UK)	13,4 (12,5)	Once in two years	Compulsory cooling liquid incoming check by customer.

* - At installing new or repaired pump

Annex “Б” (reference)
Spare Parts & Accessories Kit

Table Б.1 – Spare parts to diesel engines D-260.1S3A, D-260.2S3A, D-260.4 S3A

Part designation	Product code	Spare part description	Location in the package	Application	Quantity in a product, pcs	Quantity in a set, pcs	Notes
50-1404059-Б1	47 5341 8601	Cap gasket		260-1028010	1	1	
	50 5000 2832	Belt SPA-1182		Alternator mounting	1	1	
	50 5000 2969	Belt SPA-1307		After pump mounting	2	2	

Table Б.2 –Tools and accessories

Tool/ accessory designation	Product code	Tool/ accessory description	Quantity in a set, pcs	Notes
50-3901034 60-3901034	47 5341 2815 47 5341 3054	Plate 0,25x100 Plate 0,45x100	1 1	Location – ТК-10А

Annex "B" (reference)

Cylinder liner and piston size groups

Table B.1

Group labelling	Liner diameter, mm	Piston skirt diameter, mm
Б	$110^{+0.06}_{+0.04}$	$110^{-0.05}_{-0.07}$
С	$110^{+0.04}_{+0.02}$	$110^{-0.07}_{-0.09}$
М	$110^{+0,02}$	$110^{-0.09}_{-0.11}$

One engine set contains pistons, connecting rods and piston pins of the same weight group, the weight difference of the connection rods-pistons groups must not exceed 30 g.

Nominal crankshaft main end and big end necks sizes

Table B.2

Bearing shells nominals	Crankshaft neck diameter, mm	
	main end	big end
1Н	$85,25^{-0.085}_{-0.104}$	$73,00^{-0.100}_{-0.119}$
2Н	$85,00^{-0.085}_{-0.104}$	$72,75^{-0.100}_{-0.119}$

The crankshaft main end and big end necks and bearing shells are made in two nominal sizes.

Crankshafts, the main end and big end necks of which are made of the second nominal size, have additional marking on the first cheek:

«2К» - second nominal main end necks;
«2Ш» - second nominal big end necks,
«2КШ» - second nominal main and big end necks.

Annex "Г" (reference)

Diesel engine adjustment parameters

Table Г.1

Description	Measurement unit	Values
Oil pressure in a hot engine oiling system at the engine crankshaft rated speed.	MPa	0,28-0,45
Cooling system temperature in the cooling system.	°C	80-95
Drive belts deflection		See item 3.2.18
Gap between the rocker striker and the valve stem end for the valves in a cold engine:	mm	
intake;		$0{,}25^{+0{,}05}_{-0{,}10}$
exhaust:		$0{,}45^{+0.05}_{-0.10}$
Main threaded connections torque:	Nm	
cylinder head bolts		190-210
main end bearings bolts		220-240
big end bearings bolt nuts		100-120
flywheel bolts		160-180
counter balance bolts		120-140
injector bolts		20-25*
crankshaft pulley bolts		160-200
Centrifugal oil filetr cap nuts		35-50
air cleaner wing-nuts		8-10
damper bolts		80-100
injector staples and strap bolts		20-25
injectors drainage pipeline connector bolts		15-20
low pressure pipeline turn-elbow bolts		25-40
high pressure nuts on the side of: - injectors - rail		 20-30 40-70

Annex "Д" (reference)

Synchronization of the crankshaft and the HPFIP camshaft angle position

The necessity of synchronization of the crankshaft (torsional vibration damper with pulse rim) and the HPFIP camshaft (fuel priming pump drive gear with pulse rim) angle position may arise as a result of the HPFIP dismantling with its subsequent putting back in place after current diesel engine repair.

Installation of a silicon damper with a pulse rim and a fuel priming pump drive gear with a pulse rim maintains synchronization of the crankshaft and the HPFIP camshaft speed sensors signals with linking the sensors signals to the common initial point of the shafts positioning at the moment of the 1st cylinder piston coming through its TDC at the compression stroke.

To install the pulse wheels correctly, it is necessary to make a device for fixing the fuel priming pump drive gear with pulse rim as shown on Fig.1)

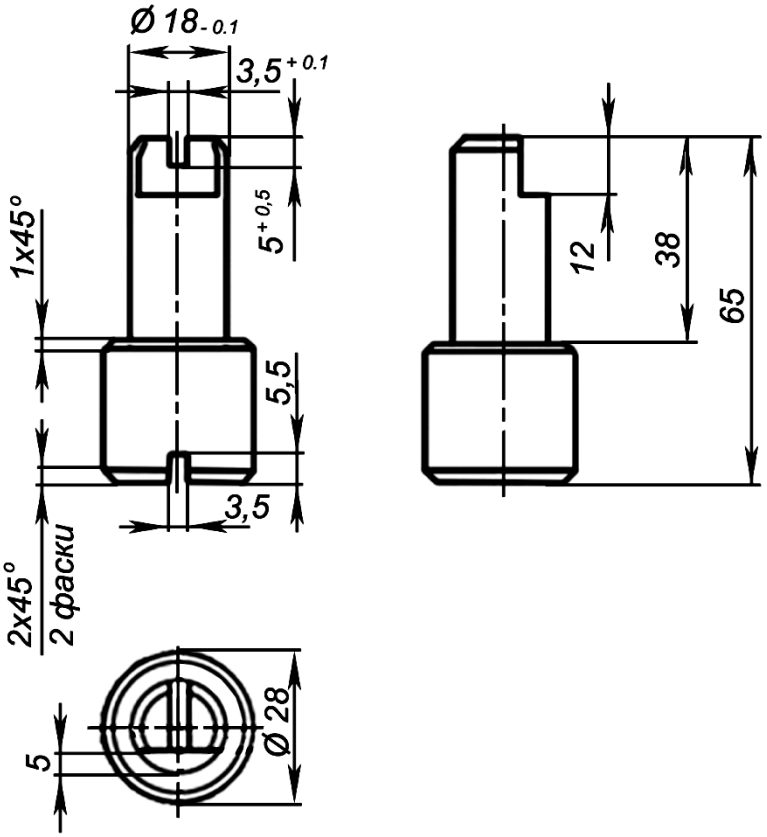


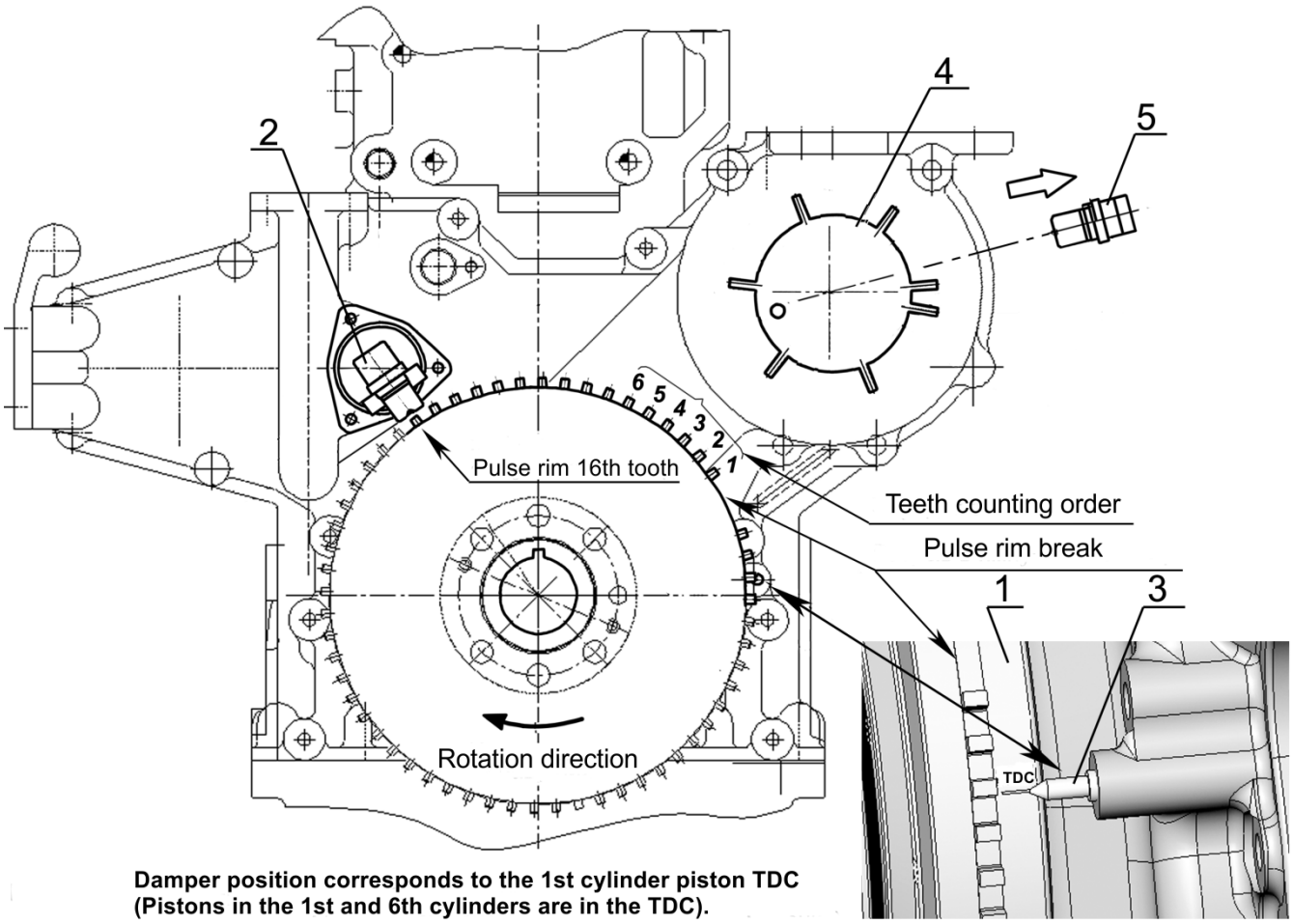
Fig. 1 – Device for fixing the fuel priming pump drive gear pulse rim

Remove the cylinder cover cap.

Place the 1st cylinder piston to the TDC position turning the crankshaft clockwise, using the crankshaft pulley mounting bolt, till the axis of the 16th tooth of the pulse rim "crown", located on the torsional vibration damper housing, coincides (counting against the clock from the pulse rim "crown" breaking segment) with the axis of sensor 2 (Fig.2).

At that, mounting 3 must be coincided with the "TDC" mark on the damper housing.

Make sure the 1st cylinder intake and exhaust valves are closed (there must be a small intake and exhaust valves rockers backlash). If the exhaust valve is open, rotate the crankshaft by a full turn and check the valves condition once again.



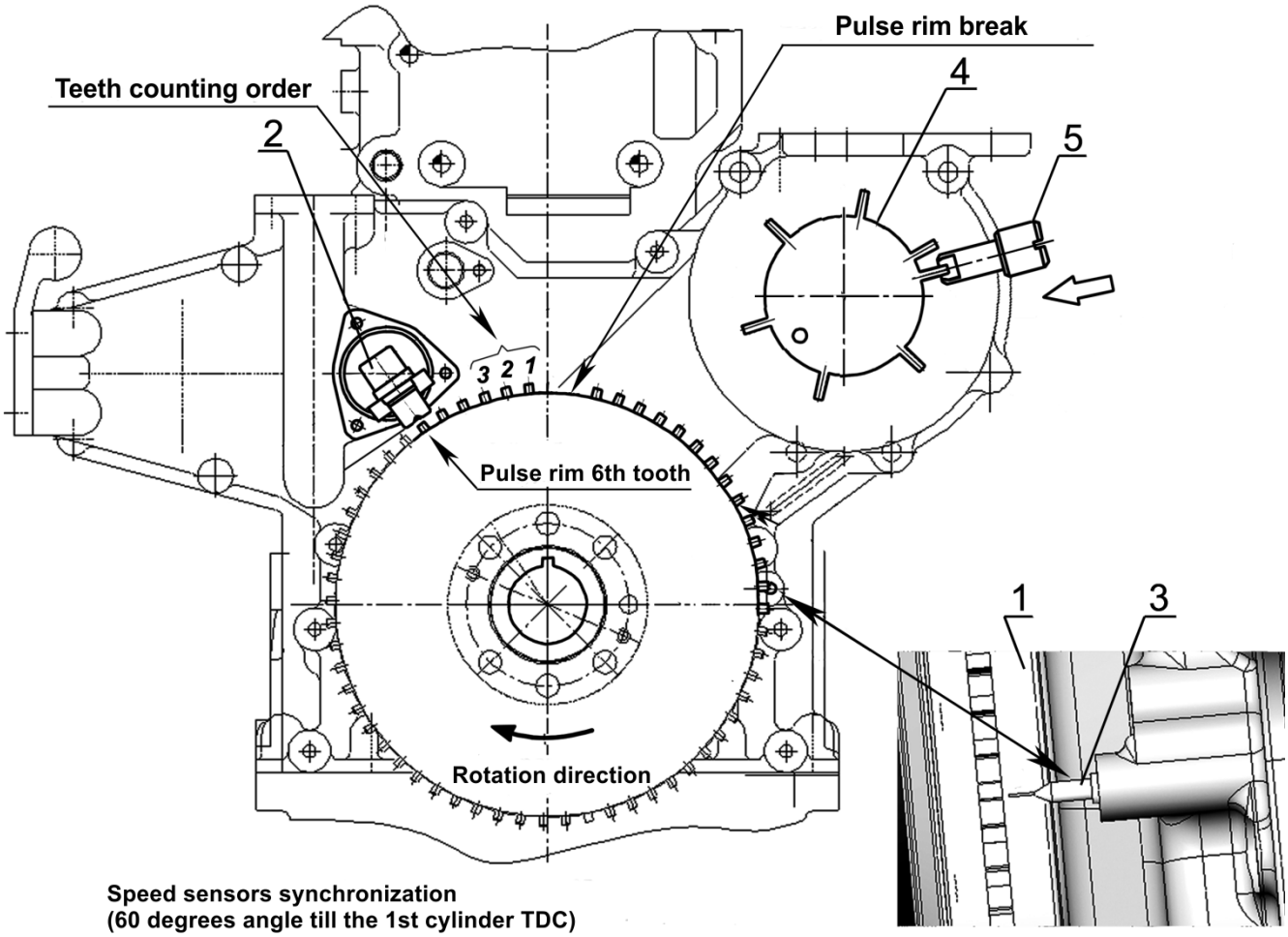
1 – torsional vibration damper housing ; 2 – crankshaft speed sensor; 3 – mounting pin; 4 – fuel priming pump drive gear with pulse rim; 5 – HPFIP camshaft speed sensor.

Fig. 2 – Placing the 1st cylinder piston to TDC

Place the 1st cylinder piston behind ≈ 60° of the crankshaft turn angle before TDC. To do that:

- rotate the crankshaft clockwise, using the crankshaft pulley mounting bolt approximately by two turns, with that, at the second turn, rotate the crankshaft till the coincidence of mounting pin 3 and "C" mark on damper 1 housing (Fig. 3);

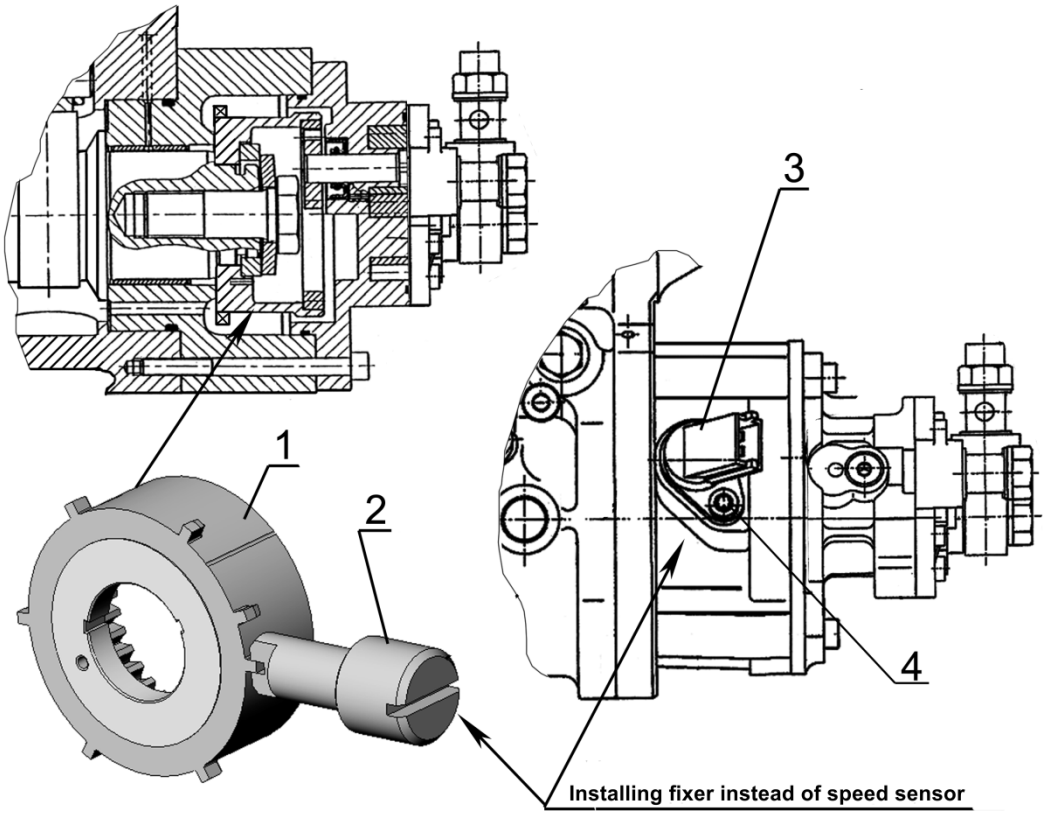
Thus, the pulse "crown" teeth will be positioned so that the axis of sensor 2 will lie along the 6th tooth of the pul rim "crown" (counting against the clock from the pulse rim "crown" breaking segment).



1 – torsional vibration damper housing; 2 – crankshaft speed sensor; 3 – mounting pin; 4 – fuel priming pump drive gear with pulse rim; 5 – fixing device.

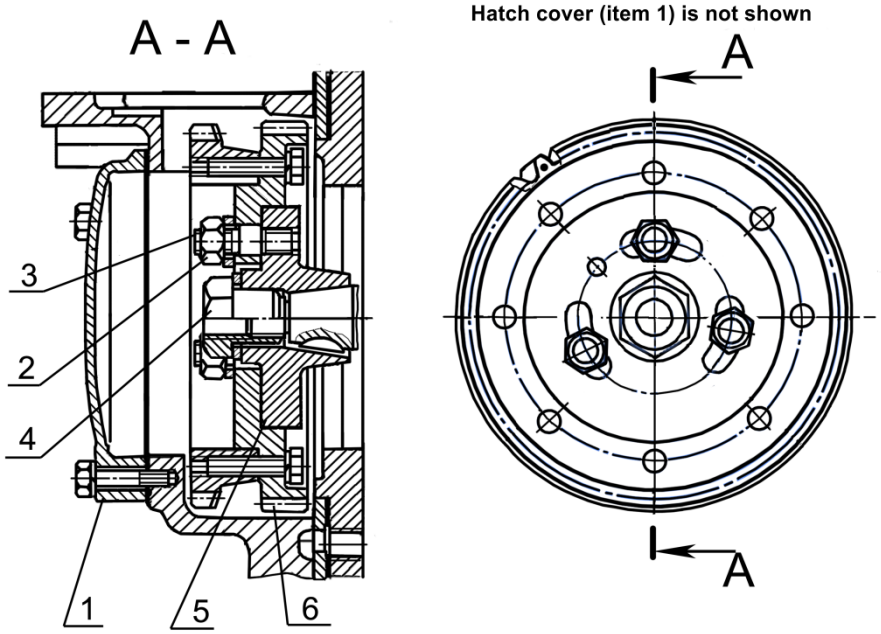
Fig. 3 – Placing the 1st cylinder piston to compression stroke

Remove the HPFIP, loosen screw 4 of speed sensor 3 (Fig. 4) and take the speed sensor out of the HPFIP housing..
Turn HPFIP drive half coupling 5 (Fig. 5) until you see two successive pulse teeth in the sensor installation window. Slightly tuening the drive in the same or the opposite direction, position the the mounting pin (the first in the crankshaft rotation direction) in the center of the wnidow (See Fig. 4).
Put the pulse rim position fixing device in the speed sensor mountying window and, slightly rocking the drive half coupling and not applying much force on the fixing device, achieve full recess of the fixing device in the sensor seat (as shown on Fig.4).
Remove hatch cover 1 (Fig. 5) and, supporting drive gear 6 through the hatch window, move studs 3 of half coupling 5 into the drive gear grooves to install the HPFIP. Fix the HPFIP on the distribution shield.
Put nuts 2 on studs 3 and screw nuts 2 not applying much force.
Take device 2 out of the sensor seat and, holding the HPFIP camshaft by special nut 4 (Fig. 5), finally screw nuts 2 with the torque 35...50 Nm.
Tightening of nuts 2 with the fixing device inserted may cause the pulse rim teeth breaking and the pump going out of operation..
Mount the hatch cover, speed sensor and fix them.
Mount the cylinder head cover cap.



1 – fuel priming pump drive gear with pulse rim; 2 – fixing device; 3 –speed sensor; 4 – sensor mounting screw;

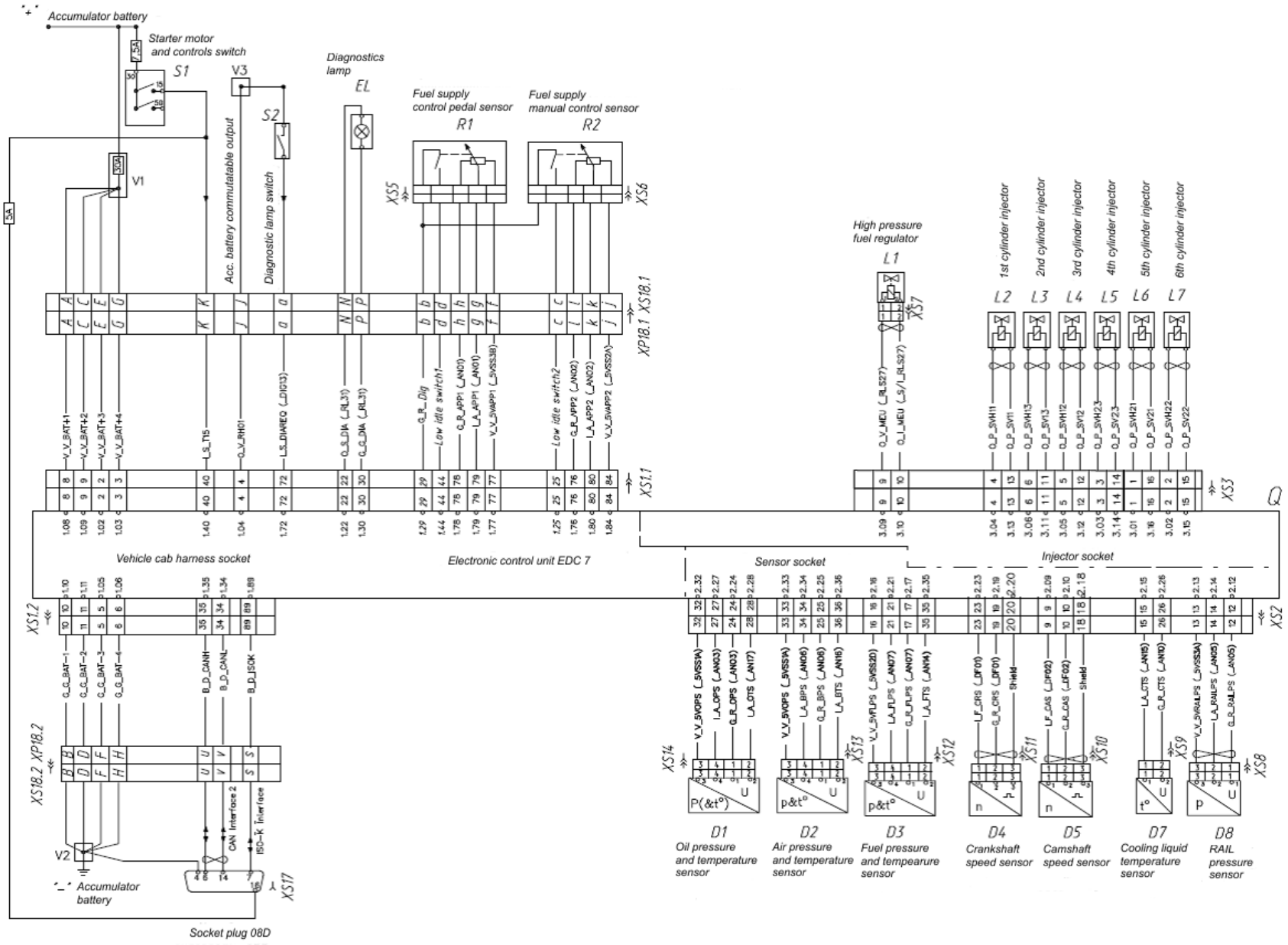
Fig. 4 – Fuel priming pump drive gear pulse rim fixing device mounting



1 – hatch cover; 2 – nut; 3 – stud; 4 – special nut; 5 – drive half coupling;
6 – fuel priming pump drive gear.

Fig. 5- Fuel pump drive

Annex E (reference) Diesel engine electronics structural electric diagram



Annex E (reference)

Designation	Description	o	Notes
01. 03	Pressure and temperature sensor (ODFT) 0 261230 112	2	'B0SCH' (Germany)
02	Charge air pressure and temperature sensor (LOFT) 0 281 002 576		'BOSCH' (Germany)
		1	'BOSCH' (Germany)
DU. 05	Speed sensor (006) 0 281 006 009	2	'B0SCH' (Germany)
D7	Cooling liquid temperature sensor (WTF) 0 281002 209	1	'BOSCH' (Germany)
08	Pressure in the RAIL sensor (RDSU.2) 0 281 002 937	1	'BOSCH' (Germany).
EL	Diagnostic lamp	1	1 max 1A. U-12B included in tractor set
LI	High fuel pressure regulator	1	Included in fuel pump set
L2...L7	Injector CR/N2	6	'BOSCH' (Germany)
0	Electronic Control Unit EDC7UC31	1	'BOSCH' (Germany)
SI	Starter motor and controls switch	1	included in tractor set
S2	Diagnostic lamp switch		1 max 0.1A. U=12B included in tractor set
R1	Fuel supply pedal control sensor	1	included in tractor set
R2	Manual fuel supply control sensor	1	included in tractor set
XS1	Jack panel 89 contact YU62 U03 036	1	'BOSCH' (Germany)
XS2	Jack panel 16 contact YU62 U03 038	1	'BOSCH' (Germany)
XS3	Jack panel 36 contact YU62 U03 037	1	'BOSCH' (Germany)
XS5. XS6	Jack panel	2	included in tractor set
XS7. XS9	Jack panel 0-936059-2	2	'AMP' (Germany).
XS8	Jack panel 0-0936061-2	1	'AMP' (Germany).
XS10. XS11	Jack panel 0-0936060-1	2	'AMP' (Germany).
XS12...XSU	Jack panel 1928U03736	3	'BOSCH' (Germany)
XS17	Jack panel OBD	1	included in tractor set
XP18	Plug Schlemmer 7811230	1	„Schlemmer“
XS18	Socket Schlemmer 7812226	1	included in tractor set

Annex E (reference)

Contact No XSLXS3	Bosch designation	Signal function	Cross sec-tion mm ²	Contact No XS18/XP18
1.02	VJ/.BA /%J	'* 12V' from accumulator battery (input3)	2.5	E
1.03	V_V_BA Γ-4	"'+"12V' from accumulator battery (input4)	2.5	G
ю/,	0_V_RH01	Commutated output '*128' АКЬ	2.5	J
105	G.GJ3A T-3	'0 B' from accumulator battery (input3)	2.5	F
106	G.GJ3A T-4	'0 B from accumulator battery (input4)	2.5	H
108	V_V_ßA T*1	*128' from accumulator battery (input1)	2.5	A
109	VJ/J3A T*2	V128' from accumulator battery (input2)	2.5	C
1.10	G.GJ\AT-1	'0 B' from accumulator battery (input1)	2.5	B
1.11	G.G_BA T-2	'0 B' from accumulator battery (input2)	2.5	o
122	O-S-DSA	Diagnostic lamp. High level	0.75	N
1.25	Low'iüe switch!	Switch x.x. of manual fuel supply control sensor	0.75	c
1.29	GJUXG	Digital earth	0.75	b
1.30	G.GJJ/A	Diagnostic lamp. Low level	0.75	p
1.3i	B_D CANL	CAN low level	0.75'	V
1.35	B-D-CANH	CAN high level	0.75'	u
1.40	U-T15	Control lamp 15 of starter motor and controls switch	0.75	K
1.44	Lowiitle smtcht	Switch x.x of fuel supply control pedal sensor	0.75	d
1.72	i-SJDtAREQ	Diagnostic button input	0.75	a
1.76	G.R-APP2	Manual fuel supply control sensor '0 B'	0.75	1
1.77	V_V_5 VAPP1	Fuel supply control pedal sensor '*5 B'	0.75	f
1.78	G_R_APP1	Fuel supply control pedal sensor '0 B'	0.75	h
1.79	!_AJIPP1	Fuel supply control pedal sensor signal	0.75	9
180	!_A_APP2	Manual fuel supply control sensor signal	0.75	k
184	V-VSVAPP2	Manual fuel supply control sensor *5 B'	0.75	J
1.89	BjDJSOK	ISO-K Line	0.75	s
2.09	USAS	Camshaft position and speed sensor signal	0.75	
2.10	G-RJIAS	Minus of camshaft position and speed sensor	0.75	
2.12	СЛПАЯР5	Minus of RAIL pressure sensor	0.75	
2.13	V VJVRAILP<	'+5 V' of RAIL pressure sensor	0.75	
2.14	!-A .RAIL PS	RAIL pressure sensor signal	0.75	
2.15	i^A.CTS	Cooling liquid temperature sensor signal	0.75	
2.16	V VJVFLPS	'*+5V of fuel pressure and temperature sensor	0.75	
2.17	G-RJ=LPS	Minus of fuel pressure and temperature sensor	0.75	
2.18	Shield	Camshaft angle and speed sensor screen		
2.19	G_R CRS	Minus of crankshaft position and speed sensor	0.75	
2.20	Shield	Crankshaft position and speed sensor screen		
2.21	U\SLPS	Fuel pressure and temperature sensor pressure signal	0.75	
2.23	U.CRS	Crankshaft angle and speed sensor signal	0.75	
2.24	G.RJ3PS	'0 V'of oil pressure and temperature sensor	0.75	
2.25	GJUiPS	'0 V' of charge air pressure and temperature sensor	0.75	
2.26	GJiCTS	'0 B' of cooling liquid temperature sensor	0.75	
2.27	W-OPS	Oil pressure and temperature sensor pressure signal	0.75	
2.28	IJ\.OTS	Oil pressure and temperature sensor temperature signal	0.75	
2.32	VJ\-5V0PS	'+5 V' of oil pressure and temperature sensor	0.75	
2.33	V V_5VBPS	\5 V of charge air pressure and temperature sensor	0.75	
2.34	!_A_BPS	Charge air pressure and temperature sensor pressure signal	0.75	
2.35	i-A-FTS	Fuel pressure and temperature sensor signal	0.75	
2.36	U\J3TS	Charge air pressure and temperature sensor temperature signal	0.75	
3.01	0J> SVH21	High level of signal on the 5th cylinder injector	15	
3.02	O-PS VH22	High level of signal on the 6th cylinder injector	1.5	
3.03	Q_P_S VH23	High level of signal on the 4th cylinder injector	1.5	
3.04	0-P^SVH11	High level of signal on the 1st cylinder injector	1.5	
3.05	0-PJ>VH12	High level of signal on the 3rd cylinder injector	15	
3.06	0_P_SVH13	High level of signal on the 2nd cylinder injector	1.5	
3.09	O-V-MCU	High level of signal on the fuel pressure regulator	1.5	
3.10	O-TJiEU	Low level of signal on the fuel pressure regulator	1.5	
3.11	0J>_SV13	Low level of signal on the 2nd cylinder injector	1.5	
3.12	0.PJSV12	Low level of signal on the 3rd cylinder injector	1.5	
3.13	0J>3V11	Low level of signal on the 1st cylinder injector	1.5	
3.14	0_P_SV23	Low level of signal on the 4th cylinder injector	1.5	
3.15	0_fL5 V22	Low level of signal on the 6th cylinder injector	1.5	
3.16	Q_P_SV21	Low level of signal on the 5th cylinder injector	1.5	
T-wire. One step per inch.				

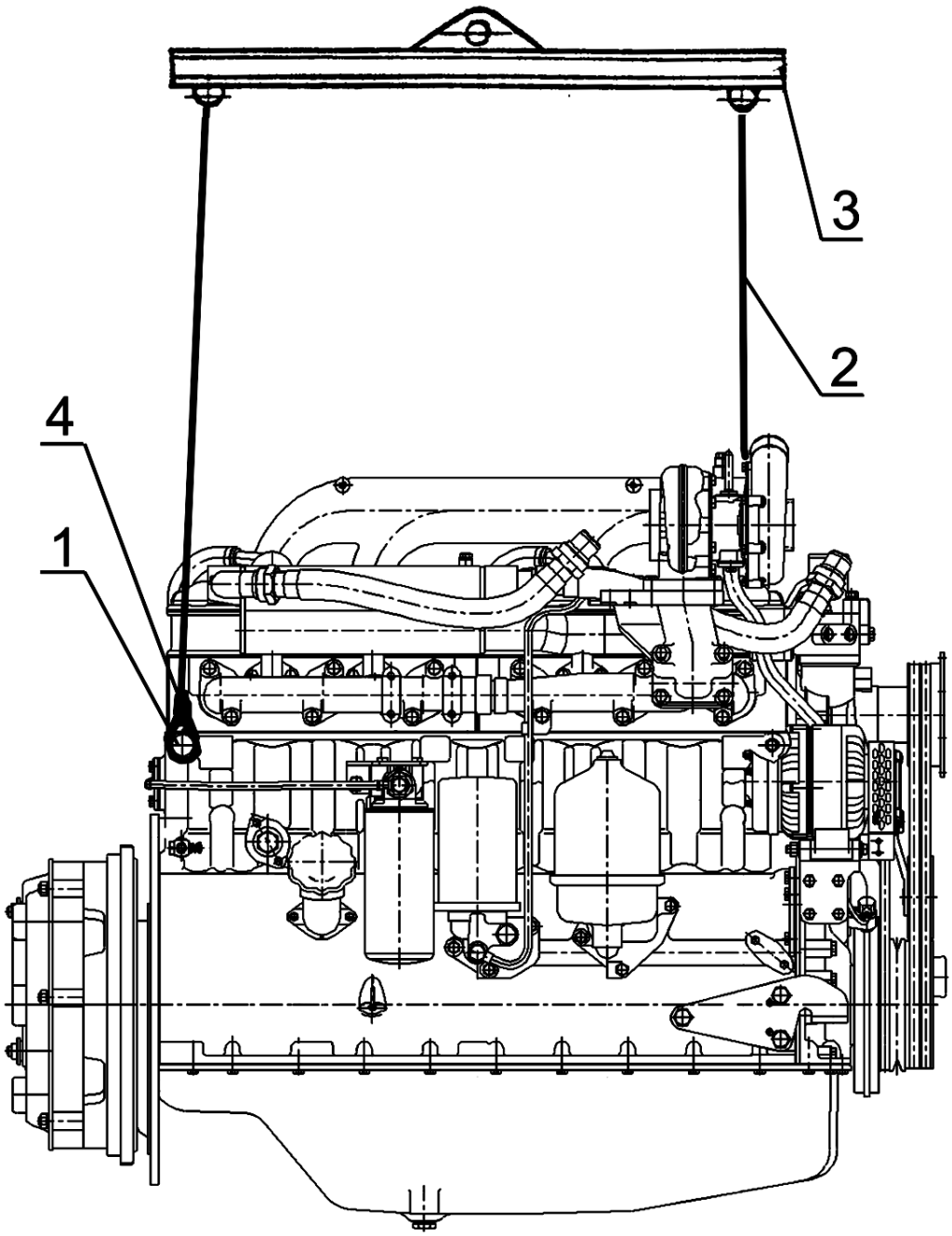
Annex "Ж"

Diesel engine and turbocharger failures identification

Character						Cause	Check	Character				
X	X	X	X		X	Lack of air	Air filter cleanness. Narrowed air supply hose, not firm (loosened) connections.	X	X			
X	X				X	Supercharge pressure drop	Narrowed (damaged, unfirm, loosened) connection between the turbocharger and the engine.		X			
X	X				X	Pressure drop in the exhaust	Exhaust pipeline (sealing) loosened, damaged, unfirm.					
X	X			X	X	High pressure in the exhaust pipeline	Obstacles in the exhaust pipeline, exhaust pipeline damaged.					
		X	X			Crankcase gases high pressure	Engine breather cleanness.	X	X			X
			X		X	Insufficient lubrication	Turbocharger inlet pipeline cleanness.					
		X	X	X		Excessive lubrication	Turbocharger oil outlet pipeline narrowed.	X	X			
X	X					Low compression	Valves, pistons and piston rings condition.					
		X	X	X		Oil in the combustion chamber	Valves and guides condition, piston rings wear.	X				
X	X					Bad injection	Fuel injection pump and injectors nozzles.					
X	X				X	Foreign particles	Air cleaner (completeness and cleanness).			X		
X	X				X	Foreign particles in the exhaust	Turbine housing damaged, part of the turbine wheel missing.				X	
					X	Vibration	Turbocharger mounting on the engine.			X	X	
X	X	X	X	X	X	Faulty turbocharger	Dismantle the turbocharger and send it for repair.	X	X	X	X	X
Power drop	**Black smoke**	**Blue smoke**	**Excessive oil consumtion**	**Oil in the exhaust pipeline**	**Noisy turbocharger**			**Oil in the turbine housing-**	**Oil in the compressor housing**	**Damaged compressor wheel**	**Turbine working wheel damaged**	**Dirty bearings housing**
Diesel engine fault								Turbocharger fault				

Annex “И” (reference)

Engine slingning scheme



1 – eye-bolt; 2 – sling (chain); 3 – beam; 4 -grip

Fig. 1 – Engine slingning scheme